Innovative strategies and their impact on the National Innovation System dynamics

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Introduction

Innovation is defined as a social and iterative process; as a consequence, nobody innovates in an isolated way (Lundvall, 1992). However, when analyzing innovation surveys, evidence seems to contradict theory. Both in developing countries and in developed ones, the rate of linkages established among the different agents of the National Innovation System is low (Anlló & Suárez, 2008; Suárez, 2007; Tether, 2000) Particularly in Latin American countries, a historically lack of articulation between firms and science and technology institutions has been observed (Lugones & Suárez, 2006).

The present document is an attempt to go deeper in understanding the linkages determinants and innovation dynamics. Therefore, an analysis regarding the linkages between firms and the other agents of the National Innovation System for the Argentine case is developed here. This study is part of a broader project framed within a research related to the doctorate thesis by the one who write in here, under the supervision of Gustavo Lugones. The main hypothesis of the doctorate project considers that there exist differentiated behaviours in respect of competitiveness search. In that sense, innovation, as a strategy, is just one of many possibilities. Moreover, despite sustainable in the long term, innovation is many times unprofitable in the short one, especially in less developed countries where the market failures and macroeconomic instability are not the exception but the rule.

This paper is also the continuity of a project already presented in Globelics México 2008, where innovative behaviours of the Argentine manufacturer firms were identified and characterized (Lugones, Suárez & Moldován, 2008). In this study, a group of firms with a virtuous innovative strategy was identified and this group was different from the rest because of the intensity and continuity of innovative expenditures. It was also possible to identify that another group –not that small- of Argentine firms could survive to one of the worst economic crises with no efforts at all on innovation activities.

The econometrical analysis showed that there is a positive relation between expenditure intensity and labour productivity together with a positive relation between this intensity and salaries (Lugones, Suárez & Moldován, 2008). So, because this innovative firms are the ones that obtain the best results regarding performance and income, what is expected to know here is whether that particular innovative dynamic could be related to a particular linkages setting or not.

Then, the objective of this paper is to analyze of the first group of firms mentioned above. It aims at studying those firms and their relationship between with the National Innovation System. This does not imply giving less importance to the interaction and dynamic of non innovative firms, which are, certainly, part of the broader study. What is expected here is to demonstrate how a particular innovative dynamic impacts on the rest of the system.

If these firms with a virtuous strategy are developing a more technological complex innovation then to them to require a deeper articulation with the knowledge supply and a bigger feedback of their supply chain is expectable. The first ones because of their condition of suppliers of one of the key inputs (knowledge) and the latter for being either suppliers of raw materials and machinery or recipients of that innovations.

If these hypotheses are true, then if those behaviours are fostered to combine entrepreneurial development with social profitability by the creation of synergies in the national innovation system (through linkages) could be possible.

The document is structured in three parts. After this short introduction, in section 1 the dataset and the methodology are presented. The results and main findings of the model are discussed in section 2. Finally, some conclusions are provided.

1. The Methodological approach

1.1. The Data Set

The sample is made up of a total of 473 innovative firms which were part of various official statistical surveys during the 1998-2004 period and it is compound by firms from different capital origins, sectors and sizes. These surveys are a powerful tool to understand the magnitude and the impact that innovation has on the domestic productive network, even when considering the difficulties which occurred when harmonizing the different surveys, plus a certain bias on the information towards the most successful firms. It is important to bear in mind that during the period under which the survey was carried out, the domestic economy was facing one of the worst crises in its history, making the firms with the worst performance show high rates of mortality.

The information was collected by the Instituto Nacional de Estadísticas y Censos (INDEC) – *National Institute of Statistics and Census*. These surveys were carried out between 1999 and 2005, and the corresponding data harmonization on the innovation surveys - together with the other data about industry and commerce -is the result of a joint effort of the INDEC and the National Ministry of Economy, so as to match the different statistic databases. This has led to the Base de Datos de Desempeño Empresarial (BDDE) - *Company Performance Database* – which contains information about the manufacturing industry for the period 1998-2004.

To distribute by size the criterion used by INDEC for the first innovation survey was adopted. Given this breakdown criterion, small firms are those with a sales level lower than $25 millions per year, the medium size firms are those with sales between $25 and $100 millions, and the big ones are those with more than $100 millions turnover per year. However, since a time series that starts with the first year of a recession and ends in a year when Argentina is on its growing stage is going to be used, to adjust the value of one of the reference key variable, sales, was necessary. For this reason, and just to develop a first description of the data, the size segmentation has been done taking into account the value of sales as an average of the sales in 1998, 2001, 2002, 2003 and 2004 in constant values deflated by the Producer Prices Index estimated by INDEC, with 1998 as the base year value. In this way the distortions of the economic cycle and specially the abrupt change of relative prices –in particular, the exchange rate- that took place from January 2002, are minimized.

A third way for the classification of firms can be found in the distinction between firms with or without foreign capital ownership. Here, the reference period to analyze whether a firm is o is not national must be specified again. In that sense, firms are going to be classified as foreign firms those that in the period 2002-2004 declared that more than 1% of the shares belonged to foreign capitals. Although arbitrary, this classification allows a good approximation to the firm origin, and is also the same classification used by INDEC innovation surveys, which improve the comparison possibilities.

Regarding the sector-based analysis, the classification of United Nations ISIC Rev. 3 will be used. Although using a 3 digits classification would be convenient (to create more homogenous groups), the structure of the panel does not allow a deeper analysis because it would involve a drastic reduction of the cases in some important sectors. On the contrary, since not all the sectors have enough cases to maintain at least a

minimum statistical signification, the analysis will be related to a particular sectoral grouping. This grouping is the following: ISIC 15 Food industry; ISIC 17 & 18, textile and clothing industry; ISIC 24, Chemical industry; ISIC 27, 28 & 29, metalworking industry; ISIC 34, automotive industry; the rest.

1.2. Innovative strategies characterization

For the analysis of the relation between innovative behaviour and the linkage structure, firms were firstly classified in respect to the intensity and continuity of their innovation expenditures. Certainly, this criterion –in line with the hypotheses that are being tested- leads to the selection of a sample composed by innovative firms (firms that made efforts on innovation activities in al least one of the years under analysis). The cutting criterion here is the expenditure level by employee, being the high intensity firms, all those firms with an expenditure level over the sector average and consequently those under that average will be called low intensity firms.

The innovation expenditure intensity indicator (innovative intensity) measures the commitment level of the firms with technological and organizational improvements search, since they account for the relative dimension of the innovation activities efforts. Innovation surveys provide the data about expenditures and total employment, which allow the estimation of the relative innovative intensity from the expenditure per employee indicator[1]. This indicator will be afterwards weightened by sectoral belonging (here is presented as a ratio between the value obtained by the firm and the sector average at 2 digits ISIC) to minimize the impact of the different productive dynamics.

In this way, to establish relative levels of expenditures intensity weightened by sector and size will be possible, approximated from the accumulated values for the whole period, given that the funds availability and the dynamic of the knowledge search can lead to an unequal distribution of expenses throughout time. At the same time, when innovative intensity is calculated based on the accumulated values, the distortions generated by the expenditures on capital goods –that are widely predominant in the innovative efforts as the Argentine innovation survey reveals- are avoided. In fact, in the period that goes from 1998 to 2004 this item were rounding 60% and 70% of total expenditures (INDEC; 2006), which implies a low attention to various items that should complement that investments to obtain a better use of the capabilities (training, engineering, R&D, organizational change, etcetera).

In relation to the continuity of expenditures, the main argument is the systematic or spasmodic frequency of the innovative efforts, which is certainly related to the composition of the expenditures. When the firms concentrate their activities in the acquisition of capital goods, an interrupted expenditure seems a bit unreasonable, even anti-economic. However, research and development or engineering and industrial design expenditures demand sustainable efforts given their special feature related to the longer period in which these activities observe results, plus the sunk costs.

The continuity assumes, as well, innovation projects with a longer return period, which is firstly related to a longer range of the results when these are finally obtained. In other words, to improve the processes inside the firm could mean incremental innovations only new to the firms, on the other hand, to get closer to the best international practice involves by definition closing the technology gap that characterized developing countries.

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1 Although the most disseminated indicator is the one that relates the expenditure with sales, the magnitude of innovative efforts will be approximated in relation to the employment since it is expected to compare this variable with the productivity evolution (approximated as the ratio between sales and employment). In this way, it is keep in both variables the same denominator, which allow the minimization of the impact related to the firm size y avoid possible mathematic inconsistencies related to the comparison of two variables where sales are the numerator in one case and the denominator in the other.

Then the continuity will be approximated from the quantity of years in which the firms declared innovation activities. The information available includes the distinction between expenditures for each year of the period between 1998 and 2004, so continuity levels can be establish. From this criterion, firms were classified into continuous and non continuous ones. The first ones are firms with innovation expenditures in more than 5 out of the 7 year under analysis (1998-2004), obviously, the latter are firms that expended in 4 or less from the years considered.

In this way, 4 groups of behaviours were created:

LINC= firms with an innovation intensity lower than the sectoral average value that also performed innovation efforts in 4 or less years;

LIC= firms with an innovation intensity lower than the sectoral average value that also performed innovation efforts in 5 or more years;

HINC= firms with an innovation intensity higher than the sectoral average value that also only performed innovation efforts in 4 or less years;

HIC= firms with an innovation intensity higher than the sectoral average value that also performed innovation efforts in 5 or more years;

Since what is expected is to analyze the linkage dynamic among the firms with more virtuous behaviours LIC, HINC e HIC firms will be the target of this study. This is because the IBNC firms show a performance equivalent to the performance of non innovative firms, so they are not included into the target population of the present document[2]

1.3. Linkages structure

The analysis will be done from the results for the Second National Innovation Survey that cover the period 1998-2001 (INDEC; 2003) since it is the only available data[3]. The survey asked about the existence of linkages, including 13 national innovation system agents and 8 possible objectives. It must be clarified that the information available accounts for the interactions between the firms and the environment during the period 1998-2001. Asking for linkages does not permit knowing whether between the firm and the agents have existed formal agreements with active participation (which is the way in what The Oslo Manual suggests for measuring cooperation) or interactions with no contracts among the stakeholders. Both approximations are valid (the first one permits knowing joint innovation projects and the second the existence of articulation between the firm and the environment) but measuring through linkages overestimate the articulation rate. However, since what is expected to know is exactly that, how firms interact with the environment, under the assumption that every interaction is equally valid regarding the possibilities of spillovers, the analysis of these interchanges (information, knowledge or resources) allows the understanding of the relation between the firm and NIS.

Targeting the objectives of the present study, linkages will be grouped into 5 categories:

a) *Linkages with the commercial chain: clients, suppliers and other non related firms;*

b) *Linkages with institutions based on science and technology: universities, technological centres and R&D laboratories/firms;*

[2] As was mentioned, the present document is part of a broader research project (still in course) so it can be supported that similarity. Similar analysis can be found in Lugones, Suárez y Moldován (2008) & Lugones, Suárez & Le Clech (2007).

[3] In 2009 the National Innovation Survey 2005 was published (INDEC, 2009), including data for that year. However, up to the date of developing the current study to access to microdata was not possible.

c) *Linkages with other suppliers of knowledge; technical education institutes, technological linkage entities and consultants;*

d) *Intra-corporation linkages: head quarter and related firms;*

e) *Linkages with public agencies devoted to promotion: Governmental agencies or programs to foster S&T.*

Regarding the objectives of the project and aiming at moving forward to the analysis of the more technological complex linkages, the study will distinguish among different linkages regarding the objectives:

a) *Linkages for R&D: R&D, design and technical assistance;*

b) *Linkages for knowledge circulation: information, training, assistance about organizational change and essays;*

c) *Linkages for funding: financing access.*

This does not involve unknowing cooperation arrangements for training or the assistance for organizational change in the search for innovation. The aim of this grouping is, on the one hand, to search for an analysis closer to technological cooperation for innovation and, on the other, to avoid the distortions generated by linkages characterized for being routine and more related to the accumulative productive process and to the observance of the rules than to the search for new products and processes[4].

For the joint analysis of the linkages setting, two complex (because they rise from aggregation) indicators were built. These indicators will allow the summarizing of linkages dynamic. The advantage of these indicators does nor lies on their statistical robustness, on the contrary, they are just a simple way to present the aggregated information in order to allow a quick lecture of the firms features regarding the articulation with the NIS through the analysis about how much intensive (quantity of objectives per agent) and extensive (quantity of agents per objective) the linkages are.

The first one of the indicators (LI) accounts for the linkages intensity. It is assumed that the more quantity of activities (linkages objectives) developed between the firm and the external agent, the more systematically the linkage will be and, with it, the deepness of the interactions. This indicator rise from averaging the quantity of linkages per agent and the result per strategy is the average of the values obtained by each firm in the group.

As a way of exemplification, a firm that interacted with all the agents for all the activities will obtain 3 points, the other way round, a firm that interacted just with one agent to develop one activity will obtain 0.25 points. The first firm interacts, on average, for the development of 3 objectives with each agent and the second, for the development of less than one (which involve that there are agents to whom did not interact).

The second indicator (LA) expects to capture the articulation between the firm and the environment. It is assumed that the more quantity of agents to whom the firm interacts, the more the articulation, independently the objective of that linkage. Then the indicator arises from adding the quantity of agents to whom the firm declared that established linkages, being the value of the strategy the average of those results. As an example and following the previous case, the first firm will obtain 4 points while the other only 1

[4] As an example, it is enough to make reference to the relation between INTI (technological center) and the manufacturer center based on the development of proves and tests of materials and final products with objectives related to certification and not innovation. At the same time, given the legal demand to give training for security and hygiene, a great amount of firms maintain linkages related to this ends.

point. As a consequence, the first will be treated as a highly articulated and linkage intensive firm, and the second as a firm with low intensity and articulation.

In general terms, the notation of each indicator would be:

$$LI = \frac{\sum_{i=1}^{4} LI_i}{N_i}$$

$$LA = \sum_{i=1}^{4} L_i$$

Where LI_i represents the quantity of objectives the firm interacted with the agent I and N the number of agents. In this case, it is about 4 types of agents and 3 possible objectives so the indicator is between [0,3], it will be null when the firm did not linkage and 3 when the firm linkage with the 4 type of agents for the 3 possible objectives. For the LA indicator, L is equivalent to 1 when the firm declared have linkage with the type of agent i, independently of the quantity or the type of objectives, so the domain of NA is [0,4], being null when the firm did not interacted (in this case LI and LA are equals) and 4 when the firm interacted with all agents. After the aggregated analysis, each indicator will be separated to analyze, as well, the linkage intensity for each agent $(LI)_i$ and the articulation level for each objective (L_i).

1.4. Testing the relation between strategies and linkages

From this classification of strategies the existence of differences regarding the intensity and articulation of linkages will be tested, under the hypothesis of a positive relation among levels in the linkage indicators and categories. In order to do that, the Kruskal-Wallis (Kruskal & Wallis; 1952) and the Jonckheere-Terpstra tests (Jonckheere, 1954; Juneau, 2006) have been used, which permits relaxing the assumption of normality in the variable distribution.

The Kruskal-Wallis test makes possible to study whether the data groups analyzed comes from the same universe and it is based on ranking the values obtained from the analyzed variables, from this, it is afterward estimated an average value within this rankings for each group of analysis (the ranking lays between 1 and all the cases of the sample and the averages are calculated for the four defined strategies).

The hypotheses to test are:

H_0 = It does not exist association between the average values and the innovative strategies. The categories come from identical populations.

H_{alt}= At least one o the medias is significantly different. So there is some association between the average values and the categories (innovative behaviours).

Given the hypothesis, the Kruskal-Wallis statistic value estimates the measure in what the average value of the ranking inside the group differs from the average value of the rest of the groups. The KW statistic value assumes a ji-squared distribution so the asymptotic significance accounts for the probability of obtaining a ji-squared that determines the inexistency of differences among the groups (and accepts the null hypothesis).

To testing each variable, the general notation of the K-W would be:

$$KW = \frac{N-1}{N} \sum_{i=1}^{C} \frac{n_i \left[\bar{R}_i - \frac{1}{2}(N+1) \right]^2}{(N^2-1)/12}$$ where:

n_i = number of observations in the i group;

$N = \sum n_i$, number of observations for the whole sample;

$\bar{R}_i$ = average value for each group.

Since the Kruskal-Wallis test permits identifying statistically significant differences among groups of cases but not a hierarchy (although it is possible to suspect them from the average value inside the ranking) another test was carried on, the Jonckheere-Terpstra one.

The hypotheses to test are:

H_0 = It does not exist relationship between the ranking criterion and the magnitude of the variables.

H_{alt}= The variable levels rise as the value given for the ranking criterion.

In other words, this test allows verifying the null hypothesis that states that the analyzed variables do not have a ranking associated to the group membership. The alternative hypothesis affirms that the firms of low intensity and continuous efforts (1) reach lower levels than the ones with higher intensity but non continuous efforts (2) and these have lower values in comparison to the ones with high intensity and continuous efforts (3), in each of the analyzed variables (LI and LA).

To test each variable, the general notation of the J-T statistic value would be:

$$JT = \sum_{i=1}^{l-1} \sum_{l=2}^{k} U \tau_i \tau_l$$ where:

$$U_i = R_i - \frac{n_i(n_i + 1)}{2}$$

τ_i = value of the variable under study for the group *i*;

$i < j < ... < k$ = quantity of groups nominated from smaller to bigger;

R_i = adding of the ranges in the group i ;

n_i = quantity of observations in the group i .

So, the J-T statistic value is the generalization of the U statistic value for 2 samples (Mann & Whitney; 1947) and it is calculated from the estimation of the differences between pairs of tables of contingency that combine the pre-established categories (in this case from 1 to 3, it is, 3 groups) with the values rise for the variables to test. So the statistic value counts how many times the responses of the group i are smaller than the responses of group j (organized from i to j). In this case, the quantity of times in which the values raised by the firms with low intensity and continuous efforts are lower than the values of firms of high intensity but non continuous efforts, which are compared afterwards with the firms of high intensity and continuous efforts.

2. Innovative strategies and the interactions with the National Innovation System

2.1. Innovative behaviours and linkages

According to the Second Innovation Survey (INDEC, 2003), Argentinean firms interact a lot with the National Innovation System (NIS): between 1998 and 2001, 74% of the innovative firms (almost 90% of the sample) declared that established linkages with other agents. For instance, by observing the type of agent the firms interacted with, a high interaction with universities and technological centres is declared (27%). These results contrast with what happen, for instance, in United Kingdom where only 16% of the firms pointed universities as a relevant source of information (Tether, 2000). At the same time, values seem to contradict what is directly perceived in Argentina: specific qualitative works states that one of the main deficiencies in the NIS is the scarce articulation among agents (Lugones et al., 2005).

One possible explanation for these findings relays, of course, in the methodology used to gather the information. While the Community Innovation Survey (CIS) asks about formal linkages, specifically about formal cooperation agreements for innovation, in the Argentine survey firms are asked if they have interacted with other agents of the system in the context of their innovative activities, no matter the degree of formality.

An alternative explanation is the one that arise from the specific articulations firms are declaring. The wide range of objectives which are included as options and the fact that the survey asks about "interaction" cover almost all of the activities a firm performs when looking for improvements, no matter how involved the firm or other agents where in the interaction.

Another issue has to do with the answers the survey wants to tackle. Since the linkage question wants to gather information about the NIS articulation and does no want to analyse the firm's capacity or possibility of absorbing external knowledge (aspect which is usually tacked with technological opportunity variables), the indicators tend to capture how much the firm interacts with the environment given the assumption that the higher the interaction the higher the spillovers to the rest of the society by means of knowledge generation and circulation. This does not imply, of course, that a higher interaction with the environment impacts on the firm by increasing its technological opportunities.

Giving the aim of the present paper, all agents and all objectives are equally important and have the same potential of contributing to a more successful innovative process. In other words, the type of agent neither determines the complexity of the technological activity performed, nor the activity performed determined the importance of the agent involved in the interaction. R&D, design and technical assistance activities are as valuable as funding or information access.

Keeping all these aspects in mind, Table 1 synthesize a group of selected indicators which allow a quick approximation to the characteristics of the linkages that analysed firms present[5]. The HIC group is the one with the highest levels in all cases for the three indicators, followed by LIC firms. However, distances among average values are reduced, especially between both continuous groups. While 94% of HIC firms declared have established linkages with at least one agent of the NIS, this percentage drops to 87% among LIC firms and to 77% among the HINC ones. The highest linkage rate per agent is observed in the interactions with the supply chain and, in a second level, in the interactions with S&T institutions, where no difference is observed among continuous firms. For the rest of the agents, the order of strategies matches what expected: higher levels among HIC firms and lower ones among the HINC group.

In the case of public agencies of innovation promotion the fact that they are a specific public organism should be consider, this group does not represent the public S&T system (mostly included inside the "S&T institutions" group). Then, the low linkage rate

[5] In all cases, values have been calculated in respect of the total number of firms in each strategy as well as the total innovative panel. This is so due to the fact that the probability of establishing linkages a firm faces is what is wanted to be measured. This means that the tables do not show the characteristics of the firms that actually interacted.

accounts for the scarce interaction with this specific agent of the public system, the national agencies aimed at fostering innovation.

Table 1: Linkage rate per agent (% firms over each group's total)

Agent	LIC	HINC	HIC	Total Innovative firms
Commercial Chain	74	69	74	65
S&T Institutions	65	42	63	49
Other Knowledge Supply	53	41	57	45
Intra-Corporation Linkages*	67	79	80	75
Public Agencies	7	9	15	8
Total	87	77	94	79

* Only firms that belong to a holding.
Source: BDDE (INDEC, 2007).

Regarding the objectives of the linkages, the highest rates for all strategies are reached in the case of information circulation goal, followed by R&D activities. In this case, differences among strategies increase: wile 77% of HIC firms interacted for R&D activities, the percentage drops to 67% and 53% among LIC and HINC ones, respectively (Table 2). At the same time, even though the differences between the more innovative intensity groups, continuous firms present higher rates for all objectives, percentages that are ever higher of the average value for innovative firms. The other way around, non continuous firms present lower rates than the innovative group in general, this would account for a lower articulation between the later and the environment.

The low linkage rates in the case of funding access could be explained by the well known difficulties firms face when it comes to apply for funds. The fact that 26% of innovative firms declared that interacted for this goal does not imply that the rest 74% does not required funds. The highest rates among the high intensity groups are also the expected since their innovation efforts demand more access to funding sources and this could trigger a more aggressive behaviour in that matter.

Table 2: Linkage rate per objective (% firms over each group's total)

	LIC	HINC	HIC	Total Innovative firms
R&D, design and technical assistance	67	53	77	57
Information circulation	84	76	93	77
Funding	23	30	34	26
Total	87	77	94	79

Source: BDDE (INDEC, 2007).

The importance of each one of the considered agents in each one of the objectives follows the order presented in table 2. In all the consulted objectives, the highest rates are firstly regarding the commercial chain, secondly the S&T institutions, then other agents and finally regarding the public agencies. As expected, in the case of funding access, intra-corporation linkages are high, although they are lower than the ones with suppliers and clients. Differences among strategies are low and the continuous firms remain the ones with the highest rates, again the HI over the LI group[6].

Since R&D linkages usually imply a higher technological complexity, their separated analysis seems appropriate. Table 3 presents the distribution of R&D, design and technical assistance linkages among agents and strategies. Once again, the highest interaction rate in the one between the firm and the commercial chain (suppliers, clients and non related firms) and only 2,7 of every 10 HIC and LIC firms and 1,9 HINC declared interacting with S&T institutions. For the rest of the agents, differences

[6] Tables with the linkage rate per agent and per objective are included in the annexes.

between continuous groups remain and in the case of the intensity classification the distance does not seem significant, expect from the intra-corporation linkages.

Although the analysis of linkages with S&T institutions is far from the aim of this paper, it is important to point out that in average firms search for or access to activities with a higher knowledge content by means of the commercial chain and they do not do it by interacting with specific institutions, institutions that are, at the same time, the main beneficiaries of the public budget on science and technology. This could imply that the possibilities of spillovers from the S&T system towards the productive sector are reduced. One possibility is that intuitions do not offer what firms need, another one is that firms can not access to what the institutions offer. In any case, more research should be carried out in the field of this interaction if synergies between knowledge supply and demand want to be created.

Table 3: R&D Linkages per agent (% firms over each group's total)

	LIC	HINC	HIC	Total Innovative firms
Commercial Chain	45	36	52	38
S&T Institutions	27	19	27	21
Other Knowledge Suppliers	23	12	27	18
Intra-Corporation Linkages*	38	50	54	44
Public Agencies	2	1	3	57
Total	67	53	77	0

* Only firms that belong to a holding.
Source: BDDE (INDEC, 2007).

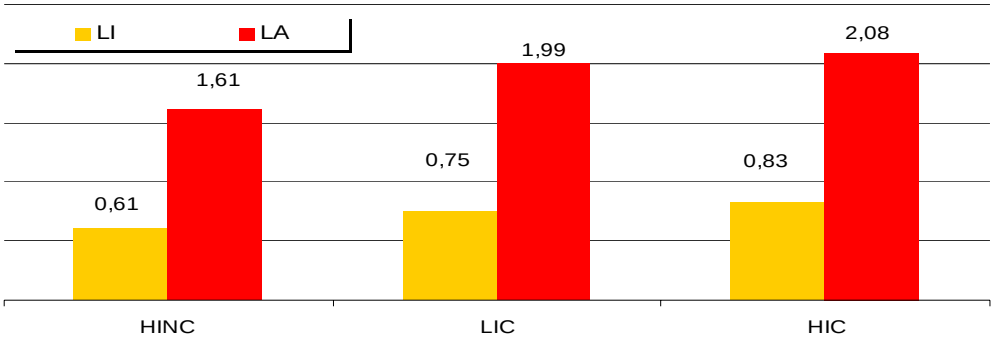
Given the stated hypothesis and the findings presented so far, the later can not be accepted. There seems to be no difference among innovative strategies, although continuity has a stronger explicative power than intensity. Differences between continuous and non continuous firms are higher than the differences between firms with high and low innovative intensity and this last criterion is, in some cases, almost irrelevant.

What rests is to combine agents and objectives to see if there is any difference among strategy with more solid bases. In that sense, the analysis of the level of intensity of linkages and the analysis of the extension of interactions could contribute to test the hypothesis and to study the NIS linkages in a more integrated way.

Graph 1 presents the values for every indicator presented in the methodological section for all defined innovative strategies. In a first approach, the better performance of continuous firms is obvious and, between these two groups, the HI over the LI. Again, the HINC group reaches the last position. Distances among strategies are higher and the more virtuous behaviour (HIC) is the one with a more intense and articulated linkage structure. This group of firms interact with more agents and in order to accomplish more objectives[7].

[7] In both indicators intra-corporation linkages are being dropped out given the bias that arise from the presence of null values in the total simple when the firm is not part of a corporation.

Graph 1: Linkage intensity (LI) and Linkage articulation by Innovative Strategy



Source: BDDE (INDEC, 2007).

In order to test the statistical significance of differences among strategies the Kruskal-Wallis and the Joonckheere-Terpstra where run. Results are present in table 4 and the tests show that the differences are significant (the K-W statistic is significant with a 99% level of confidence for both indicators) and confirm that the order of average values puts HIC firms in the first place (the highest values), followed by the LIC group and finally the HINC. Once again, continuity has more explicative power than intensity. If the ordering is re-codified (HIC-INC-HINC) then the J-T coefficient becomes statistically significant with confidence levels higher than 99%.

Then, although the linkage rates among firms with different strategies are similar, the intensity and articulation analysis confirms that a more virtuous innovative strategy is associated to a higher tendency to interact with the rest of the NIS. Those firms with a more virtuous strategy are more inserted in the environment by means of a denser and more articulated linkage structure (interact with more agents for more objectives).

Table 4: Rank per strategy

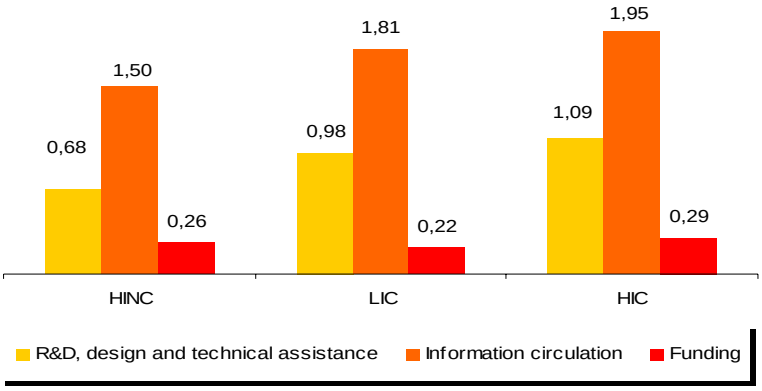
	N	LI	LA
LIC	175	236,23	240,21
HINC	90	198,18	197,47
HIC	205	251,26	248,18
Total	470	470	470
Kruskal-Wallis Test*			
Kruskal-Wallis		9,786	9,652
Asintot. Sig.		0,007	0,008
Jonckheere-Terpstra Test (order HIC-HINC_LIC)			
Observed J-T Statistic		36983,000	36207,500
J-T Statistic Mean		35037,500	35037,500
J-T Statistic Standard dv.		1557,004	1525,509
Standarised J-T Statistic		1,250	0,767
Asintot. Sig. (bilateral)		0,211	0,443
Jonckheere-Terpstra Test (order HIC-LIC-HINC)			
Observed J-T Statistic		39554,000	39064,500
J-T Statistic Mean		35037,500	35037,500
J-T Statistic Standar dv.		1557,004	1525,509
Standarized J-T Statistic		2,901	2,640
Asintot. Sig. (bilateral)		0,004	0,008

* GL: 2.
Source: BDDE (INDEC, 2007).

This more virtuous strategy of HIC firms is also confirmed when linkages objectives are R&D and information, followed in terms of levels by LIC firms (Graph 2). For both objectives, these firms remain as the ones with the highest levels of the articulation (the same objective with different agents). For instance, in order to perform R&D, HIC firms interact, in average, with 1,09 agents (vs. 0,98 among LIC firms and 0,68 in the case of

the HINC group). The values lower than one imply that among this last group of firms there are cases where firms did not interact with any agent at all for R&D. As observed before, in the case of the search for funding, innovative intensity seems to be more important and the order of the strategies is different: firstly the HIC group, secondly the HINC one and finally the LIC firms.

Graph 2: Level of articulation by Innovative Strategy and objectives



Source: BDDE (INDEC, 2007).

The K-W test corroborates the statistical significance of the higher values reached by the HIC group except from the funding objective where no difference among strategies is observed (probably due to the fact than only a reduced number of firms that actually interacted for this goal). In the other two objectives (R&D and information), descriptive statistics apply: the differences are significant and the ordering is the expected (HIC-LIC-HINC) (Table 5).

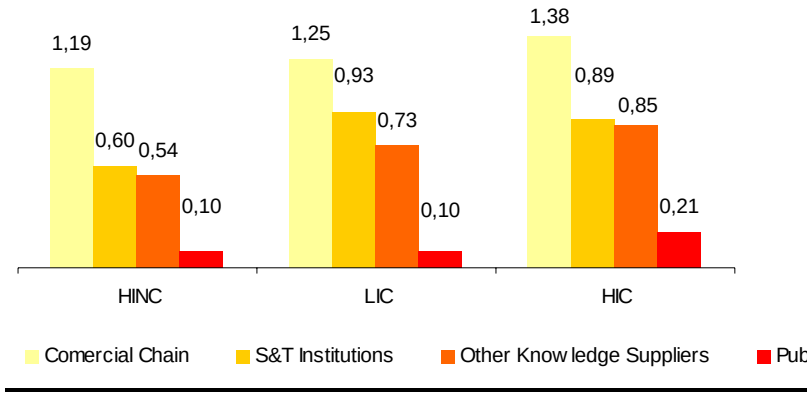
Table 5: Ranks per strategy*

	N	R&D, design and technical assistance	Information circulation	Funding
LIC	175	240,06	236,39	227,56
HINC	90	194,64	200,37	236,24
HIC	205	249,54	250,17	241,96
Total	470	470	470	470
Kruskal-Wallis Test**				
Kruskal-Wallis		11,804	8,956	2,072
Asintot. Sig.		0,003	0,011	0,355
Jonckheere-Terpstra Test (order HIC-HINC_LIC)				
Observed J-T Statistic		36381,500	36829,000	36654,500
J-T Statistic Mean		35037,500	35037,500	35037,500
J-T Statistic Standard dv.		1487,876	1527,285	1128,824
Standarized J-T Statistic		0,903	1,173	1,432
Asintot. Sig. (bilateral)		0,366	0,241	0,152
Jonckheere-Terpstra Test (order HIC-LIC-HINC)				
Observed J-T Statistic		39451,500	39260,000	36067,500
J-T Statistic Mean		35037,500	35037,500	35037,500
J-T Statistic Standard dv.		1487,876	1527,285	1128,824
Standarized J-T Statistic		2,967	2,765	0,912
Asintot. Sig. (bilateral)		0,003	0,006	0,362

*The contrasted variables arise from the average number of agents that firms established linkages for each activity. ** GL: 2.
Source: BDDE (INDEC, 2007).

Regarding the intensity of the linkages, the differences decrease again although the HIC firms´ values are still the highest, except from the linkages with S&T institutions. Graph 3 summarizes the average number of objectives per agent. Among HIC firms, linkages with the commercial chain had, in average, 1,38 objectives (vs. 1,25 among LIC firms and 1,19 among HINC group). For the rest of the agents, the average quantity of linkages below the unit implies that the number of firms, in all strategies, that did not interact with any agent at all is elevated.

Graph 3: Linkages Intensity by Innovative Strategy and Agents



Source: BDDE (INDEC, 2007).

Once again, table 6 presents the result of the K-W and the J-T tests. The distance between means in the case of linkages with the commercial chain is not significant, which implies that the average intensity of interactions is similar for all strategies. For the rest of the agents, each strategy values are different and statistically significant (with confidence levels over 90%). The order seems to be the same as the one observed in the case of linkages intensity: the highest level is among HIC firms, followed by the LIC group and finally the HINC firms.

Table 6: Ranks per strategy *

	N	Commercial Chain	S&T Institutions	Other Knowledge Suppliers	Public Agencies
LIC	175	229,08	248,33	234,37	227,53
HINC	90	221,25	194,08	204,39	230,41
HIC	205	247,24	242,73	250,12	244,54
Total	470	470	470	470	470
Kruskal-Wallis Test**					
Kruskal-Wallis		3,212	11,991	8,323	5,630
Asintot. Sig.		0,201	0,002	0,016	0,060
Jonckheere-Terpstra Test (order HIC-HINC_LIC)					
Observed J-T Statistic		37158,000	34704,000	37010,000	36993,000
J-T Statistic Mean		35037,500	35037,500	35037,500	35037,500
J-T Statistic Standard dv.		1500,217	1474,917	1455,555	849,772
Standarized J-T Statistic		1,413	-,226	1,355	2,301
Asintot. Sig. (bilateral)		0,158	0,821	0,175	0,021
Jonckheere-Terpstra Test (order HIC-LIC-HINC)					
Observed J-T Statistic		37730,000	38336,000	39059,000	36790,000
J-T Statistic Mean		35037,500	35037,500	35037,500	35037,500
J-T Statistic Standard dv.		1500,217	1474,917	1455,555	849,772
Standarized J-T Statistic		1,795	2,236	2,763	2,062
Asintot. Sig. (bilateral)		0,073	0,025	0,006	0,039

* The contrasted variables arise from the average number of objectives that firms established linkages for each agent.
** GL: 2.
Source: BDDE (INDEC, 2007).

In short, when the characteristics of the linkage structure is analysed in an isolated way, the proposed segmentation criterion are not relevant. Although HIC firms present higher probabilities of interaction, the percentage of firms that interacted with at least one agent of at least for one objective is not so different than that reached in the LIC or the HINC groups. However, when the intensity and articulation of interactions is taking into account, then strategies present in fact different characteristics and the HIC firms outstand from the rest.

These findings imply that the linkage structure of HIC firms is denser in terms of the number of agents the firm interact to and more complex in terms of the chased objectives. Then is possible to sustain that HIC firms are more articulated with their environment and this could be a sign of more knowledge circulation between the firms and the system. Of course, no causality explanation is possible although a bidirectional relationship (instead of a lineal one) seems to be more likely to be the case. HIC firms demand a higher articulation with the environment given the technological complexity of their innovative dynamic and the more complex technological dynamic is the result of the absorption of more knowledge, information and resources from the environment.

2.2. Linkages structure by sector, size and capital origin

Giving the importance of the specific characteristics of the firm, this section analyses the linkage structure distinguishing between sector, size and capital origin of firms. In order to simplify the presentation of the results, intensity and articulation indicators will be discussing[8]. At the same time, it should be noted that the inclusion of these breakdown categories leads to the reduction of observations for each group, especially in the case of sectoral classifications. Nevertheless, cuts remain relevant and help to go deeper in the strategy characterization.

[8] Linkages rates and LI and LA breakdown by agent and objective are included in the annexes.

Distinction by sector of activity shows again that higher levels of intensity and articulation linkages are present in the case of those firms with the most virtuous behaviour (Table 7). Exceptions are observed among LIC and HINC textile and metalworking firms. However, since the observations drop dramatically (less than five cases in both groups) this figures are not significant. Besides these exceptions, HIC firms are the ones with the higher levels of linkages intensity (the average number of objectives per agent) and for the rest of the strategies the order is not so clear or it seems to be the same in all sectors. Among food firms, for instance, HINC enterprises rank in the second place, but among those belonging to automobile industry they are in the last position.

Table 7: LA and LI by sector of activity

	Linkages intensity			Linkages articulation		
	HINC	LIC	HIC	HINC	LIC	HIC
Food & beverage	0,72	0,65	0,93	1,94	1,83	2,24
Textile & Cloth	0,47	0,86*	0,57	1,29	2,33*	1,43
Chemical products	0,83*	0,73	0,79	2,00*	1,93	1,89
Metalworking	0,49	0,88	0,79	1,24	2,08	2,07
Automobiles	0,79*	0,92	1,22*	2,17*	2,44	2,89*
Other industries	0,63	0,72	0,83	1,66	1,95	2,14

*The number of observations is lower than 10 firms.
Source: BDDE (INDEC, 2007).

These finding confirm, one more time, that continuous and high intensity strategies presents virtuous characteristics in terms of spillovers to the rest of the society and that it happens independently of the activity sector. Of course, the sectoral impact and especially the technological trajectories of the main S&T institutions in our country as well as the position this firms have in the global value chains impact on the firm's behaviour. However, it is possible to find firms with a virtuous strategy, which is translated into a higher articulation with the environment.

Size distinction shows that the hypothesis can not be confirm in the case of large firms, although the influence of their lower participation in the total panel, which leads to a reduce number of observations when the sample is segmented (Table 8). In fact, there are only 7 and 10 large HINC and LIC firms, respectively. The ordering for the small and medium enterprises (SME) remains as expected: HIC, LIC and HINC. Medium size firms presents the higher values: while, in average, small and large firms establish linkages with 1,9 and 2,12 agents per firm, respectively; among the medium size ones this value climbs to 2,4. The intensity of linkages is lower than one in all cases and, once again, medium size firms exceed the average values for all groups, being the ones with a HIC behaviour those reaching the highest levels. In this last case, since the value is closer to one, then almost all firms have interacted with all agents in order to perform, at least, one objective.

Table 8: LA and LI by size

	Linkages intensity			Linkages articulation		
	HINC	LIC	HIC	HINC	LIC	HIC
Small	0,54	0,72	0,76	1,37	1,94	1,96
Medium	0,66	0,78	0,96	1,88	2,13	2,40
Large	1,11*	0,80*	0,91	3,29*	1,90*	2,12

*The number of observations is lower than 10 firms.
Source: BDDE (INDEC, 2007).

The order for both indicators shows again the importance of continuity of innovation efforts in the matter of linkages. In respect of the minimum required thresholds to access and incorporate external knowledge, the observed values allow the following hypothesis for the HIC firms. Large firms are mostly owned by foreign capitals and they are part of a globalize corporative strategy, then the analysis of the Argentinean subsidiary is not enough to capture the hole strategy (it will not be logical either), this

leads to these firms to present different results than the ones observed for the rest of the enterprises. Small firms, in turn, present a strategy necessarily associated to a lower scale and, with, that, to lower possibilities of developing more complex technological innovations (in this case, the innovation indivisibilities are the ones acting as barriers). Medium size firms, finally, present a medium scale, higher relative innovation intensity than large enterprises and higher absolute intensity regarding small ones; all of that in a context of an innovative dynamic that probably concentrates their main activities in the same place that the firm operates in. This combination is the one capturing the higher level of linkages among medium size firms.

Finally, the fact that small firms present lower rates of linkages does not affect in any way the differential impact of a virtuous strategy. On the contrary, if scale is acting as a barrier (to investment and to production) the continuous expenditure firms seem to be taking better advantages of the interaction with the environment or, at least, of the possibilities of generating productivity improvements by means of a more extensive and intensive interaction with the National Innovation System.

The last characterization of strategies is the one that split groups according to their national or foreign capital owning. In the case of national firms, the level of articulation and intensity of linkages matches the expected order: continuity is more important than intensity. In average, HIC firms establish linkages with 2,22 agents for 0,9 objectives, HINC firms, in turn, establish linkages with 1,4 agents for 0,53 objectives (Table 9).

Evidence for firms with foreign capital owning is contradictory and even though most of the results are being determined by large firms, the lost of observations leads to results with low statistical significance. However, it is worthy to mention that the higher rates of linkages among the firms with the less virtuous strategy could be the result of the observation of a partial aspect of the strategy (that part that is corresponded to the Argentinean subsidiary) or it could be the result of a higher level of capabilities gained by intra-corporation linkages which allows the firm to take more advantages of the interaction with the environment.

Table 9: LA and LI by capital origin

	Linkages intensity			Linkages articulation		
	HINC	LIC	HIC	HINC	LIC	HIC
National Firms	0,53	0,72	0,90	1,39	1,92	2,22
Foreign firms	0,83	0,79	0,72	2,26	2,17	1,90

Source: BDDE (INDEC, 2007).

Another issue that can be associated with the less virtuous foreign firms is the one that arises from table 10. In this table the rates of linkages with the corporation (headquarters and other related enterprises) is shown. As presented, firms with a HIC and a HINC strategy present the highest rates of intra-corporation linkages in the case of R&D activities the former and access to funds the latter. The dangerously aspect of this situation is that it could be the result of the difficulties our system has to generate linkages capable of capturing the knowledge generated inside HIC firms (which also presents the most positive features for the Argentinean environment). Another explanation is the one related to the interaction between the knowledge supply and the demand. Foreign firms with a virtuous behaviour could be generating knowledge required abroad (in their headquarters or another subsidiary) and it is more complex and sophisticated than the one generated locally. In that case, national knowledge supply is easily replaced (or in fact exists) with the knowledge that circulates inside the corporation. In other words, these firms could be operating in the international knowledge frontier and our NIS does not.

Table 10: Intra-corporation linkages – Foreign firms (%)

	LIC	HINC	HIC
R&D, design and technical assistance	43	48	62
Information circulation	57	74	63
Funding	17	39	21

Source: BDDE (INDEC, 2007).

In the case of HINC firms, the higher rates of linkages could be the result of a higher appropriation of the knowledge existing in the environment they operate which is combined with a higher interaction with the headquarters. However, the dangerous situation here is that the knowledge creation of the NIS generates a crowding-out effect on firms investments. This would be in line with what Arza & Lopez (2008) identified: linkages with high private appropiability and low social spillovers. From a more optimistic point of view, the fact that these firms are more connected with the NIS opens up the possibility of developing a public policy capable of foster a more virtuous behaviour (with private and social benefits) using the existing linkages as a take off platform.

In short, higher levels of intensity and articulation are observed in HIC firms from all sizes, sectors and capital origins. The exceptions are those related to the large foreign firms. In both cases, the order of the strategies presents an invert relationship with the linkages rates and that could be explained, on the one hand, by the number of observations; on the other, by the fact that only national subsidiaries are included. In any case, more research in needed in this matter in order to identify key aspects to foster a virtuous strategy.

For the rest of the groups, which at the same time represent the bulk of the Argentinean productive structure, the more virtuous innovative strategies comes with a more articulated and intense interaction with the environment no matter the size or the sectoral belonging. The causality in terms of impact remains unknown but the theory and the field studies have proved that the relationship between linkages and technological competences (and with them the innovative performance and the income levels) is bidirectional and also generates feedback effects. The existence of these feedback effects exposes the utility of a combined public policy: to foster knowledge generation (public goods) and, at the same time, to foster appropiability in the private sector.

3. Conclusions

The analysis here performed has allowed the verification of the fact that firms with a virtuous strategy present a more dense and articulated linkage structure. This implies that the structure of HIC firms' interaction is characterized by a higher number of agents involved and by a more complex requirement of knowledge and external resources.

The analysis also shows the explicative value of the innovative continuity over the intensity in the case of R&D activities and the search for information and, the other way around in the case of accessing to funding sources. This is in line with what literature highlights regarding the necessity of capability thresholds in order to access to the knowledge available in the system. If continuous firms present higher levels of competences, then they are in a better position to interact with other sources of knowledge. On the contrary, the lack of competences inside the firm becomes an obstacle for interaction and that is how a vicious cycle starts: these firms do not interact because their lack of competences and the competencies do not improve because of the lack of interaction.

If innovation is understood as a mean for competitiveness, then the higher the levels of competitiveness associated to a dynamic innovative behaviour, the higher the needs

for cooperation. However, the opposite hypothesis could also apply: the higher the levels of cooperation, the more dynamic the innovative behaviour.

The second hypothesis seems to be closer with what the NIS approach states and also in line with the literature about clusters and sectoral innovation systems (Lundvall, 1992; Breschi & Malerba, 2007; Cooke, Cooke, 1996). The first one, in turn, seems to be more related to the approaches associated to endogenous competences and capability thresholds (Borello, et al. 2006; Delfini et al. 2006).

In any case, the existence of a reduced group of enterprises with a high level of innovative dynamism where the differences among productive sectors tend to disappear matches the evidence gather by De Negri et al. (2005) for the case of Argentina and Brazil. It also coincides with what Lugones et al. (2006 & 2008) and Suárez (2008) observed regarding the existence of differentiated behaviours in the matter of innovation where independently of the sectoral belonging; those firms with a more balanced behaviour in terms of innovative activities are the ones presenting more virtuous trajectories in terms of performance.

Then the hypothesis is confirmed, firms with a HIC presents a more virtuous dynamic of interaction with the National Innovation Systems. This dynamic includes more linkages with the commercial chain and more interactions with the knowledge supply, in all cases seeking for research, development, technical assistance and design. However, since only the HIC firms are the ones that combine private with social benefits, the novelty of these findings lays on the fact that even though all innovation is good, not every innovative behaviour are equally good in terms of welfare. Only the so called virtuous strategies simultaneously maximize productivity and incomes.

The analysis here performed included just a short list of strategies and characteristics; this does not imply that these variables are neither the most important nor the only ones. However, if the level of innovative behaviour is associated in a direct way with the intensity and articulation of linkages and this happens in all sectors, then public policy should foster high-tech niches (by means of a dynamic innovative strategy) in the sectors that already exists in Argentina, sectors which explains the bulk of the productive structure and are far from what standard recommendations sustain (to improve the activity of high-tech sectors). On the other hand, the existence of differentiated strategies accounts for the necessity of differentiated policies. The interaction with the environment of low intensity firms could be use as a channel foster a more intense innovative dynamic and to foster interactions could improve the social and private impacts of the non continuous innovative strategies. As for the HIC firms, their existence accounts for the possibility of developing a virtuous strategy even in a traditional and low-tech sector and even in an unstable and underdeveloped environment, they are the benchmarking of Argentinean firms and they should be well identified and characterize in order to reproduce their dynamics.

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Annexs

Table 1: Linkages intensity and linkages articulation by innovative strategy

	HINC	LIC	HIC
LI	0,61	0,75	0,83
NA	1,91	2,21	2,50

Source: BDDE (INDEC; 2007).

Table 2: Level of articulation by innovative strategy and objectives

	HINC	LIC	HIC
R&D, design and technical assistance	0,87	1,10	1,37
Information circulation	1,77	2,00	2,32
Funding	0,37	0,27	0,40
Total	**1,91**	**2,21**	**2,50**

Source: BDDE (INDEC; 2007).

Tabla 3: Linkages intensity by innovative strategy and agents

	LIC	HINC	HIC
Comercial chain	1,25	1,19	1,38
S&T institutions	0,93	0,60	0,89
Other knowledge suppliers	0,73	0,54	0,85
Intra-corporation linkages	0,36	0,57	0,78
Public Agencies	0,10	0,10	0,21
Total	**0,61**	**0,75**	**0,83**

Source: BDDE (INDEC; 2007).

Table 4: Linkages by agent and objective by innovative strategy

	LIC			HINC			HIC		
	R&D, design and technical assistance	Information circulation	Funding	R&D, design and technical assistance	Information circulation	Funding	R&D, design and technical assistance	Information circulation	Funding
Commercial chain	45	66	13	36	66	18	52	66	20
S&T institutions	27	62	3	19	40	1	27	61	1
Other knowledge suppliers	23	48	2	12	40	2	27	56	2
Intra-corporation linkages	38	60	16	50	71	29	54	72	22
Public Agencies	2	5	3	1	4	4	3	12	6

Source: BDDE (INDEC; 2007).

Table 5: Linkage rate by agent (% of firms)

	Commercial chain			S&T institutions			Other knowledge suppliers			Intra-corporation linkages			Public Agencies			Total		
	LIC	HINC	HIC	LIC	HINC	HIC	LIC	HINC	HIC	LIC	HINC	HIC	LIC	HINC	HIC	LIC	HINC	HIC
Food and beverage	67	72	76	67	56	69	46	50	71	75	86	79	4	17	7	88	83	95
Textile y Cloth	78	71	67	78	24	43	78	35	29	40	100	60	0	0	5	89	71	86
Chemical products	77	67	63	67	33	74	47	100	42	83	100	77	3	0	11	87	100	95
Metalworking	73	65	68	69	35	61	50	18	61	67	50	79	15	6	17	81	71	98
Automobiles	100	83	89	56	67	78	78	33	89	100	80	71	11	33	33	100	83	89
Other industries	71	66	78	62	45	62	53	48	55	61	85	82	8	7	19	88	76	95
Small	72	63	72	64	34	53	53	36	47	65	67	83	8	4	18	86	70	94
Medium	78	81	78	72	50	79	56	44	75	65	83	74	6	13	8	88	94	97
Large	80	100	69	60	100	65	50	86	62	100	100	86	0	43	15	100	100	88
National Firms	74	66	77	64	34	64	51	31	61	65	62	76	6	7	18	89	70	94
Foreign firms	71	78	66	71	65	62	63	70	50	69	90	84	11	13	9	83	96	94

Source: BDDE (INDEC; 2007).

Table 6: Linkage rate by objective (% of firms)

	R&D, design and technical assistance			Information circulation			Funding			Total		
	LIC	HINC	HIC	LIC	HINC	HIC	LIC	HINC	HIC	LIC	HINC	HIC
Food & beverage	58	56	79	79	83	95	25	28	33	88	83	95
Textile & Cloth	44	35	57	89	65	86	11	29	33	89	71	86
Chemical products	73	67	79	80	100	95	23	33	21	87	100	95
Metalworking	73	59	78	81	71	93	31	18	32	81	71	98
Automobiles	78	83	89	100	83	89	44	67	44	100	83	89
Other industries	68	52	78	86	76	95	18	31	37	88	76	95
Small	66	46	69	83	69	92	23	25	40	86	70	94
Medium	69	75	87	84	94	97	16	44	30	88	94	97
Large	80	71	85	90	100	88	50	43	15	100	100	88
National Firms	68	45	74	84	69	93	21	22	34	89	70	94
Foreign firms	66	78	82	83	96	94	31	52	34	83	96	94

Source: BDDE (INDEC; 2007).

Table 7: Linkage intensity by size, sector and capital origin

	Commercial chain			S&T institutions			Other knowledge suppliers			Intra-corporation linkages		
	LIC	HINC	HIC	LIC	HINC	HIC	LIC	HINC	HIC	LIC	HINC	HIC
Food & beverage	0,96	1,17	1,50	1,00	0,78	1,00	0,58	0,72	1,10	0,04	0,22	0,14
Textile & Cloth	1,33	1,18	1,29	1,00	0,29	0,62	1,11	0,41	0,33	0,00	0,00	0,05
Chemical products	1,33	1,67	1,11	0,87	0,67	1,16	0,63	1,00	0,79	0,07	0,00	0,11
Metalworking	1,35	1,18	1,18	1,19	0,47	0,83	0,73	0,24	0,83	0,23	0,06	0,24
Automobiles	1,78	1,33	1,33	0,78	1,00	1,22	1,00	0,50	1,44	0,11	0,33	0,56
Other industries	1,19	1,14	1,42	0,84	0,66	0,82	0,74	0,66	0,81	0,10	0,07	0,26
Small	1,20	1,10	1,34	0,92	0,54	0,72	0,72	0,48	0,64	0,11	0,06	0,26
Medium	1,31	1,44	1,48	0,94	0,56	1,16	0,78	0,50	1,13	0,09	0,13	0,10
Large	1,60	1,43	1,27	0,90	1,29	1,00	0,70	1,29	1,12	0,00	0,43	0,27
National Firms	1,26	1,15	1,46	0,91	0,48	0,93	0,70	0,42	0,91	0,09	0,09	0,25
Foreign firms	1,20	1,30	1,21	0,97	0,96	0,79	0,86	0,91	0,72	0,14	0,13	0,13

Source: BDDE (INDEC; 2007).

Table 8: Level of articulation by size, sector and capital origin

	R&D, design and technical assistance			Information circulation			Funding		
	LIC	HINC	HIC	LIC	HINC	HIC	LIC	HINC	HIC
Food & beverage	0,83	0,83	1,33	1,58	1,83	2,07	0,17	0,22	0,33
Textile & Cloth	1,00	0,35	0,57	0,11	1,24	1,43	0,11	0,29	0,29
Chemical products	0,90	1,00	1,21	0,17	2,00	1,79	0,17	0,33	0,16
Metalworking	1,27	0,65	1,00	1,92	1,12	1,90	0,31	0,18	0,27
Automobiles	1,00	1,00	1,89	2,33	2,00	2,89	0,33	0,17	0,11
Other industries	0,95	0,69	1,01	1,71	1,52	1,97	0,22	0,31	0,33
Small	0,97	0,63	0,87	1,77	1,30	1,74	0,23	0,25	0,34
Medium	0,94	0,69	1,33	2,06	1,69	2,29	0,13	0,25	0,24
Large	1,20	1,14	1,46	1,60	3,00	2,04	0,40	0,29	0,15
National Firms	1,01	0,61	1,18	1,75	1,30	2,02	0,21	0,22	0,36
Foreign firms	0,86	0,87	0,91	2,06	2,09	1,79	0,26	0,35	0,15

Source: BDDE (INDEC; 2007).