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THE DETERMINANTS OF FIRMS' DISTANT COLLABORATION. EVIDENCE FROM ARGENTINA 1998-2001

Valeria Arza¹
Andrés López²

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¹ Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Centro de Investigaciones para la Transformación (CENIT), varza@fund-cenit.org.ar

² Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Centro de Investigaciones para la Transformación (CENIT), anlopez@fund-cenit.org.ar

**The determinants of firms' distant collaboration.
Evidence from Argentina 1998-2001**

Valeria Arza*

Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET)
Centro de Estudios para la Transformación (CENIT)
Callao 796 6to piso
(1023) Buenos Aires, Argentina

Andrés López**

Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET)
Centro de Estudios para la Transformación (CENIT)
Callao 796 6to piso
(1023) Buenos Aires, Argentina

Abstract

Firms' cooperation is a key factor for technological upgrading. In the present era of globalization, international cooperation has become more relevant than in the past, but it has not deserved as much attention in the literature. In this paper we explore the determinants of the probability of cooperating with partners located at different distances in Argentina. Our hypothesis is that international cooperation requires stronger technological capabilities and firms' openness. Our findings largely confirm the hypotheses. Firstly, foreign firms or those that trade intensively are more likely to cooperate abroad. Secondly, skilled labour intensive firms and firms that allocate more resources to innovation activities show higher probability of forming international partnerships.

Key words: Innovation systems, firms' cooperation, international linkages, technological upgrading, geographical distance, Argentina.

JEL Codes: O33; O31; F02

* Corresponding author. Email: varza@fund-cenit.org.ar; Tel & Fax +54 11 4815 1310

**E-mail: anlopez@fund-cenit.org.ar

1) Introduction

Scientific and technological novelties are increasingly the result of joint efforts of a network of innovators, who interact formally or informally, purposely or without awareness as part of their normal social behaviour. The mad and inventive scientist who created path-breaking inventions in isolation is more than ever a stereotype. The rapid pace of development of new scientific and technological knowledge together with technological and market uncertainty associated to developing new products and process, has pulled the demand for collaboration.

Innovation is increasingly the result of a combination of a multiplicity of disciplines, actors and locations. Especially in those fields of fast technological progress, the sources of knowledge are widely spread and no single actor could gather the necessary competences for creating something novel (Hagedoorn and Duysters, 2002, Powell, *et al.*, 2005, Powell and Grodal, 2005).

In fact, the literature has posed many arguments claiming that collaboration is a positive sum game in innovation performance (see Pittaway, *et al.*, 2004 for a review).

Collaboration allows actors to access a wider stock of knowledge and to some extent promotes knowledge spillovers, since collaborating partners would be more open to share knowledge and they would also develop a common language through which they could become more explicit about their tacit knowledge. This is particularly important since it is more likely that tacit (rather than codified) knowledge conveyed novelty (Maskell and Malmberg, 1999). In other words, collaboration contributes to the diffusion of novelties that are relevant to the partners, even if they only interact to solve very specific problems. In this vein, some authors have claimed that firms need to collaborate in order to stay updated, especially in technologically dynamic sectors

(Powell, *et al.*, 1996) and also that organisations lacking of interaction capacity would fall behind in (Powell, *et al.*, 2005).

Moreover, collaboration it is not just about diffusion; the combination of existent knowledge may create novelty in itself (Fleming and Sorenson, 2001), since actors would acquire more experience and different competences. It is believed that collaboration creates a virtuous cycle since firms learn how to interact, developing strategic network capabilities, which in due time increases their chances of becoming innovators and facilitates the formation of new linkages (e.g. Hagedoorn, *et al.*, 2006, Pittaway, *et al.*, 2004, Powell and Grodal, 2005).

Partners may contribute with similar or different capabilities to collaborative arrangements. Since collaboration opens up the opportunity to exploit complementary assets, networks will perform better when different capabilities are being complemented, promoting the technological specialisation of partners (e.g. Dussauge, *et al.*, 2000, Mowery, *et al.*, 1996). In any case, collaboration would reduce duplication efforts.

Moreover, in rapidly changing contexts strategic alliances could be instrumental for risk sharing (Sarkar, *et al.*, 2001) and some studies have claimed that collaboration increases the chances of survival (and growth) of small and newly founded firms (e.g. Bruderl, *et al.*, 1992, Larson, 1992, Sarkar, *et al.*, 2001, Shan, *et al.*, 1994).

However, too close collaboration may also create a lock-in effect, by means of reducing possible lines of research and by making actors too focused into their own community. This is particularly important when collaboration is only locally conceived. Nowadays innovations are generated and diffused not only locally and regionally but globally,

therefore the network of innovators should not be constrained geographically³ Linkages may well be international. .

This is the most important for innovation systems of developing countries, where promoting *local* linkages may come at the expense of achieving novelty and updated knowledge. In these countries strictly local collaborations may perpetuate the innovation systems backwardness and their lack of diversification, rather than promoting technological dynamism. Marin and Arza (2009, forthcoming) have discussed the importance for developing countries of promoting the system's "international involvement", or in other words creating the mechanisms for making the system involved in the international processes of knowledge creation and diffusion. One way of opening-up the system, would be via international collaborations.

In this paper we aim at identifying factors that drive firms to establish international linkages. In particular, we shed some light on the extent to which determinants of international linkages differ from national linkages through the study of the case of the manufacturing sector of Argentina. Departing from the premise that firms' international collaboration is positive for technology development and innovation, the paper policy goal is promoting firms forming international partnerships. To this end, we need to identify the main drivers of such collaboration.

The paper is structured as follows. Section 2 presents the literature on distant interactions, their main drivers and their role in innovation systems. Section 3 presents the data and the methodology employed. Section 4 discusses the results and Section 5 concludes.

³ See Archibugi, et al., 1999, Archibugi and Michie, 1995 for a discussion on the literature on innovation systems and globalization and the implications for each other. See also Cooke, et al., 1997 for a discussion on how globalization strengthens regional innovation systems.

2) International collaboration and innovation systems

One of the key contributions of the innovation systems literature has been to highlight the importance of complex relations amongst different actors for achieving innovative outcomes. This literature has rejected the idea that innovative outcomes are the results of isolated actors. Innovation occurs in systems, which include economic, social, political, and other factors that influence innovation. It is believed that this common framework would affect actors' trust and entrepreneurship, affecting the way they behave and interact with each other.

In particular, there is one strand of literature on innovation systems that more explicitly study causes and consequences of the formation of linkages. This literature includes clusters studies, regional studies, industrial districts, industrial geography, etc. and we will encompass it altogether under the name of local systems of innovation (LIS) literature. Their premise is that interactions work as channels for transmitting tacit knowledge, which demands face-to-face communication for efficient transmission since tacit knowledge cannot be isolated from the *knowing person*. It is also believed that this type of knowledge conveys more novelty than explicit/codified knowledge, since the latter is less costly and therefore diffuses widely. As a consequence, geographical proximity appears as a highly important pre-requisite for knowledge transfer and innovation (e.g. Fischer, *et al.*, 2006, Ivarsson and Alvstam, 2005, Maskell and Malmberg, 1999). The drawback of this conception is to neglect the possibility of learning through distant cooperation. This is particularly restrictive in an era when the diffusion and production of technologies have become global.⁴

⁴ In contrast, the literature on *sectoral* systems of innovation has stressed the global factors affecting the development of particular technologies (e.g. Malerba, 2002), but this literature downplays the importance of macroeconomic, institutional and local factors in learning and innovation.

Bell and Albu (1999) discussed the LIS literature studying developing countries and argued that most of the studies examined the internal characteristics of the local environment (e.g. market and production structure, local linkages, local institutions, culture identity, etc.) despite the fact that there was a number of case-studies that had already highlighted the importance of external linkages for the technological dynamism of clusters in these countries (they quoted three doctoral theses: Nadvi, 1996, Sandee, 1995, Visser, 1996). Moreover, they questioned the importance of spatial proximity for the performance of local innovation systems and they argued, instead, that developing countries should aim at being connected to knowledge from outside their local systems.

In fact, we believe that one reason why geographical proximity was given such level of importance in LIS literature is that most research in that field was done based on innovation systems of developed countries. Developing countries, instead, have very limited access to knowledge and technologies close to the international frontier. Sources of updated knowledge in these countries usually come from abroad. Therefore, agents in developing countries might be more susceptible to be trapped in technological lock-in effects if they only interact locally.

Besides, LIS literature has somehow overplayed the importance of tacit knowledge while downplaying the likelihood of knowledge codification⁵. Moreover, as other have claimed LIS literature has fallen short in examining the actual ways in which knowledge

⁵ There is knowledge that although being articulable remains unvoiced because the costs of codification are too high. Therefore, some authors have aimed at understanding the conditions that will encourage codification (see for example Ancori, et al., 2000, Cohendet and Steinmueller, 2000, Cowan, et al., 2000, Cowan and Foray, 1997)

is appropriated, many of which may not be associated to co-location⁶. As a result, the probability of transferring knowledge has been (misleadingly) associated to geographical proximity⁷.

Although the importance of external linkages was somehow understated by the literature *vis à vis* the relevance of internal linkages, since Bell and Albu (1999) research on the characteristics and roles of external linkages in LIS in developing countries has grown. . To name just a few, firms absorptive capabilities were found as important drivers for forming both internal and external linkages, as found by Giuliani and Bell (2005) studying a wine cluster in Chile. In turn, Saxenian (2005) pointed out to reverse brain-drain flows of US-educated Indian and Chinese-born engineers, as an increasingly important source of external knowledge in information technology industries in India and China. Looking at the performance side, Nadvi and Halder (2005) analysed external linkages of two clusters one in Germany –developed country- and another one in Pakistan –developing country- of the global surgical instrument industry and concluded that external linkages together with internal ones were important in both clusters to raise competitiveness as well as to respond to global challenges. More

⁶ Breschi and Lissoni, 2001 pointed out that network specific technologies are developed within a system of production transactions, and these interactions usually occur at distance. Moreover, they argue that certain knowledge might be embodied in the organization and its cooperation practices, thus face-to-face interactions might not be a requirement for knowledge transmission.

⁷ Torre and Rallett, 2005 claim proximity is a concept much more ambiguous than localization. They divide the concept in *organized proximity* and *geographical proximity*. The former is based on the *logic of belonging* and the *logic of similarity* (e.g. two researchers from the same organization will tend to cooperate more between each other than with outsiders), while the other is based on co-localization. Their contention is that the former offers mechanisms for distant collaboration and therefore the search for geographical proximity is not at the core of firms' strategies anymore.

specifically and studying Latin America, Giuliani *et al* (2005) used primary and secondary sources to study 40 clusters in several countries. They argued that governance of global value chains and collective efficiency⁸ of the cluster matter for firms' innovativeness.⁹ They also pointed out to the fact that sectors specificities mediate such relationships.

Most of the existing LIS literature that *does* study external linkages studies them in relation to global value chains. The role of global value chains in upgrading industrial clusters in developing countries was put forward by Humphrey and Schmitz (2002). The authors claimed that global value chains are *quasi-hierarchical* in developing countries. This implied an asymmetry of competence and power in favor of global buyers who set product and process parameters. On the one hand, this type of governance creates incentives for local firms' fast upgrading, but on the other hand local firms might find themselves locked-in in low value added activities that are functional to global buyers' interests. The authors recognized the fragility of these types of governance of global value chain which predominates in developing countries and suggests ways in which local firms move forward.

This study will also analyse firms' external linkages. In particular we will compare drivers of external linkages with those of local and national linkages. However, we will not restrict the analysis to vertical linkages. The partnerships to be assessed here include

⁸ The authors take Schmitz, 1995's definition of collective efficiency: "comparative advantage derived from local external economies and joint actions" p. 530

⁹ However, there is also a need to analyse the types of international linkages that are being established, since it could well be that these international linkages do not open up new opportunities for learning but they just substitute the opportunities that are available within the NSI (see some of the articles published in a book about the Mexican NSI edited by Cimoli, 2000, for example the articles by Capdevielle, et al., 2000, Casas, et al., 2000, Unger and Orlariz, 2000).

suppliers, clients, other organisations within corporations and the scientific community. By dealing with so heterogeneous actors, we could assume that power relations would not interfere in a single direction. Thus, we will assume that by cooperating with the international community firms will have better access to updated technological information which would contribute to their upgrading and competitiveness. In this paper, however, we will not test for the validity of such statement. Instead our goal is to evaluate the determinants of firms' propensities to cooperate with national and international actors, assuming that proximity aids the likelihood of cooperating (i.e. *ceteris paribus* firms will find easier to cooperate with national partners than with Latin-American partner than with other international partners) but the further away the cooperation is established the greater the opportunities for accessing updated technology.

Our methodological approach also differs from most of the existing literature, which has been mainly confined to qualitative methodologies based on specific LIS. Instead, we will estimate a multinomial logit model which will jointly identify the determinants of connecting at different levels of proximity for a sample of firms which is representative of the Argentinean manufacturing sector.

All in all, our object of study fits better with the interests of the literature on national system of innovation (NSI) rather than with those of the LSI literature. This makes our contribution more noticeably, since openness has not been thoroughly conceptualised in the NSI literature. Although some authors reasonably pointed out to the need for policy makers to remain alert to technologies developed in other systems (e.g. Liu and White, 2001, Lundvall, *et al.*, 2002), the internationalization of the NSI was never a key aspect of research in that area, neither conceptually nor empirically. As a matter of fact, Archibugi *et al.* (1999) claimed that the debate within NSI literature –although having

originated at the surge of the globalization era- was surprisingly disconnected from the international business literature that studied *globalized* innovative activities of business corporations. Similarly, Carlsson (2006) argued that very few papers within NSI literature have empirically addressed the internationalization of activities¹⁰ while no single paper on internationalization of corporate R&D has dealt with components or relations of the system that remain nationally-bounded. Marin and Arza (2009, forthcoming) also highlighted the scarce research done in relation to innovation systems' *international involvement* and have joined the call for more research analysing the role and characteristics of external linkages of innovation systems. This paper aims to partially fulfil this goal.

In particular, our hypotheses are the following

I) *The system's openness is self-enforcing*: there is a higher probability that exporting, importing and foreign firms cooperate with distant partners

As the literature has largely testified, global value chains open opportunities for further collaboration that could influence on firms' innovativeness. Therefore, firms that are commercially integrated (i.e. exporting and importing firms) and/or are part of a multinational corporation (MNC) (i.e. foreign owned firms) would be more likely to establish collaborations with distant partners than firms that operate mostly within the national boundaries. Instead, international integration might not be necessarily conducive to establish local or national linkages. Even more, if one assumes –as we do here- that international cooperation implies better access to updated technologies, and therefore, *ceteris paribus*, would be preferable *vis à vis* national linkages, we could

¹⁰ In fact, Carlsson, 2006 found only five studies that examine empirically internationalization at system level, those are: Bartholomew, 1997, Fransman, 1999, Niosi and Bellon, 1994, Niosi and Bellon, 1996, Niosi, et al., 2000

hypothesise that firms that have the chance to contact distant partners would do so. In sum, our hypothesis is that subsidiaries of MNCs and firms that trade internationally enjoy better chances to cooperate internationally (and they would take advantage of them) than other firms, relatively to cooperating locally.

II) The system's openness is self-selective: there is higher probability that firms with higher absorptive capacities cooperate with partners further away

Similarly, if connecting with international partners involves higher sophistication in knowledge transfer, it would be important to have acquired absorptive capabilities to be able to cooperate efficiently with technologically dynamic partners. The literature has been highlighting the role of absorptive capabilities as drivers of collaboration.

However, our hypothesis is, instead, that there is a differential impact of absorptive capabilities on the probability of collaborating at different levels of proximity. Since it is technologically more demanding to collaborate with international partners, capabilities are more of requisite there than to collaborate *only* with national partners.

3) Methodology

3.1.) Data and definition of variables

We aim at characterising firms' international linkages with different partners in an attempt to identify the main differences between determinants of national linkages – about which the literature has been traditionally concerned with- and two types of international linkages classified according to the cultural and geographical proximity of Argentinean partners (i.e. Latin-America and other parts of the world).

To this end we used information from the National Innovation Survey 1998-2001¹¹. The sampling methodology for that Survey makes it representative of the national manufacturing sector. It includes information for 1337 firms (response rate 76%) which are both innovative and non innovative. Their sales represent around 30% of total sales of the manufacturing sector for the period 1998-2001.

Firms in the sample were requested to answer whether they have cooperated with other partners. Cooperation could take place amongst different partners, and we define four types of partnerships as can be seen in the Table 1A. Besides, firms were asked to identify the geographical location of their partners, which could be: Local (<100km), National, Regional (i.e. MERCOSUR), Latin-America, European Union, United States and Canada, East Asia, or others. We re-classified these categories in three groups as can be seen in Table 1B. As defined by the Survey form, cooperation was broadly understood; it could follow objectives as different as information requirements, funding, training, consultant, organisational change, R&D, tests, design, or technical assistance.

Insert Table 1 (A & B) around here

Therefore, four categorical variables were defined (COOP_ST, COOP_IC, COOP_VERT, COOP); each of them could adopt four values, 0 if no cooperation exists, 1 if the furthest partners were within the national frontier (NAT), 2 if the furthest

¹¹ Unfortunately, it is impossible to compare firms' collaborating activities across different innovation surveys in Argentina, since the definition of cooperation has changed for every edition of the Survey. In the National Innovation Survey 1992-1996, there was information only for year 1996 and in relation to R&D. There was no information on location, either. Innovation Surveys for subsequent years do not inform about localization of partners.

partner were within Latin-America (LA) and 3 if the partners were from other international location (INT).

The literature analysing drivers for the likelihood of cooperation, has usually found firms' size, absorptive capacity, information opportunities and sectoral affiliation as important determinants of firms' cooperation (e.g. Cassiman and Veugelers, 2002, Giuliani, *et al.*, 2005, Koschatzky and Sternberg, 2000, Veugelers and Cassiman, 2005). As can be seen in Table 2, we include employment in a quadratic form to account firms size, firms' expenditures in innovative activities *and* workforce' skills to proxy firms absorptive capacity, the use of internal and external sources of information to proxy for information opportunities and a variable that account for the sectoral weighted-intensity of cooperation with every type of partners to account for unobserved sectoral specificities that may affect the probability to cooperate. Moreover, we also add firms' trade integration and a dummy for foreign firms to test for our first hypothesis. The second hypothesis will be based on analysing the differential impacts of workforce skills and innovative expenditures on collaborating nationally and abroad.

Insert Table 2 around here

3.2. Model specification and estimation methods

From the discussion on how we defined the dependent variables, firms' cooperation decisions drop in four mutually exclusive categories: either they did not cooperate (NO) or they cooperate and the furthest partner they reach was national (NAT), or it was Latin-American (REG) or it was from the rest of the world (INT). Therefore, a multinomial logit was chosen to test for our research hypotheses.

We shall assume that

$$(1) Y_{ij}^* = \beta_j' X_t + \varepsilon_{ij}$$

where Y_{ij}^* is the level of indirect preference of firm t to j types of collaboration, which are four (NO, NAT, REG, INT). X_t is the vector of firms-specific variables (i.e. the values of our independent variables).

Then, the probability that the t^{th} individual makes the choice j is:

$$(2) P_{ij}(Y_{ij} = 1) = e^{\beta_j' X_t} / \sum_{k=0}^3 e^{\beta_k' X_t}$$

As normally in multinomial logit models, to carry out the estimation one category must be used as a benchmark, which is normalised to 0. We chose NO (i.e. firms that do not cooperate) as the base category.

Then, formally, if $k=0$

$$(3) \ln(P_j / P_k) = X_t' \beta_j$$

The coefficient then represents the effect of a change in the independent variable on the probability of cooperation j relative to the probability of not cooperating. Therefore, in order to determine the direct effect of each independent variable on the probability to cooperate as far as each category (and also in order to be able to compare the influence of each independent variable across categories) we estimate and report the marginal effects evaluated at the mean of the independent variables¹². All estimations were done with robust standard errors.

¹² This was done with the command `dmlogit2`, created by Bill Sribney from StataCorp.

Given our research hypotheses we expect the coefficient for EXPORT, IMPORT, FOREIGN, SKILLS and INNOV_ACT to increase for longer distance collaborations. Finally, since the decision to collaborate could also influence the amount invested in innovative activities, we control for the endogeneity of INNOV_ACT using a two-step procedure. However, deciding about the first step of the estimation was not simple. On the one hand, the variable INNOV_ACT is censored: more than 40% of firms report zero expenditures in innovative activities. On the other hand, it was difficult to find instruments, since most of the available information that relate to INNOV_ACT also related to the different definitions of COOP. We discuss the details of the procedure used when we present the econometric results.

4) Results

4.1. Main characteristics of the sample

As said above, we use data from the National Innovation Survey 1998-2001. After controlling for extreme observations in nominal variables we kept around 1200 firms that inform valid data for all the variables used in the econometric estimations.

Table 3 shows mean values for the control variables across cooperation categories. As we defined localisation (i.e. the furthest located partner) columns reflect exclusive categories (i.e. per row, every firm falls in one single column -therefore per row, columns sum up to 100%) while the rows reflect cooperation with different partners, which are not exclusive (e.g. a single firm could cooperate with international suppliers and with international scientific institutions, thus it will turn up in COOP_VERT_INT and in COOP_ST_INT, and also in COOP_INT –therefore per column, rows sum more than 100%).

Most firms (69%) declared to have cooperated with some partner in some location; 39% have reached international partners (30% reached partners beyond Latin-America) and 30.6% reached only national partners. The probability of reaching international partners is larger for cooperation with suppliers and clients, than with cooperation with scientific and technological institutions. In the latter case, most linkages remain within the national boundaries. As expected, the majority of firms do not cooperate with other firms within the corporation, since the majority of firms are independent units. However, among those that *do* cooperate, they do it mostly with international partners, which reflects the incidence of foreign firms on this type of cooperation.

It is important to highlight at this point, that although we estimate models for cooperation with different types of partners, the only hypotheses we had are in relation to the level of proximity and not in relation to types of actors. Moreover, as could be seen in Table 3, for linkages with science and technology (S&T) organizations and also for intra-corporative linkages, there are no critical number of firms in each category. Therefore in the analysis of the empirical results, we will focus mostly in cooperation broadly defined (with any partner, COOP).

In terms of size, firms that cooperate with international partners tend to be bigger in average than those that cooperate only nationally (almost 3 times larger) and also bigger than those that do not cooperate¹³. This is not surprising since cooperating abroad is demanding in infrastructure, especially in countries that are further apart and where international collaboration is not publicly promoted. Another interesting finding related to size, is that at any level of proximity firms that cooperate with S&T institutions are larger than those that cooperate with other partners.

The last two variables in Table 3 show the importance of external and internal sources of information for innovation activities across groups of firms that cooperate at different proximity. One reason for cooperating is to get access to information, so, it is to be expected that cooperative firms give more value to information in general than those that do not. This is exactly what we find when we compare the importance allocated to both sources of information between firms that *do* and *do not* cooperate. However,

¹³ Anova tests indicate that difference are significant at 1% across location categories for all cooperation variables.

when we compare the importance of sources of information for firms with partners located at different distances, the results depend on the type of partners. Briefly, it seems that sources of information are always important for firms that cooperate with S&T institutions and with the corporation, while among firms that cooperate vertically those that cooperate internationally are more interested in internal and external sources of information¹⁴.

Insert Table 3 around here

In sum, Table 3 suggests that firms that reach international partners are bigger and also those that collaborate with international suppliers and clients tend to give more importance to internal and external sources of information for innovative activities than those that reach national partners exclusively.

However, our real concern is related to openness and absorptive capabilities. We claim that relatively to firms that cooperate only nationally, firms that cooperate internationally tend to be those that are already integrated globally (hypothesis I) and also those with the necessary innovative capabilities so as to face technologically more sophisticated partners (hypothesis II).

To illustrate the validity of this proposition, we drew Figures 1 to 5 in which we compared, respectively, export intensity, import intensity, proportion of foreign firms, skills of the workforce and innovative expenditure intensity across different levels of

¹⁴ This statement is based on results of ANOVA tests.

proximity (NO, NAT, REG, INT) and for the four categorical variables (COOP, COOP_VERT, COOP_ST, COOP_IC).

The first three figures illustrate the validity Hypothesis I. As can be seen, in average firms that cooperate internationally export (as a proportion of sales) more than three times more than firms that cooperate just nationally. Imports (over sales) are also larger (almost double) and the proportion of foreign firms among international collaborators is more than four times the proportion of foreign firms within the pure-national collaborators.

Insert Figure 1 around here

Insert Figure 2 around here

On the one hand, as could be expected, the differences between international collaborators and pure-national collaborators in terms of foreign trade are particularly marked for those that cooperate vertically; while differences in terms of the proportion of foreign firms are especially large in the case of intra-corporative collaboration. On the other hand, there are not as large differences in the case of collaborators with S&T partners, although international collaborators in S&T export significantly more than

pure national collaborators in S&T (and also the proportion of foreign firms is significantly larger), differences are not as marked as for the other variables (COOP, COOP_VERT, and COOP_IC). Moreover, imports are fairly the same between international and national collaborators in S&T.

Insert Figure 3 around here

Figure 4 and 5 illustrate the validity of hypothesis II. It is fairly noticeable that absorptive capabilities -proxied by the intensity of investment in innovative activities and by the proportion of skilled workers in total workforce- are higher for the group of firms that reach international partners. Firms that collaborate with any type of international partners, invest almost a double proportion of their sales in innovative activities than firms that reach only national partners (Figure 4, first column). The professionals also represent more than double of the total workforce in the former than in the latter group (Figure 5, first column).

If one compares collaboration with different types of partners, one concludes that the differences in innovative expenditures between international and national are the highest in those firms that collaborate with clients and suppliers, while differences in skills are the highest for those that collaborate with other actors within the corporation. In this latter case, there are not significant differences in expenditures in innovation as a proportion of sales between international and national collaborators (Figure 4)

Insert Figure 4 around here

Insert Figure 5 around here

4.2. Econometric results

The econometric results on the multinomial model for our main variable (COOP) are presented in Table 4. We report the marginal effects evaluated at the mean of the independent variables. The second set of columns corrects for endogeneity of the variable INNOV_ACT. The correction is done in two-steps.

Since the variable INNOV_ACT is censored, we estimate a Tobit model (presented in Table A1 in Appendix) and we calculate the expected value of INNOV_ACT conditional on being within the interval (0,1). These predicted values were used in the second step¹⁵. As we mentioned before, we experienced difficulties in finding the right instruments, since most available data that relate to expenditure in innovation also relate

¹⁵ The spearman correlation coefficient between the INNOV_ACT and predicted-INNOV_ACT was 0.58.

to our main variable COOP. Our strategy was to increase the explanatory power of the Tobit model (1st step) as long as we did not create multicollinearity between the predicted-INNOV_ACT and the other regressors in the second step. The definition of instruments is presented in Table A2 in Appendix.

Confirming our descriptive findings respect to the control variables, we can see that firm size more largely affect the probability of collaborating internationally than nationally only. Moreover, it seems that firms' size decreases the probability of collaborating *only* nationally. In terms of sources of information, firms that allocate high importance to internal sources of information, have also higher chances to be collaborative, both nationally and internationally, while being interested in external sources of information increases the chances of collaborating internationally.

The econometric exercise also replicates the descriptive findings in what respect to the main explanatory variables. Exporting and importing increase the probability to cooperate international and being foreign also increases the likelihood to cooperate internationally. Oppositely, exports and foreign ownership reduce the probability to interact *solely* with national partners. Similarly, absorptive capability, proxied by the proportion of sales devoted to innovative activities and the proportion of professional within the workforce, increases the chances of cooperating internationally while it does not affect the probability of cooperating nationally. In other words, these results suggest that while openness and absorptive capabilities are significant determinants of international collaboration they are not significant determinants of national collaboration (as a matter of fact, being open reduces the probability of cooperating just

nationally). All these results are independent on whether the estimation is done in one or two steps.¹⁶

Insert Table 4 around here

Similarly, Table 5 presents the marginal coefficients for models on cooperation with different types of partners.

In the case of cooperation with suppliers and clients (COOP_VERT), foreign trade, as expected, increases the chances of cooperating internationally and decreases the chances of cooperating *only* nationally. Ownership, in turn, has no effect on the probability of cooperating vertically at any distance. Finally, absorptive capabilities seem to have some positive effect on the probability of cooperating internationally but affect negatively the probability of cooperating *just* nationally (coefficient for skill is negative).

Cooperating with S&T organisations (COOP_ST) has its own particularities. On the one hand, it is to be expected that firms that collaborate for this purpose with partners in

¹⁶ As can be seen by comparing the coefficients of INNOV_ACT and predicted-INNOV_ACT, there are differences in scale between these two variables. As a matter of fact, although the median for the original INNOV_ACT was just less than 0.02, the smallest estimated value for predicted-INNOV_ACT was larger than 0.02 and the median was 0.03. The predicted values of INNOV_ACT were very sensible on the restriction of the lower limit. If unrestricted, it would adopt negative values and the median value would be 0.0005. Coefficients for all the other variables remained fairly unchanged.

every location are particularly interested in innovative activities¹⁷. Thus we would expect skills and innovative activities to positively affect the probability of cooperation at every distance. This is what we find for skills and innovative activity when endogeneity is not being controlled for. When estimation is done in two steps, the variable loses its significance in the case of cooperating *just* nationally. On the other hand, there are very few firms that cooperate internationally with S&T partners (only 6% of firms in the sample plus another 5% that cooperate regionally); in other words, this type of cooperation remains very much nationally bounded. This might be explained by the incidence of public institutes as partners in COOP_SC. Therefore, foreign ownership does not significantly increase the probability of cooperating with S&T partners. Trade, in turn seems to have an ambiguous effect: on the one hand, importing affects the probability of cooperating nationally and exporting the probability of cooperating internationally. These results could be spurious due to the scarce number of observation in S&T collaboration with international partners.

Finally, cooperating with other partners within the corporation (COOP_IC) also constitutes an especial case of partnerships. Firms that cooperate in this category are basically national conglomerates or foreign firms. As expected, there is a high incidence of foreign firms on the probability of cooperating internationally. Exporting increases the probability of cooperating regionally and importing the probability of cooperating internationally. Respect to variables related to absorptive capabilities, skills affect the probability of cooperating internationally, while expenditures on innovation changes its

¹⁷ It is worth remembering that the definition of collaboration from the Survey is very broad and include collaboration in any activity associated to production, thus it is not clear that the collaboration done with other partners (e.g. suppliers & clients) also has innovation as the preliminary aim.

significance when endogeneity is being controlled for; with no controls, the variable is only significant to explain international partnerships, when controls are established, it is also significant to explain merely national collaborations.

In sum, results on Table 5 largely replicate results on Table 4; especially for cooperation with vertical partners. The other two types of collaboration show some particularities. On the one hand, there is a high incidence of technologically able firms that cooperate with S&T organisations. On the other hand, there is bias towards size and ownership among firms that cooperate with other partners within the corporation. Therefore, absorptive capabilities are important determinants of collaborating with S&T organisations at any distance, and openness (and size) significantly affects the likelihood of cooperating within the corporation.

However, in order to validate our hypotheses, we need to compare coefficients across distances. Results on this exercise are presented in Table 6. For each of the regression in Tables 4 and 5 we test the hypotheses that coefficients for international collaboration were the same than coefficient for national collaboration. P-values are presented in Table 6. When these coefficients are lower than 10%, we claim that differences are significant. Significant differences are shaded, but when the difference's sign does not go in the hypothesised direction cells are also dotted.

As can be seen, the hypotheses are totally validated in the case of cooperation with any partners. On the one hand, the difference in openness is significant, or, in other words, firms that cooperate internationally are open while those that cooperate just nationally are closed. On the other hand, absorptive capabilities exert significantly higher

influence on the probability of collaborating internationally than on the probability of cooperating *just* nationally. As a matter of fact, we have seen in Table 4 that absorptive capabilities did not affect the probability of collaborating just nationally. These are important results. **This means collaboration at national level *only* might not aid knowledge diffusion at its best. This is because skills and innovative behaviour make firms more likely to collaborate regionally or internationally rather than only nationally.**

Insert Table 5 around here

Although less significantly, these findings are also confirmed for cooperation with clients and suppliers. For cooperation within the corporation, only ownership exerts a larger influence on the probability to cooperate internationally. As we said above, since the characteristics of this type of collaborators are already quite specific (they would basically be either big national conglomerates or foreign firms) we could not find significant differences on the determinants of cooperating nationally and internationally besides ownership.

In the case of cooperation with S&T partners, although we have seen in Figures 1 to 5 that in average firms that cooperate internationally have higher absorptive capabilities and are more open than firms that cooperate just nationally, we see in Table 6 that

absorptive capabilities and importing exert larger influence on the probability of cooperating *just* nationally than on the probability of reaching international partners. Thus, results for COOP_ST go in the opposite direction as hypothesised. One possible speculation for this could be the quality filter imposed to firms collaborating with (national) public institutions. Thus, it might be more important as a pre-requisite to access national S&T partners to have high absorptive capabilities than it is to collaborate internationally. It is worth noting, however, that there are very few firms that reach international partners in S&T, and around 90% of them also reach national partners in S&T. The main difference that we could find among those groups is that while in international partnerships laboratories predominate, in national partnership universities and technology centers do. This justifies our speculation, public research institutions might select their partners based on their quality –and therefore the chances to collaborate with them largely increase with skills and innovative expenditures- while collaborating with private laboratories and R&D firms might be more responsive to market demand.

Insert Table 6 around here

Once again we want to highlight that our hypotheses on the reinforcing effect of firms' absorptive capabilities and international involvement on the probability to collaborate internationally were developed for cooperation broadly defined. Thus, our discussion

was on the determinants to reach distant partners, whoever they were. We were interested in analysing the determinants of going international in general and in particular whether it was necessary to be already “capable” and “open” to reach international partners, more than it was to reach national partners.

5. Conclusions

As it is widely acknowledged in the received theoretical and empirical literature, firms do not innovate in isolation and cooperation is key for technological activities. The NSI literature has stressed the value of cooperation among partners located within the national boundaries (firms, universities, S&T institutions, etc.) and the role of cooperating with partners abroad has received less attention. However, in the globalization era cooperation with foreign partners could be more relevant than in the past. Furthermore, in the case of developing countries, this kind of cooperation could be more important than cooperation with national partners, since knowledge and capabilities available within the country's frontiers could be not enough for firms wishing to develop ambitious innovative activities.

In this paper we do not explore the relevance of different kinds of cooperation, but the determinants of the probability of cooperating with partners located at different distances. We do it so through the study of the Argentina's manufacturing firms' cooperation behaviour. Our hypotheses were that internationally integrated firms (through trade or through foreign investment) and technologically able firms (those with high absorption capabilities, measured through the availability of skilled workforce and the development of innovation activities), could be more prone to cooperating with international partners, rather than with just national partners.

Our findings largely confirm these hypotheses. Firms that export, import and/or have foreign ownership show higher probabilities of establishing cooperation linkages with international partners. The same goes for skilled labour intensive firms and for firms

that allocate more resources to innovation activities. Larger firms and firms that assign higher importance to external sources of information are also more prone to collaborating with international partners. These findings go in line with our arguments that international cooperation is self-enforcing (to be internationally integrated demands and/or induces cooperation with distant partners) and self-selective (to cooperate abroad demands higher capabilities than national or regional collaboration).

When disaggregating cooperation with different kind of partners these finding are mostly confirmed in the case of cooperation with clients and suppliers. When analyzing intra-firm cooperation the only significant determinant of international cooperation is foreign ownership. This is not surprising since very few domestically owned firms have affiliates abroad, hence observations for the variable intra-firm cooperation corresponds almost exclusively to foreign owned firms. Local affiliates of foreign firms by default establish cooperation linkages with their headquarters and/or with other affiliates of the corporation, since their technological behaviour is mostly dependant on the innovations they receive from those partners. Hence, it could be expected that independently of the characteristics of those affiliates, they establish international cooperation linkages insofar their production activities depends, to a large extent, on information received from other partners within the corporation.

When dealing with cooperation with S&T institutions, our hypotheses are rejected. We found that absorptive capabilities and imports exert higher influence on the probability to cooperate nationally only than internationally. Our speculation for this is related to the pre-requisites for accessing collaborative agreements. Given that the majority of international scientific and technological partners are private labs and R&D firms while

in the case of national partners they are universities and research centers, it could be argued that the latter implement an institutional selection process based on ‘quality’ to select partners among firms wishing to collaborate, while the former accept partnerships on a market demand basis.

Summing up, we have found that openness and absorption capabilities are key determinants of international cooperation in general (while they are not for cooperation done within the national boundaries). To some extent, this means that promoting *only* domestic interaction might not be the best policy action if technology diffusion is aimed at, because collaboration agreements among only national partners are predominantly established by technologically less able firms. Instead, technologically more able firms establish international cooperation. Therefore, if one is ready to assume that the opportunities for accessing novel knowledge increase for a firm that establishes international collaboration agreements, one is ready to claim that international collaboration is self-enforcing. Under these assumptions, from a policy point of view, international agreements should be promoted so as to avoid the trap of interacting within a community of firms with low technological capabilities.

However, some of the drivers for international cooperation are beyond the scope of public policy actions (e.g. foreign ownership –in fact, it would not be wise to recommend domestic firms selling their equity to foreign hands in order to increase the chances of establishing international linkages). But not all of them:

On the one hand, there could be a virtuous circle between trade and international cooperation. Firms engaged in foreign trade could be more prone to cooperating

internationally and, in turn, this cooperation might increase their competitiveness.

Hence, promoting firms to engage in export activities could not only have a positive impact in terms of trade balance, but also on the firms' competitiveness levels through learning and innovation, an argument that has been suggested in the received literature.

On the other hand, employing skilled labor and allocating more resources to innovation activities also increases the chances of cooperating internationally with a broad range of partners. Another virtuous circle emerges in this case, since cooperation could further increase absorption and innovative capabilities.

This paper was set within specific limits, both empirically and conceptually. Firstly, we have been limited by the lack of panel data. It would have been more convenient to perform panel data analysis to better control for firms' fixed effects.

Secondly, although we have controlled for sectoral specificities on the probability to cooperate, we have not tested whether the determinants of cooperation affect the probability to cooperate nationally/internationally differently for different sectors. For example, firms that belong to sectors that are far behind the technological international frontier might need to compensate for this with higher internal capabilities than firms from sectors in which there is a national advantage. Similarly, technological specificities could make absorptive capabilities more necessary in some sectors and less in others. We did not have enough data to disaggregate the estimations per sector, thus it is left for further research. In particular, it would be interesting to assess whether the determinants of international collaboration change for different sectors.

Thirdly, based on our reviewing of the literature we have departed from the assumption that international cooperation is more relevant for learning in developing countries and even more so in the globalization era. Some scholars within the NSI literature might dispute this assumption. On the one hand, NSI scholars might believe on the existence of learning economies associated to interacting, even if only nationally. On the other hand, the international specialization of many developing countries might make national firms technologically subordinated to international partners. A sort of vicious circle could thus arise insofar those countries are specialized in activities with low opportunities for endogenous technological learning which in turn would reinforce their dependence on foreign partners. We believe that more empirical research should be done aiming at assessing the difference in technological upgrading and economic performance between firms that cooperate nationally against those that do so internationally. For example, are the latter technologically more dynamic and more productive than the former?

Finally, the data available did not allow us to distinguish different modes of collaboration and we believe this is an important drawback to be overcome when more data is made available. While some modes of collaboration might result in very little knowledge involved (e.g. funding, tests, etc.) or knowledge transfer in a single direction (e.g. training, consultancy, etc.), there is much more to gain in terms of capability improvement with other modes of collaboration (e.g. joint R&D projects).

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Appendix

Table A1: Tobit regression on Innovative expenditure over Sales, Argentina 1998-2001

	INNOV_ACT
EMPLOY	0.000* [0.051]
EMPLOY_2	-0.000* [0.078]
PATENTS	0.008* [0.075]
INFO_CORP	0.081*** [0.000]
BASICNESS	0.000*** [0.003]
PUBLIC_SUPPORT	0.012 [0.131]
INNOV_ACT_SECTOR	0.112** [0.048]
PATENTS_SECTOR	0 [0.347]
CONSTANT	-0.030*** [0.000]
Observations	1323
df	8
Log likelihood	1132.376
Pseudo R3	-0.198
LR chi2(8)	374.41
Prob > chi2	0.000
N of observations	1323

p values in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Source: Own elaboration based on the National Innovation Survey 1998-2001

Table A2: Definition of regressors of Table A1

EMPLOY	Employment
EMPLOY_2	Squared employment
PATENTS	Dummy variable that adopts the value 1 if the firm obtained at least one patent.
INFO_CORP	Internal (to the corporation) sources of information, normalized in a 0-1 scale.
BASICNESS	Ratio of (1) importance of universities, research centers or technological centers (national or international, public or private) as sources of information for innovative activities (normalized in a 0-1 scale) and (2) importance of market partners (clients, suppliers and competitors) as sources of information (also normalized in 0-1 scale)
PUBLIC_SUPPORT	Dummy variable that adopts the value 1 if the firm utilized public funding for innovative activities.
INNOV_ACT_SECTOR	Innovative activities: Average expenditures in R&D (in-house and external), in engineering and industrial design, hardware, software, capital goods , licenses, management, consultants and training over Sales, by sector ISIC 2 digits.
PATENTS_SECTOR	Dummy variable that adopts the value 1 if the firm obtained at least one patent, by sector ISIC 2 digits.

Source: Own elaboration

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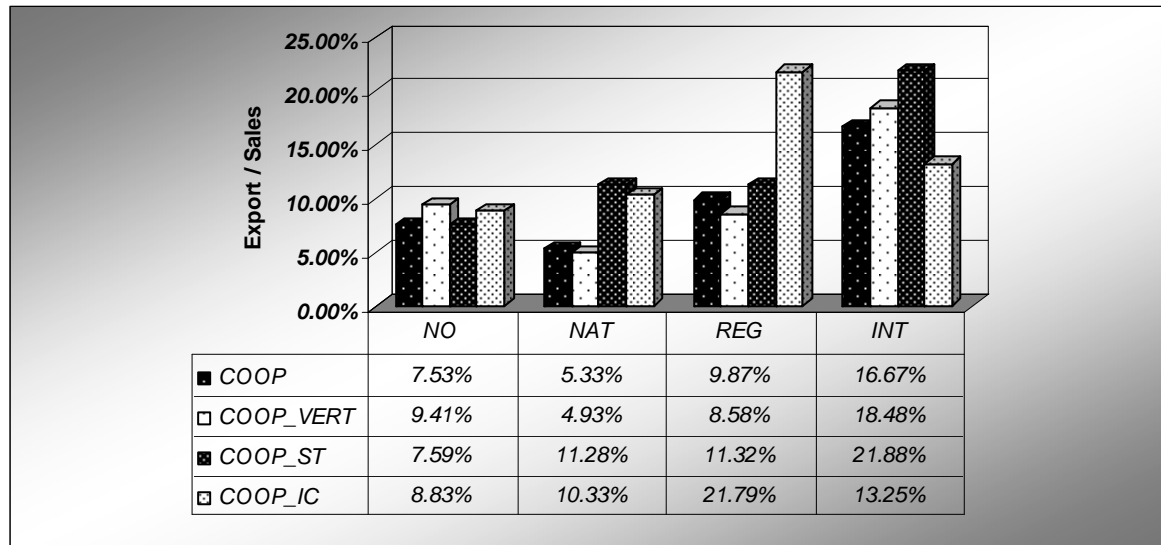
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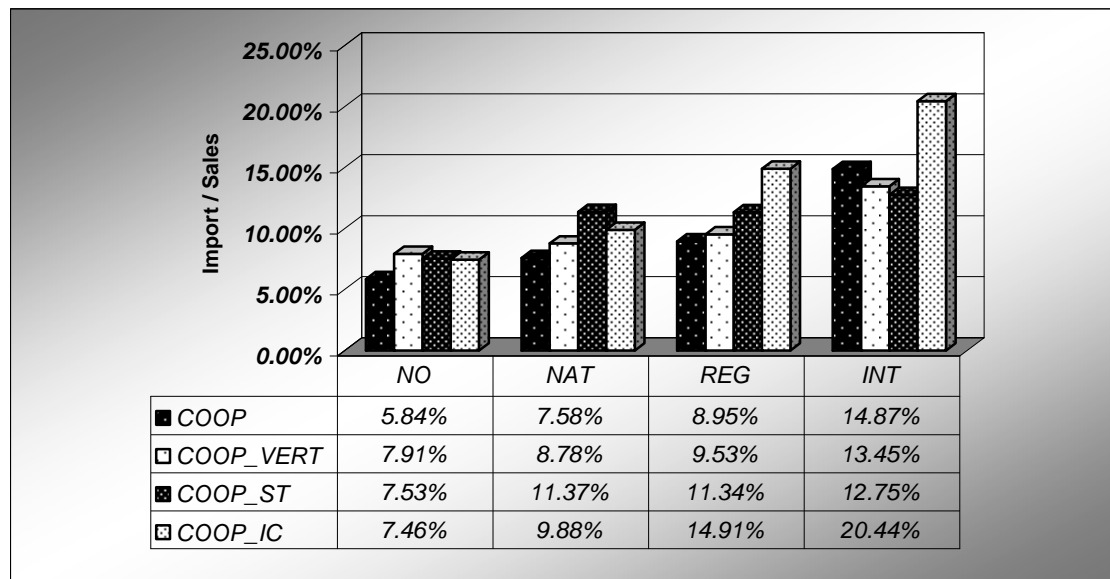
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Figure 1: Exports as a proportion of sales across types of collaborating firms, Argentina 1998-2001



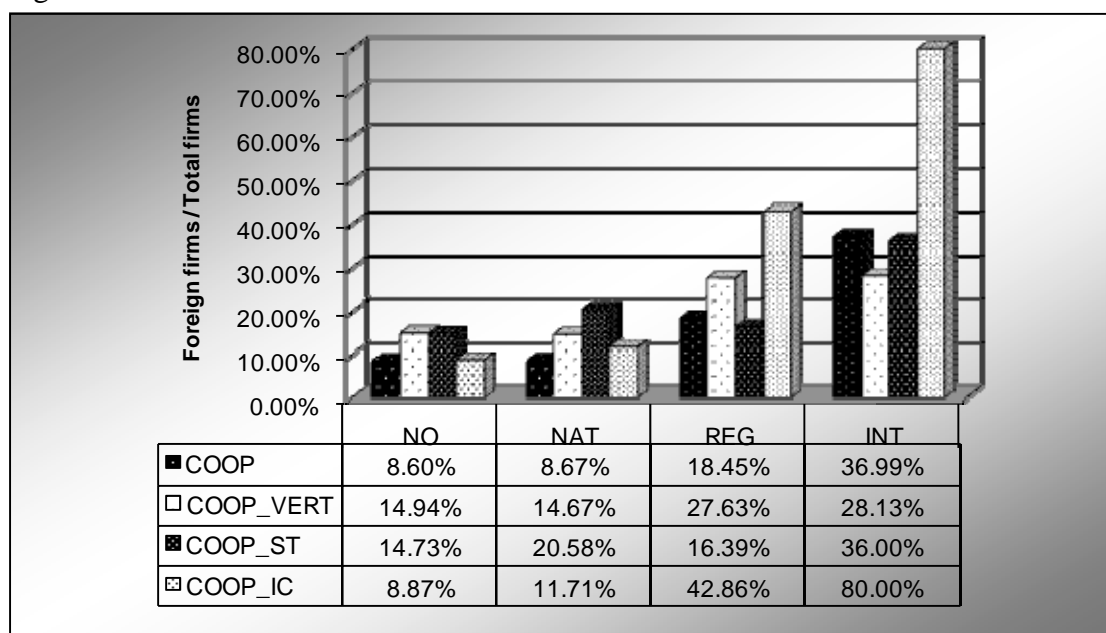
Source: Own elaboration based on the National Innovation Survey 1998-2001

Figure 2: Imports as a proportion of sales across types of collaborating firms, Argentina 1998-2001



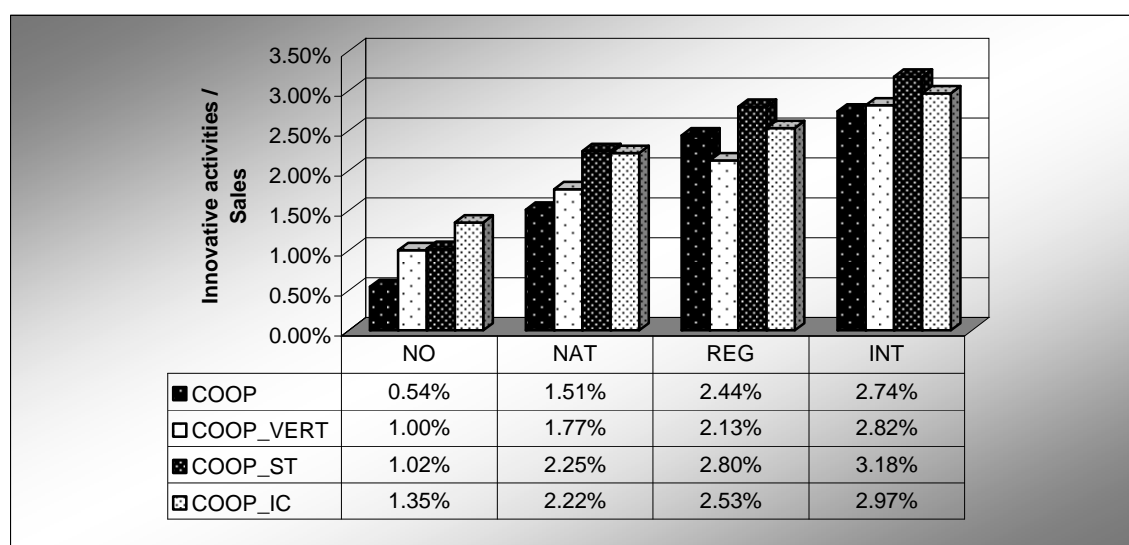
Source: Own elaboration based on the National Innovation Survey 1998-2001

Figure 3: Foreign firms as a proportion of total firms across types of collaborating firms, Argentina 1998-2001



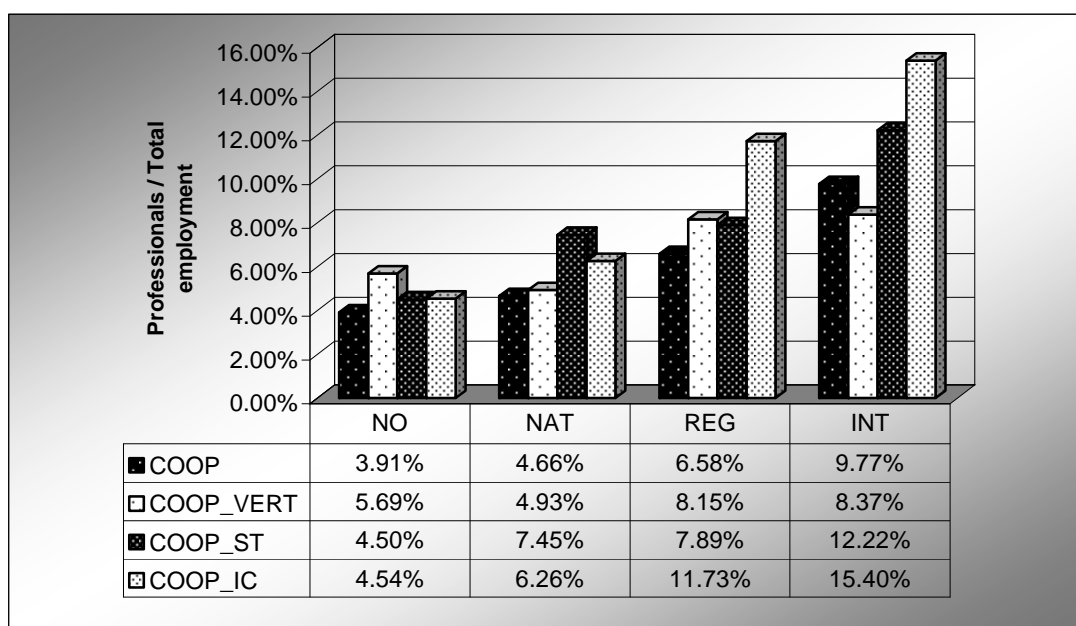
Source: Own elaboration based on the National Innovation Survey 1998-2001

Figure 4: Investment in innovative expenditures as a proportion of sales across types of collaborating firms, Argentina 1998-2001



Source: Own elaboration based on the National Innovation Survey 1998-2001

Figure 5: Skills of the workforce across types of collaborating firms, Argentina 1998-2001



Source: Own elaboration based on the National Innovation Survey 1998-2001

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Table 1: Definition of dependent variables

A) Partners		
Variable Label	Variable Name	Firms declared cooperation with:
Cooperation with Science and Technology (S&T) partners	COOP_ST	Universities, technology centres, technical training institutes, laboratories, R&D consultants, institutes for technology linkages or Government agencies for S&T projects
Intra-corporation cooperation	COOP_IC	Headquarters or other firms within the corporation
Vertical cooperation	COOP_VERT	Clients and suppliers
Cooperation with any partner	COOP	Any of the above or consultants or other firms (competitors)
B) Location		
The furthest location of partners was	Location value	Variable suffix
None	0	NO
Local or national	1	NAT
Regional or Latin-America	2	LA
European Union, United States and Canada, East Asia, or others	3	INT

Source: own elaboration

Table 2: Independent variables, calculated in average for the period 1998-2001

Variable	Definition
SIZE	Employment in natural logarithms
EXPORT	Export intensity: Export/Sales
IMPORT	Import intensity: Import/Sales
INNOV_ACT	Innovative activities: Average expenditures in R&D (in-house and external), in engineering and industrial design, hardware, software, capital goods , licences, management, consultants and training over Sales. All expenditures are strictly related to firms' innovative activities.
SKILLS	Workforce skills: Professionals / Employment
FOREIGN	Dummy variable that adopts the value 1 if at least 10% of capital belong to foreigners
INFO_EXT	Information opportunities or incoming spillovers: Importance of public information (i.e. expositions, conferences, journals, catalogues, databases, internet) as sources of information for innovative activities. Normalized in a 0-1 scale
INFO_INT	Internal (to the firm) sources of information, normalised in a 0-1 scale
SECTOR	Control for sector specificity. It is construct as the sector propensity to cooperate (i.e. firms that cooperate over total firms in the sector ISIC Rev3, 2 digits) weighted by the number of firms sampled in each sector. This variable changes over the different definition of cooperation

Source: own elaboration

Table 3: Mean values of control variables across cooperation categories, 1998-2001

	Proportion of firms (%)			
	NO	NAT	REG	INT
COOP	31%	31%	9%	30%
COOP_VERT	45%	28%	6%	21%
COOP_ST	55%	34%	5%	6%
COOP_IC	77%	9%	4%	11%
	Employment (n° employees)			
	NO	NAT	REG	INT
COOP	100.3	130.2	198.8	336.9
COOP_VERT	141.3	162.3	218.8	320.1
COOP_ST	125.1	222.1	244.0	523.9
COOP_IC	133.4	301.0	340.9	437.5
	Incoming spillovers (normalized 0-1 scale)			
	INFO_EXT			
	NO	NAT	REG	INT
COOP	0.12	0.31	0.36	0.40
COOP_VERT	0.18	0.34	0.38	0.41
COOP_ST	0.19	0.38	0.39	0.47
COOP_IC	0.25	0.39	0.43	0.38
	Internal sources of info (normalized 0-1 scale)			
	INFO_INT			
	NO	NAT	REG	INT
COOP	0.24	0.60	0.75	0.73
COOP_VERT	0.36	0.63	0.76	0.73
COOP_ST	0.39	0.71	0.74	0.77
COOP_IC	0.49	0.64	0.81	0.72

Source: Own elaboration based on the National Innovation Survey 1998-2001

Table 4: Multinomial logit marginal probabilities on collaboration at different distances, Argentina 1998-2001

	1-step			2-steps		
	NAT	REG	INT	NAT	REG	INT
SIZE	-0.027* [0.053]	0.001 [0.919]	0.087*** [0.000]	-0.022 [0.118]	0.000 [0.972]	0.078*** [0.000]
EXPORT	-0.449*** [0.000]	0.026 [0.567]	0.413*** [0.000]	-0.453*** [0.000]	0.027 [0.547]	0.425*** [0.000]
IMPORT	-0.121 [0.377]	-0.054 [0.573]	0.435*** [0.000]	-0.140 [0.301]	-0.034 [0.717]	0.486*** [0.000]
INNOV_ACT	-0.070 [0.928]	0.760** [0.023]	2.476*** [0.000]	-4.402 [0.158]	2.252 [0.179]	10.827*** [0.000]
FOREIGN	-0.158*** [0.003]	0.024 [0.374]	0.196*** [0.000]	-0.118** [0.033]	0.013 [0.660]	0.137*** [0.001]
SKILLS	-0.330 [0.205]	0.087 [0.467]	0.572*** [0.002]	-0.261 [0.281]	0.068 [0.566]	0.469*** [0.004]
INFO_INT	0.086* [0.050]	0.096*** [0.000]	0.108*** [0.010]	0.132** [0.019]	0.083*** [0.008]	0.012 [0.823]
INFO_EXT	0.056 [0.413]	0.023 [0.500]	0.237*** [0.000]	0.073 [0.287]	0.022 [0.518]	0.230*** [0.000]
SECTOR_COOP	-0.462 [0.258]	-0.371 [0.178]	0.590 [0.135]	-0.439 [0.281]	-0.374 [0.178]	0.587 [0.142]
CONSTANT	0.308*** [0.000]	-0.161*** [0.000]	-0.736*** [0.000]	0.377*** [0.000]	-0.206*** [0.000]	-0.928*** [0.000]
Observations	1198	1198	1198	1198	1198	1198
Pseudo-R2	0.20			0.12		

p values in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Source: Own elaboration based on the National Innovation Survey 1998-2001

Table 5: Multinomial logit marginal probabilities Collaboration with different types of partners at different distances, Argentina 1998-2001

	COOP_VERT						COOP_ST						COOP_IC					
	1-step		INT	2-steps		INT	1-step		INT	2-steps		INT	1-step		INT	2-steps		INT
	NAT	REG		NAT	REG		NAT	REG		NAT	REG		NAT	REG		NAT	REG	
SIZE	-0.003 [0.833]	0.002 [0.751]	0.047*** [0.000]	-0.003 [0.791]	-0.001 [0.903]	0.051*** [0.000]	0.045*** [0.001]	0.007 [0.306]	0.022*** [0.000]	0.044*** [0.002]	0.006 [0.368]	0.021*** [0.000]	0.030*** [0.000]	0.007** [0.030]	0.017*** [0.000]	0.028*** [0.002]	0.006* [0.065]	0.011** [0.018]
EXPORT	-0.498*** [0.000]	-0.032 [0.319]	0.302*** [0.000]	-0.499*** [0.000]	-0.032 [0.323]	0.300*** [0.000]	0.075 [0.318]	0.011 [0.702]	0.063*** [0.000]	0.081 [0.288]	0.012 [0.673]	0.067*** [0.000]	-0.013 [0.778]	0.034*** [0.010]	-0.003 [0.895]	-0.012 [0.797]	0.036** [0.010]	0.001 [0.939]
IMPORT	-0.009 [0.939]	-0.044 [0.544]	0.190** [0.033]	-0.010 [0.935]	-0.049 [0.500]	0.227*** [0.009]	0.217* [0.051]	0.028 [0.553]	-0.025 [0.334]	0.255** [0.021]	0.039 [0.407]	-0.027 [0.344]	0.025 [0.738]	0.026 [0.224]	0.070** [0.012]	0.033 [0.676]	0.027 [0.223]	0.066** [0.010]
INNOV_ACT	0.154 [0.789]	0.090 [0.721]	1.324*** [0.002]	1.122 [0.643]	1.712* [0.088]	-2.336 [0.217]	1.474** [0.014]	0.414** [0.014]	0.329*** [0.006]	2.440 [0.381]	0.925 [0.277]	1.457** [0.023]	0.423 [0.180]	0.078 [0.415]	0.287*** [0.004]	7.495*** [0.000]	2.012*** [0.005]	4.989*** [0.000]
FOREIGN	-0.007 [0.860]	0.027 [0.156]	0.004 [0.905]	-0.014 [0.749]	0.013 [0.570]	0.026 [0.442]	-0.068 [0.131]	-0.027 [0.143]	0.000 [0.999]	-0.077 [0.116]	-0.034* [0.087]	-0.012 [0.325]	-0.011 [0.713]	0.030*** [0.001]	0.093*** [0.000]	-0.035 [0.269]	0.025** [0.010]	0.066*** [0.000]
SKILLS	-0.578*** [0.001]	0.057 [0.416]	0.150 [0.192]	-0.600*** [0.001]	0.032 [0.698]	0.199* [0.082]	0.484** [0.016]	0.095 [0.177]	0.134*** [0.000]	0.448** [0.020]	0.085 [0.254]	0.123*** [0.000]	0.142 [0.124]	0.092*** [0.005]	0.139*** [0.001]	0.075 [0.427]	0.077** [0.018]	0.083** [0.010]
INFO_INT	0.132*** [0.000]	0.069*** [0.000]	0.063* [0.069]	0.120** [0.011]	0.047** [0.035]	0.117*** [0.003]	0.216*** [0.000]	0.033** [0.038]	0.004 [0.699]	0.209*** [0.000]	0.030 [0.125]	-0.010 [0.502]	-0.004 [0.893]	0.024*** [0.006]	0.014 [0.209]	-0.084** [0.015]	0.002 [0.906]	-0.057*** [0.001]
INFO_EXT	0.184*** [0.002]	0.036 [0.151]	0.190*** [0.000]	0.184*** [0.002]	0.030 [0.238]	0.210*** [0.000]	0.254*** [0.000]	0.040 [0.103]	0.056*** [0.000]	0.257*** [0.000]	0.040* [0.099]	0.053*** [0.000]	0.100*** [0.005]	0.020 [0.137]	0.012 [0.486]	0.081** [0.035]	0.014 [0.323]	-0.011 [0.558]
SECTOR_COOP_VERT	-1.418*** [0.007]	0.174 [0.529]	0.571 [0.203]	-1.400*** [0.008]	0.178 [0.519]	0.532 [0.230]												
SECTOR_COOP_ST							0.528 [0.317]	0.136 [0.521]	0.013 [0.923]	0.502 [0.340]	0.125 [0.558]	-0.009 [0.950]						
SECTOR_COOP_IC													-0.219 [0.614]	-0.216 [0.201]	0.325* [0.054]	-0.308 [0.512]	-0.241 [0.205]	0.238 [0.216]
CONSTANT	0.023 [0.674]	-0.163*** [0.000]	-0.493*** [0.000]	0.000 [0.995]	-0.187*** [0.000]	-0.456*** [0.000]	-0.515*** [0.000]	-0.176*** [0.000]	-0.212*** [0.000]	-0.557*** [0.000]	-0.192*** [0.000]	-0.238*** [0.000]	-0.339*** [0.000]	-0.135*** [0.000]	-0.222*** [0.000]	-0.505*** [0.000]	-0.180*** [0.000]	-0.289*** [0.000]
Observations	1198	1198	1198	1198	1198	1198	1210	1210	1210	1210	1210	1210	1209	1209	1209	1209	1209	1209
Pseudo-R2	0.13			0.12			0.15				0.15		0.26		0.30			

p values in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Source: Own elaboration based on the National Innovation Survey 1998-2001

Table 6: P-values for test on marginal coefficients from Table 4 and 5. Null hypotheses: coefficient for cooperating solely nationally =coefficient for reaching international partners.

1-steps models					
	INNOV_ACT	SKILLS	FOREIGN	EXPORTS	IMPORTS
COOP	0.008	0.015	0.000	0.000	0.010
COOP_VERT	0.081	0.002	0.847	0.000	0.227
COOP_ST	0.051	0.066	0.135	0.878	0.030
COOP_IC	0.667	0.968	0.002	0.839	0.565
2-steps models					
	predicted-INNOV_ACT	SKILLS	FOREIGN	EXPORTS	IMPORTS
COOP	0.001	0.032	0.002	0.000	0.004
COOP_VERT	0.295	0.001	0.508	0.000	0.147
COOP_ST	0.723	0.077	0.190	0.859	0.012
COOP_IC	0.189	0.927	0.003	0.794	0.674

When hypotheses are confirmed, significant differences and correct signs

When hypotheses are rejected, significant differences and incorrect signs

Source: Own elaboration based on the National Innovation Survey 1998-2001