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

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1. Introduction

This paper studies the determinants of new successful export activities in Argentina in the past 25 years with the goal of shedding light on the roles played by information and coordination externalities that make uncertain the ex-ante profitability of the new export, and on how these hurdles were overcome. It also seeks to unveil the roles played by previously accumulated capabilities, industry-specific public goods and public policies in the emergence of these activities.

Hausmann and Rodrik (2003) (HR) show that developing new export activities may require sinking capital in experimentation to discover if the endeavour is profitable or not. Once the profitability is revealed free entry into the activity erodes profits impeding the pioneering entrepreneur from recouping the experimentation costs, which would lead to sub-optimal investment in these activities under *laissez faire*. Additionally, the new activity may fail to be discovered because of coordination failures such as the lack of industry-specific public goods, which are not available because the activity that would demand them still does not exist.

It is very important to learn how the coordination and information externalities were resolved and whether this resolution facilitated the growth of the new activities via an information revelation process and the development of industry specific public goods for several reasons. First, insufficient investment due to information externalities may generate efficiency losses that are not visible because socially profitable activities fail to be developed. Second, 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, insufficient experimentation may lead to export concentration which in turn has a negative effect on growth (see De Ferranti et al, 2001). Finally, widespread experimentation is needed to discover those activities with bigger scope for catching-up to the world quality frontier (Hwang, 2006).

Economic environments where experimentation is not facilitated (through targeted subsidies, carrots and sticks, direct government involvement, provision of industry-specific public goods and/or adequate export-facilitating policies and institutions) may lead to an emergence of new exports mostly in activities where the pioneer can introduce brand, technology or scale barriers to entry to compensate for the knowledge externality that harm diffusion. In sectors where the pioneer does not have this ability to subdue diffusion, a *laissez faire* scenario would lead to sub-optimal investment in learning about the new activities and/or to the complete absence of experimentation in some potentially profitable new activities.

In this vein, the main interest lies in analyzing to what extent the self discovery of local profitability for the new export activities creates knowledge externalities that lead to a large diffusion of these activities, à HR, or whether these discoveries result from the exploitation of proprietary knowledge and/or the ability to introduce barriers to entry, with negative impact on diffusion. We also

care about the effects of the different drivers of discoveries for the accumulation of capabilities for subsequent structural transformation.

While HR emphasized the need to discover local costs of production for new export activities, there may be other sources of uncertainty regarding the ex-ante profitability of these new activities. These uncertainties are related to discovering: a) position and slope of the foreign demand curve for differentiated goods, b) the costs of quality upgrading to meet technical and consumer requirements abroad, c) the best commercialization strategies and export product mix, d) how binding non-tariff barriers actually are, and e) whether the good can be locally produced at all through R&D activities. Even with adequate 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 and will have different implications for the diffusion of new exports. For instance, when the uncertainty is related to commercialization and foreign demand 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 discovering new export activities, and how efficient has been the emergence of new activities in the absence of government intervention. We are interested in understanding if fast and widespread diffusion is always desirable or if there are instances (especially in differentiated goods markets or in markets with scale economies and love for variety) where limited diffusion is advised. We also consider the relative importance 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 provide a background on the trading environment in which the emergence of new exports occurred, analyzing the aggregate and sectoral behavior of traditional and new exports. We also evaluate the contributions of new exports to overall and sectoral export growth and to changes in

the patterns of revealed comparative advantage, and their characteristics (factor intensity and scope for catching up to the world quality and price frontier).

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. We allow for competing (or at times complementary) explanations for investing in new activities that arise from industrial organization models based on: a) brand development and sunk costs, 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 possible inefficiencies under *laissez faire*.

Then we contrast the predictions arising from the theoretical framework with a case study analysis of the actual 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. 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 regarding the drivers of discovery and diffusion is the counterfactual analysis of sectors that shared some common features with the new export activities, and yet failed to take-off and/or showed a different pattern of diffusion.

The choice of case studies was 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. The chosen counterfactuals respectively are fresh raspberries, sugar confections and biotechnology in Brazil.

Section 2 and the Statistical Appendix provide an empirical evaluation of the trading environment for new exports, and of their contributions to structural transformation. 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 and their lessons. Sections 8 and 9 respectively present the development and policy implications that arise from the case studies. Section 10 concludes.

2. Trading environment for new exports and contribution to structural transformation

This section provides a background on the trading environment in which the emergence of new exports occurred, analyzing first the aggregate and sectoral behavior of volumes and values of

traditional sectors. Then it evaluates the aggregate and sectoral performance of new exports, their contributions to overall and sectoral export growth and to changes in the patterns of revealed comparative advantage, and their characteristics (factor intensity and scope for catching up to the world quality and price frontier). The background statistical information and graphical and correlation analysis that support this appraisal are included in the Statistical Appendix.

Overall export behavior

Argentine exports largely stagnated during the 1980s, were very dynamic during the 1990s (until 1998), and grew less than world trade since then. During 1993-2004 there was a significant increase in the participation of natural-resource based exports in total exports. These new external sales were largely associated to privatizations and deregulation.

There was a lackluster evolution of unit export prices during the past 20 years, which suggests that only a handful of sectors showed improvements in the quality of their 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 equipment and in chemical products.

Hence the overall trading environment was not very dynamic, especially regarding prices, and Argentina deepened its specialization in less modern activities.

New exports

For the identification of new exports at the 6-digit level of the Harmonized System (HS) between 1993-94 and 2003-04 we used the following criteria. Exports had to grow at least 300% during this period (so as to include sectors with bigger than average, 154.7%, and median, 263%, export growths). They must also display minimum average exports of US$ 10 millions during 2003-04 and maximum average exports of US$ 1 millions during 1993-94. This criterion leaves us with only 87 products that meet all our requirements (out of 4,198 products at this level of disaggregation with positive exports in 2004).

New exports represented a relatively small number of products, but rapidly increased their shares in total exports, generating a significant structural change in the composition of Argentine external sales. 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. However, this increase in participation was based on the expansion of quantities, as the prices of new exports tended to fall relative to the prices of world exports and of traditional exports in Argentina.

The HS 2-digit level sectors with the largest presence of newly exported products (5% or more of the total number of 6 digit-level exported goods within each 2-digit level 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 no newly exported products in "modern" activities such as Medical, Precision and Optical Instruments, Electronics, Electrical Machinery, and Computing Equipment.

New exports contributed to more than 20% of export growth in most 2-digit level sectors, and to 60% or more in 5 sectors. Sectoral export growth was bigger in those activities where there emerged a bigger number of newly exported products. However, most sectors experienced substantial intrasectoral changes in the composition of their exports, even those where there were relatively few newly exported products. Nevertheless, in the sectors where new exports were more frequent, prices either declined relative to those of traditional sectoral exports, while the opposite occurred in the sectors where discoveries were less frequent. This suggests that discoveries mostly did not target the most valuable opportunities.

The emergence of newly exported products was more frequent in industries that are less labor-intensive, which is consistent with the bigger frequency of new exports in natural resource based activities, which tend to be more capital intensive, and with the fact that capital was relatively cheap vis-à-vis labor during the 1990s.

New exports did not appear to represent jumps between trees within sectors with revealed comparative advantage (RCA), but rather jumps to new sectors without RCA as only 29% of the 6-digit level new exports were in 2-digit sectors with RCA in 1993. Indeed, those 2-digit level sectors that had bigger frequency of new exports ended up reversing revealed comparative disadvantages.

This analysis suggests that despite a significant structural change in the composition of exports, the discovery of valuable new exports in modern sectors appears to have been an exception rather than a rule. Hence the case study analysis of successful new exports of modern goods will be very helpful to understand which the main obstacles for structural transformation are and how they can be solved.

3. Theoretical framework for the analysis 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. 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).

Discovering foreign demand

Uncertainty about foreign demand and positive externalities from enhanced reputation or country brand name (demand shifting) can play a key role in the emergence of new exports in semi-industrialized economies. 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).

Other uncertainties that may be involved in the self-discovery process

Aside from local costs of production and foreign demand, developing new exports may also entail uncertainties regarding:

- Costs of quality upgrading to meet technical and consumer requirements abroad.[1]
- Costs of logistics.

[1] 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.

- 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).
- Finding out whether the good can be locally produced at all, via R&D activities.
- Best production techniques. Even if profits are known to be positive ex-ante (because of very high export prices), it may pay to wait for others to sink capital in discovering the cheapest production technique. However, if the minimum expected profits are large enough, it may pay to start experimenting right away, raising the possibility that there may be more than one pioneer.

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 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).

Conditions for the emergence of new successful export activities

The previous analysis suggests that in order to understand the actual process of emergence of successful new export activities we must 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.

Accumulated capabilities and the choice of new export activities

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, specialized input networks, commercialization channels). 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.

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.

Revealed information and the process of diffusion

The analysis made above also suggests that diffusion is more likely to occur when:

- Knowledge externalities are large and the pioneer cannot introduce barriers to entry.
- There exist agglomeration economies.
- 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).

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

Welfare analysis

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). Other possible inefficiencies suggested by our theoretical framework would be: 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 wrong expectations regarding the foreign demand saturation point.

We must also add other 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.

Finally, when appraising the social returns of the activities that are discovered we must also include the following considerations: a) accumulated capabilities in the new activities and the types of new exports that they will later allow to develop, b) rent shifting from foreign competitors.

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

This section seeks to shed light on the drivers and the extent 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 cases 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. This case offers very interesting implications regarding when the discovery of new exports should be subsidized, and when diffusion is socially optimal or not (in this case there is the possibility that diffusion could be immiserizing). It is also a very interesting case because its monopoly position made the pioneer undertake 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 it managed to create a revealed comparative advantage through brand development and vertical product differentiation.

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 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 different stages, 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 ways 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.

4.2. Methodology for case study analysis

First we used data from secondary sources (official trade statistics, websites, and publications) and from preliminary interviews to preliminarily identify: 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 analyses were undertaken. A standard questionnaire was designed and employed in all the case study interviews, based on the predictions of our theoretical framework and on the preliminary background information available. We interviewed pioneers, imitators, business associations, and involved government agencies and officials.

We then contrasted the predictions of our theoretical framework with the responses obtained in the interviews to determine, based on qualitative criteria, which of the predictions were more relevant for describing the actual processes of discovery and diffusion of new export activities and their welfare implications.

In order to strengthen our case study findings we also performed counterfactual analyses. To this end we appraised cases involving sectors that share some common features with the new successful exports that we consider, and yet failed to take-off. The comparison of the features that are not shared among these sectors helped us identify more accurately the key determinants of the success, or lack of, of discovery and diffusion.

In the case of blueberries, where there is discovery and sizable diffusion of its export as a fresh fruit, the counterfactual we chose is the production and exports of fresh raspberries, where the discovery was attempted but failed, despite sharing many market and technological characteristics

with blueberries. This counterfactual analysis also involved a comparison with the Chilean success in discovering and diffusing the exports of both types of berries.

In the case of chocolate confections, where there has been little diffusion, the counterfactual analysis was based on sugar confections, another successful exporting sector. This older export activity, where diffusion has been more widespread, shares with chocolate confections 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, we chose Brazil as a counterfactual. Despite a substantial government promotion effort, this country has not been as successful as Argentina in developing these exports. Brazil differs in terms of a much less significant presence and trajectory of national pharmaceutical laboratories than in Argentina (which developed the BHH sector) and in terms of its initial endowment of life science researchers.

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.[2]

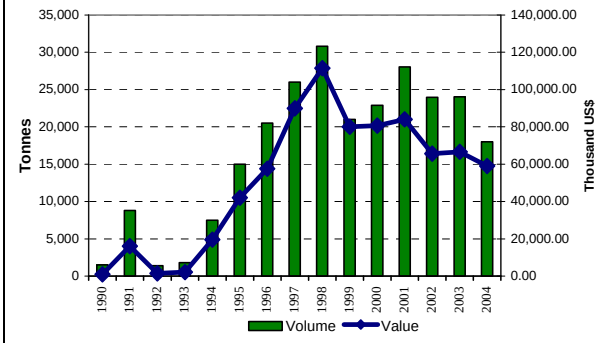
There are about 125 firms that manufacture chocolate products in Argentina. Production is moderately concentrated. Arcor, a family-owned Argentine firm, is the leading producer of chocolate confections in Argentina, followed by Georgalos, another family-owned Argentine company. Ferrero, an Italian-based multinational corporation, is the third producer and the largest exporter. Exports are more concentrated than production: 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.

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. This rapid export expansion involved sizable investment in production capacity, technological upgrading and market diversification.

[2] 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.

Figure 1. Exports of chocolate confections



Source: IERAL from Fundación Mediterránea based on MECON

Exports grew very significantly between 1992 and 2005, from US$ 9 millions to US$ 72 millions (according to national trade statistics from INDEC), led by Arcor and 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).

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.

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 sector[3]

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

Arcor was the pioneer for exporting chocolate confections (differentiated products) at a large scale and to multiple markets in the early 1990s. This firm was also the first significant exporter among Latin American firms. It is not however the pioneer for production in Argentina. Aguila-Saint had been the major manufacturer of chocolate products in Argentina since the 1880s, but was acquired by Arcor in 1993.

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), on which Argentina enjoys a natural comparative advantage because of the relative abundance of sugar, milk and glucose. 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. The Rocklets are candy 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 Arcor's distributors abroad. Chocolate confections are natural complements of sweets and candies, as they are sold in the same stores and they can be distributed by the same person/firm. 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.

[3] 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).

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

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 suppliers and clients, and technological barriers. Arcor's previous scale in the production, commercialization and exports of sugar confections certainly helped in this regard.

Hence commercial complementarity with sugar confections coupled with Arcor's network of own distributors (which introduce fixed costs and demands 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 has been an imitator at the world level. 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 where they solved? What was discovered? Where 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. 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. They still had to learn the use of the technologies for flour (for the wafers in the BOB), for differentiated chocolate products, and for temperature management as well, but this learning did not involve sizable uncertainties. 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.

They also acquired further production know-how through the purchase of Aguila-Saint. 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. To this end Arcor had to make investments to find out 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, i.e., it had to learn the position and slope of the demand curves for its products.

Let us consider the case of the BOB. 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 there came Arcor, which imitated and innovated upon the product, replacing the Brazilian cashew nut paste filling by a peanut paste filling that is preferred in Latin America. 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 and then 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 (Arcor currently manufactures 550 million units of BOB per year). 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 (WalMart), and part of this uncertainty was resolved by the experimentation made by Arcor's own distributors and commercial representatives.

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 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.

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. For instance, in South Korea the right price is 100 wons (US$ 0.10), a very low price that is the pocket change in that country, whereas it is impossible to sell for 150 wons 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).

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. This process became more efficient when they focused on a small set of products in the mid-90s, after the success of the exports of BOB and Rocklets. Before that there was confrontation between the views of distributors, which pushed for shipments of assorted goods that allowed risk diversification, and the new chocolate management, incorporated via the acquisition of Aguila, who had long understood the importance of focus in the chocolate market.

The selection of new products to experiment with 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.

There were also important uncertainties regarding the markets where products could be profitably sold, as Arcor had to discover the prevailing commercialization system in each country (and if it suited Arcor's products), its ability to deal local temperatures (chocolate consumption decreases with heat), local preferences, and the existing non-tariff barriers. 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.

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), where they opened their first office in Miami 15 years ago, and which presented some important commercial uncertainties. For instance, they had a hard time finding the adequate distribution channel, as there are only 6 or 7 highly concentrated channels (they finally signed contracts with Wal-Mart). Then they started to slowly open commercial offices in almost all of Latin America, which was closer in terms of language, preferences, packaging and freight costs. 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. As overseas markets grew, a commercial office was opened in Barcelona, from where to take care of Europe, Israel and Africa.

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. Hence there were no potential coordination failures at the production stage impeding the emergence of this sector.

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 and was facilitated by Arcor's size and internal resources. 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. 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?

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. 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.

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 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. This reduced a significant part of the commercial uncertainty and helped increase the chances of success. 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.

Arcor was able to cross subsidize experimentation in chocolate confections with established profitable activities (sugar 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 which sets it apart from local branches of multinational companies and from other local firms. 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 and to preserve monopoly rents?

Two types of actions for consolidating export success 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 local and foreign competitors that target the same market and product segments.

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 can be negatively affected by macroeconomic shocks that 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), and that introduce large uncertainty regarding the availability of critical inputs.

Arcor dealt with these threats through large value addition via product differentiation, quality development, marketing and branding, which helped reduce the incidence of labor costs in prices (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). It also opted for upstream and downstream vertical integration, which allows it to increase profit margins and to better absorb negative cost shocks. The investment in the most advanced

technology, which sizably increased productivity, ensured quality, and reduced production costs also helped in this regard. 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.

All these actions and strategies also introduce barriers to entry to competitors in the form of brand barriers, sunk costs, scale economies and technological barriers.

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

This discovery generated knowledge externalities about the profitability of exporting chocolate confections from Argentina. It also produced public goods (reputation for Argentine exports). Finally, it generated production learning and demanded product and process certifications that are then passed on to input suppliers and to other producers. Other Argentine firms in the sector were not be able to benefit significantly from these impacts for reasons related directly to the pioneer's actions, to market imperfections and to the firms' current productivities/scales of productions.

Information revelation:

Arcor did reveal important information, especially about demand (products and markets) and commercialization strategies that work best. 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. It also revealed the advantages of undertaking innovative imitation. 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.

Arcor did not reveal much technical information about production, and product and quality development. This firm 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. 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, multinational clients (via contract manufacturing) and the access to technical training of European experts.

Arcor's learning-by-doing and productivity improvements and its spill-overs:

Exports of chocolate confections brought forth significant productivity gains for Arcor. The demands of certification (ISO 9001, HACCP and GMP) 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 their 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. 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. Some of these productivity and quality gains spilled over to 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. For instance, inspired by the BOB, they have developed a bubble gum with juicy filling, which is an imitation of the Bubbaloo (of Cadbury-Adams). Arcor innovated on the original product by changing the coating and the shape. This product, which is an export success for Arcor-Brazil, required three years of development, and they are still experimenting with new markets.

Development of specialized network of suppliers:

Arcor relies on external suppliers for milk, milk jelly, cocoa, peanuts 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, evaluating and providing technical assistance to suppliers, taking advantage of the expertise obtained from auditors sent by clients from the US and Europe. This interaction has generated an implicit long-term contract between Arcor and its suppliers, who tend to work exclusively with this firm. Hence the quality improvements in this area do not spill over to other chocolate producers. Indeed there appears to be an important idiosyncratic component in the relations of chocolate producers with suppliers of specialized inputs (lack of export diffusion does not contribute either). For instance Ferrero Argentina (the other largest exporter) had to undergo through a prolonged process of search and negociations with large local producers until they could secure continuous and reliable access to some inputs of the required quality, like milk. 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.

There are instead some spillovers in the area of peanuts, although not always to local producers. Arcor is devoting substantial effort to the development of peanut suppliers and many of them already are very advanced in terms of certifications and are exporting a lot. For instance there is

one producer that supplies peanuts of similar characteristics to Mars for the M&Ms and to Arcor for the Rocklets.

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.

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

There has been an almost nil diffusion of the discovery of exports of differentiated chocolate confections among Argentine firms (see Table 1). The only other Argentine firms included among the top ten exporters are Georgalos and Felfort, which export very little. There emerged only one other major exporter, Ferrero Argentina, the local branch of Ferrero International (a global firm with headquarters in Italy). The other local branches of multinational firms are very minor exporters. This last group includes Cadbury-Stani and Kraft Foods (Nestlé does not produce chocolates in Argentina). As a result, Arcor (which owns Estirenos as well) and Ferrero represent 97% of all exports.

Table 1. Other chocolate and other food preparations containing cocoa.
Code 180690
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.CY 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
Nestle 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
Others	3.88	4.25	4.92	1.99	0.96	1.10	0.87	1.72	0.90	0.85	1.09	1.69
Total exported	14,365,962	32,673,966	40,800,223	67,062,129	85,737,650	63,421,344	67,779,246	65,713,571	52,703,665	50,998,644	64,988,924	72,772,767

Total firms: 197
Selectionated firms: 10 largest exporters
Source: IERAL from Fundación Mediterránea based on Aduana Argentina

Production geared towards import substitution is more diffused among local firms, under the umbrella of Mercosur's common external tariff (23%) and the logistic complications of chocolate exports. Georgalos is the second largest manufacturer of chocolate tablets, industrial chocolates, and chocolate confections in Argentina, and Felfort is another important player in the local market.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 hollow 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.

While there has not been a diffusion process of exports towards local competitors, 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, which benefit from the local availability of cocoa, traditionally targeted mostly their large domestic market, where they sold chocolate tablets and bonbons in assorted boxes. This did not change 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 type of product in Latin America, using similar sales strategies (sold in units as individual products) and flavor adaptations as Arcor. Kraft-Lacta is exporting a product very similar to the BOB under the "Gallito" brand (a leader brand in Central America) and Nestlé is exporting the Garoto original version of the BOB. 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, 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). Other regional producers like the Chilean Costa-Carozzi and the Colombian Compañía General de Chocolates are trying to compete with Arcor in Latin American markets with similar commercial strategies, but without success yet. 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.

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.

Determinants of extent of diffusion among locals

International markets for these chocolate confections 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.[4] 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. For instance, while Arcor has 300 people devoted to international commercialization *alone*, Georgalos, the second largest producer, has a total number of 600 employees. Credit constraints do not help either. Faced with such barriers, local firms 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. Some of them, like Georgalos and Felfort, are experimenting with niches not targeted by the sectoral leaders, like sugarless chocolates, 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. 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, and that these capabilities did not spill over to other firms.

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. Interviews with executives from some of these companies revealed that local branches are usually 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-

[4] 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, and less labor-intensive than the major competitor in Brazil (Garoto), which helped them to significantly reduce costs as long as they produced at a large scale.

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 a 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 a 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.

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 Kinder Surprise (KS). 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 (the other KS plants are located in Germany, Belgium, Poland and Italy). 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%). Arcor successfully 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. Ferrero's 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 multi-product plant of smaller scale, oriented to the domestic market and Mercosur.

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 has been to make substantial new top-of-the-line-technology capacity investments to defend the BOB brand. 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. Arcor does so because it considers that these firms can commit only to exporting to regional markets, and lack Arcor's scale in order to be able compete price- and cost-wise at a global level.

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. 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. However the latter compete in a market with more brand barriers and product differentiation, and Argentina does not enjoy a natural comparative advantage in their production.

Table 2. 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
OTHERS	1.4	2.0	1.8
Total exported	75,739,983	76,402,290	60,246,607

Total firms: 75
Selected firms: 10
Source: IERAL from Fundación Mediterránea based on Aduana Argentina

As expected, 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 (see Table 2). In contrast there are only three firms that export more than US$ 1 million in the chocolate confection sector, and two of them are multinationals that are engaged mostly in intra-firm trade. A 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, and on the cost advantages granted by its scale in this last activity.

Arcor benefited strongly from the capabilities for the production of chocolate tablets and confections accumulated by Aguila-Saint when it acquired this firm.

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.

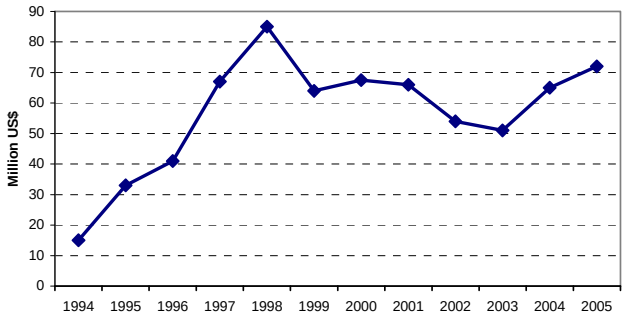
5.3. Welfare analysis

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. We must add that the 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 demand-related information externalities and demand shifting effects. Arcor acted as a monopolist that replicates the investment of a social planner, speeding up export growth at the beginning (to take advantage of demand shifting reputation effects), and then slowing down as it learned that the saturation points became near (see Figure 2). 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.

Figure 2. Chocolate confections. Total exports



Source: IERAL from Fundación Mediterránea based on

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.

The little technological spillovers and little development of open-to-all network of specialized inputs suppliers 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 discovery of exports of chocolate confections helped to move Argentina's export closer to the densest part of this space. For instance, chocolate confections lie close to a variety of products related to packing goods, which might probably require some of the same capabilities demanded by chocolate confections.[5]

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 the when pioneer can introduce barriers to entry, because of inadequate public policies, investments and institutions.

[5] These goods include "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."

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, which number has grown to 80 nowadays. Some examples are human insulin, hepatitis B vaccine, EPO, G-CSF, and human growth hormone, among others.[6]

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.

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. 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 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.

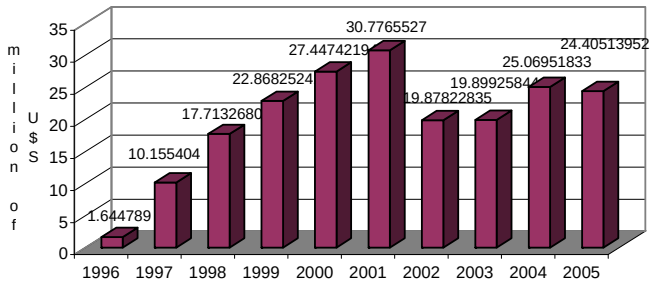
[6] Biotechnology is a collection of technologies that entail the use of cellular and bimolecular processes to solve problems or make useful products. To these ends it takes advantage of the fact that the DNA information manual of one cell can be read and implemented by cells from other living things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

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

We will hence focus on biopharmaceuticals. This segment started to be targeted by the national pharmaceutics industry during the 80´s through biotechnology developments which became mature a decade later. These labs self-financed these research investments and made use of local researchers in the area of life sciences.

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 (see Figure 3).

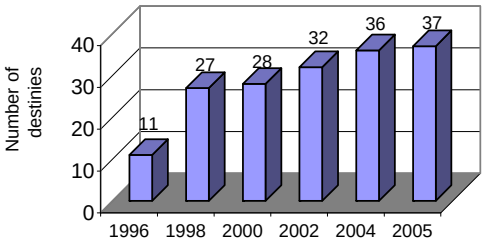
Figure 3. Biopharmaceutical exports



Source: IERAL from Fundación Mediterránea based on INDEC.

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 (see Figure 4).

Figure 4. Exports: geographic diversification

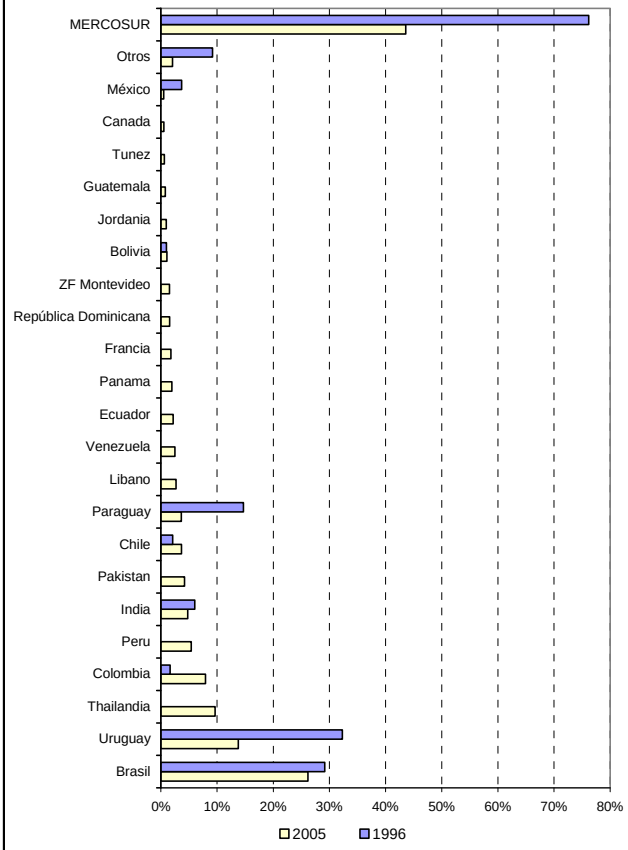


Source: IERAL from Fundación Mediterránea based on INDEC.

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, which compare very favorably to rich countries in terms of less stringent barriers to entry (patents, registry requirements and costs of clinical approval tests).

Figure 5. Exports by main destinations



Source: IERAL from Fundación Mediterránea based on INDEC

Brazil and the rest of MERCOSUR played an important role at the onset due to the knowledge of regional diseases that Argentine labs had developed and to the fact that the Brazilian BHH sector still had not fully developed.

Exports grew very fast until 2001, favored both by the initial advantage within Mercosur and by the domestic recession between 1999 and 2001. The recovery of the domestic market after 2002, together with the expansion of the Brazilian BHH sector, reduced exports, which nevertheless quickly resumed their growing trend.

6.2. Analysis of the emergence of this export sector[7]

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) for local and regional markets with less restrictive IPRs. Sidus is also involved in horizontally related biotechnological activities, applied to plants and to animals, through spin offs in these areas.

Their initial developments and exports included the interpheron-alpha (the first development) and the erythropoietin (EPO) (the firm's main export product). Its first developments took place shortly after this activity emerged in industrialized countries in the late 1980s, and preceded several years those of other Argentine firms that managed to develop similar saleable BHH products. Indeed, Bio Sidus managed to develop these products earlier than in most other developing countries, and even before several more developed countries. For instance, the commercialization of EPO in rich countries started in 1989, and Bio Sidus was already an active exporter in the mid 1990s. As a result Argentina currently 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.

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. As a result, Bio Sidus currently exports approximately US$ 17 millions 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. This is akin to an exogenous shock that "shook the tree" and forced the monkeys to jump to other trees. The resources sunk in traditional pharmaceutical activities generated incentives to consider this new activity.

Additionally, Bio Sidus' experience in the traditional pharmaceutical industry allowed it to identify BHH in developing countries as an export market that was underserved by rich country labs. There are several reasons why rich country labs were not serving less developed country markets. The relatively laxer IPRs in the latter 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

[7] 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).

reduction required from rich country labs 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 face much larger fixed and variable costs than their less developed countries' counterparts because of: a) the high cost of clinical 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. The R&D process in the traditional pharmaceutical activity 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. This relatively smaller barrier to entry facilitated the investment of a national laboratory like Sidus.

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

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:

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

Then there was the idiosyncratic uncertainty as to whether the R&D effort would succeed. The research success of Bio Sidus (as high as 70%) was based on focusing its R&D effort on a narrow set of goods (i.e., applying a linear model of innovation). This knowledge is fully proprietary (a "knowledge niche"), at least in principle.

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 products. They only did reverse engineering in generic drugs, which can be relatively easy with the information contained in patents. Hence they lacked a specific research protocol and an *a priori* identification of qualified researchers that could successfully develop these new goods.

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.

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).

The initial strategy of Bio Sidus was to focus on the development of a product (the interpheron-alpha) already existing in the global market, clinically and commercially proved, and to produce it at a cheaper price and with similar quality.

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). 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.

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.

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

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 support this type of investment. 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 for Bio Sidus not to go ahead with its investment. The pioneer was a large firm that could use its own resources to finance its investment in advance of having the regulatory framework and the domestic basic infrastructure.

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 a 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.

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. 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 were already discussed: detecting the capable human capital, focusing on a narrow range of products that were already existing (clinically and commercially approved) and targeting a then unattended market (cheaper price and similar quality than the BHH equivalents produced in rich countries).

The success was facilitated by Sidus' previous experience in the pharmaceutical sector, targeting similar product and market ranges and successfully adapting products to the characteristics, pathologies and requirements of developing country markets. 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 pharmaceutics also gave it access to resources for the internal financing of the required substantial investment in R&D and in obtaining the approval (clinical or commercial) for the new products (the technological development involves no less than 6 years, and the subsequent approval usually requires about 4 years). Bio Sidus' decision to invest its own revenues from traditional pharmaceutical activities in highly uncertain new developments in biotechnology set it apart for a good number of years from the other domestic laboratories.

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

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

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. 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 existing products that would provide it with new temporary monopoly profits (interpheron beta, G-CSF, etc.).

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

Information revelation:

The pioneer revealed the important information that the human capital available in Argentina was suitable for R&D in BHH developments. This knowledge externality 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."

Pioneer's learning and productivity improvement and its static and dynamic spill-overs:

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. These previous developments provided improved research know-how that can save 25% of time in R&D activities (with substantial financial savings). However, there are not big specific technological spillovers between one particular development and the next, i.e., previous developments do not provide any increased knowledge as to whether a new molecule is going to work or not.

The pioneer is now getting ready to access high income markets (EU, USA, Japan and Australia, which represent 90% of the world market) in the case that patents on BHH products such as the EPO cease to apply and bio-generic rules are approved for BHH. It is also applying the profits and the acquired learning in BHH R&D to develop original highly sophisticated process and/or products, some of which 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 farmaceútico') that produces human growth hormone, an already existing 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.

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).

Improvement of the functioning of the national innovation system:

A traditional criticism to the national innovation system in Argentina 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. The government's recent interest in promoting R&D, possibly fostered by the demonstration effect of Bio Sidus and others, was also very important in this regard.

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.

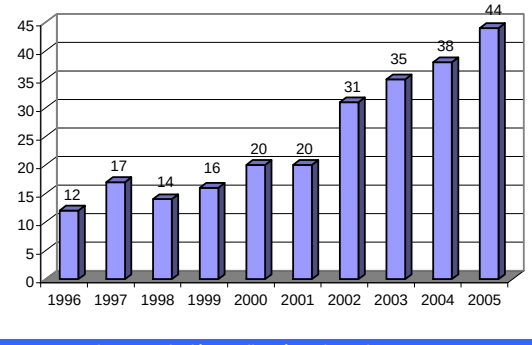
6.2.7. Was it there diffusion of this export activity? What were the key drivers of this diffusion (or lack of)?

Extent of diffusion among firms located in Argentina:

Although Bio Sidus is still the leader among BHH exporters, a big 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 (see Figure 6). 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 (see Table 3).

Figure 6. Number of exporting firms



Source: IERAL from Fundación Mediterránea based on INDEC.

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. 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.

Table 3. MAIN EXPORTING FIRMS OF BIOPHARMACS*

in dollars

Name	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
BIO SIDUS S.A.	26.16	77.43	83.09	78.32	76.12	80.66	70.14	71.47	69.91	58.08
LABORATORIO PABLO CASSARA	5.22	0.69	2.45	6.28	11.57	6.04	4.17	8.56	5.42	9.05
INSTITUTO MASSONE S.A.	7.20	3.12	2.27	1.55	0.85	0.92	1.96	2.43	2.21	2.90
UNIVERSIDAD NAC.DE CORDOBA	0.00	0.02	0.00	0.00	0.16	0.27	1.17	0.67	1.65	2.89
FERRING SA.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.89	1.09	2.31
BAXTER IMMUNO S.A.	2.88	1.25	0.02	0.25	0.20	0.47	0.02	0.32	0.34	2.30
BIOPROFARMA SA	0.00	0.00	0.00	0.00	0.10	0.02	0.03	0.51	0.77	1.97
SANDOZ SA.	1.64	0.16	0.00	0.00	0.00	0.00	0.00	0.77	2.24	1.88
PC GEN S.A.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90	4.38	1.88
SCHERING-PLOUGH S.A.	15.96	5.42	2.56	2.76	2.14	0.88	3.82	1.78	1.30	2.66
LABORATORIOS POEN S.A.C.I.F.I.	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.82	1.44	1.75
PURISSIMUS S.A.	0.00	0.01	0.04	0.97	0.82	0.23	0.51	1.44	0.71	1.62
MONTE VERDE S.A.	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.46	0.39	1.49
LABORATORIO ELEA SACIFA.	0.01	0.08	0.03	1.43	0.93	0.58	0.81	1.26	0.98	1.43
PRODUCTOS ROCHE S.A.Q.E.I.	11.47	3.21	2.27	2.71	1.85	2.41	6.18	2.42	1.17	0.99
AGROINSUMOS S.A	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.69	1.04	0.87
SERVYCAL S.A.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.12	0.84
BIOGENESIS S.A.	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.02	0.23	0.48
GRIFOLS ARGENTINA S.A.	2.25	0.24	0.04	0.16	0.15	0.04	0.19	0.42	0.31	0.45
M.R. PHARMA S.A.	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.28	1.27	0.42
Subtotal	72.78	91.62	92.76	94.43	94.91	92.51	90.04	96.16	96.98	96.24
Others	27.22	8.38	7.24	5.57	5.09	7.49	9.96	3.84	3.02	3.76
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 U$S 10.000 dollars

Source: IERAL from Fundación Mediterránea 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.

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. For instance, in China there are 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 on 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. 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.

6.2.8. Determinants of extent of diffusion

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.

The newcomers have 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 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 (interpheron 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. This association also gave it knowledge on how to perform successful R&D in BHH in general. Like the pioneer, Cassará 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.

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, such as vaccines, for its subsequent developments (although they are still both very active in "traditional" BHH products, such as EPO, interpheron-alpha and G-CSF). 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. For instance, Cassará created a new hepatitis vaccine that requires one less dose than the preexistent one, which is an important advance in the prevention of this illness because less than 20% of vaccinated actually complete the third dose. This vaccine is going to be produced and commercialized at an international level by an international lab with whom Cassará is associating with. 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.

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. PCGen was located in the same building as Cassará, but was free to pursue its own projects. It is also associating with other SMEs to pool financial and research resources for more ambitious projects. 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 facilitates technological spillovers.

Up to now diffusion has been restricted mostly to pharmaceutical firms that have enough resources to invest in these new developments. The absence of wide capital markets in Argentina restricts the development of small laboratories, 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.

There are also important deficiencies in the industry-specific public good area 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).

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

The presence of pre-existing national pharmaceutical laboratories that had the resources and flexible decision-making to finance medium and long term R&D activities, together with their accumulated capabilities for dealing with the characteristics and needs of the developing countries markets, greatly facilitated the takeoff of BHH in Argentina.

Argentina also benefited from its relatively large endowment of scientifically skilled human resources engaged in biological and medical research, including a number of Nobel Prizes in these areas, and from 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). However, the accumulated research capabilities in the area of life sciences, especially in public universities and public research institutions such as CONICET, provided the "general" skills for conducting applied research with a commercial orientation in BHH 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).

The support from the public sector was not always the most adequate, but improved over time. For instance, 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). After the Argentech credit, Bio Sidus 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. The lack of adequate public knowledge about the BHH sector was an obstacle 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).

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 suffice to give the small labs a chance to commercialize their own developments.

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 in Argentina. This is an interesting case 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.

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 ratio 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.

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 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.

The dearth of skilled personnel in some specific areas of 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, 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.

The determinants of the Brazilian BHH failure to take off suggest that the key drivers of success in Argentina were: a) the presence of national pharmaceutical laboratories, with the resources, flexibility and willingness to undertake risky R&D investments and with accumulated industry-specific capabilities, and b) the availability of life science researchers. These factors were especially important for entering early into world markets, before Asian labs started bringing prices down.

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 the local researchers would be up to the challenge. 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.

There are 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. 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. In this vein, 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.

More diffusion is also required to 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.

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.

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 help the Argentine export basket move closer to the densest part of the forest. These new exports probably share some the capabilities that are required for yet undeveloped exports of goods such as '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, which are of high productivity.

7. Case study of blueberries

7.1. Background information

Before 1992 the production of blueberries was scarce and disperse, and lacked any commercial value. Starting that year some varieties of the plant were imported and planted, the first harvest took place and the first exports were undertaken by a pioneering entrepreneur. Exports started growing fast after 1998, when diffusion became more widespread. In 2005, total exports reached US$ 28 million, becoming Argentina's 7th largest fruit export.

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 sector[8]

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.

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 used a project evaluation methodology to search for innovative investment alternatives with highly profitable niche export

[8] 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.

markets in the agricultural sector. He considered a wide variety of products that faced a low degree of competition in world markets, which included iguanas, capers, asparagus, raspberries, chestnuts, artichoke, kiwi and goat cheese.

The blueberry opportunity came by chance, during a business trip to Italy, where he learnt about the attractiveness of the European off-season market for this fruit from local business contacts**.** A preliminary project evaluation yielded very high expected payoffs, given the high world prices in the Northern off season, which exceed between two and ten times the seasonal prices. He thus decided to learn more about the product and to evaluate the feasibility of its production in Argentina. To this end he contacted a US nursery, from which he gathered information about production techniques and plant varieties. He also contacted UK importers who 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. The expectation of a temporary monopoly period (2 to 4 years), due to the time lag for the plantations of potential imitators to mature, also facilitated his decision. Another contributing factor for his choice was the relatively low initial investment that was required.

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.

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. 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.

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 partly overcome these problems by contracting a US consultant to assist him in dealing with different problems regarding production and sanitation, but there still remained high uncertainty demanding experimentation. In fact, a significant proportion of plants in the first field died, despite the technical assistance. 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. It also had to experiment with plants in his nursery activity, as the imported ones lacked the required phytosanitary quality. The pioneer chose to use macro-propagation techniques for the multiplication of plants, which was cheaper, faster and less uncertain to implement than micro-propagation techniques (which are much more productive, but require costly and lengthy R&D). This allowed him to start producing earlier, albeit probably with less reliable plants and a lower productivity.

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 productivity of the first plantations.

Regulatory framework:

During Caffarena's search process for the most attractive new activity, which lasted more than a year, he faced important regulatory uncertainties. 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). In the case of blueberries it was also uncertain that SENASA would let Vergel to import new plants and varieties, but it managed to overcome these bureaucratic barriers thanks to its previous learning in trying to import chestnut plants.

Location and returns:

There was some relevant uncertainty about investment returns. Input prices and labor costs for harvest were relatively well known and the choice of macro-propragation techniques helped control costs. The actual prices were more uncertain as they vary depending on the date of harvest and the transportation method 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.

In a first stage Caffarena planted 2 hectares that he owned in Zárate, in northern Buenos Aires, without knowing if this was the best location for production. 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. This location 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.[9] Contrastingly, the price that Chile and New Zealand received was up to ten times smaller (see Table 4). This price advantage made the business profitable even if the worst possible production techniques were used (with Chilean prices the profitability under poor production techniques was not granted).

Table 4. Initial off-season FOB prices for blueberries

Year	Argentina	Chile	New Zeland
1994	20.11	1.29	4.22
1995	22.11	1.91	5.11

Source: IERAL from Fundación Mediterránea based on COMTRADE

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 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 was the fact that costs were one half those of Chile ($ 40,000 per hectare vis-à-vis $ 80,000) despite the bigger Chilean experience, and learning, in producing berries.

Having discovered the robustness of the profitability of this business in Argentina, Caffarena decided to expand production and to integrate the nursery business, which gave him the opportunity to generate a separate line of business.

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.

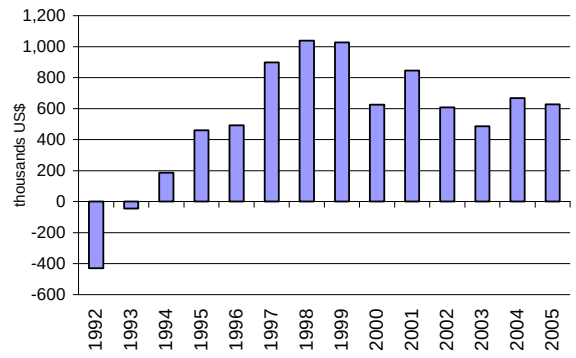
This subsequent plantation in Entre Ríos, northward from Buenos Aires, allowed him to experiment with locations and varieties in different latitudes and climates. This kind of information was so important that imitators followed him closely in these new locations (sometimes so closely that they located in the nearest fields).

One key issue for the project 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. 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,

[9] 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.

Vergel was at least two years ahead from any other competitor, which guaranteed it breaking even and several years of monopoly. An ex-post calculation using 1994-2005 actual prices showed a higher than 60% IRR at the onset of this activity (see Figure 7), suggesting that the uncertainty over the stream of future prices was of a second order relative to the technological uncertainty. 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.

Figure 7. Cash flow for a 10 hectare production in Buenos Aires



Source: IERAL from Fundación Mediterránea based on

Furthermore, besides the initial monopoly power, 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:

Commercialization was not a relevant barrier or uncertainty during these first steps, as 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.

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, which was within his financial reach. The managerial requirements were also within his scope. This low scale was facilitated by the fact that he got access to a niche market where he was the only supplier.

7.2.4. 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 generated a large knowledge externality regarding production techniques and profits. 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 and also solved coordination failures that accelerated the emergence of the sector, providing basic technological assistance and commercial certainty to new farmers.

Public goods:

At a later stage, when diffusion was already more widespread, Vergel 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 a new fumigation infrastructure in Argentina. The USDA requirements were strict and demanded the construction of a fumigation chamber with the newest technology, not yet developed in Argentina, which required 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.

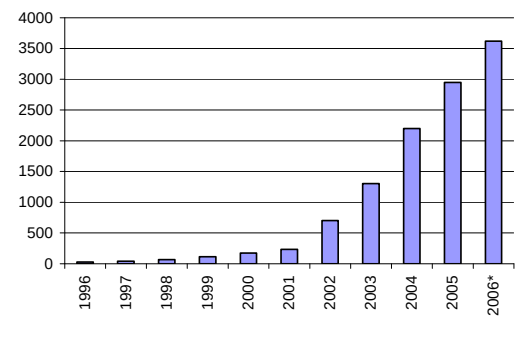
Most exporters now use this technology and many other similar chambers have been constructed. Vergel undertook this risky investment because at that time competition was not that widespread and the US market was very large and rich. Hence he expected to enjoy high prices and large sales for a time span that was long enough to recoup the investment. While the *approval* of the fumigation technology was a public good, the physical infrastructure developed by Vergel was a private good, which helped it sell a new service to its clients. It expected that this new service would consolidate and eventually help it enlarge its farm client base.

The importance of this openness can be appraised when considering that the US market currently represents the 60% of total exports.

7.2.5. 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, which took place at the production level from 1994 to 1998, was promoted by the pioneer, was limited in scope and concentrated 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. Lastly, since 2002 there is a boom in blueberry plantations that was promoted both by the 2002 devaluation and by the opening of the US market by the pioneer (sees Figure 8).

Figure 8. 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. 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. 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.

From the pioneer's point of view an additional hectare planted reduced his profits through a cut in FOB prices 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 would 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.

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. It also offered potential investors a calculation of blueberry IRR and opened its plantation for extension activities.

Since the pioneer still had not fully mastered the technological aspects of production, this initial diffusion coexisted with an experimental phase in which some techniques, soils and varieties continued 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, using the right technology the almost 3 tons exported in 1996 could have been produced in only one hectare planted in 1992, while at that time almost 20 hectares were planted, with a potential production of more than 15 tons.

Caffarena promoted diffusion only 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 capital in a market that could be contested in the near future. According to many farmers interviewed, Vergel would have had a chance to remain a monopolist had he provided an adequate technical knowledge to newcomers, so as to reduce the latter's rate of failure and consolidate a long term relationship with them. Nevertheless, the initiatives aimed at maintaining some type of monopoly would have been fruitless in any case, since all three stages of the value chain are highly competitive in other countries.

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, the signaling effects of the pioneer's first investments and its limited diffusion of production, and 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, although none of them was aware of the others' endeavors. These new nurseries had different core businesses, but both can be considered as pioneers the development of micro-propagation techniques, which make possible an exponential growth in plants multiplication and that ensure the provision of healthy plants.[10]

[10] Blueberry plants can be propagated using two different techniques. The simpler one is macro-propagation technique, or propagation by stakes. On the other hand, micro-propagation technique is the multiplication in vitro of a plant. During the interviews we found some controversy about both methods. Macro-propagation 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

One of these firms was Cuinex, which 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. They thus realized that in order to promote the diffusion of this activity they had to develop healthy and high quality plants. They made a big investment in a two-year experimentation process, after which they finally learned all the relevant issues about micro-propagation techniques. 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. They overcame the large initial technological uncertainties and finally began their plant sales around 1995.

A direct engagement in production never entered Cuinex's plans. They expected that production would somehow emerge in response to the high prices and that blueberry plantations would boom during 1995/96. Their estimates proved to be wrong, as only after 1998 the blueberry production diffused significantly. They attributed this slow diffusion to the insufficient initial investment of Vergel in learning about the most adequate production technologies and plant varieties.

Meanwhile the pharmaceutical firm Sidus had developed a new firm devoted to plant biotechnology, which in 1992 became Tecnoplant, whose core was the micro-propagation of plants. As Cuinex, they started investing in the nursery business ahead of the expected emergence of production in response to the high prices. This firm focused on developing new early varieties, in order to differentiate them from the Chilean supply. There was a two year period of experimentation during which biotechnology techniques were adjusted and 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.

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 micro-propagation 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.

The limited diffusion promoted by Vergel forced Cuinex and Tecnoplant to be actively committed with this diffusion phase. For example, Tecnoplant provided project appraisal, technical assistance, financing of packaging plants, and commercialization contracts to farmers.

It is worth noting that the initial investments in R&D and laboratories operate as barriers to entry to micro-propagation. Hence Cuinex and Tecnoplant emerged simultaneously 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 who had core in trading and logistics, as 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. Chilean exporters were the main contestants, given that the production from Argentina is complementary to the Chilean one due to the different harvest month, which allows 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 Argentina in 2000. Other local newcomers 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.

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

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 plantations had become senescent and needed to be reconverted. New owners, mainly corporate managers and independent 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. For instance, 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 west from Buenos Aires

city. He chose blueberries as a possible alternative and contacted Vergel, acquiring information from it, visiting its plantation and receiving advice about Vergel's production techniques. But he finally decided to buy the plants from Cuinex, which also offered specialized advice in production.

During this phase there were interesting examples of cooperation among farmers in solving coordination failures which could lower their profits significantly. For instance, Pazos powered a union of small farmers to improve commercialization and production techniques and to eventually cut costs. Most of the members were located around the Route 41 near Mercedes, and had administrative - professional background. When a packing plant was required the members invested jointly in its provision. 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.

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

Third stage of diffusion

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

Blueberry plantations boomed since 2002-2003, when clusters of newcomers proliferated in small plantations and big firms or groups of investors started large plantations of 200 hectares or more. New locations were discovered, including Tucumán in the north, Entre Ríos in the east and San Luis in the west, which helped 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 to one of the biggest players that without having access to the US markets, the investment would have been 200 hectares instead of 2000.

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 (see Table 5). 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.

Table 5. Blueberries. HS Code: 081040

Share (%)

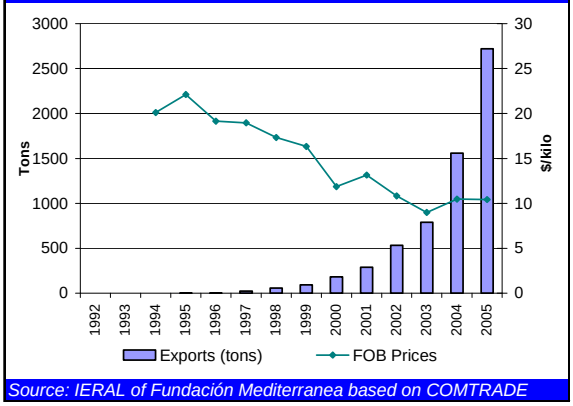
Firms	1998	1999	2000	2001	2002	2003	2004	2005
Tecnovital SA		14.21	31.89	8.73	25.82	16.67	32.78	23.36
North Bay Argentina SA				24.97	28.13	32.41	21.08	19.85
Berries del Plata SA		27.51	27.59	25.64	20.21	23.99	19.87	12.42
Blueberries SA						1.07	3.82	9.77
Vergel SA	79.32	57.45	6.85	23.33	14.93	11.05	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**
Total exported (US$)	**1,007,109**	**1,506,358**	**2,287,740**	**3,824,716**	**6,015,668**	**7,085,889**	**16,366,342**	**28,371,183**

Source: IERAL de Fundación Mediterránea based on Customs Agency.

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 (see Figure 9). This 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.

Figure 9. Argentine blueberry exports and FOB prices



Source: IERAL of Fundación Mediterranea based on COMTRADE

There currently exists fear 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. This view is supported by CAPAB's recent successful initiative to block legislation that sought to introduce cheap credit lines for new plantations. 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.

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 many are being financed with trust funds.

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

There were no previously accumulated product-specific capabilities 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. This was the case of nurseries devoted to traditional crops and of agronomic engineers with research and entrepreneurial skills that assisted producers in alternative crops. The emergence of blueberries also benefited from the existence of an entrepreneurial class that was made out of former executives of large firms, plus biotechnological firms with vast reaching interests and capabilities. In a later stage the entry of other fruit exporters (with accumulated capabilities in apples, pears, and lemons) gave an extra boost to this sector. Some initial required capabilities were imported, like the consulting and technical assistance of foreign experts. The accumulation of the required product-specific capabilities was entirely done by the private sector, and was motivated by the expected private profits.

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. The interviewees stressed the deficiencies of local involved institutions when compared to those of other countries. For example, they underscored 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 Mediterranean fruit fly or in helping producers to negotiate new protocols with the USDA. 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, we

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 there appears to be an overinvestment in the sector.

The current 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 such as: 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.

7.3. Welfare analysis

This is 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, generating a very large information externality. However, the lack of public policies to support the development of this sector together with the presence of information and coordination externalities led to a too slow growth of this activity. Due to these externalities and to financial constraints, there was too little ex-ante experimentation in production by the pioneer, which was much smaller than that of the social planner.

While no demand shifting effects were present, this case somehow fits into Vettas (2000) 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 investment and exports because of the poor productivity of the initial plantations, caused by the sub-optimal investment in experimentation by the pioneer. The demand revelation externalities may have failed here, as exports remained much more subdued than plantations for too long, leading to a diffusion of production beyond the market saturation point.

The pioneer's investment in solving coordination failures was also sub-optimal because of his aim to reach the monopoly optimum, 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.

This discovery appears to offer a positive social return, as it is based on the exploitation of an untapped natural comparative advantage and allows exploiting a monopoly position and capturing positive rents in foreign markets. 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 at an industry level.

When looking at Hausmann and Klinger product space we observe that blueberries 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 appears to share some of the capabilities required for the exports of chilled vegetables, frozen vegetables and vegetable juices, which offer similar productivities (in the sense of Hausmann, Hwang and Rodrik, 2005) as blueberries. 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 the producers fetch when exported as fresh fruit.

On the other hand, 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 in 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. 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).[11]

[11] 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 [12]

We can isolate the most important factors permitting the emergence of blueberries as a new successful export activity by analyzing the lackluster experience of fresh raspberries, which share several basic traits with blueberries, but also differ along some important dimensions.

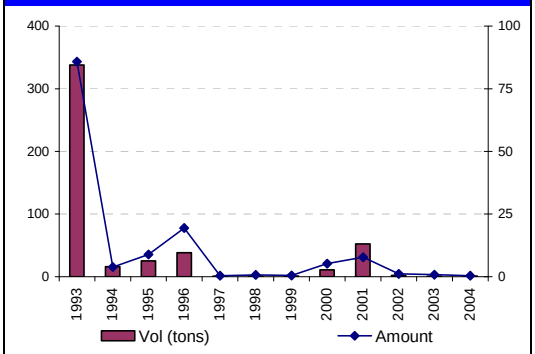
We can also identify the factors that led to a sub-optimal initial investment in experimentation by the pioneer and to a slow initial diffusion by contrasting the emergences of this sector in Argentina and in Chile, which differ in terms of the previously accumulated capabilities, the provision of ISPG and the government's promotion of discovery and diffusion.

7.4.1. Fresh raspberries in Argentina

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. Nevertheless, these exports went down to insignificant levels in the years that followed (see Figure 10).

[12] 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 Meiliolli, 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, Agrobit.com.

Figure 10. Export of Raspberries - Argentina



Source: IERAL of Fundación Mediterránea based on COMTRADE

The 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, but were limited in size from 1/2 to 5 hectares. This boom was driven by the growing trend in world demand and the perception that it was feasible for Argentina to become a competitive supplier of the Northern Hemisphere in the off season. There was not an identifiable first mover. Raspberry farmers attempt to export fresh production was based on the Chilean success and on information gathered from specialized publications.

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

Lack of comparative advantage and poor timing

Unlike the case of blueberries, 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 has lowered prices, what is negatively affecting Chilean exporters.

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

Low export profits

Exports had to compete with a very attractive domestic demand for frozen raspberries. During the early 1990s the local market demanded more raspberries that the local production capacity, leading to yearly imports of 260 tons of frozen raspberries.

Local prices of fresh raspberries are around AR$12/kg (US$4), while export prices (in Chile) vary from US$1.75/kg to US$4.5/kg and the experiences of exports from Argentina show a price around US$4. In fact, Argentina had been importing (from Chile) an important proportion of its consumption. Apart from the relatively low gains, exporting also entailed significant risk in logistics and commercialization. The devaluation of 2002 promoted a 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.

Profits were significantly higher for blueberries, which 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, raspberry costs of harvest are almost 3 times the ones of blueberries. The low yields of initial plantations were inconvenient for blueberries but did not jeopardize their profitability. But for raspberries initial shortcomings meant a definite failure for several farmers.

Fast perishability and logistics costs

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 them 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 hectare), the immediate cooling and packing of the product (including fumigation), its transportation by truck to the international airport, and by air to the Northern Hemisphere for its immediate distribution. Due to this fast perishability, the transportation by truck and then by plane demanded a level of coordination in logistics that was never reached. Perishability also conditioned severely choosing the optimal soils and climates for planting exportable raspberries, such as those of Patagonia, which are far from international airports. Finally, perishability disallowed exports to the US, as the fumigation required to get rid of the Mediterranean fruit fly would ripen the plant before it could reach its foreign consumption market.

Large coordination externalities

A plantation has to target 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), that allows absorbing the fixed costs of logistics and commercialization, 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. 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 1 ton of exportable fresh fruit, while raspberries require 30 hectares. This difference arises because raspberries require to be shipped every day, while the production of blueberries can be stored for several days.

Lack of public support

Public policies and institutions did not offer any support. For example, INTA's research activity and extension assistance lagged behind private investment. Additionally, logistics and infrastructure for exporting fresh fruit is not adequately facilitated, particularly for handling 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.

Lessons for the success of blueberries

It could appear that raspberries would have stood a chance of success if the large coordination problems had been solved. However, our analysis reveals that even in the case of achieving this coordination, the combination of low export prices from having entered late the export markets, the competition with the domestic market, the high costs of harvest, and the fast perishability together with the Mediterranean fruit fly and the poor transportation logistics for the best planting areas (Patagonia) were dooming this experiment from the onset.

The comparison with blueberries reveals that the key reason why the latter succeeded was because it enjoyed a unique comparative advantage, which is that because of geographical advantages it could be exported to the Northern Hemisphere during a period where they faced no competition from other Southern Hemisphere producers, obtaining very large profits. This advantage together with the fact that it was much less perishable allowed it to overcome other hurdles, stemming from knowledge and coordination externalities and lack of public support.

7.4.2. Blueberries in Chile

The comparison with Chile (see Agosin and Bravo-Ortega, 2007) confirms that the lack of government involvement in facilitating experimentation, compensating for the knowledge and coordination externalities, and promoting the accumulation of industry-specific capabilities and public goods was what led to a sub-optimal investment by the pioneer and to a slow initial diffusion, which may result in a current overinvestment.

The discovery and diffusion of blueberries in Chile was promoted by Fundación Chile, which participated in Berries La Unión, a public-private joint venture that did the socially optimal experimentation. This endeavor built upon the government program to develop the berry sector in this country. This program had generated 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, and which were ready to take advantage of the technological and price information (harvest period) revealed by Berries La Unión. This was very important because Chilean blueberry exporters faced significantly lower world prices from the onset than the Argentine pioneer (and higher costs of production). 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.

Additionally, and in contrast with Argentina, Chile was free of the Mediterranean fruit fly pest, and hence the investments of blueberry exporters were always of a relatively large magnitude, consistent with their access to the US market. This access was also facilitated by the Chilean trade negotiations with the US, whereas in Argentina this access had to be negotiated by the pioneer at a late stage, which greatly slowed diffusion.

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 social returns to investment and their apropriability.

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 barriers to entry, there was sub-optimal investment in discovery but diffusion eventually emerged, albeit more slowly and with lower productivity 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 there may be a low appropriability of the social returns to investment in self-discovery which is detrimental to development in Argentina.

The fact that some new exports have succeeded despite the absence of government intervention suggests that there are 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 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 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. This is a case of large payoffs to public investment 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 an 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 possibly to discover new exports in other sophisticated related activities such as organic chemicals and other pharmaceutical products. BHH additionally generated technological spillovers that led to the creation of a dynamic cluster of BHH firms of different sizes, and to an accumulation of industry-specific knowledge that 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 niche agricultural activities. 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 via brand, technological and scale barriers to entry. Hence it is remarkable that a firm from a developing country could become an active worldwide exporter, overcoming 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. These 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 hence could facilitate further structural transformation towards more sophisticated exports.

Our case studies provide interesting insights on 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. 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. 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 initial investments made by the pioneer to solve the involved uncertainties and coordination failures were relatively large in the cases of chocolate confections and BHH and relatively small in the cases of blueberries. 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 the expected accumulation of capabilities for subsequent discoveries, regardless of whether this accumulation occurs at a firm or industry level.

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 theses activities would probably not be the most attractive, unless they were able to introduce barriers to entry that offset the cross-border externalities 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.

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 although in some cases got involved in the diffusion stage. The lack of involvement in discovery by foreign owned 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. 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 in the blueberry sector in Argentina, or the cases of the foreign owned Brazilian imitators of Arcor. 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 domestic firms.

A final consideration which arises from our case studies refers to how open the world markets are to the discovery of new sophisticated export activities from LDCs. 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. More generally, 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. In the face of these protectionist measures, the

scope for 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 export activities they seek to foster or to facilitate, and to the natures of the involved information and coordination externalities.

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

In this vein, we find 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).

The blueberry case raises the issue of whether the government should be involved in supporting pre-competitive experimentation, or if it should design and implement mechanisms that support discovery after the pre-competitive experimentation by the pioneer has revealed the new activity to have a potentially high social return but the pioneer still has not sunk significant capital in production. The same applies to the solution of coordination failures, as it probably would not have made sense 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.

Our case studies also reveal that the implementation of policies that promote diffusion does not always offer a positive social return, as in the case with chocolate confections. The timing to promote diffusion also matters, as in the case of blueberries which should have been promoted early and not when there is the risk of overinvestment in this activity.

When diffusion is advisable, the best policies 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, the best policies include providing access to long term financing to R&D through credit channels like FONTAR. 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 were extremely important for the discoveries and that the required sector-specific capabilities and ISPGs could be developed afterwards. However, the direct provision of ISPGs by the private sector was usually smaller and slower than optimal (save for the case of chocolate confections). 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, the cross-border externalities in the case of chocolate confections attenuate the case for the subsidization of discovery. Furthermore, this is an activity where a private monopolist undertakes the same investment that a social planner would. Instead the promotion of the discovery of activities where there are cross-border externalities and where the pioneer cannot introduce barriers to entry would call for a combination of support to discovery together with strategic trade policies.

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.

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. Hence our case studies offer no general lesson regarding the role of devaluation on discovery and diffusion. At most we can conjecture that devaluation may favor the discovery of labor-intensive activities but may have a negative effect on the discovery of capital-intensive sectors. Indeed our statistical analysis shows a bigger frequency of discoveries in capital-intensive industries during the 1990s, a period of real exchange rate appreciation.

10. Conclusions of case study analysis

The analyzed new successful exports reflected self-discovery of comparative advantage (blueberries), the exploitation of knowledge niches (BHH), and the introduction of barriers to riches (chocolates) which in these differentiated product markets actually were barriers to poors.

In the absence of government support to discovery, these new exports emerged because the pioneers could introduce permanent or dynamic barriers to entry. When they could only introduce temporary barriers to entry, the *laissez faire* investment in experimentation was sub-optimally small. These findings point to the possibility that we may see relatively little investment in discovery in activities with more competitive fringes.

These new exports emerged in sectors where there were entrepreneurs with superior international networking and business planning skills and/or there were larger firms that can self-provide the required ISPG and solve coordination failures by themselves.

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, 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.

The pioneer's commitment to exporting and/or to undertake risks was very important. The pioneers were all national firms/entrepreneurs that were willing and able to take chances in risky investments in the discovery of new activities. This set them apart from the local branches of multinational corporations.

The emergence of these new exports involved solving uncertainties about local costs, production technologies and/or foreign demand and commercialization strategies. Each type of uncertainty had different implications for the optimal diffusion process and the optimal policies.

Success in the discovery of new activities, particularly those that involve differentiated goods, was facilitated when the pioneer focused on a relatively narrow range of goods and targeted products that already existed somewhere else so as to get rid of uncertainty of 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 were further enhanced when the pioneers focused on market segments that are not targeted by rich country competitors.

Some of the cases analyzed here displayed demand shifting effects (chocolates) and demand revelation externalities (chocolates and blueberries). In the case of chocolate confections, a monopolist internalized the social returns and undertook the socially optimal investments. In the case of blueberries, the *laissez faire* promotion of diffusion by the pioneer was sub-optimal.

Our findings suggest that there is no unique policy recipe for promoting the emergence of new successful export activities, which will depend on the types of uncertainties and coordination failures involved and the previously accumulated capabilities. The cases analyzed here reveal that the set of policies required for promoting the emergence of new export activities will go beyond the targeted support to catalyst firms 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 incentives given by the fact that it is becoming increasingly harder to capture rents in the initial market segments due to rising competition from other developing countries. Indeed, new exports of goods with horizontal or vertical product differentiation and downward sloping demand are likelier to succeed when they are targeted at an early stage of the world product cycle. In this vein, the emergence of BHH is a nice example of realization of the payoffs of investing in research activities by public agencies, as the resulting availability of qualified biologists was a *sine qua non* for being able to target this activity as soon as it emerged in the world.

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 under *laissez faire*. 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, leading to the lack of discovery of many potentially attractive new activities in more competitive fringes.

11. Statistical Appendix

11.1. Aggregate and sectoral export growth

Argentina's aggregate exports have not been very 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 A1). 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.

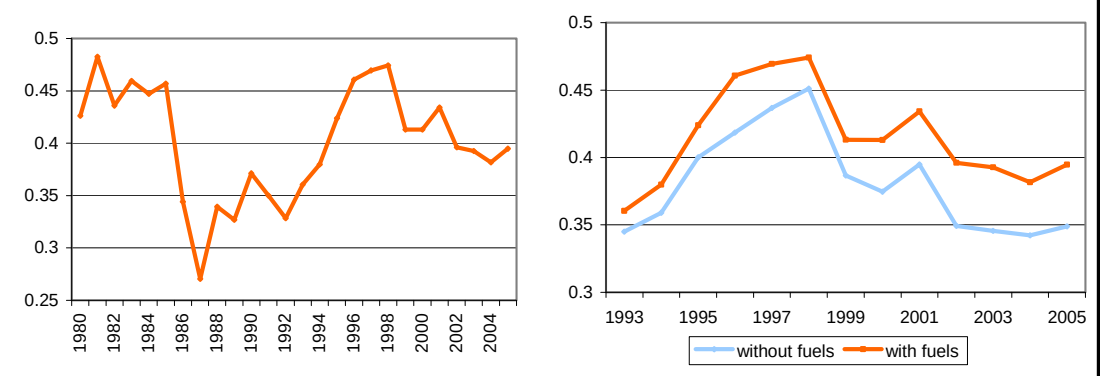
Table A1. Exports dynamics

Annual growth rate	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 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 volatile real exchange rate). In this period, its share in world export fell to 0.27% in 1987 (see Figure A1). Argentina recovered its world trade share during the '90, a period that was associated to macroeconomic stabilization, trade liberalization, deregulation, large capital inflows, real exchange rate appreciation, fast GDP and productivity growth until 1998. Its share in world trade started to decline again with the devaluations in Brazil and other emerging countries after 1998. Despite the large devaluation of the Argentine peso in 2002, exports have failed to grow faster than world trade. 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).

Figure A1. Argentine´s share of world exports

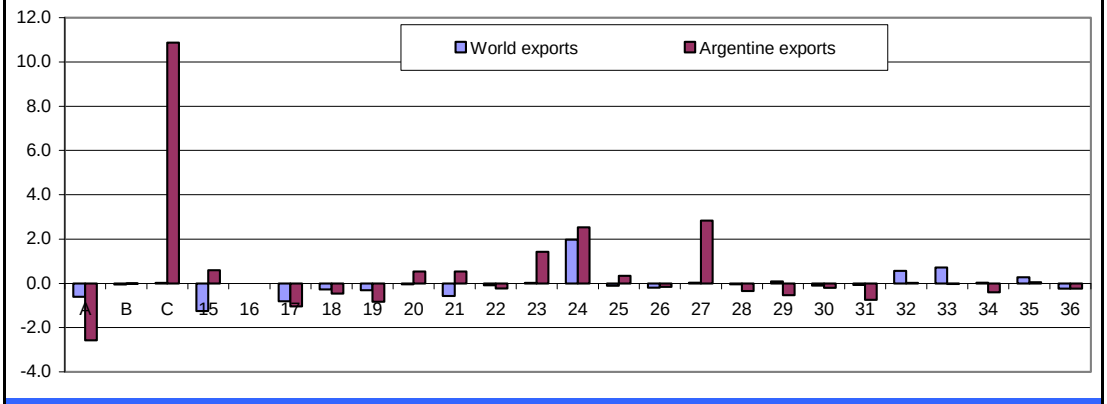


Source: IERAL from Fundación Mediterránea based on IFS and INDEC.

The exports of manufactures of chemicals and chemical products were the most dynamic 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 Figure A2). 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).

Figure A2. Share´s growth by sectors

Period: 1994 vs 2004



Source: IERAL from Fundación Mediterránea based on INDEC and IFS.

Table A2 shows that relative unit export prices vis-à-vis the world prices (which may proxy for quality) rose for 10 sectors out of 25 at the 2-digit level, suggesting a mediocre quality growth.

Table A2. 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.

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 (see Table A3). Mining and Agriculture Products have improved their net external balance. In 2005 64.5% of overall exports were exports of products with RCA. Revealed comparative disadvantage has also deepened, especially in Machinery and in Chemical Goods, which respectively account for 49.8 and 19% of all imports.

Table A3. 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 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, finding 4,198 products with positive exports 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 identification of new exports we first imposed the condition that exports should have grown at least 300% between 1993-94 and 2003-04, so as to include sectors with above average export growth (154.7%) and median export growth (263%). There are 1,797 sectors (42.8% of all export products) that meet this first condition. In order to concentrate only on those activities that have sufficient economic significance, we next imposed 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 in 2004. 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.[13] As a result, we have 87 products that meet all our requirements.

[13] They are exports reserved for the particular use of the contracting parts and have no significance in our analysis.

Table A4 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 fuels	0.09	13.35	13.25
Fuels	0.00	7.55	7.55

Note: There are 90 new products

Source: IERAL from Fundación Mediterránea based on

Table A4 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***

Source: IERAL from Fundación Mediterránea based on

While representing a relatively small number of products, the new exports rapidly increased their shares in total exports (see Tables A4). The emergence of new exports since the early 1990s have generated a dramatic structural change in the composition of 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. The new exports showed a more dynamic behaviour than overall exports, and contributed with more than one third of overall export growth (see Table A5).

Table A5. 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

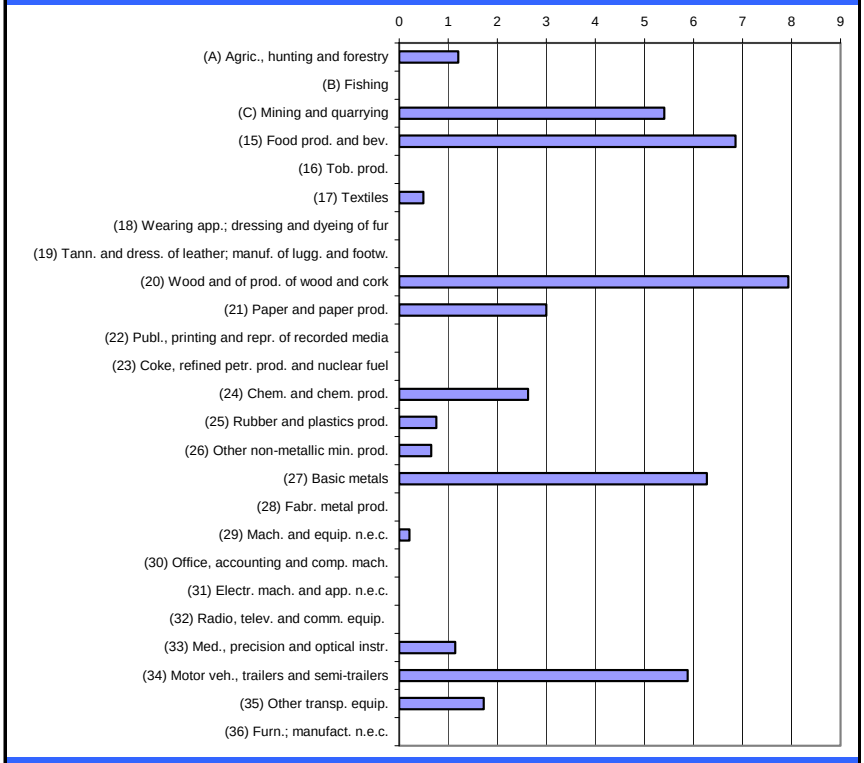
Source: IERAL from Fundación Mediterránea based on INDEC and COMTRADE

These new Argentine exports grew significantly faster than their world counterparts, allowing them to increase nine times their participation in world trade, from 0.11% in 1995 to 1.01% in 2004. Their current share of world exports compares very favorably to the participation of total Argentine exports in world trade (0.39%).

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.[14] Figure A3 shows the frequency of new export 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.

Figure A3. % of new exports in the selected sectors



Source: IERAL from Fundación Mediterránea based on INDEC..

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.

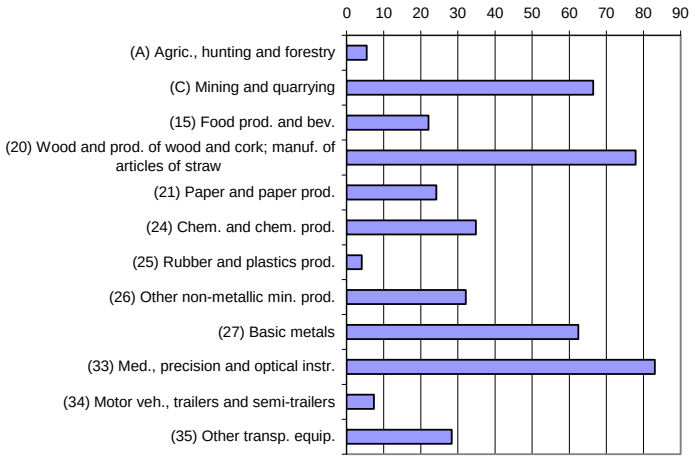
The concentration of new exports in activities linked to natural resources is consistent with the previously described gain in participation of these sectors in total Argentine exports.

[14] 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.

Figure A4 displays the contribution of new exports to each sector's export growth.[15] 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 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. 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.

Figure A4. New export´s contribution to the sector´s growth

Period: 2004-2003 vs 1994-1993

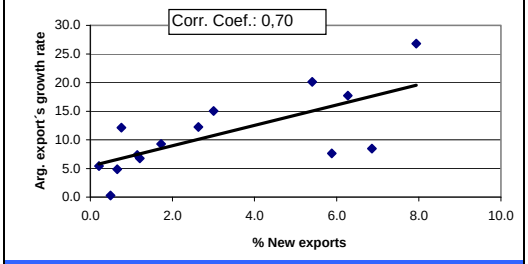


Source IERAL from Fundación Mediterránea based on INDEC.

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 (see Figure A5).

[15] 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).

Figure A5. % of new exports vs. Argentine export´s annual growth rate



Source: IERAL from Fundación Mediterránea based on INDEC

The new exports displayed declining export prices in most sectors. Table A6 shows the average change in export prices between 1995 and 2004 for the new exports in each sector, together with the frequency of new exports by sector. In the eight sectors where new exports were more frequent, prices either declined more than for total sectoral exports (compare to Table A2), or grew less. In the four sectors where discoveries were less frequent, new export prices tended to grow in absolute terms and/or relative to the prices of total sectoral exports (compare to Table A2). This suggests that discoveries occurred more frequently in activities with smaller scope for catching up to the world price and quality frontier.

Table A6. Annual growth rate for the prices of new exports

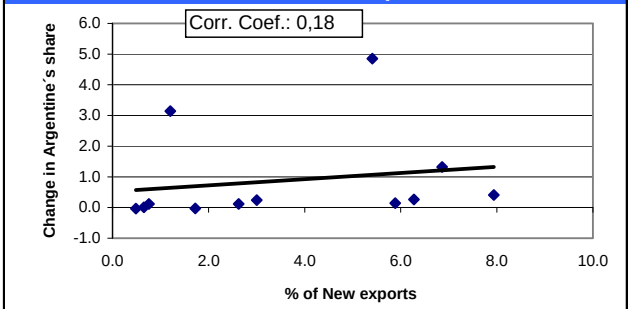
Period: 2004-1995

ISIC2d	Sectors description	Argentina (%)	% NE
20	Manuf. of wood and of prod. of wood and cork	-2,69	7,94
15	Manuf. of food prod. and bev.	-6,84	6,86
27	Manuf. of basic metals	-4,68	6,27
34	Manuf. of motor veh., trailers and semi-trailers	-1,82	5,88
21	Manuf. of paper and paper prod.	---	3,00
24	Manuf. of chem. and chem. prod.	-4,39	2,63
35	Manuf. of other transp. equip.	11,70	1,72
A	Agric., hunting and forestry	-35,02	1,20
33	Manuf. of med., precision and optical instr.	11,57	1,14
25	Manuf. of rubber and plastics prod.	-2,08	0,76
26	Manuf. of other non-metallic min. prod.	2,48	0,65
29	Manuf. of mach. and equip. n.e.c.	5,04	0,21

Source: IERAL from Fundación Mediterránea based on INDEC and COMTRADE

Figure A6 additionally shows that a bigger frequency of new exports by sector did not appear to contribute to significant gains in world trade shares. This is consistent with the poor price dynamics of the new exports in the sectors where discoveries were more frequent.

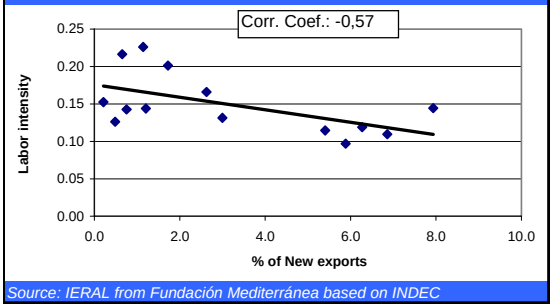
Figure A6. % of new exports vs. Change in Argentine´s share in world exports



Source: IERAL from Fundación Mediterránea based on INDEC

Figure A7 shows that the emergence of newly exported products has been more important in industries that are less labor-intensive.[16] 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.

Figure A7. % of new exports vs. Labor intensity



Source: IERAL from Fundación Mediterránea based on INDEC

Finally, new exports did not appear to represent jumps between trees within sectors with revealed comparative advantage (RCA), but rather jumps to new sectors without RCA, as only 28.9% of new exports were in sectors with RCA in 1993 (see Table A7). New exports changed the pattern of RCA as 60% of new exports in 2004 were then in sectors with RCA.

Table A7. % of New Exports in sectors with revealed comparative advantage

	1993	2004
Quantity	28.9	60.0
Value	25.3	77.3

Source: IERAL from Fundación Mediterránea based on COMTRADE

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 (See Table A8).

Table A8. 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.

[16] Labor intensity is measured as the labor/sectoral value added ratio, obtained from the 1997 Input-Output Tables.

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.

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