

# Innovation and Cooperation: Evidences from the Brazilian Innovation Survey

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## ABSTRACT

Innovative Cooperation is regarded as an interesting alternative for a firm that is trying to improve its innovating performance in the market. Since the 80's there has been an increase in cooperative activities between firms and institutions. Based on data of PINTEC 2005, the aim of this study is to identify the reasons why Brazilian firms engage in innovative cooperation emphasizing the relation between the type of partners and the choice of cooperation for innovation. The size, the sector, the appropriability regime, and the types of partners are investigated as motivating elements of the cooperative activities in the innovative firms.

Key-words: Innovation, Co-operation, PINTEC, Brazilians Firms.

## RESUMO

Cooperação para inovação vem sendo considerada uma alternativa interessante para a empresa ampliar seu desempenho inovativo no mercado. Desde a década de 80 tem ampliado o número de atividades de cooperação entre empresas e instituições. Com base nos dados da PINTEC 2005, esse artigo busca identificar as razões que justificam as empresas brasileiras a realizarem atividades de cooperação em inovação, enfatizando a relação entre os tipos de parceiros e a escolha por cooperação para inovação. Tamanho, setor, regime de apropriabilidade e tipos de parceiros são analisados como elementos motivadores das atividades de cooperação para as empresas inovadoras brasileiras.

Palavras-Chave: Inovação, Cooperação, PINTEC, Empresas Brasileiras.

**JEL: O30, O32**

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## 1. Introduction

During the last decades, the intensification of the innovation-based competition process among firms and the consequent acceleration of R&D efforts have stimulated firms to adopt increasingly aggressive innovative strategies. In this context, innovative cooperation between different institutions can be considered an important way for firms to carry out technological activities in order to remain in a good position in market leadership.

Since the beginning of the 60s there has been an increase in the number of firms using innovative cooperation strategies. However, it is in the decades after the 80s where the biggest increase in cooperative activities can be observed, when it became clear to firms that their internal expertise were no longer enough to obtain an innovative insertion in the market. (Hagedoorn, 2002). Thus, cooperative activities started to represent opportunities of access to knowledge and complementary technological resources to accelerate the innovating process of the firm as well as to cost and risk sharing (Faria and Schmidt, 2007).

Facing this reality, many authors have been trying to identify, by means of empirical studies, the motives that lead to cooperative activities for innovation among firms and different institutions, such as universities, research institutions, clients and/or suppliers.

The aim of this paper is to identify the factors that lead Brazilian innovative firms to innovative cooperation, emphasizing the relation between the type of partners for cooperation (firms, universities, research centers, clients and suppliers) and the reasons for the choice of this strategy by Brazilian manufacturing industry. To reach this objective, this article has been divided into 5 sections. Section 2 brings a brief review of literature on innovative cooperation, emphasizing the elements that motivate the company to choose the cooperation strategy for innovation. Section 3 presents some characteristics of innovative firms that cooperate in Brazil, taking into account the size of the companies and the industrial sectors they operate in. Section 4 shows the econometrical model which is adopted, some the characteristics of the sample and the results obtained during the study that was carried out to identify the variables that lead the firm to the decision to cooperate, and to show the correlation between these variables and the type of partners. And finally, in section 5, some conclusions of this study are presented.

## 2. Literature Review

The innovative cooperation may be regarded as a fairly fast and efficient way for a firm to get external technological expertise and, thus, attempt to become a market leader in the field of technology. As from the 80s, and more intensely in the 90s, innovative cooperation activities have become very popular especially in the sectors of biotechnology and information technology (Hagedoorn, 2001). Based on this, with the aim to identify which elements are related to the decision of the firm to cooperate with other companies, universities, clients and suppliers, to engage in innovative activities, there has been an expressive increase in empirical studies on this phenomenon (Tether, 2002; Cassiman and Veugelers, 1999, 2002; Negassi, 2004; Schmidt, 2005).

Hagedoorn (1993) systemizes the specific motives of a firm to carry out R&D activities. Box 1 presents some motives that justify innovative cooperation: to obtain scale and scope benefits in R&D, the need to incorporate complementary technology, costs sharing in R&D projects, absorption of the partner's tacit knowledge and reduction of the innovation cycle.

### **Box 1: An overview of motives for (strategic) interfirm technology cooperation**

<p><b>I. Motives related to basic and applied research and some general characteristics of technological development:</b></p> <ul style="list-style-type: none"> <li>- Increased complexity and intersectoral nature of new technologies. Cross-fertilization of scientific disciplines and fields of technology, monitoring of evolution of technologies, technological synergies, access to scientific knowledge or to complementary technology;</li> <li>- Reduction, minimizing and sharing of uncertainty in R&amp;D;</li> <li>- Reduction and sharing of costs of R&amp;D.</li> </ul>
<p><b>II. Motives related to concrete innovation processes:</b></p> <ul style="list-style-type: none"> <li>- Capturing of partner's tacit knowledge of technology, technology transfer, technological leapfrogging;</li> <li>- Shortening of product life cycle, reducing the period between invention and market introduction.</li> </ul>
<p><b>III. Motives related to market access and search for opportunities:</b></p> <ul style="list-style-type: none"> <li>- Monitoring of environmental changes and opportunities;</li> <li>- Internalization, globalization and entry to foreign markets;</li> <li>- New products and markets, market entry, expansion of product range.</li> </ul>

Source: Based on Hagedoorn (1993, p.373).

With the objective to find new elements that explain the motivation of firms to cooperate, besides the motives presented by Hagedoorn (1993), authors such as Tether (2002) defend the thesis that innovative cooperation is more closely related to the type of innovation the firms carry out than to their characteristics. Based on data of innovative firms in the United Kingdom, the author presents evidence that firms which concentrate on radical innovation are more involved in cooperation and innovation than firms that concentrate on the development of incremental innovation.

Cassiman and Veugelers (2002) advance the debate and test the hypothesis that the decision of a firm to cooperate with other institutions is partly based on the flow of information that enters and leaves the firm. They show that in order to take advantage of this information flow, the firms need internal technological expertise, specifically R&D expertise. They consequently discuss the existence of complementarity (or replacement) between internal and external R&D resources presented by the choice of the company between “making or buying” R&D activities (Veugelers and Cassiman, 1999). These authors show that firms which are more likely to cooperate are those who have the knowhow to efficiently receive and use the external expertise. The debate is based on the concept of “the absorption capacity” developed by Cohen and Levinthal (1989) which they define as the capacity of a firm to incorporate and successfully use the flow of external information or spillovers for the development of innovative activities for its own benefit.

With the aim to advance this debate, Cassiman and Veugelers (2002) built a model to identify to what extent the “incoming spillovers variable” and the “appropriability variable” affect the probability of a firm to cooperate with innovative activities, based on data for firms of the Belgian Community Innovation Survey. In this survey they come to the conclusion that “incoming spillovers” and “appropriability” affect propensity of the Belgian companies to cooperate with R&D and also affirm that the effects of these variables can be different when the types of cooperative partners are taken into account.

Similar to the work done by Cassiman and Veugelers (2002), Schmidt (2005) analyses the R&D cooperation determiners for the German firms, based on data from the Third Community Innovation Survey (CIS 3). Not only does the author find a positive relation between the flow of expertise and cooperative activities, but he also tests the hypothesis that the choice to cooperate is related to the type of partnership that is established. Based on this it can be observed that firms with a big intramural innovative capacity are more likely to cooperate with universities and research institutions than with suppliers or clients. In the several researches that have been done, Veugelers and Cassiman emphasize that in order to understand the motives of a firm to cooperate, it is essential that its heterogeneity is taken into account. Firstly they consider the important factors that affect the probability of a firm to engage in innovative cooperation as well as the size of the firm and the industrial sector it operates in.

As regards the size of the firm, a positive relation between innovativity and size is considered. (Dachs et al, 2004). Veugelers and Cassiman (1999) have found evidence in his study that big Belgian firms that employ more than 500 workers, are more likely to carry out internal innovative activities and, at the same time establish cooperation partnerships, while small firms choose to carry out exclusively internal innovative activities, or to buy externally; in other words they cooperate to innovate.

Besides the company size variable, it is suggested that the decision to cooperate to innovate also depends on the characteristics of the industry. The industrial sector variable plays an important role in the process of understanding the behavioral dimensions of the firms as regards the probability to cooperate, such as technological opportunities of the firms and the cumulativeness of expertise. (Veugelers and Cassiman, 1999; Tether, 2002)

Besides considering such variables (company size and industrial sector) these authors also include in their analyses the appropriability conditions as choice determiners for the firm to cooperate or not. However, there is little consensus in the international literature regarding the relationship between appropriability and cooperation. Cassiman and Veugelers (2002) continue the debate and create an appropriability indicator considering two types of protection: legal protection, such as patents and copyrights; strategic protection, such as secrecy and complexity. Using a probabilistic model, the authors conclude that the more developed the appropriability capacity of a firm is, the more likely this firm is to cooperate with clients and suppliers. However no evidence about the decision to cooperate with universities or research centers is found in the research.

Thus, a new point of discussion is brought up: is the type of partner relevant to explain the reasons for a firm to opt for innovative cooperation?

Tether (2002) believes that understanding the motives for cooperation is related to the identification of the type of partner. Belderbos et al (2005) also regard the type of partner as an essential element to understand the motives of firms for R&D cooperation. They conclude that firms who cooperate with competitors and suppliers focus on incremental innovation and productivity growth, while firms that cooperate with universities and research centers concentrate on radical innovation to increase market sales of products and services. Some authors like Faria and Schmidt (2007) investigate which factors specifically induce companies to cooperate with foreign partners, located in other countries to carry out innovative activities. As regards the German firms they find that firms with external insertion are more likely to cooperate with foreign partners. Dachs et al (2004) test the same hypothesis as export firms, in other words, those who operate on the international market

Another element presented in the literature is related to the stimulating role of the government in projects of cooperation by means of policies aiming at firms that are interested in making partnerships. Negassi (2004) carries out a micro econometrical study with 3,801 firms in France, between 1990 and 1996, 46% of which were classified as innovative in this period. The author shows an increase in the number of companies engaging in cooperative activities with other companies when supported by the government. In this debate, Dachs et al (2004) stands out for being one of the few studies in the literature that presents no evidence of a positive relation between the participation of governmental R&D plans and an increase in cooperative activities among firms.

Based on this debate this paper intends in the following sections to describe the characteristics of innovative firms that cooperate in Brazil and to identify the motives that induce firms to engage in innovative cooperation activities. Based on this, the paper also aims to identify the existence of a relation between appropriability and cooperation as well as to investigate whether the type of partner (other firms, universities, research centers, clients and/or suppliers) influences the choice of firms to cooperate in innovation.

### **3. Characterization of Innovative Firms and (others) those that Cooperate to Brazilian Innovation**

Based on the theoretical referential regarding the motives for cooperation for innovation presented in the previous section, the aim of this section is to, by means of empirical research, characterize the profile of the firms that are considered to be innovative and carry out activities of cooperation for the innovation of the Brazilian Industry of transformation. The analysis is based on data collected during the Research of Technological Innovation (PINTEC 2005) for the Brazilian firms between 2003 and 2005. The concept of “innovative firm” is used for firms, which between 2003 and 2005, carried out innovation activities aimed at the product and, or the process. In Brazil, PINTEC (Pesquisa Industrial de Inovação Tecnológica /Industrial Technological Innovation Survey), from IBGE (Brazilian Institute of Geography and Statistics), is a survey that collected information on technological innovation of Brazilian industrial enterprises, which follows the methodology by the “Oslo Manual.” This Brazilian survey contains information about: 1) the characteristics of firms and their innovative efforts (expenditures for innovative activities, expenditure of internal and external R&D, acquisition of R&D, if the firm has R&D department, the qualification of the employees, etc.); 2) the kind of the innovation (to the market or only to firm); 3) if the firm realize some cooperation and the partners, 4) if the firm participated of the some public policy to financial the innovative activities, etc.

It must also be clarified that according to PINTEC “cooperation and innovation” are regarded as the participation of the firm in R&D projects as well as projects of innovation in cooperation with other organizations, firms or institutions, which does not imply that those who are involved obtain instant commercial benefits. It can be verified in the literature on this subject that the type of partner is of great relevance to explain the accomplishment of this activity. This study considers 3 types of partners for cooperation:

- a) Cooperation with (S&T) Scientific and Technological infrastructure, such as universities and other research centers;

- b) Cooperation with other firms, including cooperation with suppliers, clients and other institutions that are not part of the group;
- c) Cooperation with firms of the group.

For being part of a group of studies coordinated by CEPAL, a sectoral classification that is different from the one used by PINTEC is employed, in other words, the 23 constituent industrial sectors of the National Classification of Economic Activities (CNAE) are aggregated in 14 sections as shown in Box 2.

**Box 2- Sectoral Classification**

<b>SECTORS CLASSIFICATION - 14 sectors</b>	<b>SECTORS PINTEC – CNAE - BRAZIL 23 sectors</b>
D.1: foods, drinks and tobacco	Foods and Drinks ; Tobacco
D.2: textiles and clothes	Textil; Clothes and accessories
D.3: shoes and leather products	Shoes and leather products
D.4: wood and paper	Wood; Paper; Furniture
D.5: edition and impression	Edition and impression
D.6: oil and derivatives	Oil and derivatives
D.7: chemical	Chemical ( <i>excluded</i> pharmaceuticals)
D.8: pharmaceuticals	Pharmaceuticals
D.9: minerales no metals	Minerales no metals; Metallurgy
D.10: metals products	Metals products
D.11: machinery	Machinery ; Office Equipament; Precision Equipaments to hospitals and to ind. automation
D.12: electrical machines	Electrical machines
D.13: transportation material	Transportation material
D.14: others manufactures n.e.c.	Plastic and rubber products; Electronical products to communication; Recycling

According to the results presented at PINTEC 2005, the Brazilian Transformation Industry predominantly consists of non-innovative firms. It can be verified in chart 1 that of the 12,009 firms present in the research about 50% (5,964 firms) can be regarded as innovative firms. Among these firms a small number declares to have carried out cooperation activities, irrespective of the partner between 2003 and 2005, or in other words, 15.2 % of the innovative firms cooperate with R&D.

**Table 1- Characterization of Innovative Brazilian firms that Cooperate (Number and Participation)-PINTEC 2005**

	<b>Number and (%)</b>
Firms (Observations)	12,009
Innovative firms (% all firms)	5,964 (49.66%)
Cooperating Firms (% of innovative firms)	907 (15.21%)
Cooperating with STI (% of innovative firms)	490 (8.22%)
Cooperating with other firms (% of innovative firms)(i)	724 (12.14%)
Cooperating with firms of the group (% of innovative firms)	283 (4.75%)

(i) This includes cooperation with suppliers, clients or other firms outside the group. It includes competitors.

The most distinguished types of partners for cooperation are industries, such as suppliers, clients and other firms out of the group with 12.14 % of the innovative firms, or in other words, 724 innovative firms are involved in this type of cooperation. In second place comes the cooperation with Scientific and Technological infrastructure (S&T) (490 firms) representing 8.22 % of the innovative firms. The least representative type of partners are the firms of the group (283 firms) with a participation of 4.75 % of the innovative companies.

Initially is important to comprehend the Brazilian specificities about the innovative behavior of the Brazilian firms, and after this, to discuss about the motives that firm choice to cooperate in innovation. Some studies analyzing the innovation of Brazilian manufacturing firms suggest that their technological behavior is related with sector, technical system of production, capital foreign and size (Kupfer and Rocha, 2003; Kannebley Jr, Porto and Pazzelo, 2002)

The innovation rhythm of Brazilian industry presents specificity by sectors, because is more related with the sector than OECD countries. The R&D activities in Brazil are concentrated on sectors intensives in scale (including foods, textile, and shoes) with specialized suppliers of mechanical and electrical machinery (Zucoloto, 2004).

**Table 2- Participation of the Innovative Firms that Cooperate by Activity Sector**

By Sector	Innovative Firms (A)	Cooperative Firms (B)	% (B) / (A)
D.1: foods, drinks and tobacco	939	128	13.63
D.2: textiles and clothes	642	44	6.85
D.3: shoes and leather products	276	33	11.96
D.4: wood and paper	712	63	8.85
D.5: edition and impression	192	23	11.98
D.6: oil and derivatives	66	9	13.64
D.7: chemical	379	103	27.18
D.8: pharmaceuticals	136	39	28.68
D.9: minerales no metals	437	78	17.85
D.10: metals products	383	39	10.18
D.11: machinery	706	124	17.56
D.12: electrical machines	223	49	21.97
D.13: transportation material	346	82	23.70
D.14: others manufactures n.e.c.	527	93	17.65
<b>Total Firms</b>	<b>5,964</b>	<b>907</b>	<b>15.21</b>

Source: PINTEC 2005.

The table 2 shows the heterogeneity about the innovative and cooperative behavior by sectors. The 907 firms that cooperate with some type of partner (15.21% of the innovative firms) are distributed in 14 industrial sectors as shown in table 2. This table presents in decreasing order the pharmaceutical sector (D8), the chemistry sector(D7) , and the Transportation material sector (D13) as the sectors that most carry out cooperation activities, irrespective of the partner, among the innovative firms, with participations of 28.68%, 27.18%, and 23.70% respectively.

As regards the size of the firms that innovate and carry out cooperation activities to innovate, it can be verified, through table 3, that the PINTEC sample mostly concentrates on small firms. Of the 5,964 innovative firms, 2,648 employ less than 100 workers, and the 1,186 firms with more than 500 employees are innovative firms. Verifying the participation of the cooperating innovative firms, in relation to the

total number of innovative firms, it can be noticed that the large firms have a much bigger participation. Among the innovative firms, the cooperative firms represent about 39% of these firms.

**Table 3- Participation of the Innovative firms that Cooperate by Size**

By Size (Number of Employees)	Innovative Firms (A)	Cooperative Firms (B)	% (B) / (A)
0 – 49	1,551	98	6.3%
50 – 99	1,097	94	8.5%
100 – 249	1,306	145	11.10%
250 – 499	824	109	13.23%
> 500	1,186	461	38.87%
<b>Total Firms</b>	<b>5,964</b>	<b>907</b>	<b>15,21%</b>

Source: PINTEC 2005.

An important indicator that shows the internal effort to carry out innovative activities and which must be considered refers to the number of workers participating in R&D activities in relation to the total number of workers of the firm. Considering the total number of firms in this research, the number of workers engaged in innovative activities in innovative firms is 0.46% of the total number, whereas in cooperating innovative firms this number reaches 1.28%, or in other words, the ratio of workers engaged in innovative activities in cooperative firms is about 1/100.

In chart 4 it can be observed that the ratio of workers engaged in R&D activities to the total number of workers of the firm shows similar characteristics in all the sectors: in the cooperating innovative firms the ratio of workers engaged in cooperative activities is superior to that of the innovative firms. This can be justified by the fact that cooperating firms show greater internal innovative efforts than other firms which characterizes cooperative activities as complementary activities of the internal effort and not as replaceable activities. However, an important heterogeneity should be emphasized among the sectors of the Brazilian transformation Industry. According to chart 4 it can also be observed that the cooperating innovative firms among all the sectors show distinct characteristics as regards this relation.

**Table 4 -Number of Employees (NE) in R&D in relation to the Total Number of Employees of Innovative Firms and Innovative Firms that Cooperate**

Sector	Innovative Firms	Cooperative Firms
	NE R&D / NE Total (%)	NE R&D / NE Total (%)
D.1: foods, drinks and tobacco	0.16	0.31
D.2: textiles and clothes	0.06	0.32
D.3: shoes and leather products	0.05	0.14
D.4: wood and paper	0.15	0.40
D.5: edition and impression	0.15	0.51
D.6: oil and derivatives	0.82	2.06
D.7: chemical	1.30	1.96
D.8: pharmaceuticals	1.06	1.53
D.9: minerales no metals	0.31	0.84
D.10: metals products	0.29	0.69
D.11: machinery	1.11	2.22
D.12: electrical machines	0.95	1.84
D.13: transportation material	1.46	2.42
D.14: others manufactures n.e.c.	0.71	2.03
<b>Total Firms</b>	<b>0.463</b>	<b>1.28</b>

Source: PINTEC 2005.

Another indicator of the internal efforts is the expenditure on internal activities of R&D in relation to the total expenditure on innovative activities. In most of the industrial sectors the amount spent on internal activities of R&D in relation to the total amount is superior in cooperative firms; 29.4% in cooperative firms and 20.9% in non-cooperative firms. According to chart 5 it can be confirmed that cooperative firms a priori already carry out internal efforts of R&D.

**Table 5- Expenditure on Innovative Activities and Expenditure on Internal Activities of R&D in Innovative Firms that Cooperate. (R\$ 1,000 and %)**

Sector	Innovative Firms			Cooperative Firms		
	Innovative Activities Total (1000 R\$) (A)	Internal R&D Activities (1000 R\$) (B)	% (B) / (A)	Innovative Activities Total (1000 R\$) (C)	Internal R&D Activities (1000 R\$) (D)	% (C) / (D)
D.1: foods, drinks and tobacco	4,080,727.41	314,342.67	7.70	1,538,532.06	158,985.60	10.33
D.2: textiles and clothes	1,011,253.69	90,037.28	8.90	108,244.94	36,314.46	33.55
D.3: shoes and leather products	555,855.44	66,597.29	11.98	210,420.98	51,900.67	24.67
D.4: wood and paper	1,915,893.84	192,052.87	10.02	802,127.34	83,403.12	10.40
D.5: edition and impression	660,768.47	18,769.29	2.84	188,645.16	5,336.83	2.83
D.6: oil and derivatives	1,764,080.34	949,922.28	53.85	1,559,903.08	942,172.06	60.40
D.7: chemical	2,914,088.56	683,912.97	23.47	1,639,356.98	466,722.14	28.47
D.8: pharmaceuticals	1,038,727.35	180,462.22	17.37	510,973.24	110,345.27	21.60
D.9: minerales no metals	3,008,976.01	289,820.63	9.63	1,598,899.36	193,082.52	12.08
D.10: metals products	1,231,921.15	87,183.55	7.08	260,177.10	22,450.62	8.63
D.11: machinery	3,581,692.60	694,764.54	19.40	1,963,561.59	375,146.23	19.11
D.12: electrical machines	1,052,513.75	394,837.89	37.51	764,350.98	316,519.86	41.41
D.13: transportation material	7,445,695.44	2,466,724.41	33.13	5,629,171.96	1,997,044.71	35.48
D.14: others manufactures n.e.c.	3,462,499.69	605,925.50	17.50	1,212,185.28	345,156.51	28.47
<b>Total Firms</b>	<b>33,724,693.73</b>	<b>7,035,353.38</b>	<b>20.90</b>	<b>17,986,550.06</b>	<b>5,104,580.61</b>	<b>29.40</b>

Source: PINTEC 2005.

As it was mentioned before, it is important to consider the type of cooperating partner to better understand the behavior of the Innovative firms in Brazil, as shown in table 6. Firms employing more than 500 workers, predominantly present the largest participation among the innovative firms. This group of firms concentrates the major number of cooperative firms, and the most important partner to cooperation is other firm (31.7%) than the cooperation with firms of the group (17.6%). Firms that employ no more than 50 workers carry out more cooperative activities with other firms, such as suppliers and clients (5.0%). This group of firms presents a distinguishing participation in the cooperation with institutions of S&T (3.5%) and in the cooperation with firms of the group (0.6%) (table 6).

**Table 6- Characterization of the Brazilian Innovative Firms that Cooperate by Type of Partner and by Size (Number and Participation) – PINTEC 2005**

By Size (Number of Employees)	Number and % of innovative firms (total firms)	Number and % of cooperative firms (on innovative firms)	Number and % of coop firms with S&T institutions (on innovative firms)	Number and % of coop firms with other firms (i) (on innovative firms)	Number and % of coop firms with other firms of the group (on innovative firms)



					firms)
10 – 49	1,551 (33.2%)	98 (6.3%)	54 (3.5%)	77 (5.0%)	9 (0.6%)
50 – 99	1,097 (45.0%)	94 (8.6%)	31 (2.8%)	77 (7.0%)	15 (1.4%)
100 – 249	1,306 (60.0%)	145 (11.1%)	68 (5.2%)	114 (8.7%)	29 (2.2%)
250 – 499	824 (67.4%)	109 (13.2%)	53 (6.4%)	80 (9.7%)	26 (3.2%)
> 500	1,186 (79.2%)	461 (38.9%)	284 (23.9%)	376 (31.7%)	204 (17.2%)

(i) This includes cooperation with suppliers, clients or other firms outside the group. It includes competitors. Source: PINTEC 2005.

Table 7 shows the importance of the sector when choosing the innovative firms by the type of cooperative partner. As to cooperation with infrastructure of S&T the distinguishing sectors are the Chemical sector and the Transport Material sector with participations of 14.4% and 12.7% respectively. Regarding the cooperation with firms of the group, the Petrol sector and the Electrical Equipment sector are the most outstanding with participations of 5.5% and 5.2% respectively

**Table 7- Characterization of the Brazilian Innovative Firms that Cooperate by Type of Partner and by Sector (Number and Participation)- PINTEC 2005**

Sector	Number and % of innovative firms (total firms)	Number and % of cooperative firms (on innovative firms)	Number and % of coop firms with S&T institutions (on innovative firms)	Number and % of coop firms with other firms (i) (on innovative firms)	Number and % of coop firms with other firms of the group (on innovative firms)
D.1: foods, drinks and tobacco	3,789 (32.5%)	251 (6.6%)	106 (2.8%)	211 (5.6%)	48 (1.3%)
D.2: textiles and clothes	4,784 (29.3%)	141 (3%)	53 (1.1%)	137 (2.9%)	10 (0.2%)
D.3: shoes and leather products	1,490 (32.7%)	101 (6.8%)	69 (4.6%)	95 (6.4%)	5 (0.4%)
D.4: wood and paper	4,309 (30.9%)	126 (2.9%)	44 (1%)	100 (2.3%)	15 (0.4%)
D.5: edition and impression	1,451 (36.5%)	36 (2.5%)	13 (0.9%)	33 (2.3%)	8 (0.6%)
D.6: oil and derivatives	103 (50.1%)	11 (11.1%)	9 (8.3%)	5 (4.4%)	6 (5.5%)
D.7: chemical	1,574 (49.5%)	254 (16.2%)	115 (7.3%)	226 (14.4%)	55 (3.5%)
D.8: pharmaceuticals	326 (52.4%)	60 (18.4%)	41 (12.6%)	40 (12.4%)	7 (2.1%)
D.9: minerales no metals	2,234 (27.5%)	193 (8.6%)	155 (7%)	168 (7.5%)	35 (1.6%)
D.10: metals products	2,668 (31.1%)	173 (6.5%)	48 (1.8%)	128 (4.8%)	12 (0.4%)
D.11: machinery	3,055 (44.1%)	288 (9.4%)	147 (4.8%)	261 (8.5%)	41 (1.3%)
D.12: electrical machines	865	109	56	50	45

	(45.7%)	(12.6%)	(6.5%)	(5.8%)	(5.2%)
D.13: transportation material	1,024	144	47	130	50
	(36.5%)	(14.1%)	(4.6%)	(12.7%)	(4.9%)
D.14: others manufactures n.e.c.	2,280	250	142	154	34
	(35.5%)	(11%)	(6.2%)	(6.8%)	(1.5%)

Source: PINTEC 2005.

## 4. Econometric Evidence

Based on the profile description of the innovative firms that cooperate, by the size of the firms and the industrial sectors, made in the previous item, this section presents the results of the econometric study carried out in order to identify the variables that affect the decision of the firm to cooperate and how this differs when different types of partners are considered. These variables emphasize the relation between the appropriability strategies of the firms, such as their methods of protection, brands and patents and the decision to cooperate with universities, other firms and with the group they belong to.

### 4.1 Methodological Procedures

The employment of the Probit model aims to estimate probabilities that may occur during a certain event. In this study the model aims to estimate the probability of firms engaging in activities of cooperation.

Four models were built with the following dependent variables:

Model 1- Cooperation, regardless of the partner

Model 2- Cooperation with Science and Technology infrastructure

Model 3- Cooperation with Industries, companies out of the group such as suppliers, clients or competitors

Model 4- Cooperation with Firms of the Group

The explanatory variables used in the models are divided into 3 groups: micro-characteristics of the firms, capacitation and obstacles. Among the characteristics of the firms are selected variables of size, age, origin of capital and engagement of the company in international commerce. The variables that embody the firms capabilities include indicators of innovative efforts, number of employees of R&D/ Total number of Employees (skill), engagement in continuous activities of R&D, as well as result indicators such as the variable of appropriability (Aprop). The third group is composed of variables that show the obstacles to innovation, as regards the qualification of personnel and the identification of market opportunities (Box 3).

### Box 3 - Explanatory Variables of the Models

<b>Micro characteristics of the firms</b>	
Age	Number of the years of the firm.
Size	ln (Number of employees).
Size2	ln (Number of employees) <sup>2</sup> .
Foreign Capital (FCap)	Dummy variable that takes the value 1 if the firm has more than 10% of foreign capital, and 0 otherwise.
Export Coefficient (Exp)	Proportion of International sales on total of sales.
<b>Capabilities</b>	
Skills	Proportion of R&D employment on total number of employees.

R&D Continuous (Con)	Dummy variable that takes the value 1 if the firm realize R&D continuous activities and 0 otherwise.
Appropriability (Aprop)	Dummy variable that takes the value 1 if the firm asks and/or obtains patents in Brazil or in the rest of the world.
Differentiation / Novelty of innovation (Diff)	Dummy variable that takes the value 1 if the firm has obtained innovative results novel for the market (local, regional or international). It takes the value 0 if the firm obtained results novel only for the firm.
Sale Effort (SEffort)	Value of the investments of firm with marketing and efforts to sale.
Public Support (Pub)	Dummy variable that takes the value 1 if the firm has received public financial support for innovation activities and 0 otherwise.
Technological Opportunities on the S&T Infraestructure (TO1)	Dummy variable that takes the value 1 if the firm assigns high importance the external information on the S&T infraestructure and 0 otherwise.
Technological Opportunities on the Industry (TO2)	Dummy variable that takes the value 1 if the firm assigns high importance the external information on the Industry (Suppliers, Clients, Competitors) and 0 otherwise.
Technological Opportunities on the Group (TO3)	Dummy variable that takes the value 1 if the firm assigns high importance the external information on the Group and 0 otherwise.
<b>Constraints</b>	
Lack of qualified personnel (Qualif)	Dummy variable that takes the value 1 if the firm assigns high importance as an obstacle to the innovation process to the lack of qualified personnel, and 0 otherwise.
Lack of access to finance (Finan)	Dummy variable that takes the value 1 if the firm assigns high importance as an obstacle to the innovation process to the lack of availability of financial resources, and 0 otherwise.
Lack of access to inform on technology (Techn)	Dummy variable that takes the value 1 if the firm assigns high importance as an obstacle to the innovation process to the lack of availability of information about technologies, and 0 otherwise.
Lack of access to information on markets (Mark)	Dummy variable that takes the value 1 if the firm assigns high importance as an obstacle to the innovation process to the lack of availability of information about markets and 0 otherwise.

## 4.2 Characteristics of the Sample

Initially, some characteristics of the analyzed sample are worth presenting. The firms of the sample that cooperate regardless of the partner have an average of 553 employees. When approached distinctively, this figure is even bigger, reaching the average number of 1.681 employees in the group of firms that cooperate for innovation with the group in which they participate.

**Table 8- Descriptive Statistics of the Variables of the Model**

Variable		Cooperation with all partners	Cooperation with S&T institutions	Cooperation with Industry	Cooperation with Group
Size	Méd	553.02	881.93	589.40	1,681.32
Skills	Méd	0.08	0.05	0.10	0.09
Foreign Capital	%	28	21	13	20
Public Support	%	12	3	7	10
Differentiation	%	25	7	12	20
Appropriability	%	18	5	9	14
Lack of access to finance	%	8	1	5	6
Lack of access to information on markets	%	11	2	7	8
Lack of access to inform on technology	%	9	1	7	8
Lack of qualified personnel	%	7	1	3	5

Regarding the innovative effort of the firms of the sample it can be affirmed that in firms who cooperate with all the partners, on average, 8% of the employees are involved in activities of R&D. This percentage goes up to 10% when it concerns firms that cooperate with industries.

Only 12% of the cooperative firms could count with the financial support of the government to carry out innovative activities. The financial support of the government was the lowest among companies cooperating with infrastructure of S&T. (3%).

According to the result indicators of the innovation of the companies, only 18% of these firms follow some kind of appropriability strategy. When it regards the type of partners, firms that cooperate with other companies of the group show the highest percentage (14%).

### **4.3 Discussion of the Results**

The results in chart 9 show 5 explanatory variables whose associated coefficients are statistically different from zero in the four models that are presented: size of the firm, differentiation, source of the capital, information about the infrastructure of S&T and obstacles to qualification of personnel. The coefficient related to the size of the company variable, measured by the number of employees, is positive and statistically significant, which means that the bigger the company is, the greater the chances of cooperation are.

The differentiation strategy, measured by either the innovation of the product or the process for the market, presents a positive and statistically significant coefficient. This shows that the firms with a differentiation strategy have bigger chances to cooperate than firms that do not. The coefficient related to the origin of the capital is positive and statistically significant, which means that if the firm possesses more than 10% of foreign capital, the bigger the chances to cooperate are.

All the models regard the information variable, obtained at the infrastructure of S&T and measured as an external source of information, as of high and average importance. The companies that consider this information as of high and average importance are more likely to cooperate for innovation.

The shortage of qualified labor also increases the chances of the firm to cooperate. This shortage is a relevant obstacle in the four models as the coefficients associated to this variable are positive and statistically significant. According to this result it may be assumed that firms engage in cooperative activities when unable to ensure themselves with intra-firma qualified labour, thus stimulating partnerships with other organizations.

Another variable which, except for model 4, presents a positive and statistically relevant coefficient, is the financial support of the government. Firms that cooperate with infrastructure of S&T and with other firms are more likely to cooperate when receiving financial support from the government for innovative activities.

The appropriability variable presents, only in model 2, a coefficient which is positive and statistically significant. Firms that possess appropriability strategies are more likely to cooperate with infrastructure of S&T. The R&D continuous variable changes its significance between the models. When is considered only the cooperation between S&T infrastructure (model 2) and Group (modelo 3) this variable which is positive and statistically significant. A hypothesis for this result is based on the fact that these kinds of cooperation are focused on basic research that needs a persistent effort on R&D.

Model 2 presents the age variable, which is measured by the period of existence of the firm. This variable presents a positive and statistically significant coefficient, which shows that older firms are more likely to cooperate with infrastructure of S&T. Another variable in this model is the skill variable measured by the employees taking part in R&D in relation to the total number of employees. The coefficient presented by this variable is positive and statistically relevant, thus showing that firms with more personnel involved in R&D in relation to the total number of employees are more likely to cooperate with S&T infrastructure.

**Table 9- Results of the Probit Models**

		<b>Model 1</b>	<b>Model 2</b>	<b>Model 3</b>	<b>Model 4</b>
<b>Independent Variables</b>		<b>Cooperation with all counterparts</b>	<b>By type of partner</b>		
			<b>STI Infrastruct</b>	<b>Industry</b>	<b>Group</b>
<b>Micro Characteristics of Firm</b>	Intercept	-3.035 (0.359)*	- 4.220 (0.541) *	-3.329 (0.338) *	-3.455 (0.387)*
	Age	0.0000 (0.003)	0.006 (0.004)***	0.001 (0.003)	-0.006 (0.004)
	Size (ln n. employees)	0.170 (0.036)*	0.179 (0.044)*	0.129 (0.039)*	0.169 (0.053)*
	Size squared ((ln n employes)^2)	0.000 (0.0000)	0.000 (0.0000)	0.000 (0.0000)	0.000 (0.0000)
	Foreign Capital	0.331 (0.088)*	0.228 (0.103)**	0.191 (0.090)**	1.404 (0.116)*
	Export Coefficient	-0.191 (0.418)	0.022 (0.509)	-0.007 (0.419)	-0.730 (0.589)
<b>Capabilities</b>	Skills	0.272 (0.413)	0.945 (0.415)**	-0.436 (0.549)	0.045 (0.800)
	R&D Continuous	0.183 (0.114)	0.288 (0.148)**	0.202 (0.118) ***	-0.019 (0.165)
	Appropriability	0.091 (0.080)	0.154 (0.095)***	0.120 (0.082)	0.088 (0.110)
	Differentiation	0.344 (0.083)*	0.319 (0.101)*	0.301 (0.086)*	0.433 (0.123)*
	Sale Effort	-0.031 (0.082)	0.054 (0.098)	0.009 (0.084)	0.148 (0.113)
	Inf S&T Infra	0.583 (0.082) *	1.112 (0.112)*	0.477 (0.085)*	0.473 (0.118)*
	Inf Industry	0.251 (0.155) ***	0.050 (0.191)	0.831 (0.196)*	0.062 (0.208)
	Inf Group	0.500 (0.290)***	0.033 (0.470)	0.341 (0.294)	0.480 (0.201)*
	Public support	0.144 (0.082)***	0.416 (0.094)*	0.136 (0.084)***	0.051 (0.114)
<b>Constraints</b>	Lack of qualified personnel	0.186 (0.102)***	0.234 (0.115)**	0.206 (0.102)**	0.271 (0.135)**
	Lack of access to finance	0.043 (0.125)	-0.034 (0.140)	0.047 (0.126)	-0.296 (0.172)
	Lack of access to info. On technology	0.029 (0.113)	-0.020 (0.128)	0.058 (0.114)	0.223 (0.152)
	Lack of access to information on markets	0.147 (0.121)	0.242 (0.133)	0.121 (0.121)	0.210 (0.154)
<b>Statistics of Models</b>	Pseudo-R <sup>2</sup>	0.1524	0.2534	0.1375	0.3134
	Observations	1.258	1.258	1.258	1.204
	Log Likelihood	-713.95921	-501.6066	-680.41664	-366.1449

Source: Own compilation. \* significant 1%, \*\* significant 5%, \*\*\* significant 10%.

Models 2 and 3 present the R&D variable with a positive coefficient which is statistically significant, showing that firms engaged in constant activities of R&D are more likely to cooperate with S&T infrastructure and with industry, clients, suppliers and competitors.

Table 9 presents the group as an essential external source of information. The result shows that firms who consider the group as an essential external source of information to be of high and average importance are more likely to cooperate with firms of the group.

Table 10 presents the marginal effects of the previously described Probit models. Through these results the marginal probability of each of the variables can be determined.

The appropriability variable, which is the aim of this study, presents non conclusive results. In model 2 only is the associated coefficient positive and statistically significant. This shows that the chances to cooperate with S&T infrastructure increase by 3.6% when the firm adopts appropriability strategies. However, it must be stated that even though no positive coefficients are presented in the other models, all variables show positive signs which demonstrates the absence of an inverted relation between the appropriability variable and the cooperation variable.

Model 1 shows that a 1% increase in size of the firm results in a 6.4% increase in probability to cooperate. Another important result is presented by the origin of capital variable. The chances of firms to cooperate for innovation increase by 12.7% when they own more than 10% of foreign capital. It is important to mention that firms who realize continuous R&D increase their chances to cooperate by 6.7% as demonstrated by the continuous R&D variable. Accordingly, firms that carry out differentiation strategies increase by 12% the chances to cooperate regardless of the type of partner. Regarding the government support variable, it can be concluded that support of the government implies in a 5.5% increase in the chances of the firm to cooperate with any kind of partner.

In Model 2, a 1% size increase of the company implies that its chances to cooperate increase by 4.1%. As regards foreign capital, companies possessing more than 10% of foreign capital increase their chances to cooperate by 5.5%. The skill variable in model 2 shows that the chances of the firm to cooperate increase by 21.8% provided there is a 1% increase in employees engaged in R&D activities in relation to the total amount of employees. As for cooperation with S&T structure, support from the government for innovative activities, increases the chances of the firm to carry out this kind of cooperation by 10%.

The results in Model 3 show that chances of the firm to cooperate increase by 4.4% on assumption that the company increases its size in 1%. As regards the origin of capital possessing more than 10% of foreign capital increases in 6.7% the chances of the firm to cooperate with other firms of the industry, such as clients, suppliers and competitors.

In Model 4, a 1%-size increase of the firm increases in 2.7% the probability of this firm to cooperate. The firm possessing foreign capital increases its chances to cooperate with the group it belongs to by 31.1%. As regards the obstacles to the innovation, the chances to cooperate decrease by 4% if the lack of financial support is regarded as of high or average importance by the firms of the group.

**Table 10 - Marginal Effects of the Models**

		<b>Model 1</b>	<b>Model 2</b>	<b>Model 3</b>	<b>Model 4</b>
<b>Independent Variables</b>		<b>Cooperation with all counterparts</b>	<b>By type of partner</b>		
			<b>STI Infrastruct.</b>	<b>Industry</b>	<b>Group</b>
<b>Micro Characteristics of Firm</b>	Intercept				
	Age	0.000 (0.001)	0.001 (0.001)	0.000 (0.001)	-0.001 (0.001)
	Size (ln n. employees)	0.064 (0.014)*	0.041 (0.010) *	0.044 (0.013) *	0.027 (0.008)*
	Size squared ((ln n employees)^2)	0.000 (0.000)	0.000 (0.0000)	0.000 (0.0000)	0.000 (0.0000)**
	Foreign Capital	0.127 (0.034)*	0.055 (0.026)*	0.067 (0.032)**	0.311 (0.030)**
	Export Coefficient	-0.072 (0.158)	0.005 (0.1179)	-0.0027 (0.144)	-0.115 (0.093)
<b>Capabilities</b>	Skills	0.103 (0.156)	0.218 (0.096)**	-0.149 (0.188)	0.007 (0.127)
	R&D Continuous	0.067 (0.041)***	0.060 (0.028)**	0.067 (0.037)***	-0.003 (0.027)
	Appropriability	0.034 (0.030)	0.036 (0.022)***	0.041 (0.028)	0.014 (0.017)
	Differentiation	0.128 (0.030)*	0.072 (0.023) *	0.102 (0.029) *	0.066 (0.018)*
	Sale Effort	-0.012 (0.031)	0.012 (0.022)	0.003 (0.029)	0.023 (0.017)
	Inf S&T Infra	0.215 (0.029)*	0.240 (0.023)*	0.160 (0.028)*	0.066 (0.017)*
	Inf Industry	0.091 (0.053)***	0.011 (0.042)	0.219 (0.036)*	0.062 (0.208)
	Inf Group	0.169 (0.084)**	0.065 (0.075)	0.106 (0.080)	0.550 (0.201)*
	Public support	0.055 (0.031)***	0.100 (0.024)*	0.047 (0.029)	0.008 (0.450)
<b>Constraints</b>	Lack of qualified personnel	0.071 (0.039)***	0.057 (0.029)**	0.072 (0.036)**	0.046 (0.024) ***
	Lack of access to finance	0.016 (0.048)	-0.008 (0.032)	0.016 (0.044)	-0.041 (0.021)**
	Lack of access to info. On technology	0.011 (0.043)	-0.005 (0.029)	0.020 (0.040)	0.038 (0.028)
	Lack of access to information on markets	0.056 (0.047)	0.060 (0.036) ***	0.042 (0.043)	0.210 (0.029)

Source: Own compilation.

\* significative 1%, \*\* significative 5%, \*\*\* significative 10%.

## 5. Final Remarks

Innovative cooperation between different institutions to carry out innovative activities can be regarded as an important resource for a firm to remain in a market leading position. However as regards Brazil, as shown by the results obtained during the PINTEC 2005, this strategy is still in its early stages. The transformation industry presents a small number of innovative firms (50%) of which only 15% cooperate in R&D.

Due to the interest in the motivating factors of innovative cooperation, several studies in the literature (Veugelers and Cassiman, 1999; Cassiman and Veugelers, 2002; Schmidt, 2005) emphasize the need to take the homogeneity of the firms into account. Among the important factors are the size of the firm, the industrial sector it operates in, the origin of its financial resources, the appropriability strategy of the firm and most importantly the type of cooperative partner.

As regards the Brazilian transformation industry, the industrial sectors that contain the largest number of cooperating innovative firms are the pharmaceutical sector (D8), the chemistry sector (D7), and the Transport sector (D13), irrespective of the partner, among the innovative firms, with participations of 28.68%, 27.18%, and 23.70% respectively. As to the size of the firm as a motivating element, the bigger Brazilian firms present at the PINTEC 2005 cooperate more than smaller firms, or in other words, 50% of large innovative firms realize innovative cooperation. With respect to the type of partner, the Chemical and Transport sectors concentrate on cooperation with S&T Infrastructure. A hypothesis for this result is based on the fact that they concentrate on basic research done by these institutions.

Based on this scenario, the study carried out an econometric study similar the one realized in the international literature. The evidence found coincides in many aspects with the results obtained in other countries.

With respect to the size of the firm, as well as the results obtained by Veugelers and Cassiman (1999), Negassi (2004) and Frisch and Lucas (2001), the coefficient related to the size of the company variable, measured by the number of employees, is positive and statistically significant, which means that the bigger the company is, the greater the chances of cooperation are. As regards the results of the side effects of the models it should be emphasized that Model 1 shows a 1% increase in size of the firm results in a 6.4% increase in probability to cooperate.

As shown by Cassiman and Veugelers (2005) to Belgian firms, for Model 2, the appropriability variable presents a positive and statistically significant coefficient. Firms that possess appropriability strategies are more likely to cooperate with infrastructure of S&T.

Another variable that was analysed refers to continuous R&D as an option for cooperation. Negassi (2004) finds in his study that for Belgian firms the realization of continuous R&D activities increases the chances of the firm to cooperate. The author also states that these continuous R&D activities enable companies to absorb external expertise thus stimulating the choice to cooperate, following the concept of "the absorption capacity" of Cohen and Levinthal (1989).

The result obtained in Model 1 of this present study is similar to that found by Negassi (2004), as it shows that a 1% increase in size of the firm results in a 6.4% increase in probability to cooperate. Another important result is presented by the origin of capital variable. The chances of firms to cooperate for innovation increase by 12.7% when they own more than 10% of foreign capital. It is important to mention that firms who realize continuous R&D increase their chances to cooperate by 6.7% as demonstrated by the continuous R&D variable.



As regards the origin of resources as a determining factor for the choice to cooperate, the result obtained in model 3 shows that firms the possession of more than 10% of foreign capital, increases by 6.7% the chances of a firm to cooperate with other firms of the industry, such as clients, suppliers and competitors. In Model 4, the firm possessing foreign capital increases its chances to cooperate with the group it belongs to by 31.1%

Another variable that was tested in this study refers to public support, with results coinciding with those found by Negassi (2004) for French firms. Model 1 shows that support of the government implies in a 5.5% increase in the chances of the firm to cooperate with any kind of partner. As for cooperation with S&T structure, support from the government for innovative activities, increases the chances of the firm to carry out this kind of cooperation by 10%.

On account of this first empirical investigation a contribution is believed to have been made to the debate on innovative cooperation in peripheral countries. An attempt has been made to identify, in new studies and by means of new methods, more than the motives that lead Brazilian firms to opt for innovative cooperation activities. The following investigation will explore the reasons for such limitations trying to relate them to the innovation rhythm that still prevails in the country, with special emphasis on the appropriability gaps resulting from the scarcity of specific complementary assets withheld by medium size firms, particularly in the higher technological intensity sectors in the country.

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## APPENDIX

**Table 1A – Marginal Effects – Cooperation with all partners**

	dy/dx	Std. Err.	z	P>z	[ 95% Interv. Conf. ]		X
Age	0.00	0.00	0.02	0.98	-0.02	0.00	28.67
Size (ln n. employees)	0.06	0.01	4.69	0.00	0.04	0.09	6.02
Size squared ((ln n employees)^2)	0.00	0.00	0.61	0.54	0.00	0.00	5900000
Foreign Capital	0.12	0.03	3.73	0.00	0.06	0.19	0.30
Export Coefficient	-0.07	0.16	-0.46	0.64	-0.38	0.24	0.07
Skills	0.10	0.15	0.66	0.51	-0.20	34.95	0.05
R&D Continuous	0.06	0.04	1.65	0.10	-0.01	0.15	0.81
Patenting	0.03	0.03	1.14	0.25	-0.02	0.09	0.51
Differentiation	0.12	0.03	4.21	0.00	0.07	0.19	0.57
Sale Effort	-0.01	0.02	-0.38	0.70	-0.00	0.05	0.57
Inf S&T Infra	0.21	0.03	7.42	0.00	0.15	0.24	0.57
Inf Industry	0.09	0.05	1.71	0.08	-0.01	0.19	0.92
Inf Group	0.17	0.08	2.01	0.04	0.00	0.33	0.95
Public support	0.05	0.03	1.76	0.08	-0.00	0.11	0.40
Lack of qualified personnel	0.07	0.04	1.81	0.08	-0.00	0.15	0.32
Lack of access to finance	0.01	0.05	0.34	0.73	-0.08	0.10	0.18
Lack of access to info. on technology	0.01	0.04	0.25	0.80	-0.08	0.09	0.22
Lack of access to info. on markets	0.05	0.05	1.20	0.23	-0.03	0.15	0.20

**Table 1B – Marginal Effects – Cooperation with S&T institutions**

	dy/dx	Std. Err.	z	P>z	[ 95% Interv. Conf. ]		X
Age	0.00	0.00	1.63	0.10	0.00	0.00	28.67
Size (ln n. employees)	0.04	0.01	4.04	0.00	0.02	0.06	6.02
Size squared ((ln n employes)^2)	0.00	0.00	1.12	0.26	0.00	0.00	5900000
Foreign Capital	0.05	0.03	2.10	0.04	0.00	0.10	0.30
Export Coefficient	0.00	0.12	0.04	0.96	-0.23	0.24	0.07
Skills	0.22	0.09	2.28	0.02	0.03	0.40	0.05
R&D Continuous	0.06	0.03	2.17	0.03	0.06	0.12	0.82
Patenting	0.04	0.02	1.6	0.10	-0.00	0.08	0.51
Differentiation	0.08	0.02	3.24	0.00	0.03	0.12	0.56
Sale Effort	0.01	0.02	0.56	0.58	-0.03	0.05	0.57
Inf S&T Infra	0.25	0.02	10.46	0.00	0.19	0.28	0.56
Inf Industry	0.01	0.04	0.27	0.79	-0.07	0.09	0.924
Inf Group	0.06	0.07	0.86	0.39	-0.08	0.21	0.95
Public support	0.10	0.02	4.20	0.00	-0.06	0.13	0.05
Lack of qualified personnel	0.06	0.03	1.95	0.05	0.00	0.11	0.32
Lack of access to finance	-0.00	0.03	-0.24	0.80	-0.07	0.05	0.18
Lack of access to info. on technology	-0.00	0.03	-0.16	0.87	-0.06	0.05	0.22
Lack of access to info. on markets	0.06	0.04	1.69	0.09	-0.01	0.13	0.20

**Table 1C – Marginal Effects – Cooperation with Industry**

	dy/dx	Std. Err.	z	P>z	[ 95% Interv. Conf. ]		X
Age	0.00	0.00	6.10	0.00	0.03	0.07	5.54
Size (ln n. employees)	0.04	0.01	1.13	0.26	0.00	0.00	6200000
Size squared ((ln n employes)^2)	0.00	0.00	1.63	0.10	-0.01	0.10	0.23
Foreign Capital	0.07	0.03	1.02	0.30	-0.02	0.08	0.22
Export Coefficient	-0.00	0.14	-0.30	0.76	-0.04	0.03	0.10
Skills	-0.15	0.18	0.23	0.81	-26.39	33.47	0.00
R&D Continuous	0.07	0.04	3.61	0.00	0.04	0.13	0.37
Patenting	0.04	0.03	5.40	0.00	0.08	0.16	0.48
Differentiation	0.10	0.02	6.45	0.00	0.10	0.18	0.76
Sale Effort	0.04	0.03	1.94	0.05	0.00	0.10	0.43
Inf S&T Infra	0.00	0.03	2.64	0.01	0.02	0.14	0.16
Inf Industry	0.16	0.03	0.26	0.79	-0.10	0.13	0.04
Inf Group	0.22	0.04	0.68	0.49	-0.08	0.16	0.05
Public support	0.05	0.03	-0.31	0.75	-0.10	0.07	0.07
Lack of qualified personnel	0.07	0.04	2.87	0.00	0.27	1.42	0.08
Lack of access to finance	0.02	0.04	1.94	0.05	0.00	0.12	0.32
Lack of access to info. on technology	0.02	0.04	-0.24	0.76	-0.05	0.05	0.18
Lack of access to info. on markets	0.04	0.04	-0.16	0.88	-0.05	0.04	0.22

**Table 1D – Marginal Effects – Cooperation with Group**

	dy/dx	Std. Err.	z	P>z	[ 95% Interv. Conf. ]		X
Age	-0.00	0.00	-1.46	0.14	-0.00	0.02	28.62
Size (ln n. employees)	0.03	0.00	3.20	0.75	0.01	0.04	6.07
Size squared ((ln n employes)^2)	0.00	0.00	2.30	0.02	0.00	0.00	6200000
Foreign Capital	0.31	0.03	10.50	0.00	0.25	0.37	0.31
Export Coefficient	-0.11	0.09	-1.24	0.21	-0.29	0.07	0.07
Skills	0.01	0.13	0.06	0.95	-0.24	0.26	0.05
R&D Continuous	-0.00	0.03	-0.11	0.90	-0.05	0.05	0.85
Patenting	0.01	0.01	0.80	0.42	-0.02	0.05	0.52
Differentiation	0.07	0.02	3.69	0.00	0.03	0.10	0.58
Sale Effort	0.02	0.02	1.32	0.18	-0.01	0.06	0.58
Inf S&T Infra	0.06	0.02	3.86	0.00	0.03	0.10	0.57
Inf Industry	0.06	0.21	0.31	0.76	-0.05	0.07	0.93
Inf Group	0.55	0.21	0.78	0.43	-0.03	0.08	0.05
Public support	0.01	0.02	0.45	0.66	-0.02	0.04	0.42
Lack of qualified personnel	0.05	0.02	1.88	0.06	-0.02	0.09	0.32
Lack of access to finance	-0.04	0.02	0.48	0.63	-0.03	0.04	0.18
Lack of access to info. on technology	0.04	0.03	1.36	0.05	0.00	91.00	0.22
Lack of access to info. on markets	0.21	0.03	1.26	0.21	-0.02	0.09	0.20