

Innovative behaviour and its impact on firms' performance

Gustavo Lugones¹
Diana Suárez²
Néstor Le Clech³

INTRODUCTION

During the nineties, Argentina went deep into the process of structural reforms that had begun in the seventies. The same as many Latin America countries, the reforms were based on liberalization, privatization and deregulation and respond to the recommendations of the so called Washington Consensus. Trying to overcome the inflation and regenerate the confidence of economic actors, the plan fixed the exchange rate to the dollar and created mechanisms to promote the entry of foreign direct investment.

The impact on the productive sector was not homogeneous. The change in the macro and microeconomic environment led to the redefinition of enterprises strategies and, with them, to the modification of the productive structure. This consolidated a pattern of specialization on products based on the exploitation of natural resources, a more open production function and an increasing participation of imports in the total purchasing of private sectors. (Porta and Bonvecchi, 2003)

The microeconomic behaviour during the nineties was not homogeneous either: enterprises showed different responses to the new environment. Kosacoff (1998) explains that there were two kinds of firms. A minority group increased its productivity levels and closed the gap with the international frontier in a context of an "offensive" strategy, which combined imports of capital goods with the development of new capacities. The other group ("defensive" strategy) was composed by those firms that, although they increased their productivity level, it was based on the incorporation of embodied technology and minor organizational change, specially the expulsion of labour force.

After the 2002 devaluation, the new relative prices created the incentives to a new export-lead growth period. From 2002 up to the date, Argentina has held significant twin

¹ Centro Redes – UNQ - glugones@ricyt.edu.ar

² Centro Redes – dsuarez@ricyt.edu.ar

³ Universidad Nacional de Quilmes (UNQ) – nleclech@unq.edu.ar

surpluses: commercial and fiscal. (Rapetti, 2005) In this recovering context, Government has carried out an active intervention in order to sustain these surpluses and to avoid the inflation problem derivated from the recovering. Export taxes were established, higher in agriculture and mining exports, in order to reduce the impact of the devaluation in the domestic market and to hold the fiscal surplus.

Microeconomic innovative behaviour in post crisis environment has been also heterogeneous. During the nineties, innovative firms presented better performance than the average of the productive sector in general and than non innovative firms in particular. However, among innovative enterprises there have been a small group that maintained a **balanced** technological behaviour, this is, firms that combined expenditure on investment in machinery and equipment with other efforts associated with organizational change, design, training, engineering and R&D activities. Statistical data confirmed that these firms presented better performance indicators –such as sales, productivity, exports, and employment- than those also innovative firms whose efforts were biased to exogenous technology incorporation –capital goods- or endogenous technology incorporation –R&D. (Lugones, Peirano, Suárez and Giudicatti, 2006)

The new growth cycle that started in 2002 has come with an interesting debate in respect of the possibilities of taking advantage of the favourable economic situation to develop dynamic, genuine, sustainable and cumulative advantages and re-orientate the productive specialization patterns towards a more intensive participation of high and medium technology intensity goods.

The present paper's aim is to become a contribution to that debate by exploring the idea of the existence of important performance differences among enterprises depending on the specific composition of their innovation efforts. This has become a very interesting research field for us since the identification of differential impacts on firms' performance, particularly regarding the possibilities of reaching competitive improvements depending on the specific strategies adopted by innovative firms.

It is important to observe that firms with similar innovative efforts (similar amounts of expenditure in innovation activities as a proportion of sales) perform different innovative strategies which imply different growth trajectories and different results in productivity improvements.

In that sense, the performed analysis confirms that the combination of investments in machinery and equipment with other efforts associated with organizational change, design, engineering, training and R&D activities strengthen the competitive capabilities of firms and this allows them to reach a higher level of competitiveness than the one that can be reached by means of actions concentrate only on a few of these aspects, in detriment of the others. **In other words, we could confirm that those firms which present an equilibrated relationship of expenditure in innovation activities (IA) were able to take a better advantage of their efforts and obtain better results than those firms which concentrated their actions only on a small number of activities.**

The implications related to the formulation of public policies that can be derived from these observations are not trivial. They could reveal, for instance, the inconveniency of implementing public policies that foster partial or fragmented entrepreneurial behaviours which although they are enough to improve the performance, they are not sufficient to assure the continuity of the innovation activities in a self-sustainable way.

In order to do so, the present paper is structured as follows. After this brief introduction, the principal researches about firm innovative behaviour are reviewed. In the second part, the research project and the hypothesis are presented. Next, the characteristic of the manufacturer sector database are described. Afterwards, the general results that come out from the used microdata are presented. After that an econometric model is developed in order to test the presented hypothesis. Finally, the conclusions are exposed.

1. LITERATURE REVIEW

Several researches have come close to prove the positive impact of innovation as a competitive strategy empirically. It is worthy to mention the analysis performed by Yoguel et.al. (2004, 2006), Chudnovsky et.al. (2004) Kosacoff (1998), De Negri et.al. (2005) and Kempt et.al. (2003). In all that researches it is observed that innovative firms present better performance indicators than non innovative firms. It is also observed that the former are able to reduce the impact of the economic cycles, they manage to minimize the losses during recessions and to maximize the positive impact of growth periods.

In general, the coincidences in this field are based on the idea that states that those firms that perform innovation activities achieve a sustainable competitive position in a context of a better relative performance.

What was said can be exemplify by making a brief review of the mentioned works. With the aim of analysed the technological behaviour of the Argentinean manufacturer firms during the final phase of the Convertibility Plan (1998-2001), Yoguel at.al. (2004) establish a relationship between the level of technological competences and the innovative efforts made by firms. Following the hypothesis that the mentioned competencies are positively related to the agent's size, sector, capital origin and the level of external insertion, the authors analysed the data provided by the Second Innovation Survey in order to explain the causes of the heterogeneity in the technological behaviours observed during the period 1998-2001. Their findings confirm the stated hypothesis and verify a positive relationship between competences and economic performance. However, the authors remark that although the industrial sector counts with a group of firms with a virtuous performance, this is a small one. Most of the firms present low levels of technological competencies and carry out low efforts in innovation.

Another research is the one did by Chudnovsky et.al. (2004).These authors focus their attention on the relationship between the acquisition of capital goods and endogenous innovative efforts (R&D, mainly). By working with a database with 718 enterprises polled by the First and the Second Innovation Surveys, they found that innovative firms –that is to say, firms that have carried out innovation activities- presented a better performance than non innovative ones. In long term analysis, these firms also presented a higher increase in labour productivity.

Regarding the hypothesis about the relationship between the technology acquisition and the performance of R&D, their analysis revealed that those innovative firms that performed in-house R&D had higher probabilities of becoming innovator ones. If these efforts are made in a continuous way, the mentioned probability increases significantly. At the same time, technology acquisition is the activity that increases the most the innovation impact, if measured by labour productivity, which is an aspect that is also positively related to the size of the firms.

Regarding the relationship between the innovative behaviour and the competitive situation, Kosacoff (1998) stylized the strategic reaction of firms when competence conditions changed abruptly in the Argentinean economy during the first half of the nineties. The new fixed exchange rate, the commercial liberalization and the boom of Foreign Direct Investment led a group of firms to adapt themselves to the new scenario based on a “defensive” strategy, which consisted basically of the activities rationalization, the reduction of the mix production, the incorporation of products made by third parties in their own product supply and the reduction of their payroll. On the contrary, a minor group of firms stand out for an “offensive” strategy, which was characterized by articulated innovative efforts in order to reach the international technological frontier.

The first group almost completely coincides with the non innovative firm group, that is to say, those firms that did not carried out actions to introduce product, process or organizational novelties in the production system. The other group seem nearer the innovative firms, that is to say, firms that have expended in IA with the purpose of producing competitive improvements. As it was pointed out, the available data show clear differences in the performance in both groups of firms, with significantly advantages in the case of the innovative ones.

In the Latin American context, De Negri, Salerno and Barros de Castro (2005) analyze the characteristics of the Brazilian industry. According to these authors, the different innovative behaviours can be distinguished either the firm looks for achieving a competitive advantage based on product differentiation or looks for a cost reduction. Using this hypothesis, the authors classify Brazilian firms into three groups, according to their competitive strategy, and compare their performance:

1. Exporter and innovative firms that differentiate product,
2. Exporter and innovative firms specialized in standard product or commodities,
3. The rest.

By using the statistical information provides by the Brazilian Innovation Survey, the authors show that the first group of firms (1.7% of the total industrial population) presents better production, productivity and export performance indicators, a higher

average salary and a higher employment stability. This group of firms accounts for the 26% of the total industrial production and the 13.2% of the industrial labour.

In the European context, when in 2000 the region set up the goal of becoming the world's most competitive and innovative region by 2010, the studies about innovation and its relationship with the firm performance became a central aspect of the economic analysis. Within that framework, Kemp et.al. (2003) reviewed the results of different European studies and remarked that, in general, it is observed that not every firm is equally efficient in translate research into sales or profits improvements. Consequently, every analysis of the innovative process in firms should incorporate inside the model not only the study of the inputs and the outputs –efforts and results- but also the impact on the firm as a whole.

By using this analysis scheme, the authors studied the innovative process in Dutch small and medium enterprises. They explored various econometric models in an attempt to find out the input determinants, defined as the intensity in the innovation expenditure, the output determinants, defined as the new products and/or process, and the impact of the innovative process on firm's performance. Regarding the last one, the authors tested different performance measures: growth of sales, labour, productivity and profitability. The empirical evidence suggested that innovation activities had a positive and significantly impact on the growth of sales and employment and that there was a negative relationship between the size of the firm and the intensity of the expenditure, but there was a positive one between exports growth and efforts intensity. The authors concluded by pointing out the necessity of going deep into the analysis related to the relationship between innovation and productivity due to the fact that, from a theoretical perspective, both variables should be positively related.

2. THE RESEARCH PROJECT

The compilation of the First and the Second Argentinean Innovation Surveys (Indec, 1998, 2003) allowed the observation and analysis of different entrepreneurial strategies, which, at the same time, were associated with different performance evolutions (Lugones, et al., 2006). Innovative firms presented better indicators of sales, exports and labour than not innovative. Among the former, three types of behaviours were identified, which were also associated with different evolutions in performance indicators.

The observed conducts seemed to be related to the characteristics of the efforts made by the firms. In particular, it is observed that those firms that held a balanced behaviour between internal innovation activities (R&D, Engineering and Industrial Design, Training) and external ones (capital goods, hardware) are the group that presents the highest performance among innovative firms. This also seems to be associated with the search for new products and process capable of leading an export growth based on what De Negri et.al. (2005) called “premium price”. The available information support the hypothesis that firms with a balanced behaviour present better turnover, exports and labour trajectories than firms with a biased behaviour and, of course, than non innovative enterprises. However, the predominant conduct observed among Argentinean firms is the one biased to the acquisition of capital goods, that is to say, firms that have addressed the biggest part of their innovative efforts to the purchasing of embodied technology. Balanced firms, on the contrary, seem to be a small group inside the industrial structure.

With the realization of the Third National Innovation Survey (Indec, 2006), it was possible to add data for the period 2002-2004 and this way to observe behaviours and performances during three macroeconomic moments: the peak of the “Convertibility Plan”, the end-of-the-decade crisis and the post devaluation recovery after the abandonment of the Plan. This information would allow, at the same time, to develop a more complex characterization of those innovative strategies with major impact on firm’s performance.

So, the hypotheses are:

1. The innovation as a competitive strategy allows the development of competitive, sustainable and cumulative advantages.

2. A balanced combination among the innovation activities increases its positive impact on performance. The innovative strategy should combine exogenous and endogenous efforts.
3. Innovative strategies that combine efforts and differentiate products have simultaneous advantages in competitiveness and labour.

In order to contrast these hypotheses empirically, the methodology will be based on the analysis of the evolution and innovative behaviour of a group of firms which participate in the three innovation surveys. By using econometric analysis, the aim of this project is to identify differentiated strategies and also differentiated impacts on the firms' performance defined as turnover, exports and labour evolution.

If the hypotheses are correct, that is to say that technological innovation reaches its major impact when it is the result of the combination of endogenous and exogenous efforts, then innovation incentives should orientate enterprises to invest in this way. At the same time, if product differentiation is accepted as a way of generating competitive, sustainable and cumulative advantages, then policies oriented to foster industrial development should address the creation of incentives for the search for new differentiated products.

Finally, if the identification of innovative behaviours is the means to identify different economic trajectories, then the collection of information about the characteristics of the expenditure in innovation activities becomes a key factor to the development of public policies capable of fostering the industrial development.

3. THE IDENTIFICATION OF THE DIFFERENT INNOVATIVE STRATEGIES

3.1. Research Setting

Three Innovation Surveys have been carried out in Argentina. These three surveys are overlapped with three significantly different macroeconomic moments. The First Survey, which covered the period 1992-1996 and collected information about 1639 manufacturer firms (INDEC; 1998), took place during a macroeconomic situation of an increase in the total product and a decrease in the rate of employment (between 1992 and 1996, the GDP reach a 14.7% accumulated increase). Although the industrial product increased, which was reflected in the 3.5% increment in its physical volume, the unemployment reached the 17.2% of the labour force (vs. the 7% registered in 1992). (Cepal, 2006)

The Second Survey gathered information about 1688 industrial firms for the period 1998-2001. (INDEC; 2003) This time the survey was overlapped with one of the worst Argentinean recessions. The GDP, the industrial product and the employment rate trajectories were negative. The GDP registered a fall of 8.4%, the physical industrial product decreased more than 20% and the unemployment rate reach the 17.4% of the labour force.

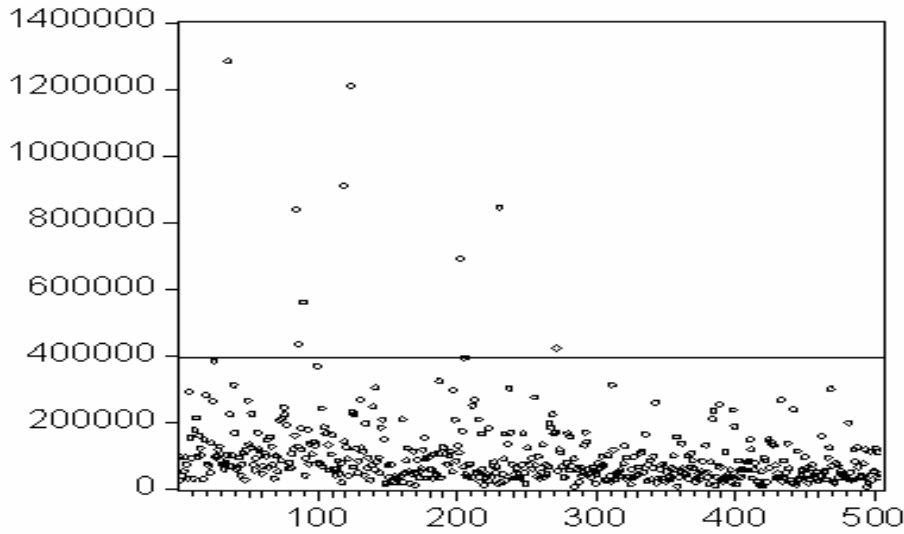
In 2002, the economy started to grow again and the Third Survey (INDEC, 2006), which examined the period 2002-2004 and polled 1627 firms, coincided with a period of economic prosperity: the GDP reached an accumulate increase of 19%, the physical volume 33% and the unemployment decrease in a similar percentage (33%).

In all cases, the field work was done by the National Statistical Office (in Spanish, INDEC) and the resulting sample was representative of the industrial population. Although three different forms were used in the exercises, all of them complied with the Oslo and Bogotá Manual recommendations so it is possible to analyze different variables related to the innovation process along the time.

By matching the three Innovation Surveys, a group of 502 innovative firms with information about the innovative process for the periods 1992-1996, 1998-2001 and 2002-2004 was conformed.

After the construction of the database that will be used in the econometric model, some of its characteristics were analysed. This way, some extreme observations were identified. These outliers generated serious obstacles in the econometric estimations by producing a severe Heteroskedasticity problem. As it can be seen in Graph 1, where variable **P** is graphed (sales per employee in the axis of ordinates) for each firm (identified in the axis of abscissas), there is a reduced group of enterprises that presents what can be considered as anomalous observations. Because of that, those observations with values higher than 400.000 pesos per employee were discarded; as a result 9 cases were eliminated and the Heteroskedasticity problem observed in the econometric estimations was solved. By doing this, a deputed database of 496 observations was conformed.

Graph 1: Scatter graph of Sales per employee per firm.



Source: calculations based on INDEC (1998, 2003, 2006)

3.2. Variables

In order to test the established hypothesis empirically, first the characteristics of a balanced strategy were defined. The database contains a total of nine types of innovative efforts, that is to say, nine different innovation activities: intramural R&D, extramural R&D, acquisition of capital goods, acquisition of hardware, training, engineering and industrial design, consulting contracts and expenditures in transference of technology. These nine activities were grouped into four categories, which are presented in Table 1.

Table 1: Categories included in the Balance of the Innovative Strategy Index

Category (i)	Description	Weight (α)
a	Expenditure in R&D (intra and extramural)	0.25
b	Expenditure in Engineering and industrial design (IID) + expenditure in training	0.25
c	Expenditure in capital goods + Expenditure in hardware	0.25
d	Expenditure in Technology Transfer (TT) + Expenditure in consulting services + expenditure in software (TT)	0.25

Secondly, each category was weighed in order to generate an index of the balance of the innovation expenditure strategy (IB), which represents the relative weight of the expenditure in every category in respect of the total IA efforts.

Since the target of the present document is to analyze the impact of a perfect balanced strategy on firm's productivity versus an unbalanced one, the assigned weight was 0.25 to each one of the four categories.

As a result, the general notation of the index is:

$$IB_j = \frac{n - \sum_{i=1}^n \frac{\left| \left(\frac{g_i}{IA} \right) - \alpha_i \right|}{\left(\frac{g_i}{IA} \right) + \alpha_i}}{n} \quad \text{with} \quad 0 < IB_j \leq 1$$

Where j identifies the firm, i identifies each category, g is the firm's expenditure in each i , IA is the total expenditure in innovation activities, α is the weight coefficient for each i (in this case 0.25 in the four cases), and n is the total number of the analysed categories (in this case, 4).

The domain of IB is $(0,1]$. This means that it will never be zero but it could tend infinitely to that value depending on the value of the weight coefficient and the number of categories included. This also means that the analysis will be centred in the innovative firm group due to the fact that the index is the result of weighing the expenditure in innovation activities.

It is worthy to mention that it is not the aim of the analysis to find the optimum value for the index but to analyse its incidence on the productivity of the firm and that is why similar weights are given to each one of the categories. By doing this, it is possible to associate every firm with a specific equilibrium level in its IA expenditures, from the perfect balanced strategy (an index equal to 1) up to the perfect unbalanced strategy (when the index tends to 0). Consequently, a clear line for future research is the analysis of the optimal weight of the innovation activities, this weight could be determined, partially, by matters relative to the scale and sectoral belonging of the firms.

The level of total sales, the level of sales per employee – as a proxy of productivity- and the level of exports in respect of total sales are the relevant variables for this analysis of the impact on firm's performance. This set of variables is the result of making compatible the objectives of the present investigation with the available information. It is important to

clarify that in spite of the deficiencies associated with the relationship between sales and employees as a productivity indicator, this association allows the quantification of the scale differences among firms, beyond their total turnovers. At the same time, this is a commonly used indicator of performance (Mohnen and Hoareau, 2002, Kemp, et al., 2003, Chudnovsky, et al., 2004) and because of that, the obtained results will be enriched by the possibility of comparing and discussing them with the contribution made by other colleges with a similar approach, although not always with the same methodological emphases or criteria.

4. THE ANALYSIS OF THE INNOVATIVE STRATEGIES

4.1. Panel data distribution

Once the balance of the innovative strategy index was created, a first analysis of the data set was made and firms were distinguished according to their reaching a value equal to or higher than 0.5 or lower than it. The latter, hereinafter biased firms, are characterized by concentrate their innovative efforts on the acquisition of capital goods, or, the other way around, by presenting a low level of effort in the acquisition of external technology. Therefore, the other group of firms presents an equilibrated behaviour among the different activities, which combines the acquisition of embodied technology with the development of intramural knowledge. It is exactly this one last group, named "**Balanced**" firms, the one that would show **the most promissory achievements regarding the creation of competitive advantages.**

The panel distribution according to the identified strategies and the firm size are presented in Table 2. The group of balanced firms is equivalent to less than a third of the total panel and, in relative terms, it has a higher proportion of large enterprises: while the 7.4% of this group is explained by firms with an average turnover higher than 100 million pesos, in the case of biased firms this percentage decreases up to 1.8%. At the same time, it is observed that the group of large firms present a higher percentage of balanced firms than the small and medium enterprises (SMEs).

Table 2: Firms distribution according size and innovative strategy

	BIASED ₁		BALANCED ₂		TOTAL PANEL	
	Nr.	%	Nr.	%	Nr.	%
LARGE ₃	6	33.3	12	66.7	18	100
SMEs ₃	327	68.4	151	31.6	478	100
T. PANEL	333	67.1	163	32.9	496	100

	BIASED ₁		BALANCED ₂		TOTAL PANEL	
	Nr.	%	Nr.	%	Nr.	%
LARGE	6	1.8	12	7.4	18	3.6
SMEs	327	98.2	151	92.6	478	96.4
T. PANEL	333	100	163	100	496	100

1/ BIASED: firms whose expenditure in IA was unbalanced between 1992 and 2004 and their IB is lower than 0.5.

2/ BALANCED: firms whose expenditure in IA was balanced between 1992 and 2004 and their IB is equal to or higher than 0.5.

3/ LARGE: firms whose average annual turnover between 1992 and 2004 –constant prices 1993- was higher than \$ 100.000.000.

SMEs: firms whose average annual turnover between 1992 and 2004 –constant prices 1993- was lower than \$ 100.000.000.-

Source: calculations based on INDEC (1998, 2003, 2006)

4.2. Firms' Performance according to types of strategy

By using total sales, export in relation to total sales and the relationship between sales and total employment –as a proxy of labour productivity- as key variables, it is observed that balanced firms present a better performance than firms with a biased behaviour. In other words, evidence allows sustaining that those firms with a balanced strategy present the most auspicious performance indicators. As a matter of fact, among balanced firms, the average annual growth of turnover between 1992 and 2004 was 0.7% versus a negative trend around the 0.1% among biased firms. (Table 3)

It is also observed that the increase in labour productivity in the balanced group of firms was higher than the one observed in the biased group. Among the former, the average annual growth was 2.5% whereas among the latter it was 0.5%.

Regarding exports, the balanced firms which exported during 1996 and 2004 presented a better exporter insertion and reached an annual rate of growth a third higher than the one observed among the biased firms (7% and 5% respectively between 1996 and 2004).

**Table 3: Selected indicators
(Average annual rate of growth)***

	BIASED₁	BALANCED₂
Sales	-0.1%	0.7%
Sales / Labour	0.5%	2.5%
Exports / Sales	2.28%	3.26%

* Average annual rate of growth, period 1992-2004, except from exports where the analyzed period was 1996-2004. In all cases, values are in constant prices 1993.

1/ BIASED: firms whose expenditure in IA was unbalanced between 1992 and 2004 and their IB is lower than 0.5.

2/ BALANCEADAS: firms whose expenditure in IA was balanced between 1992 and 2004 and their IB is equal to or higher than 0.5.

Source: calculations based on INDEC (1998, 2003, 2006)

Labour productivity, measured in absolute values, also shows that balanced firms have a better trajectory. (Table 4) In 2004, while sales per employee among the former were 150 thousand pesos per year, in the case of biased firms this amount hardly surpassed 100 thousand pesos. As it was mentioned, the relationship between sales and labour allows appreciating the different scales among firms, beyond their total turnovers. It is observed that while in 1992 balanced firms invoiced 10% per employee more than biased, in 2004 that difference reached the 45%.

Table 4: Quotient between sales and labour*

YEAR	BIASED₁	BALANCED₂
1992	75.95	83.96
1996	89.67	103.68
1998	92.99	114.11
2001	83.01	99.98
2002	81.02	130.63
2003	93.59	135.93
2004	103.19	150.62

* In thousands of pesos in constant values 1993.

1/ BIASED: firms whose expenditure in IA was unbalanced between 1992 and 2004 and their IB is lower than 0.5.

2/ BALANCEADAS: firms whose expenditure in IA was balanced between 1992 and 2004 and their IB is equal to or higher than 0.5.

Source: calculations based on INDEC (1998, 2003, 2006)

If the evolution of labour productivity is analysed separating firms by their size, then it is observed that balanced firms presented higher values in respect of both large and SMEs. In particular, it is observed that regardless of the firm size, in 2004 balanced firms duplicated their productivity levels in respect of 1992 whereas among the biased ones the increment was no higher than 25%. (Table 5)

Table 5: Quotient between sales and labour by size*

YEAR	BIASED ^{1/}		BALANCED ^{2/}	
	SMEs	LARGE	SMEs	LARGE
1992	75.13	105.80	77.10	170.27
1996	87.92	162.38	93.44	232.50
1998	91.93	123.52	106.74	206.93
2001	82.04	108.71	91.15	211.13
2002	78.50	129.12	116.60	307.21
2003	87.61	147.32	121.41	318.62
2004	97.05	131.44	132.39	380.03

* In thousands of pesos in constant values 1993. Large: firms whose average annual turnover between 1992 and 2004 – constant prices 1993- was higher than \$ 100.000.000. SMEs: firms whose average annual turnover between 1992 and 2004 –constant prices 1993- was lower than \$ 100.000.000.-

1/ BIASED: firms whose expenditure in IA was unbalanced between 1992 and 2004 and their IB is lower than 0.5.

2/ BALANCEADAS: firms whose expenditure in IA was balanced between 1992 and 2004 and their IB is equal to or higher than 0.5.

Source: calculations based on INDEC (1998, 2003, 2006)

Regarding the external sales, it is observed that the level of exports among balanced firms was always over the level reached by the biased ones: while in 2004 biased firms exported 13 thousand pesos per employee, in the case of balanced firms this amount was more than 30 thousand. It is also important to remark that the fall among balanced firms between 2001 and 2003 was explained by an abruptly fall in the export level of four enterprises whose values decreased from 124 thousand pesos per employee in 2001 to 12 thousand in 2004. (Table 6)

Table 6: Quotient between exports and labour*

YEAR	BIASED ^{1/}		BALANCED ^{2/}	
	Thousand of \$	% Annual Var.	Thousand of \$	% Annual Variation
1996	8.7	-	13.7	-
1998	7.8	-10.6%	14.8	7.8%
2001	8.4	8.2%	16.8	14.0%
2003	10.4	23.5%	14.3	-14.9%
2004	13.7	32.1%	31.9	123.1%

* In thousands of pesos in constant values 1993.

1/ BIASED: firms whose expenditure in IA was unbalanced between 1992 and 2004 and their IB is lower than 0.5.

2/ BALANCEADAS: firms whose expenditure in IA was balanced between 1992 and 2004 and their IB is equal to or higher than 0.5.

Source: calculations based on INDEC (1998, 2003, 2006)

Regarding the relationship between exports per employee and firm size, it is observed that except for a fall between 2001 and 2003, among SMEs, the balanced group reached rates of growth higher than the biased ones. Specially, it is observed that towards 2004, the balanced SMEs exported 85% more per employee than the biased ones. At the same time, among large firms the exported value was more than twice than the value reached by the same size biased firms. (Table 7)

Table 7: Quotient between exports and labour by size*

YEAR	BIASED ₁		BALANCED ₂	
	SMEs	LARGE	SMEs	LARGE
1996	8.32	29.26	11.54	40.67
1998	7.34	31.07	11.99	48.46
2001	7.84	39.20	13.25	61.15
2003	9.99	32.28	9.54	74.39
2004	13.05	50.48	24.18	129.58

• In thousands of pesos in constant values 1993.

1/ BIASED: firms whose expenditure in IA was unbalanced between 1992 and 2004 and their IB is lower than 0.5.

2/ BALANCEADAS: firms whose expenditure in IA was balanced between 1992 and 2004 and their IB is equal to or higher than 0.5.

Source: calculations based on INDEC (1998, 2003, 2006)

In respect of employment, significant differences in quantity and quality between the two groups of strategies are observed. Balanced firms seem to present a trajectory with smaller oscillations than the ones observed among biased enterprises due to the fact that all along the analysed period the employment level oscillate close to the 1992 values. (Table 8) Biased firms, on the contrary, present an evolution with stronger oscillations, which seem to correspond with the evolution of the macroeconomic cycle.

Table 8: Labour evolution

YEAR	BIASED ₁		BALANCED ₂	
	1992=1	% Annual Var.	1992=1	% Annual Variation
1992	1.00	-	1.00	-
1996	1.10	10.5	1.03	3
1998	1.25	13.2	1.07	5
2001	1.11	-10.6	1.01	-6
2002	1.05	-5.8	0.95	-6
2003	1.11	6.2	1.01	6
2004	1.20	7.8	1.08	8

1/ BIASED: firms whose expenditure in IA was unbalanced between 1992 and 2004 and their IB is lower than 0.5.

2/ BALANCEADAS: firms whose expenditure in IA was balanced between 1992 and 2004 and their IB is equal to or higher than 0.5.

Source: calculations based on INDEC (1998, 2003, 2006)

Finally, regarding the firms' endowments of qualified personnel –measured as the relationship between professional employees and total labour- balanced firms differ from biased ones again. Despite the significant increase in the mentioned relationship among the later, it is almost 50% smaller than the one observed in the balanced group.

Table 9: Evolution of the relationship between professionals and total labour

YEAR	BIASED ^{1/}		BALANCED ^{2/}	
	Prof / total employment	% Annual Variation	Prof / total employment	% Annual Variation
1992	3.6%	-	7.3%	-
1996	4.1%	13.2	8.2%	11
1998	4.5%	11.4	7.4%	-9
2001	5.3%	17.9	8.4%	14
2004	5.0%	-5.9	9.1%	7

1/ BIASED: firms whose expenditure in IA was unbalanced between 1992 and 2004 and their IB is lower than 0.5.

2/ BALANCED: firms whose expenditure in IA was balanced between 1992 and 2004 and their IB is equal to or higher than 0.5.

Source: calculations based on INDEC (1998, 2003, 2006)

5. ECONOMETRIC ANALYSIS MAIN RESULTS

The central hypothesis of the analysis states that increments in the human capital endowment and in the innovation expenditures intensity improve labour productivity. At the same time, enterprises with a more balanced structure in their IA expenditures tend to achieve better results in the improvement of their productivity levels. Among other aspects, this seems to be the result of a more consistent and perdurable strategic design inside the firm innovation policy. It also seems to be the result of the fact that these firms take a better advantage of the efforts they make; that is to say, the combination and complementation of the different activities increased the expenditure impact. Besides these key factors in productivity improvements, two additional very important determinants were taken into account: the size of the firm, because it allows the firm to reach higher scale economies in the production, and the external insertion, due to the fact that it predisposes and obligates firms to improve their competitive capabilities.

By taking these hypotheses into account, the econometric model that will be estimated is as follows;

$$\ln P_i = \alpha + \beta_1 \ln IB + \beta_2 \ln IE + \beta_3 \ln H + \beta_4 \ln x + \beta_5 Siz + \mu_i \quad (1)$$

where:

P= labour productivity, where sales per employee was used as a rough measure.

IB= balance of the innovative strategy index, it corresponds with the IB previously developed,

H= human capital endowment, it will be approximated by measuring the relationship between the employees with professional training in respect of the total employees plus 1⁴,

IE= relative intensity of the innovation expenditure, measured by the relationship in the IA expenditure per employee,

x= is an external insertion index, measured by exports participation in the total volume of sales plus 1,

Siz= firm size. It is a dummy variable which is equal to 1 to identify large size firms; the indication is activated when the firm presents an average turnover equal to or higher than 100 million pesos per year⁵.

μ_i , as usual, it identifies the error term in the regression, which is expected to be normally distributed.

In all cases, calculations were made with constant values. Time series were deflated with the index of evolution of the producer prices elaborated by the INDEC. Then, the whole period average value for each series and for each firm was taken⁶. The first estimation on the total depurated sample (496 observations) was made based on equation (1). The estimation results by OLS are shown in Table 10. There is clearly observed that the regression adjustment is relatively good for this kind of estimations, expressed in a 0.33 R² value. At the same time, the normality in the residuals and the lack of heteroskedasticity was verified. All variables have the expected sign and they are significant at levels higher than 95%.

The human capital endowment variable is the one that had shown the highest impact on the improvement of labour productivity. This seems to express that the higher the relative professional endowment, the higher the productivity level. After that variable, the export activity appears as one of the main determinants in productivity

⁴ In order to avoid the lost of observations due to the existence of values equal to zero (a datum that disappear when the log is calculated), a value of 1 is added to both, the **H** variable and de **x** one. In any case, $\ln(1)=0$.

⁵ As it was explained before, large enterprises are those that reached an average annual turnover higher than 100 millions of pesos, in constant values, between 1992 and 2004.

⁶ This index presents information with a 3 digits of opening of the ISIC 3rd. Rev. Every firm series was adjusted by applying the index which matched their industrial sector.

improvements, the same happen with the firm size, which implies that it has a positive contribution to the entrepreneurial performance. Innovation expenditure have also a positive contribution, meaning that for every percentage point of increase in the expenditures per employee, a 0.15% of increase in the volume of sales per employee – labour productivity- takes place. Finally, **the balance of the innovative strategy index (IB) appears as a positive determinant in productivity gains. This way, the pointed out hypothesis that stated that a more equilibrated strategy leads to a better performance in labour productivity is confirmed.**

Table 10: Dependent Variable: Ln(P). Method: OLS

In(P)	C	In(IB)	In(H)	In(IE)	In(x)	Siz
Coef.	10.07***	0.09**	2.37***	0.15***	0.59***	0.55***
	(0.13)	(0.04)	(0.48)	(0.02)	(0.20)	(0.15)
R-squared = 0.33. Included observations: 496. Jarque-Bera Normality Test = 2.14 / H ₀ Prob.= 0.34. White Heteroskedasticity Test: Obs*R-squared = 25.87 / H ₀ Prob.=0.13 Standard error in parentheses. Significant at *** 1%, ** 5 % y * 10%.						

It is interesting to analyse the possibility of verifying some kind of differential behaviour between the two groups of firms, that is to say, those firms with a relative equilibrated innovation strategy, which will be refer as “balanced strategy” (BA) and those firms with a biased behaviour, “biased strategy” (BI). In order to create this cut, the original sample was divided into those firms that obtained a balance index equal to or higher than 0.5 (enterprises with an equilibrated innovation strategy level over the mean) and those firms that reached an index lower than 0.5 (biased firms).

The regression results of enterprises from the sample that belong to the BA group are presented in Table 11 and, in table 12, it is possible to observe the obtained results for the BI group of enterprises. In general terms, the regression adjustments for both estimations present similar results to the ones obtained in the previous estimation in terms of robustness. The regression adjustment is relatively good, expressed by a R² equal to 0.33 and to 0.30, respectively. Homoskedasticity and normality in the error term were confirmed in both cases.

Table 11: Regression on BA Group. Dependent Variable: Ln(P). Method: OLS.

In(P)	C	In(IB)	In(H)	In(IE)	In(x)	Siz
Coef.	9.96***	0.12	1.71***	0.17***	0.49*	0.62***
	(0.28)	(0.28)	(0.65)	(0.04)	(0.30)	(0.19)

R-squared = 0.33. Included observations: 163.
 Jarque-Bera Normality Test = 0.01 / H₀ Prob.= 0.99.
 White Heteroskedasticity Test: Obs*R-squared = 19.05 / H₀ Prob.=0.45
 Standard error in parentheses. Significant at *** 1%, ** 5 % y * 10%.

Table 12: Regression on BI Group. Dependent Variable: Ln(P). Method: OLS.

In(P)	C	In(IB)	In(H)	In(IE)	In(x)	Siz
Coef.	10.17***	0.13**	3.04***	0.14***	0.65**	0.49*
	(0.16)	(0.06)	(0.72)	(0.02)	(0.27)	(0.26)

R-squared = 0.30. Included observations: 333.
 Jarque-Bera Normality Test = 2.51 / H₀ Prob.= 0.28.
 White Heteroskedasticity Test: Obs*R-squared = 22.05 / H₀ Prob.=0.28
 Standard error in parentheses. Significant at *** 1%, ** 5 % y * 10%.

From the results of the regression, some important questions arise. In the first place, it is interesting to observe that in the estimation that corresponds to the BA group of enterprises the balance index does not present a significant coefficient, that is to say that statistically this coefficient is highly probable equal to zero, which would indicate that a point of cut, as the one established it is correct since it was not possible to find significant differences among the enterprises that belong to this group in the statistical estimations. This means that the balanced range, in the superior tail, is relatively wide regarding the successful strategy previously defined⁷. At the same time, **in the estimations for the group of BI enterprises, a significant and positive coefficient was obtained. This coefficient is also much higher than one estimated in the total sample estimations, which indicates that these enterprises could obtain important improvements in their productivity levels by means of redefining their innovation policies towards a more equilibrated strategy.**

A second interesting finding is that the human capital endowment impact is bigger in the case of the BI group than in the case of the BA one. This finding seems to show the existence of differences in entrepreneurial structure and the probable decreasing returns of human capital. This would be so due to the fact that those BA firms have a higher

⁷ Sectoral characteristics probable have an important part in that sense. That is why an interesting research line for further investigations seems to be in sectorial analysis on this mater.

professional endowment in relative terms⁸ which diminishes the impact of an addition of one more professional in their total personnel. On the contrary, those biased firms reach higher increments with the addition of professionals since the diminishing return effect is lower.

Another interesting result to point out is **that the innovation expenditures per employee have a bigger effect on labour productivity in the BA group than in the BI one** (in the first case, with a 0.17 coefficient and, in the second one, with an estimated coefficient of 0.14). This result, would confirm, again, the stated hypothesis regarding the importance that the type of entrepreneurial strategy has in the matter of innovative efforts. In other words, these findings would indicate that **a 1% increment in the innovation expenditure in the BA group produces a 0.17% improvement in productivity, whereas the same effort in the BI group produces a 0.14% one**. BA enterprises take a better advantage of their innovative efforts due to the strategic planning of the IA expenditures. By planning strategically their IA, these firms put in order and adapt the productive means and the production techniques to take a bigger advantage of the expenditures, the result of that is a superior productivity impact of the innovation activities.

External insertion has a positive impact on both groups, although it is hardly superior in the BI group of firms (which is observed in a 0.65 estimated coefficient in the case of BI and in a 0.49 one in the case of BA). This would imply that the productivity gains which arise from the exposition to the external competition and the generated spill over effects from this external activity produce an important impact on both groups.

Finally, regarding the firm size, we obtained a very important finding. In both estimations, positive and significant estimations were obtained. In the case of the BA group, the estimated coefficient is higher than the one obtained in the BI group, which implicates that scale economy effects are particularly present in the first group of enterprises. This is probably the result of a more complex phenomenon, since larger enterprises have higher probabilities (at least in resources) of developing a more planned innovative

⁸ The top 50 enterprises of the BA group (that is to say, the 50 enterprises that reached the highest balance index values) have a 0.08 professionals per worker mean whereas in the case of the last 50 firms of the BI group (the ones that reached the lowest values) that mean is only 0.02. This implies a 4 to 1 relative difference.

strategy capable of allowing a more equilibrated behaviour regarding the firm activities, which would ensure more profitable results of the innovation efforts.

6. CONCLUSIONS

In this paper, we have presented evidenced that remarks the incidence that the firms' innovative strategy could have in their competitive performance. In other words, it is important not only the innovative efforts but also the adopted strategy to carry them on. We can affirm that a strategy that maintains a relative equilibrium among the different innovation activities allows the firm to take a bigger advantage of the expenditures associated with these activities.

We have shown that the BA group (balanced strategy) reached a level of productivity improvement for every invested peso in innovation activities higher than the impact obtained in the case of BI firms (biased strategy). In other words, the maximization of gains in competitiveness due to the performance of innovative efforts does not depend only on the invested amounts but also on the specific combination of efforts. Consequently, the eventual redefinition of the firm strategy would create high possibilities of increase the efficiency of the resources allocated in innovation activities.

We have also detected certain diminishing returns in the accumulation of human capital since we verified that the contribution of this factor in the case of the BA firms it is lower than the one estimated among BI ones. This is because the former group presents, in general, a relative higher endowment of this factor, which supposes a lower marginal contribution. However, it is worthy to remark that this productive factor is the one that has presented the higher level of impact and, in all cases, was a key determinant in the achievements of labour productivity improvements.

Regarding the external insertion effect, it has been possible to confirm that it is an important determinant in the productivity gains, especially among BI firms. Probably, the balanced firms are less dependent on the incentives to improve productive performance that export activity generates.

In respect of the importance of the firm size, it has been verify a different behaviour whether the firm was a balanced or a biased one. In the first case, this variable has result to be an important one. Among biased firms, the size effect does not appear to be

a key determinant. Probably, this is so because large firms have a higher relative presence of among balanced firms. It seems logical to expect that large firms with a balanced strategy have a better productive articulation and a more developed innovative strategy, which allows them to take a better advantage of the scale economies. In any case, this is a very interesting aspect for future research where the identification of certain sectoral characteristics could play an important role in the searching for explanations.

Finally, it is interesting to point out that the type of the adopted innovative strategy appears to affect not only the competitiveness of the firm but also the characteristics of the labour demand (stability and quality). As a matter of fact, balanced firms would demand, in relative terms, higher level of education (which implies higher salaries) than the biased firms (point 4.2., Table 9). This suggests that a higher percentage of balanced innovative firms would lead to an increase in the average income of the labour force, in a non conflictive way with the firm competitive gains.

Although future investigations will probably allow a deeper characterization of the balanced group of firms, particularly in sectoral terms and the characteristics of the goods that the firms export, it is possible to derive some recommendations from the present analysis.

In the first place, if a balanced strategy generates a higher impact on the firm productivity, then public policies should foster not only the intensification of the expenditure but also the equilibrium among the performed activities. This way, the impact of public funds for innovation activities could be maximized. As it was mentioned, when the strategy is a balanced one, the expenditure impact on productivity is higher than the impact in the case of a firm with a biased strategy.

Secondly, the eventual identification of biased firms opens a space for the design of policies capable of lead these firms to a balanced strategy. Although it is not possible to extrapolate the panel characteristics to the total industrial population, the high level of expenditure in capital goods in respect of total expenditures observed in the innovation surveys indicates that biased firms are the majority group among innovative ones.

In the third place, it is important to take into account the rest of the productivity determinants we have analyzed in the present paper. The available evidence allows us

to sustain that the expenditure level and its distribution among the different innovation activities must come with an improvement in the endowment of qualified human capital and a search for international markets. This remarks that different public policies, which are usually design in different public spheres, must be coordinated. That is to say, it is convenient to articulate the innovation policy with those policies to foster exports and those orientated to improve education and training level. In order to maximize innovation policies impact it is necessary to coordinate actions among the different governmental levels.

Finally, the developed study allows us affirming that balanced firms manage to reach a better external insertion combined with a higher innovation expenditure level and a higher endowment of qualified human capital. This impacts on labour productivity levels and has a feedback on the possibilities of external insertion. It also improves competitiveness due to scale increments and product differentiation. In short, this generates a virtuous circle capable of fostering sustainable, cumulative and genuine competitive advantages. The other way around, this also shows the possibility of finding firms locked up in a vicious circle characterized by a low export and productivity level, which impacts on the possibility of developing a large scope innovation strategy and improving the competitive level. Consequently, there is a chance for policy makers to break this vicious circle through the coordination of different policy actions.

REFERENCIAS

Cepal (2006). **"CEPALSTAT - Estadísticas de América Latina y el Caribe"**, www.cepal.org.

Chudnovsky, D., López, A. and Pupato, G. (2004). **"Innovation and productivity: A study of Argentine manufacturing frms' behavior (1992-2001)"**, Documento de Trabajo 70, Depto Economía, Universidad de San Andrés, mayo 2004.

De Negri, J. A., Saleno, M.S. and Barros De Castro, A. (2005). **"Inovações, padrões tecnológicos e desempenho das firmas industriais brasileiras"**. Inovações, padrões tecnológicos e desempenho das firmas industriais brasileiras. D. N. y. S. (eds). Brazil, IPEA.

Delfini, M., Erbes, A., Pujol, A., Roitter, S. and Yoguel, G. (2006). **"Tramas productivas, organización del trabajo y circulación del conocimiento. Los casos de las industrias automotriz y siderúrgica de la Argentina."** Seminario Generación de Empleo desde una política industrial para el Desarrollo Latinoamericano Ministerio de Trabajo, mimeo(Buenos Aires, Argentina).

Erbes, A., Motta, J., Roitter, S. and Yoguel, G. (2004). **"La construcción de competencias tecnológicas en la fase de crisis del Plan de Convertibilidad"**, Ponencia presentada en el Seminario RED PYMES, 9ª Reunión Anual Pymes-Mercosur: "El Rol de las Pequeñas y Medianas Empresas en un nuevo modelo de desarrollo". UNGS / FUNDES / CEPAL.

Indec (1998). **"Encuesta sobre la Conducta Tecnológica de las Empresas Industriales Argentinas 1992/1996"**. Buenos Aires, INDEC.

Indec (2003). **"Segunda Encuesta Nacional de Innovación y Conducta Tecnológica de las Empresas (1998-2001)"**, INDEC - SECyT - CEPAL.

Indec (2006). **"Encuesta Nacional a Empresas sobre Innovación, I+D y TICs. 2002-2004"**. Buenos Aires, Argentina, SECYT-INDEC.

Kemp, R. G. M., De Jongm, P. J., Folkeringa, M. and Wubben, E. F. M. (2003). **"Innovation and firm performance. Differences between small and medium-sized firms"**. SCALES-paper N200213, EIM, Business & Policy Research - SCALES, Scientific Analysis of Entrepreneurship and SMEs.

Kosacoff, B. (1998). **"Estrategias empresariales en tiempos de cambio"**. Estrategias empresariales en tiempos de cambio. K. (ed.), (Buenos Aires: CEPAL, Universidad de Quilmes).

Lugones, G., Peirano, F., Suárez, D. and Giudicatti, M. (2006). **"Las Distintas Estrategias Innovativas Empresarias y su Incidencia en la Competitividad"**. Enfoques y Metodologías Alternativas para la Medición de las Capacidades Innovativas. G. L. y. F. P. (Comp). Buenos Aires, Argentina., Proyecto PICT 02-09536 (FONCYT-ANPCYT). Centro Redes. ISBN 987-22998-0-3.

Mohnen, P. and Hoareau, C. (2002). **"What tipe of enterprises forges close with universities and government labs? Evidence from CIS 2"**. MERIT - Infonomics Research Memorandum Series, MERIT - Maastricht Economic Research Institue on Innovation and Technology, The Netherlands.

Porta, F. and Bonvecchi, C. (2003). **"Las condiciones de consistencia micro/macroeconómica"**. (REDES-CECE). Préstamo BID 925/OC-AR. Pre II. Coordinación del Estudio: Oficina de la CEPAL-ONU en Bs. As., a solicitud de la Secretaría de Política Económica, Ministerio de Economía de la Nación.

Rapetti, M. (2005). **"La macroeconomía argentina durante la post-convertibilidad: evolución, debates y perspectivas"**. Trabajo preparado para la Policy Paper Series del Observatorio Argentino del Programa de Graduados en Asuntos Internacionales (GPIA) en la New School University (NSU), setiembre 2005.