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Foreign direct investment spillovers and the absorption capabilities of domestic firms in the Argentine manufacturing sector (1992-2001)

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Abstract

Argentina received large amounts of FDI inflows during the 90s. At the same time, deep structural reforms were introduced, forcing domestic firms to rapidly undertake restructuring processes in order to adapt to the new economic and institutional environment. This paper explores to what extent FDI helped or hindered those restructuring processes, analyzing whether positive (or negative) productivity spillovers arose from the increasing presence of TNCs affiliates. We found that TNCs affiliates have higher productivity levels than domestic firms and that the latter, on average, received neither positive nor negative horizontal and vertical (backward) spillovers from the growing presence of foreign firms in the local economy. However, we also found that domestic firms with high absorption capabilities reaped positive spillovers from TNCs presence while those with low absorption capabilities were more likely to receive negative spillovers. These findings suggest that those capabilities are key determinants of the possibilities of domestic firms to take advantage of incoming FDI flows into their countries.

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1) Introduction and background

Structural reforms were carried out in Argentina in a quick and far reaching way during the 90s, by opening the trade and capital accounts, deregulating most economic activities and privatizing almost all State owned firms. At the same time, regional economic integration gained momentum with the creation of MERCOSUR in 1991 and its consolidation into an (imperfect) custom union in 1995. In turn, after the hyperinflation crisis suffered between 1989 and 1990, price stabilization was achieved through a currency board scheme, which pegged the Argentine peso to the US dollar (the so called Convertibility Plan) from 1991 until the end of 2001.

As a consequence of these sweeping policy changes, the economy grew at an annual rate of 8.7% in 1991-94. After a fall of 2.8% in 1995, the economy resumed fast growth in 1996 and 1997, slowed down since late 1998 and finally entered in a long recession and then into a deep financial and institutional crisis in 2001 and 2002.

The rapid transition to a more open and competitive economic environment meant a great challenge for domestic enterprises. Whereas many indigenous entrepreneurs were not able to upgrade the organizational, productive and technological capabilities accumulated during the import substitution industrialization (ISI) stage and either broke or sold their businesses, a significant number of domestic enterprises were able to meet that challenge through restructuring and modernization processes.

In their search for higher competitiveness, domestic firms often incorporated (mostly imported) machinery and equipment and new product and process technologies. However, at the same time, many of them reduced their domestic technological efforts and the national content of their products, weakening the local value chain as well as the linkages with the national innovation system (NIS).

The main “winners” of the restructuring process of the Argentina’s economy were transnational corporations (TNCs) affiliates². Between 1992 and 2001 foreign direct investment (FDI) inflows amounted to more than U\$S 76,000 million and the FDI stock went from 6.4 to 25.6 % of the country’s GDP. As a consequence, the presence of TNCs in Argentina’s economy, which was already large, expanded substantially. The TNCs affiliates share in the sales of the 1000 largest Argentine firms increased from 39 to 67% between 1992 and 2000. During the same period the number of TNCs among the 1000 largest firms augmented from 199 to 472.

Takeovers of public and private firms were the prime way of entry of foreign firms, explaining around 60% of FDI inflows. The oil industry attracted 1/3 of FDI inflows between 1992 and 2000, while the manufacturing industry received around 22% of those inflows. Chemicals (especially petrochemicals), automobiles and food and beverages were the branches where most manufacturing FDI was attracted. The rest went to services activities, not only in privatizations, but also in banking, retail commerce, etc.

The massive increase in FDI inflows had significant impacts on Argentina’s economy. We have examined some of those impacts –especially regarding foreign trade and balance of payment issues- in previous studies (see Chudnovsky *et al*, 2001; Chudnovsky, López *et al*, 2002). In a

². In this study, we call TNCs to all firms that have made outward direct investments, irrespectively of the number of their affiliates.

nutshell, we found that, like in the ISI stage, market seeking strategies were predominant. However, most FDI in tradables also took advantage of the opportunities opened by MERCOSUR and it mainly had efficiency seeking objectives. Resource seeking investments³ (mainly concentrated in the oil and mining sector) were also important.

The trade performance of TNCs affiliates in Argentina (at least, until the mega-devaluation of 2002) showed a sort of “asymmetric integration” in the world economy: while they produced for the internal market and, to some extent, for the regional one (i.e., Mercosur), they imported inputs, equipment and final goods from developed countries. Affiliates obtained productivity and/or costs gains in the 90s due to the access to better and/or cheaper inputs and capital goods, as well as to the possibility of reducing their local product mix (since they could complement it with final products imports), hence benefiting from scale economies without losing scope economies. However, our studies showed that these gains had not been reflected yet in a significant improvement in their export performance.

A key aspect not studied in our previous research is the possibility that TNCs presence could generate spillovers for domestic firms in Argentina. TNCs affiliates usually have ownership advantages (Dunning, 1993) that allow them to successfully compete in the host markets where they invest. Those advantages may arise from different sources (access to state of the art technologies and financial resources, superior organizational and marketing systems, innovative capabilities, etc.). Nonetheless, TNCs are not always able to reap all the benefits associated with those advantages. Hence, different kinds of positive spillovers for domestic firms may arise:

- a) There may be an increase in the human capital stock in host countries through the growing availability of workers, technicians and engineers trained by the TNCs affiliates. This kind of spillovers would arise when the demand for skilled labor is growing and only to the extent that people trained by TNCs affiliates are later employed by local firms or open their own businesses.
- b) TNCs affiliates usually have higher productivity levels than the local firms with whom they compete. Thus, horizontal or intra-industry spillovers may appear when domestic firms are induced to increase their productivity or improve the quality of their products by reorganizing their business, increasing their innovative efforts and/or acquiring machinery, equipment and disembodied technologies. Sometimes, knowledge leakages (in areas such as work process organization, product design, marketing, etc.) that can help domestic firms to enhance their productivity levels may arise from the presence of TNCs, although the latter have an incentive to prevent these spillovers (Kugler, 2000).
- c) Contrary to the above case, TNCs affiliates may have an incentive to promote vertical or inter-industry spillovers. The diffusion of knowledge across sectors probably does not represent a loss of profits for TNCs and could even benefit them to the extent that it helps their clients and/or suppliers to become more competitive and efficient. For instance, TNCs may provide technical and marketing assistance and information, training, etc. to their suppliers contributing to generate positive spillovers.

But not only positive spillovers may arise from TNCs presence. Foreign affiliates could also lead to negative horizontal spillovers when domestic firms are forced to reduce their production – causing lower productivity in their establishments if they are operating with high fixed costs-, or even to exit the market, as a result of the increasing presence of TNCs (Aitken and Harrison,

³. Market seeking investments are aimed at exploiting the host country's market. Efficiency seeking FDI aims at increasing the efficiency of TNCs affiliates' activities by integrating assets, production and markets to exploit economies of scale and scope. Resource seeking FDI is attracted by the availability and/or cost of natural and human resources (Dunning, 1993).

1999). Negative vertical spillovers may also appear when, for instance, domestic suppliers are displaced from the market as a consequence of the affiliates' bias in favor of foreign suppliers.

An important conceptual consideration must be made at this point. If FDI spillovers are associated with knowledge leakages, then speaking about negative spillovers has no sense (since we would be forced to assume that domestic firms reduce their productivity or get out of business because of those leakages). However, if FDI spillovers are understood in a broad sense (including all the effects derived from TNCs competition on domestic firms), then it is possible to find both positive as well as negative spillovers (this is the criterion followed in this study).

The aim of this paper is to measure, through econometric techniques, the existence of horizontal and vertical (backward)⁴ spillovers from TNCs presence in Argentina's manufacturing sector in 1992-2001⁵. Our main objective is to learn to what extent the restructuring process which domestic firms had to undertake to face the challenge of trade liberalization and growing competition in the local market was helped (or hindered) by the growing TNCs presence in the Argentina's economy⁶.

As highlighted by part of the most recent literature on the subject, some characteristics of the NIS (see Edquist, 1997) of host countries may be key determinants regarding the possibility of positive spillovers to arise from TNCs presence. In particular, from this point of view it is important to know whether domestic firms have enough absorption capabilities so as to reap the benefits from knowledge leakages that could eventually spill from foreign firms.

In this regard, previous analysis on the Argentina's NIS in the 90s (Chudnovsky, 1999; López, 2002) show that domestic firms, especially small and medium enterprises (SMEs), often have relatively low absorption capabilities due to the lack of access to skilled personnel, the use of outdated management, productive and quality routines, the small amount of resources assigned to in house innovative activities, the lack of interactions with other firms and institutions (such as universities, R&D labs, etc.), the scant access to information about technological options, etc. This is aggravated in a context of pervasive failures in the domestic financial market.

However, as stressed in an evolutionary approach, firms are different in their capabilities as well as in their strategies and objectives, and these differences matter in terms of their performance (see Nelson, 1991). Domestic firms which already had high absorption capabilities or that in the 90s were able to improve their previously accumulated ones, could have been better equipped so as to meet the challenge of the sudden change in the rules of the game. Hence, we would expect that these firms might have reaped positive spillovers from TNCs presence.

On the other hand, it has also been suggested that spillovers may be larger the more innovation activities TNCs affiliates undertake in host countries (Marin and Bell, 2003). Then, it is also important to know whether domestic firms may benefit in case they belong to sectors where TNCs affiliates assign relatively more resources to innovation activities.

The research aims at answering the following questions:

- i. Have TNCs affiliates achieved higher levels of productivity than their domestic counterparts?

⁴. As the channels through which backward spillovers could arise are clearer than in the case of forward spillovers, we prefer to concentrate our analysis on the former.

⁵. So far the only available study on this topic is that of Marin and Bell (2003).

⁶. In Chudnovsky, López and Rossi (2003) we dealt with the same issues on the basis of information for 1992-1996.

- ii. Has the growing presence of TNCs generated positive or negative horizontal and vertical (backward) spillovers for domestic firms?
- iii. Do domestic firms with high absorption capabilities have better opportunities of receiving positive spillovers from TNCs presence than firms with low absorption capabilities?
- iv. Are TNCs affiliates with strong innovative activities in host countries more likely to generate positive spillovers than those affiliates with a weak innovative behavior?

In section 2, a brief assessment of the received empirical evidence on FDI spillovers in other countries is made. The results of our estimates on FDI spillovers in the Argentine manufacturing sector and their interpretation are contained in section 3. The concluding remarks are presented in section 4.

2) FDI spillovers: a brief assessment of the received literature

Studies on FDI spillovers have been made with different techniques and methodologies, covering both developed and developing countries that have and have not received substantial FDI inflows, considering very heterogeneous time periods and using different endogenous as well as exogenous variables. Hence, it comes as no surprise to find that some of them reveal the existence of positive spillovers, others find negative spillovers while the rest find “mixed” results (or results that are conditional on certain variables)^{7,8}

With these caveats in mind, we may classify available studies in three groups. The first group includes the early studies which generally used cross-sectional data in a single year and found positive spillovers⁹. Pioneering studies carried out on Australia (Caves, 1974), Canada (Globerman, 1979) and Mexico (Blomström and Person, 1983) found positive and statistically significant spillovers in the manufacturing sector in those countries. Subsequent studies on the Mexican manufacturing sector (Blomström and Wolff, 1994) and on United States’ investment in the manufacturing sectors of France, Germany, Japan and England (Nadiri, 1991) also revealed positive spillovers from FDI on the productivity of local firms. With data on establishments (instead of the sectoral data used in the above-mentioned studies), Blomström and Sjöholm (1998), in a study on Indonesia, found that the productivity of labor in the local firms was positively correlated with the presence of foreign firms in the same sector.

Within the second group we include a number of more recent studies that used panel data and which generally find negative spillovers. The most quoted is that of Aitken and Harrison (1999), which analyzes a panel of over 4000 establishments in the manufacturing sector of Venezuela in 1976-89, finding that TNCs presence negatively affected the total factor productivity (TFP) of local firms. The authors also show that if the exercise had not been adequately controlled to take into consideration the sector in which the firms operated, and given that FDI is mostly directed to those activities where productivity is higher, the same study in Venezuela would have led to the opposite conclusion, that is, that FDI generates positive spillovers. Based on this finding, the

⁷. See Görg and Strobl (2001) and Görg and Greenaway (2002) for surveys of the literature on FDI spillovers.

⁸ It is also worth mentioning that many studies find non-statistically significant results (for instance Braconier *et al*, 2001, on Sweden). Interestingly enough, Gorg and Strobl (2001) show that there is a “publication bias” in this area (studies of productivity spillovers are more likely to become published if they report statistically significant effects). If this is the case, there are studies which do not find statistically significant results that cannot be found in academic journals.

⁹. A table is presented in Annex 1 including the basic information about the studies on FDI spillovers which have been taken into account during our research.

authors point out that many of the earlier studies that found positive spillovers share the problem of not having introduced control variables of sectoral nature¹⁰.

Within the third group (“mixed” or “conditional” results), we may classify the available studies on the basis of the type of variables used for discriminating the existence or not of spillovers. A first set of studies in this group includes those that make emphasis on the technological and/or productivity gap between local firms and TNCs affiliates. While a large gap could mean that there is room for technological learning in domestic firms, a too large gap could also be an obstacle for spillovers to arise because local firms would not qualify as suppliers of TNCs, or would be unable to reap benefits from knowledge leakages or to improve their competitiveness through technological modernization relying on externalized sources of technology.

One of the pioneering studies in this area was that of Cantwell (1989), who analyzed the impact of the growing presence of US firms in Europe between the mid-1950s and 1970. The analysis (based on the evolution of the market shares of the US and European firms and not on their productivity levels) highlighted substantial differences among sectors and firms. The response of European enterprises to the “American challenge” was superior in those activities where local firms relied on a significant technological capacity. In turn, the weaker local firms were forced to leave the markets or to concentrate on activities that were not attractive for US affiliates.

Later on, in a cross-section study of the Mexican manufacturing sector, Kokko (1994) concludes that spillovers are less probable in those industrial sectors where foreign firms have a significant market share and use technologies that are far superior to those of their local competitors. In turn, in a study on the Uruguayan manufacturing sector, Kokko *et al* (1996) analyzed the effect of the presence of foreign firms on the performance of local firms with over 100 employees. They found evidence of positive spillovers only in the cases where the productivity gap between national and foreign firms was moderate. In a subsequent study, Tansini and Zejan (1998), with data for the Uruguayan manufacturing sector between 1988 and 1990, found positive spillovers for the whole sample examined and especially for the smaller local firms. In contrast with the previous study, they found that the spillovers were non-existent when the technological distance (measured by the differences in the capital stock per employee) between national and foreign firms was moderate, and were only significant when the technological gap was large.

Analyzing a panel of Spanish, French and Italian firms between 1993 and 1997, Castellani and Zanfei (2001) find that the combination of high TFP gaps and high levels of productivity in TNCs affiliates leads to the most positive effects of inward investments. In turn, Girma, Greenaway and Wakelin (2000), on the basis of a panel of 4000 British firms between 1991 and 1996, find, contrary to Castellani and Zanfei, that local firms benefit from TNCs presence when the TFP gap is low, while the opposite occurs when the gap is high.

A study by Haskel, Pereira and Slaughter (2002) is half way between those which make emphasis on the notion of the productivity gap and those which highlight the role of domestic absorption capabilities. The authors work with a panel of British firms with data for 1973-1992, and estimate the impact of what they call “absorptive capacity”, which is measured as a combination of three variables: total employment, TFP and skill intensity. They find that positive spillovers are more likely to occur when the gap is higher. It is clear, however, that the authors are combining a measure of the technological gap with another related with absorption

¹⁰ Other studies that find negative spillovers are a research on over 500 firms in the Czech Republic for the period 1992-1996 (Djankov and Hoeckman, 2000), a study by Haddad and Harrison (1993) on the manufacturing sector in Morocco in the period 1985-89, a paper by Kathuria (2000) on the industrial sector in India in the period 1976-89 and other by Konings (2000) for a panel of firms from Bulgaria, Poland and Romania between 1993 and 1997.

capabilities (skill intensity), hence making it difficult to understand the real meaning of their findings.

Beyond the flaws of the above-mentioned study, many authors suggest that for spillovers to arise local firms need to have significant absorptive capabilities that allow them to reap benefits from the knowledge possessed by TNCs affiliates. In fact, absorptive capabilities are also needed if local firms opt for other channels of technological modernization (such as capital goods imports, licenses, etc.). These absorptive capabilities depend, among other things, on the availability of skills and technical competences and on the magnitude and nature of the innovative activities performed by domestic firms.

Marin and Bell (2003), in a study for Argentine manufacturing firms in 1992-96, find that absorption capabilities of domestic firms do not have an impact on spillovers from FDI. In this case, absorption capabilities are measured through a variety of indicators, such as the skill intensity of the labor force, the expenditures in embodied and disembodied technology and the importance given to innovation in firms' strategies. Nevertheless, when they take into account the differences in the technological behavior of TNCs, they find significant and positive spillovers to the domestic firms that are in sectors where the foreign firms are "technologically active".

Another study which works with the concept of absorption capabilities is that of Barrios *et al.* (2002), who employ data for a group of firms from Greece, Ireland and Spain. They find that positive spillovers are contingent upon the magnitude of absorption capabilities of domestic firms (measured by their R&D expenditures and by a dummy variable which captures whether they are exporters or not). Barrios (2000), on the basis of a panel of Spanish firms with data for 1990-1994, also highlights the role of absorption capabilities as making possible positive spillovers (in this case, those capabilities are measured on the basis of R&D expenditures by domestic firms).

Other studies highlight the impact of the sectors where TNCs invest on the existence of spillovers, under the assumption that those sectors where the expenditure in R&D activities is high should be those where positive spillovers are most likely to appear. In this regard, Kinoshita (2001), analyzing a panel of Czech firms between 1995 and 1998, finds positive spillovers only in those sectors which are R&D intensive in host countries.

While all the above-mentioned studies focus on intra-industry spillovers, the papers by Schoors and Van der Tol (2002), Smarzynska (2003) and Kugler (2000) aim to identify inter-industry spillovers (forward and backward). The former employs data for a panel of Hungarian firms in 1997-1998 as well as input-output data. The authors find that intra-industry as well as backward spillovers are positive, while forward spillovers are (unexpectedly) negative, the results being dependant on the local absorptive capability and the level of sectoral openness. Smarzynska (2003) analyzes an unbalanced panel of Lithuanian firms covering the period 1996-2000, finding evidence of positive and statistically significant backward spillovers, while horizontal spillovers are not significant.

In turn, Kugler (2000) works with a stochastic multisectoral dynamic general equilibrium model and employs data for a panel of Colombian firms between 1974 and 1998. He finds that intra-industry spillovers are absent –and that they are limited by low absorptive capacity of domestic firms–, while inter-industry externalities are positive and significant. Hence, TNCs entry could have a positive effect on their suppliers and clients.

As seen from this brief revision, the discussion on the magnitude and sign of FDI spillovers is far from settled. Hence, it is no surprising that a variety of assessments on the subject has been

made. While Blomström and Kokko (1996) conclude that *“the evidence on spillovers from FDI in host countries suggests that such effects exist and that [they] may be substantial both within and between industries, but there is no strong evidence on their exact nature and magnitude”*, Rodrik (1999) considers that the empirical evidence does not corroborate the *“extravagant claims about positive spillovers from FDI”* (p.37).

The pioneer studies on the subject mostly showed evidence of positive spillover effects, but they were based on cross-sectional data, which posed obstacles to the dynamic analysis of the impacts of FDI. Moreover, those studies failed to take into account the impact of the sectoral composition of FDI. Hence, a correlation between TNCs presence and domestic productivity could appear even in absence of spillovers due simply to the fact that TNCs tend to invest in high productivity sectors.

More recent studies on spillovers, which are mostly based on panel data techniques, tend to show a more heterogeneous reality. Many of them have found negative spillovers, while others show that spillovers may exist but are contingent on different factors, mostly related with technological and innovation variables. Panel data models, besides allowing to control for non-observable sectoral factors which influence investment decisions, give room for taking into consideration changes that may affect firms' productivity due to modifications in the institutional or macroeconomic context, for instance, or the lags that may exist for local firms to absorb knowledge leakages from TNCs affiliates.

Moreover, while most of the older studies on this subject did not adequately take into account the existence of different kinds of spillovers and often failed to analyze the channels through which those spillovers arise, recent studies have begun to fill the gap between theory and measurement in this area. In this regard, studies that highlight the role of productivity gaps or absorption capabilities, for instance, are clearly in the right direction and show that the features and performance of the NIS of host countries may have a major impact on whether positive spillovers from TNCs presence arise or not. Hence, the analysis of the latter is more fruitful when it is made from the point of view of the NIS approach.

However, it is often the case that the consideration of some key contextual elements (such as the type of strategies followed by TNCs or the macroeconomic scenario and the policies in force in host countries, for instance) is absent in most studies, a fact that hinders our capacity for understanding the results of the econometric exercises through which spillovers are estimated.

Moran (2000), for instance, criticizes many of the studies we have mentioned, and particularly those which do not control key variables such as the TNCs strategies and their investment motivations (i.e., whether foreign firms are joint ventures or fully controlled subsidiaries, whether they are stand alone or integrated in international networks, whether their scales are optimal or sub-optimal, whether there is a deliberate policy of developing suppliers, etc.).

In turn, the materialization of the potential spillovers also depends on the type of policies adopted in host countries. For instance, trade, technology and enterprise policies, as well as policy measures for promoting competitiveness, might have an impact on the strategies of foreign subsidiaries and induce (or not) the generation of positive spillovers. The same kind of policies might, on the other hand, strengthen the capability of locally owned firms to benefit from spillovers generated by TNCs activities.

Further criticism to the reviewed studies could be added. For instance, several studies on developing countries refer to the effects of FDI on relatively closed economies and, therefore, do

not take into account the deep changes that have taken place in the context in which FDI operates in the 90s. It can also be seen that several cases dealt with correspond to countries with a not very developed manufacturing sector and/or that have not received much FDI.

In this study we aim not only at taking into account the more recent contributions in this area (specially those which stress the role of domestic firms' absorption capabilities and the technological behavior of TNCs affiliates), but also at analyzing the econometric results in the specific context of the restructuring of the Argentina's economy in the 90s. This will help us to overcome some of the above-mentioned deficiencies of the received empirical literature on the subject. In the next section we present the results of our research.

3) FDI spillovers in Argentina

a) Basic data

In order to test the magnitude and sign of spillovers from FDI in Argentina, we used a database of 722 manufacturing firms with detailed data for 1992, 1996, 1998 and 2001¹¹. Besides allowing us to learn about the effects of the implementation of structural reforms several years after their implementation, this base has also the advantage of covering both a period when the economy grew at high rates (1992-1998) as well as another characterized by stagnation and growing economic uncertainty (1999-2001).

The sales of the surveyed firms grew 46% and exports practically doubled between 1992 and 1998. As total employment was reduced by 8%, sales per employee increased 55%. Hence, the economic performance of surveyed firms was on the whole quite good during that period, except on employment. In contrast, sales decreased 15% (and employment 12%) while exports grew 15% between 1998 and 2001.

It is important to take into account that the majority (69%) of the surveyed enterprises was founded before 1975, while only 7% of them were created in the 90s. Hence, surveyed firms were mostly born during the ISI process. However, more than 50% of the enterprises founded before 1975 changed ownership. These changes mostly occurred in the 90s and generally involved the acquisition of indigenous firms by TNCs.

As it was expected in the context of the FDI *boom* which took place in Argentina during the 90s, the number of foreign firms¹² in the mentioned database increased from 71 in 1992 to 133 in 1998 and 145 in 2001 (this increase was the result of take overs of formerly domestic enterprises). The foreign presence grew in almost all sectors, being this growth especially significant in branches such as food and beverages, chemicals, steel and aluminum, machinery and equipment and automobiles. A similar pattern is observed regarding TNCs affiliates sectoral

¹¹. The firms were surveyed by the National Statistical Institute with the purpose of obtaining information on their innovation activities and technological behavior. The first survey covered the period 1992-96 and included 1639 firms (INDEC, 1998). The second survey covered the period 1998-01 and included 1688 firms (INDEC, 2003). Matched information from both surveys is available for a panel of 722 firms that we used for our work. These firms account for 29% of sales, 27% of employment and 24% of exports of the manufacturing sector in 1992-1996. We consider that our estimations are not subject to sample selection (attrition) issues that would arise if the available data were not representative of the population of manufacturing firms. Since the innovation surveys in Argentina were not designed or intended to follow the behavior of firms over time, but just to obtain a representative sample from the universe of manufacturing firms in the Argentine industry, the decision to include the firms in and out of the survey was made randomly.

¹². Following the criterion used by the International Monetary Fund, it is considered as *foreign* every firm in which non-resident investors own more than 10% of its equity capital.

share in sales and employment (Table 1) –these gains were mostly due to changes of ownership, while the growth of already installed affiliates did not play a significant role in this regard-.

Foreign firms are considerably larger than domestic ones in terms of number of employees (Table 2). They have higher labor productivity levels¹³ (Table 3), being the productivity gaps larger in sectors such as food and beverages, petroleum, and automotive and transport equipment. At the same time, foreign firms show higher ratios between skilled¹⁴ and total employees than domestic enterprises (Table 4). These results are in line with those generally found in other studies on the subject, especially those made in developing countries.

Finally, R&D and technology acquisition activities are more frequent in TNCs affiliates than in domestic firms. However, R&D intensity (R&D expenditures/sales) in domestic firms is higher than in foreign firms. While the latter invested relatively more in technology acquisition¹⁵ in 1996 and 1998, the opposite occurred in 1992 and 2001 (table 5).

b) Econometric analysis

We focus our analysis on the identification of spillovers on the basis of the methodology generally used in the received literature. Our basic specification is as follows:

$$(1) \frac{Y_{ijt}}{L_{ijt}} = \alpha + \beta_1 OWN_{ijt} + \beta_2 SEXTL_{jt} + \beta_3 (OWN_{ijt} * SEXTL_{jt}) + \beta_4 Z_{ijt} + \beta_5 X_{jt} + v_t + u_j + \varepsilon_{ijt}$$

where Y_{ijt} stands for total sales¹⁶ deflated by sectoral price indexes of the firm i operating in the sector j at time t and L_{ijt} is the total number of employees. The logarithm of this ratio is the dependent variable $LPRODUCT$ ¹⁷.

OWN is the foreign share in the firm's equity capital¹⁸. Therefore, if the presence of foreign capital increases productivity at the firm level, we would expect β_1 to be positive.

$SEXTL$ is the variable that captures the foreign presence at the sectoral level. It is measured by the ratio between the number of employees of foreign firms in a particular sector and the total employees of the sector¹⁹.

¹³. Labor productivity is measured as the ratio between the sales of each firm (excluding sales of goods produced by third parties) and the number of total employees.

¹⁴. Skilled employees are those that have technical or university degrees.

¹⁵. It includes expenditures in technology transfer and capital goods required for innovation purposes.

¹⁶. Excluding sales of goods produced by third parties.

¹⁷. Although it would be preferable to use the ratio between total sales and the total numbers of hours worked as the productivity variable, the latter information is not available in the innovation surveys.

¹⁸. Due to the high level of correlation between OWN and the interaction term ($OWN * SEXTL$) –see below-, we decided to use a dummy variable ($DOWN$), which takes the value 1 when foreign share is higher than 10% (see Table 6).

¹⁹. We also calculated an alternative measure based on the foreign share on sectoral sales. As the results of the estimations were similar to those obtained with the employment measure, we do not report them here. Likewise, we also made a test weighting employment (and sales) by each plant's foreign equity share, but the main findings were essentially unchanged.

$$(2) \quad SEXTL_{jt} = \frac{\sum_j Emp_{ijt} I(OWN > 10\%)}{\sum_j Emp_{ijt}}$$

being $I(\phi)$ a function which is equal to 1 if the condition ϕ is met (which, in this case, is $OWN > 10\%$). As a consequence, if the foreign presence generates positive (negative) spillovers on domestic firms in the same sector (that is, intra-sectoral or horizontal spillovers), β_2 would be positive (negative).

The last variable aimed at measuring the impact of TNCs presence on spillovers is an interaction term ($OWN * SEXTL$). The coefficient of this variable allows us to identify whether the effects of the foreign presence on other TNCs affiliates are different from those on domestic firms. If this differential impact is positive (negative), β_3 should be positive (negative).

The vector Z_{ijt} comprises a set of control variables, including:

- Firm's size (proxied by an index that takes into account firms' total sales and total employees, $SIZE$)²⁰.
- The ratio between skilled employees and total employees ($SKILLS$).
- Total exports per employee ($XTOTL$).
- Total imports (excluding imports of capital goods) per employee ($MEXKL$).
- Investments in capital goods (domestic and imported) per employee ($INVL$).
- Total expenditure in innovation activities per employee ($INNOVEXL$).
- A dummy variable that takes the value of one if the firm changed its ownership during the period under analysis ($M\&A$) and
- A dummy variable that takes the value of one if the firm belongs to an economic conglomerate ($GROUP$).

The vector X_{jt} includes sectoral variables, which allow us to control for observable sectoral characteristics that could be affecting the firms' productivity. These are the degree of trade openness (measured as the log of the sum of the sectoral ratios between exports and the gross value of production and between imports and apparent consumption, $LAPERT$) and the level of effective protection ($EFPROT$)²¹. Finally, we also include time dummies (A_{96} , A_{98} and A_{01} ,

²⁰ According to the legal definitions currently in place in Argentina (mostly for purposes of defining whether a firm has or not the right to take advantage of some policy instruments aimed at SMEs) in order to include firms in different size segments, we have used the following formula:

$$I = \left(10 \times \frac{Emp}{Emp^*} \times 10 \times \frac{Sales}{Sales^*} \right)^{\frac{1}{2}}, \text{ where } Emp \text{ stands for total employees and } Sales \text{ for total sales.}$$

$Emp^* = 300$ employees and $Sales^* = \$ 18 \text{ million}$. $SIZE = 1$ if $I \leq 0.3$ (microenterprise); $SIZE = 2$ if $0.3 < I \leq 1.5$ (small firm); $SIZE = 3$ if $1.5 < I \leq 10$ (medium firm) and $SIZE = 4$ if $I > 10$ (large firm).

²¹. The sources from which a series of effective sectoral protection was built are Lifschitz and Crespo Armengol (1995)

vector v_i) in order to control for unobservable effects varying in time that could have affected all firms (for example, macroeconomic shocks)²².

The use of panel data techniques allows us to control for problems of unobserved heterogeneity²³. As we do not have any previous assumption about the correlation between the independent variables and fixed unobservable effects, we estimated equation (1) with both fixed and random effects²⁴.

As stated above, it is important to learn whether the opportunities of profiting from the presence of TNCs affiliates are greater when domestic firms have higher absorption capabilities. Likewise, the technological behavior of foreign affiliates could also have an impact on the probability of spillovers to arise.

In order to measure absorption capabilities, following Yoguel and Rabetino (2002), we elaborated an index of absorption capabilities (ACI), that includes different factors, as follows²⁵: i) quantitative variables: the ratio of R&D employees relative to total employment, the ratio between expenditures in consultancy and sales, the payments for technology licenses relative to sales, the expenditures in capital goods related to new process or new products relative to sales and the ratio between innovation activities (including not only expenditures in formal R&D but also in adaptive and incremental innovation activities, project engineering, etc.) and sales; ii) qualitative variables: the degree of formalization of R&D activities (i.e., whether the firm has or not a R&D department), the use of modern organizational techniques (see Annex 2 for a detail of these techniques), the importance assigned to product innovation in firms' strategies, the use of information technology in the relationships with customers and suppliers and the importance of tacit and codified sources of technological information²⁶; iii) qualitative-quantitative variables: whether the firm undertook training activities and, if so, the expenditures in training relative to sales.

It is important to highlight that this indicator of absorption capabilities is considerably more refined than those employed so far in most of the received literature on FDI spillovers, a fact which would help us to better capture the impact of those capabilities on the latter.

With the aim of analyzing whether the foreign presence effects depend on the level of the absorption capabilities of domestic firms, we multiplied the variable *SEXTL* by a dummy variable that is equal to 1 if the domestic firm has high absorption capabilities -that is, if the value of ACI

and Berlinski (1998). The authors thank Eugenia Crespo Armengol for providing an update of the data for year 2001.

²². We also tested whether domestic firms had less or more probabilities of reaping spillovers from FDI according to the type of TNCs strategies (resource, market or efficiency seeking) prevailing in each sector, but no significant results were obtained (probably because in an overwhelming majority of sectors market seeking strategies were the norm).

²³ Following Aitken and Harrison (1999), unobservable effects are assumed at sectoral level. If these effects are included at the firm level (what would allow us to control for unobservable features at firm level but at the cost of reducing approximately one fourth the available degrees of freedom) the main findings are unaltered, though the efficiency of estimates is reduced.

²⁴. Fixed effects estimations are consistent, while random effects estimations are not consistent if the unobservable fixed effects (here assumed to occur at the sectoral level) are correlated with the independent variables. The advantage of using random effects is that the estimations are more efficient, at the cost of not necessarily obtaining consistent estimations. In order to take this into account, we estimated the model with both methods and then tested the consistency of the estimations using the Hausman Test.

²⁵ See annex 2 for a more detailed explanation of the construction of the index.

²⁶. Tacit sources include, among others, learning by doing, reverse engineering, interactions with customers and suppliers, etc. Codified sources are, for instance, licenses, patents, publications, databases, etc.

for that firm is above the median of the index for domestic companies-²⁷ (the interaction term is the variable ACIHIGH).

To measure the innovative behavior of TNCs affiliates, we used the quantitative variables mentioned above to construct an index (ITB) and then divided the sectors according to whether TNCs affiliates were more innovative (the value of ITB is above the median of the index for all foreign firms) or less innovative (the value of ITB is below the median) than the average. Then, to learn whether domestic firms may receive different impacts according to the level of innovative activities undertaken by TNCs investing in the same sector, we multiplied *SEXTL* by a dummy variable that is equal to 1 if the domestic firm operates in a sector where foreign firms are more innovative (the interaction term is the variable ITBACT)²⁸.

Following the methodology proposed by Schoors and van der Tool (2002), we expanded our model in order to test for the existence of backward spillovers (*BACKWARD*) –that is, if domestic firms benefit from the presence of foreign firms in sectors to which they provide inputs-. Backward spillovers were measured for every sector using the weighted average of the foreign presence in all the other sectors and the technical coefficients from the Input-Output Table of 1997²⁹.

Finally, to process the survey's data, we excluded from the sample:

- Firms with less than two observations with positive values of the ratio between sales and employees.
- Firms that belong to sectors in which there are very few firms (seven sectors at three-digit industry level of the CLANAE³⁰).

c) Main findings

Table 7 shows the results of the estimations of our basic specification using fixed and random effects. Although both groups of results are relatively similar, the Hausman test rejects the null hypothesis of non-correlation between the unobservable effects and the regressors in the case of the random effects estimation. Hence, the latter generates inconsistent estimations, which leads us to concentrate in the analysis of the fixed effects estimations.

The coefficient of the variable *DOWN* (β_1) is positive and statistically significant, suggesting that firms with foreign ownership have higher productivity than domestic ones. In turn, foreign presence seems to have a positive impact on domestic firms' productivity, since β_2 is positive,

²⁷ An alternative approach in order to identify these effects is to segment the sample according to the same criteria. However, this alternative reduces greatly the available degrees of freedom (as a consequence of the loss of observations), a fact which may affect the significance of the estimations.

²⁸ Note must be taken that these indexes of absorption capabilities and technological behavior were constructed with the information contained in the survey that covers the period 1992-1996, because some of the questions were not included in the second survey. Nevertheless, we have constructed another variable which takes into account four aspects that were included in both surveys (the ratio of R&D employees relative to total employment, the ratio between innovation expenditures and sales, the payments for technology licenses relative to sales and the ratio between expenditures in capital goods related to new process or new products and sales), which allows us to segment surveyed firms on the basis of information about their technological behavior for the whole decade. Using these alternative measures, the obtained results remain practically unchanged.

²⁹ For example, assume that the orange producers sell half of their output to marmalade producers and half to orange juice producers. If there are no TNCs in the marmalade industry but 60% of total employees working in the juice sector belong to TNCs, the *BACKWARD* variable will be calculated as $(0.5 \cdot 0) + (0.5 \cdot 0.6) = 0.3$.

³⁰ National Classification of Economic Activities.

although the coefficient is not significant. The coefficient of the interaction term is negative and significant, suggesting that a higher foreign presence generates a negative differential effect on other foreign firms³¹.

The coefficients of the variables related to size, skills, exports, imports, investment in capital goods, and expenditures in innovation activities have the expected sign (positive) and are statistically significant. While sectoral trade openness, *ceteris paribus*, tends to increase the productivity of the firms (i.e., firms in sectors with higher foreign trade intensity tend to be more productive than those in domestic market oriented sectors), the rate of sectoral effective protection does not seem to impact on productivity at the firm level. In turn, the variable related to merger and acquisitions³² has a negative coefficient, although it is not significant.

As stated before, our aim in this paper is going beyond the kind of analysis that is usually found in the literature on FDI spillovers, and analyzing whether the level of absorption capabilities of domestic firms and/or the innovative behavior of foreign firms affiliates could have an impact on the sign and magnitude of those spillovers.

The results of our estimations are shown in Tables 8 and 9. The variable *SEXTL* captures the effects of TNCs presence on our base group (which, in this case, includes domestic firms with low absorption capabilities). The coefficient turned out to be negative but not significant (column 1 of table 8). The variable *ACIHIGH* captures the differential effect of TNCs presence on domestic firms with high absorption capabilities (*vis a vis* domestic firms with low absorption capabilities). The coefficient of this variable is positive and statistically significant, suggesting that the former firms are in better conditions to benefit from TNCs presence. If we want to identify the total spillover effect of foreign presence on firms with high absorption capabilities, we must analyze if the sum of the coefficients of *SEXTL* and *ACIHIGH* is significantly different from zero. The F test rejects the null hypothesis that they are equal to zero, meaning that domestic firms with high absorption capabilities receive positive spillovers from FDI.

Although the classification of domestic firms according to the absorption capabilities index is, as expected, positively correlated with their productivity, the level of the correlation is below 25%. In fact, if we include an alternative measure of absorption capabilities (which is possible to calculate for each year, see footnote 27), as an independent variable in the regressions, the coefficient is positive but not significant. Hence, this means that when we classify domestic firms according to their absorption capabilities, we are not dividing most productive firms in one group and less productive ones in the other. This suggests that absorption capabilities do not, by themselves, lead to higher productivity, but that they help domestic firms to benefit from TNCs presence.

We also tried to learn whether spillovers for domestic firms might vary according to the level of innovative activities performed by TNCs affiliates in the same sector. In this case, our base group is conformed by domestic firms that operate in sectors where TNCs have a passive technological behavior. The results of these estimations are shown in column 2 of Table 8. The coefficients of the variables *SEXTL* and *ITBACT* are not statistically significant, which means

³¹ The F test rejects the null hypothesis that the coefficients β_2 and β_3 are jointly equal to zero, suggesting that foreign firms receive negative spillovers from the presence of other TNC affiliates.

³² Note must be taken that M&As includes both take overs by foreign firms as well as by domestic firms. As the effects of M&As by foreign firms are mostly captured by the variable *DOWN*, the lack of significance of the variable M&As could mean that take overs by domestic firms did not make a significant contribution to acquired firms' productivity, differently from what happened with take overs by foreign firms (see Chudnovsky and López, 2000, for a study on this issue where the same conclusion is reached).

that TNCs innovative activities do not impact on the probabilities of domestic firms to receive spillovers from their presence³³.

Finally, we combine both criteria with the purpose of identifying spillovers effects in the following situations (Table 9):

- i) When domestic firms that have high absorption capabilities belong to industries in which TNCs affiliates have a strong (variable *ACIHIGHA*)³⁴ or a weak innovative behavior (*ACIHIGHP*).
- ii) When domestic firms that have low absorption capabilities belong to industries in which affiliates have a strong (*ACILOWA*) or a weak innovative behavior (this is our base group).

The estimations show that domestic firms with high absorption capabilities (independently of the affiliates' behavior) are in better conditions to receive a positive effect from the foreign presence, since the coefficients of *ACIHIGHA* and *ACIHIGHP* are both positive and statistically significant³⁵. In fact, domestic firms with high absorption capabilities receive positive spillovers from foreign presence, independently of the technological behavior of the TNCs³⁶. In the case of domestic firms with low absorption capabilities, the respective results are not significant.

So far, we have been concentrated in the analysis of horizontal or intra-sectoral spillovers. Table 10 includes variables aimed at capturing the presence of vertical (backward) effects (variable *BACKWARD*) and whether they depend on domestic firms absorption capabilities (the variable *BACK_HIGH* in column 2 is an interaction term between *BACKWARD* and a dummy variable equal to one if the domestic firm has high absorption capabilities). As we can see in column 1, the backward spillovers seem to affect positively the productivity of domestic firms, although the coefficient is not statistically significant.

The effects of foreign presence on our base group (that is, domestic firms with low absorption capabilities) are captured in column two through the variable *BACKWARD*, whose coefficient is negative but not significant. Domestic firms with high absorption capabilities are more likely to receive positive vertical spillovers than firms with low absorption capabilities, given the fact that the coefficient of *BACK_HIGH* is positive and significant. Foreign presence seems to generate positive spillovers on firms with high absorption capabilities, although the F test does not confirm the hypothesis that they are significantly different from zero. In any case, our results suggest that domestic firms with high absorption capabilities are in better conditions to benefit from foreign presence through inter-sectoral linkages.

³³. These results contrast with those obtained by Marin and Bell (2003). In this regard, note must be taken that both studies employ different econometric methodologies as well as different variables to capture the effects of domestic firms' absorption capabilities and the innovative behavior of TNCs.

³⁴. In this case, the variable *ACIHIGHA* is calculated as the result of the interaction of *SEXTL* with two dummy variables: the first one is equal to 1 if the domestic firm has high absorption capabilities and the other is equal to 1 if the firm belongs to an industry in which the foreign companies have an "active" technological behavior. Similar criteria were adopted to estimate the variables *ACIHIGHP* and *ACILOWA*.

³⁵. Although firms with high absorption capabilities that operate in sectors where TNCs affiliates are technologically passive seemingly receive larger spillovers than those which are in sectors where affiliates have an active technological behaviour, the difference between both groups is not statistically significant.

³⁶ In both cases, the F test rejects the null hypothesis that the addition of the coefficients of *SEXTL* and the one of *ACIHIGHA* (or *ACIHIGHP*) is equal to zero.

4) Conclusions

On the basis of the findings described above, it is now possible to answer the four questions posed in the introduction:

- i. Expectedly, TNCs affiliates have higher productivity levels than domestic firms.
- ii. Following the standard methodology commonly used in the received literature on the subject, we have found evidence neither of positive nor of negative spillovers for domestic firms from FDI presence. This is valid both for horizontal as well as for vertical spillovers.
- iii. However, domestic firms that have high absorption capabilities are more likely to receive positive spillovers from TNCs presence than those with low absorption capabilities. This finding is valid not only for horizontal or intra sectoral spillovers (as analyzed in most received papers), but also for vertical (backward) spillovers.
- iv. Higher levels of innovative activities by TNCs affiliates did not enhance the possibilities of domestic firms to reap positive spillovers. However, it should be stressed that when we combine the indexes of domestic firms' absorption capabilities and TNCs innovative behavior, it is clear that the former are the key determinants of the sign of spillovers from FDI. In other words, when domestic firms have high absorption capabilities they are able to reap positive spillovers, no matter the innovative behavior of TNCs affiliates.

Two important conclusions follow from these findings. First, studies on spillovers need to take seriously into account the heterogeneities in firms' capabilities, since the latter seem to be a key determinant of the possibilities of domestic enterprises to benefit from foreign investments.

Second, though most surveyed firms were born and grew in the same economic and institutional scenario, they have developed different productive and technological trajectories, which finally led them to have higher or lower absorption capabilities so as to meet the challenge of the reforms and the FDI boom of the 90s.

While in a largely "market-driven" restructuring scenario a number of domestic firms were able to benefit from TNCs affiliates growing presence in the Argentina's market, it is not surprising to find that domestic firms with low absorption capabilities did not receive positive spillovers from FDI. It is worth bearing in mind that most surveyed firms had first grown under the protective umbrella of the ISI policies and later in the volatile scenario of the 80s. They had developed routines and strategies adapted to an inward oriented economy, with relatively low levels of competition and a permanent macroeconomic and institutional instability. When they were exposed to the new rules of the game of the 90s, many of them found that their previously accumulated productive, managerial and technological assets were not sufficient so as to compete with imports and with the growing presence of TNCs affiliates.

The main policy lesson that arises from these findings is that developing countries which attract significant FDI inflows should not take for granted that domestic firms will benefit from TNCs presence, since this will mainly happen when absorption capabilities are present to be able to receive both horizontal and vertical spillovers.

Hence, policies aimed at fostering in a sustained and continuous manner those capabilities (i.e., to promote the use of skilled personnel in SMEs, the undertaking of in house innovative

activities, the linkages among the agents and institutions of the NIS, the development of value chains, etc.) are at the top of the policy agenda in this area.

In the Argentine case, the existence of a significant number of firms with high absorption capabilities is a very good basis for devising public policies aimed at strengthening and expanding these capabilities, though certainly research is required to assess the existing policies and suggest appropriate and more focused policy instruments.

In the current situation in which the economy is growing again, the existing enterprise, innovation and investment policies should be assessed and expanded to be able to foster far more domestic investments in fixed and intangible assets. In this way, it will be possible to obtain even more positive spillovers from the substantial stock of FDI that Argentina has received in the boom of the 1990s and hopefully from the flows it may receive in the years to come. Since Brazil has taken the lead on many of these policies, the MERCOSUR dimension in any effort in this field should be a priority not only to level the playing field but also to search for common opportunities.

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Table 1. Foreign Sectoral Shares

SECTOR	1992				1996				1998				2001			
	N° TNCs affiliates	% on total firms	% on employment	% on total sales	N° TNCs affiliates	% on total firms	% on employment	% on total sales	N° TNCs affiliates	% on total firms	% on employment	% on total sales	N° TNCs affiliates	% on total firms	% on employment	% on total sales
15 Food & beverages	6	4.3	11.9	16.1	12	8.3	24.2	28.2	17	12.1	26.4	37.3	19	13.2	27.0	40.4
16 Tobacco	1	100.0	100.0	100.0	1	100.0	100.0	100.0	1	100.0	100.0	100.0	1	100.0	100.0	100.0
17 Textile & apparel	2	3.1	2.3	2.5	4	6.2	15.9	13.6	5	7.5	12.6	15.0	7	10.6	13.8	23.4
18 Clothing	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0
19 Leather & footwear	0	0.0	0.0	0.0	1	7.7	6.5	6.4	1	7.7	8.2	7.1	1	7.7	13.1	10.4
20 Wood & wood products & cork processing, except furniture	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0	2	10.5	29.6	70.6
21 Pulp, paper & paper products	2	10.5	23.5	24.3	4	19.0	41.9	57.2	4	19.0	31.2	56.0	3	14.3	23.0	50.5
22 Publishing & printing	2	5.7	19.2	8.2	3	8.1	19.5	13.9	4	10.8	22.2	18.0	4	10.5	24.9	20.7
23 Petroleum	2	25.0	78.9	92.3	3	37.5	81.3	89.8	3	37.5	73.6	92.0	3	37.5	79.2	94.0
24 Chemicals	22	31.0	46.3	56.4	30	40.0	55.3	64.4	34	46.6	59.9	69.6	35	47.3	59.6	71.8
25 Rubber & plastics	4	9.3	20.5	26.3	6	13.0	25.4	25.8	6	14.0	23.8	27.6	7	15.2	30.6	40.7
26 Non-metallic minerals	6	16.7	23.8	34.8	8	21.1	37.0	45.3	8	21.1	34.9	42.7	9	23.7	43.0	47.9
27 Steel & aluminum	3	13.0	12.9	16.6	5	20.8	20.3	32.9	7	29.2	57.2	65.7	7	29.2	58.4	73.2
28 Metal products, except machinery & equipment	4	10.8	11.3	12.0	6	15.8	17.4	22.9	7	17.9	19.6	25.4	7	17.9	17.8	26.0
29 Machinery & equipment	5	9.1	24.3	29.2	10	17.2	34.1	41.5	13	22.4	31.1	39.3	13	22.4	30.1	44.1
30 Computer & office equipment	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0
31 Electrical machinery & apparatus	3	13.0	43.5	47.1	5	20.8	65.6	70.2	5	20.8	70.0	77.6	5	20.8	68.4	74.6
32 Radio, TV & communication equipment	2	22.2	36.7	35.2	2	22.2	45.8	45.7	3	42.9	48.1	62.9	5	62.5	86.5	96.4
33 Medical, precision & optical instruments	2	20.0	15.0	38.3	3	30.0	14.6	50.3	3	30.0	20.4	45.8	3	30.0	23.4	48.2
34 Automotive & transport equipment	3	10.3	14.1	44.0	9	29.0	50.8	50.4	10	32.3	68.9	82.0	12	38.7	68.4	76.4
35 Other transport equipment	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0
36 Manufacture of furniture & other industrial activities	2	7.7	11.8	17.0	2	7.4	12.5	16.3	2	7.7	12.6	18.3	2	7.7	13.3	19.1
Total	71	10.4	22.5	27.3	114	15.9	30.4	35.2	133	18.9	32.8	40.1	145	20.4	36.8	46.7

Source: Own elaboration based on data from the National Innovation Surveys 1992-1996 and 1998-2001.

Table 2. Average number of employees

SECTOR		1992			1996			1998			2001		
		TNCs	Domestic	TNCs / Domestic	TNCs	Domestic	TNCs / Domestic	TNCs	Domestic	TNCs / Domestic	TNCs	Domestic	TNCs / Domestic
15	Food & beverages	1262	321	3.9	1121	271	4.1	912	269	3.4	822	261	3.1
16	Tobacco	2459			1729			1248			1486		
17	Textile & apparel	153	215	0.7	520	161	3.2	303	166	1.8	182	134	1.4
18	Clothing		503			456			467			454	
19	Leather & footwear		640		157	506	0.3	193	434	0.4	350	359	1.0
20	Wood & wood products & cork processing, except furniture		61			59			78		205	54	3.8
21	Pulp, paper & paper products	1310	225	5.8	549	179	3.1	310	161	1.9	278	155	1.8
22	Publishing & printing	454	112	4.0	357	126	2.8	301	128	2.4	319	117	2.7
23	Petroleum	1525	136	11.2	1057	146	7.2	584	158	3.7	693	137	5.1
24	Chemicals	401	222	1.8	344	216	1.6	340	215	1.6	299	201	1.5
25	Rubber & plastics	436	124	3.5	338	129	2.6	261	135	1.9	252	112	2.2
26	Non-metallic minerals	544	281	1.9	434	197	2.2	450	214	2.1	400	153	2.6
27	Steel & aluminum	211	451	0.5	455	607	0.7	1431	362	4.0	1284	207	6.2
28	Metal products, except machinery & equipment	108	129	0.8	128	114	1.1	129	115	1.1	110	114	1.0
29	Machinery & equipment	1049	111	9.5	748	101	7.4	239	120	2.0	202	99	2.0
30	Computer & office equipment												
31	Electrical machinery & apparatus	1223	128	9.6	765	85	9.0	821	73	11.3	619	59	10.6
32	Radio, TV & communication equipment	575	284	2.0	595	201	3.0	343	277	1.2	284	59	4.8
33	Medical, precision & optical instruments	66	93	0.7	45	113	0.4	40	67	0.6	37	52	0.7
34	Automotive & transport equipment	516	426	1.2	541	276	2.0	800	101	7.9	423	64	6.6
35	Other transport equipment		243			136			126			101	
36	Manufacture of furniture & other industrial activities	248	79	3.1	176	75	2.4	177	80	2.2	159	68	2.3
	Average	738	239	3.1	559	208	2.7	493	187	2.6	442	148	3.0

Source: Own elaboration based on data from the National Innovation Surveys 1992-1996 and 1998-2001.

Table 3. Average ratios of labor productivity between TNCs and domestic firms

Sector		Ratio TNCs/Domestic			
		1992	1996	1998	2001
15	Food & beverages	2.32	2.18	2.85	2.41
16	Tobacco				
17	Textile & apparel	0.99	1.20	2.33	4.27
18	Clothing				
19	Leather & footwear		1.57	1.48	1.45
20	Wood & wood products & cork processing, except furniture				6.19
21	Pulp, paper & paper products	0.87	1.99	4.14	5.18
22	Publishing & printing	0.53	0.80	1.17	1.22
23	Petroleum	2.62	1.17	1.82	2.36
24	Chemicals	1.25	1.17	1.19	1.28
25	Rubber & plastics	0.93	0.81	1.95	1.59
26	Non-metallic minerals	1.74	1.70	1.89	1.77
27	Steel & aluminum	0.69	0.95	1.10	1.34
28	Metal products, except machinery & equipment	1.09	1.58	1.22	1.28
29	Machinery & equipment	1.13	1.72	1.47	1.86
30	Computer & office equipment				
31	Electrical machinery & apparatus	1.51	1.91	2.41	2.10
32	Radio, TV & communication equipment	1.33	1.25	0.92	4.50
33	Medical, precision & optical instruments	2.02	3.20	2.88	0.96
34	Automotive & transport equipment	2.51	1.64	2.32	2.45
35	Other transport equipment				
36	Manufacture of furniture & other industrial activities	1.82	1.69	2.57	3.35
	Average	1.46	1.56	1.98	2.53

Source: Own elaboration based on data from the National Innovation Surveys 1992-1996 and 1998-2001.

Table 4. Average ratios between skilled and non-skilled employees

Sector		1992		1996		1998		2001	
		TNCs	Domestic	TNCs	Domestic	TNCs	Domestic	TNCs	Domestic
15	Food & beverages	0.25	0.06	0.32	0.06	0.50	0.27	0.51	0.28
16	Tobacco	0.40		0.42		0.23		0.23	
17	Textile & apparel	0.09	0.06	0.13	0.07	0.36	0.21	0.29	0.23
18	Clothing		0.03		0.04		0.30		0.33
19	Leather & footwear		0.06	0.05	0.07	0.09	0.19	0.08	0.18
20	Wood & wood products & cork processing, except furniture		0.03		0.05		0.23	0.59	0.21
21	Pulp, paper & paper products		0.10	0.19	0.09	0.39	0.33	0.50	0.34
22	Publishing & printing	0.52	0.12	0.42	0.17	0.79	0.46	0.86	0.49
23	Petroleum	0.40	0.26	0.38	0.28	0.56	0.63	0.62	0.66
24	Chemicals	0.33	0.20	0.31	0.22	0.58	0.48	0.62	0.50
25	Rubber & plastics	0.20	0.12	0.16	0.12	0.31	0.30	0.40	0.33
26	Non-metallic minerals	0.21	0.08	0.18	0.09	0.38	0.25	0.44	0.26
27	Steel & aluminum	0.20	0.13	0.16	0.15	0.37	0.29	0.35	0.30
28	Metal products, except machinery & equipment	0.14	0.09	0.19	0.11	0.39	0.31	0.43	0.32
29	Machinery & equipment	0.30	0.16	0.23	0.16	0.46	0.38	0.49	0.37
30	Computer & office equipment	0.48	0.09	0.38	0.11	0.48	0.29	0.48	0.30
31	Electrical machinery & apparatus	0.65	0.36	0.76	0.35	0.66	0.20	0.58	0.41
32	Radio, TV & communication equipment	0.43	0.21	0.42	0.21	0.76	0.47	0.74	0.46
33	Medical, precision & optical instruments	0.28	0.11	0.20	0.13	0.50	0.29	0.50	0.32
34	Automotive & transport equipment		0.26		0.23		0.46		0.44
35	Other transport equipment	0.07	0.06	0.08	0.07	0.67	0.23	0.67	0.27
36	Manufacture of furniture & other industrial activities								
Average		0.31	0.13	0.28	0.14	0.47	0.33	0.49	0.35

Source: Own elaboration based on data from the National Innovation Surveys 1992-1996 and 1998-2001.

Table 5. Innovative expenditures by domestic firms and TNCs affiliates (% on sales)

Innovative Expenditures		1992		1996		1998		2001	
		TNCs	Domestic	TNCs	Domestic	TNCs	Domestic	TNCs	Domestic
R&D	Average	0.46	0.97	0.59	0.89	0.63	0.95	0.56	1.10
	%*	36.2	20.8	39.5	26.8	36.9	23.2	41.3	25.2
Technology Acquisition	Average	2.81	5.67	5.06	3.97	4.65	4.11	2.51	2.94
	%*	69.6	24.1	71.1	41.2	46.2	30.5	49.0	27.6
Total	Average	2.87	4.12	5.14	3.81	4.15	3.80	2.69	3.15
	%*	81.2	42.7	78.9	56.7	62.3	42.1	65.0	40.5

Source: Own elaboration based on data from the National Innovation Surveys 1992-1996 and 1998-2001.

* % of firms (on each group) that reported a positive value for the respective variable.

Table 6. Matrix of correlations

	LPRODUCT	OWN	DOWN	SEXTL	(OWN*SEXTL)	SIZE	SKILLS	XTOTL	MEXKL	INVL	INNOVEXL	M&A	GROUP	LAPERT	EFPROT	A_96	A_98	A_01
LPRODUCT	1.00																	
OWN	0.23	1.00																
DOWN	0.24	0.93	1.00															
SEXTL	0.17	0.31	0.31	1.00														
(OWN*SEXTL)	0.20	0.86	0.79	0.47	1.00													
SIZE	0.42	0.26	0.26	0.11	0.23	1.00												
SKILLS	0.28	0.27	0.27	0.24	0.28	0.24	1.00											
XTOTL	0.22	0.14	0.15	0.05	0.12	0.16	0.14	1.00										
MEXKL	0.31	0.34	0.32	0.17	0.33	0.24	0.28	0.18	1.00									
INVL	0.17	0.09	0.08	0.03	0.07	0.11	0.07	0.18	0.16	1.00								
INNOVEXL	0.20	0.10	0.10	0.12	0.12	0.13	0.25	0.08	0.15	0.17	1.00							
M&A	0.04	0.21	0.23	0.09	0.19	0.05	0.13	0.09	0.08	0.03	0.05	1.00						
GROUP	0.23	0.33	0.34	0.16	0.32	0.28	0.18	0.08	0.18	0.06	0.09	0.19	1.00					
LAPERT	0.13	0.14	0.16	0.36	0.17	0.07	0.22	0.09	0.16	0.02	0.04	0.03	0.03	1.00				
EFPROT	-0.11	-0.11	-0.10	-0.31	-0.15	-0.05	-0.16	-0.04	-0.08	-0.03	-0.07	-0.06	0.00	-0.10	1.00			
A_96	0.05	0.00	0.00	0.04	-0.01	0.03	-0.25	0.02	0.01	0.06	-0.10	-0.03	0.01	-0.01	0.12	1.00		
A_98	0.04	0.03	0.03	0.07	0.04	0.02	0.24	0.00	0.06	0.02	0.17	0.05	-0.01	0.08	-0.05	-0.34	1.00	
A_01	-0.06	0.06	0.06	0.12	0.06	-0.05	0.28	0.05	0.01	-0.05	0.04	0.14	-0.01	0.15	-0.15	-0.34	-0.33	1.00

Table 7. Results from the estimations of equation (1)

	1	2
	FIXED EFFECTS	RANDOM EFFECTS
	LPRODUCT	LPRODUCT
DOWN	0.2134	0.19507
	[0.06720]***	[0.06735]***
SEXTL	0.12275	0.20936
	[0.10177]	[0.07697]***
(OWN*SEXTL)	-0.45029	-0.45637
	[0.15321]***	[0.14915]***
SIZE	0.44962	0.49428
	[0.03479]***	[0.03373]***
SKILLS	0.50107	0.53232
	[0.07550]***	[0.07422]***
XTOTL	0.00192	0.00196
	[0.00035]***	[0.00035]***
MEXKL	0.00379	0.0036
	[0.00051]***	[0.00051]***
INVL	0.00275	0.003
	[0.00088]***	[0.00090]***
INNOVEXL	0.01654	0.01668
	[0.00328]***	[0.00332]***
M&A	-0.03451	-0.04824
	[0.04143]	[0.04172]
GROUP	0.13728	0.14301
	[0.03707]***	[0.03748]***
LAPERT	0.07201	0.04239
	[0.02485]***	[0.01910]**
EFPROT	0.00268	-0.00749
	[0.00283]	[0.00225]***
A_96	0.01426	0.02015
	[0.04253]	[0.04172]
A_98	-0.13155	-0.15051
	[0.04734]***	[0.04469]***
A_01	-0.23922	-0.26607
	[0.04960]***	[0.04582]***
Constant	2.43656	2.57817
	[0.13349]***	[0.11832]***
Observations	2425	2425
Number of SECTORS	16	16
R-squared	0.25	

Standard errors in brackets

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

Test

F	F(16,2393)=48.61	
Prob > F	0.00	
F all u_i=0	F(15,2393)=7.01	
Prob > F	0.00	
Breusch Pagan		Chi2 (1)=167.9
Prob > chi2		0.00
Hausman		Chi2 (1)=46.78
Prob > chi2		0.00

Table 8. Results from the estimations analyzing absorption capabilities of domestic firms and innovative behavior of TNCs affiliates

	1	2
	DOMESTIC FIRMS' ABSORPTION CAPABILITIES	AFFILIATES' INNOVATIVE BEHAVIOR
	LPRODUCT	LPRODUCT
DOWN	0.24781	0.21156
	[0.06794]***	[0.06741]***
SEXTL	-0.00295	0.14725
	[0.10903]	[0.12252]
(OWN*SEXTL)	-0.30508	-0.4749
	[0.15962]*	[0.16785]***
ACIHIGH	0.3042	
	[0.09585]***	
ITBACT		-0.03982
		[0.11082]
SIZE	0.43478	0.44898
	[0.03503]***	[0.03484]***
SKILLS	0.46954	0.5022
	[0.07601]***	[0.07558]***
XTOTL	0.00192	0.00193
	[0.00035]***	[0.00035]***
MEXKL	0.00383	0.00379
	[0.00051]***	[0.00051]***
INVL	0.00278	0.00274
	[0.00088]***	[0.00088]***
INNOVEXL	0.01575	0.01655
	[0.00329]***	[0.00328]***
M&A	-0.03365	-0.03506
	[0.04135]	[0.04147]
GROUP	0.13019	0.13694
	[0.03706]***	[0.03709]***
LAPERT	0.07398	0.07173
	[0.02481]***	[0.02486]***
EFPROT	0.0029	0.00264
	[0.00282]	[0.00283]
A_96	0.00945	0.01458
	[0.04248]	[0.04255]
A_98	-0.12992	-0.13134
	[0.04725]***	[0.04735]***
A_01	-0.23761	-0.23891
	[0.04950]***	[0.04961]***
Constant	2.46412	2.43887
	[0.13352]***	[0.13367]***
Observations	2425	2425
Number of SECTORS	16	16
R-squared	0.25	0.25

Standard errors in brackets

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

Test

F	F(17,2392)=46.52	F(17,2392)=45.74
Prob > F	0.00	0.00
F all u_i=0	F(15,2392)=6.92	F(15,2392)=6.81
Prob > F	0.00	0.00

Table 9. Results from the estimations combining domestic firms' absorption capabilities and TNCs innovative behavior

	DOMESTIC FIRMS' ABSORPTION CAPABILITIES and TNCs INNOVATIVE BEHAVIOR
	LPRODUCT
DOWN	0.25398 [0.06862]***
SEXTL	-0.04226 [0.14289]
(OWN*SEXTL)	-0.28673 [0.17860]
ACIHIGHA	0.28317 [0.14826]*
ACIHIGHP	0.40399 [0.14036]***
ACILOWA	0.06234 [0.14794]
SIZE	0.43398 [0.03508]***
SKILLS	0.47578 [0.07628]***
XTOTL	0.00192 [0.00035]***
MEXKL	0.00383 [0.00051]***
INVL	0.00279 [0.00088]***
INNOVEXL	0.01589 [0.00329]***
M&A	-0.03503 [0.04140]
GROUP	0.13093 [0.03710]***
LAPERT	0.07327 [0.02483]***
EFPROT	0.00283 [0.00283]
A_96	0.01115 [0.04252]
A_98	-0.12899 [0.04727]***
A_01	-0.23661 [0.04953]***
Constant	2.46935 [0.13374]***
Observations	2425
Number of SECTORS	16
R-squared	0.25

Standard errors in brackets

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

Test

F	F(19,2390)=41.66
Prob > F	0.00
F all u_i=0	F(15,2390)=6.75
Prob > F	0.00

Table 10. Results from the estimations combining inter-sectoral spillovers and domestic firms' absorption capabilities

	1	2
	INTER-SECTORAL SPILLOVERS	INTER-SECTORAL SPILLOVERS and ABSORPTION CAPABILITIES
	LPRODUCT	LPRODUCT
DOWN	0.13601 [0.07879]*	0.1921 [0.07956]**
BACKWARD	0.09711 [0.16462]	-0.15374 [0.1739]
(OWN*BACKWARD)	-0.0026 [0.00261]	-0.00073 [0.00264]
BACK_HIGH		0.43836 [0.10101]***
SIZE	0.44756 [0.03485]***	0.42137 [0.03524]***
SKILLS	0.49242 [0.07538]***	0.43069 [0.07644]***
XTOTL	0.00194 [0.00035]***	0.00195 [0.00035]***
MEXKL	0.00373 [0.00051]***	0.00381 [0.00051]***
INVL	0.00274 [0.00089]***	0.00277 [0.00088]***
INNOVEXL	0.0166 [0.00329]***	0.01574 [0.00329]***
M&A	-0.03375 [0.04159]	-0.03576 [0.04144]
GROUP	0.13413 [0.03713]***	0.12372 [0.03707]***
LAPERT	0.07234 [0.02619]***	0.07087 [0.02609]***
EFPROT	0.00296 [0.00284]	0.00314 [0.00283]
A_96	0.01838 [0.4484]	0.02129 [0.04468]
A_98	-0.13009 [0.05315]**	-0.11101 [0.05314]**
A_01	-0.23847 [0.05726]***	-0.21995 [0.05721]***
Constant	2.44010 [0.14216]***	2.5204 [0.14284]***
Observations	2425	2425
Number of SECTORS	16	16
R-squared	0.24	0.25

Standard errors in brackets.

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

F	F(16,2393)=47.98	F(17,2392)=46.61
Prob > F	0.00	0.00
F all u_i=0	F(15,2393)=7.20	F(15,2392)=7.39
Prob > F	0.00	0.00

Annex 1. The results of the received literature on FDI spillovers

	AUTHOR / S	COUNTRIES	YEAR/S	DATA	AGGREGATION	RESULTS
	a) Developed Countries					
1	Caves (1974)	Australia	1966	Cross-Sectional	Industry	+
2	Globerman (1979)	Canada	1962	Cross-Sectional	Industry	+
3	Barrios (2000)	Spain	1990-94	Panel	Firms	Mixed (R&D)
4	Girma, Greenaway and Wakelin (2000)	United Kingdom	1991-96	Panel	Firms	Mixed (TG)
5	Girma and Wakelin (2000)	United Kingdom	1988-96	Panel	Firms	?
6	Liu, Siler, Wang and Wei (2000)	United Kingdom	1991-95	Panel	Industry	+
7	Braconier, Ekholm and Knarvik (2001)	Sweden	1978-94	Panel	Firms	?
8	Castellani and Zanfei (2001)	France, Italy and Spain	1993-97	Panel	Firms	? + (FOR)
9	Driffield (2001)	United Kingdom	1989-92	Cross-Sectional	Industry	+
10	Girma and Wakelin (2001)	United Kingdom	1980-92	Panel	Firms	?
11	Harris and Robinson	United Kingdom	1974-95	Panel	Firms	?
12	Barrios, Dimelis, Louri and Strobl (2002)	Greece, Ireland and Spain	1993-97	Panel	Firms	? + (AC)
13	Barrios and Strobl (2002)	Spain	1990-94	Panel	Firms	?
14	Castellani and Zanfei (2002)	Italy	1992	Panel	Firms	+ (PG)
15	Dimelis and Louri (2002)	Greece	1997	Cross-Sectional	Firms	? +
16	Driffield and Love (2002)	United Kingdom	1984-95	Panel	Firms	Mixed (FDI)
17	Girma (2002)	United Kingdom	1989-99	Panel	Firms	?
18	Görg and Strobl (2002a)	Ireland	1973-96	Panel	Firms	Mixed (IND)
19	Haskel, Pereira and Slaughter (2002)	United Kingdom	1973-92	Panel	Firms	+ (AC-TG)
20	Ruane and Ugur (2002)	Ireland	1991-98	Panel	Firms	? + (FOR)
21	Keller and Yeaple (2003)	USA	1987-96	Panel	Firms	+ (FOR)
	b) Developing Countries					
22	Blomström and Persson (1983)	Mexico	1970	Cross-Sectional	Industry	+
23	Blomström (1986)	Mexico	1970/75	Cross-Sectional	Industry	+
24	Haddad and Harrison (1993)	Morocco	1985-89	Panel	Firms	-
25	Blomström and Wolff (1994)	Mexico	1970/75	Cross-Sectional	Industry	+
26	Kokko (1994)	Mexico	1970	Cross-Sectional	Industry	? +
27	Kokko (1996)	Mexico	1970	Cross-Sectional	Industry	+
28	Kokko, Tansini and Zejan (1996)	Uruguay	1988	Cross-Sectional	Firms	?
29	Kinoshita (1999)	China	1990-92	Panel	Firms	?
30	Tansini and Zejan (1998)	Uruguay	1988-90	Cross-Sectional	Firms	+
31	Blomström and Sjöholm (1998)	Indonesia	1991	Cross-Sectional	Firms	+
32	Sjöholm (1999)	Indonesia	1980-91	Cross-Sectional	Firms	+

33	Aitken and Harrison (1999)	Venezuela	1976-89	Panel	Firms	-
34	Chuang and Lin (1999)	Taiwan	1991	Cross-Sectional	Firms	+
35	Kathuria (2000)	India	1976-89	Panel	Firms	-
36	Kugler (2000)	Colombia	1974-98	Panel	Firms	? + (IIS)
37	Patibandla (2000)	India	1989-99	Panel	Firms	? +
38	Kokko, Tansini and Zejan (2001)	Uruguay	1988	Cross-Sectional	Firms	?
39	Görg and Strobl (2002b)	Ghana	1987-96	Panel	Firms	? +
40	Marin and Bell (2003)	Argentina	1992-96	Panel	Firms	? + (FDI)
c) Transition Countries						
41	Djankov and Hoeckman (2000)	Czech Republic	1992-96	Panel	Firms	-
42	Kinoshita (2000)	Czech Republic	1995-98	Panel	Firms	? + (R&D)
43	Konings (2000)	Bulgaria, Poland and Romania	1993-97	Panel	Firms	-
44	Bosco (2001)	Hungary	1993-97	Panel	Firms	-
45	Damijan and Knell (2001)	Slovenia and Estonia	1995-99	Panel	Firms	+
46	Damijan, Majcen, Knell and Rojec (2001)	Bulgaria, Czech Republic, Estonia, Hungary, Poland, Romania, Slovakia and Slovenia	1994-98	Panel	Firms	? or -, + only for Romania
47	Sgard (2001)	Hungary	1992-99	Panel	Firms	? +
48	Schoors and Van der Tol (2002)	Hungary	1997-98	Cross-Sectional	Firms	Mixed
49	Zukowska-Gagelmann (2002)	Poland	1993-97	Panel	Firms	-
50	Smazynska (2003)	Lithuania	1996-2000	Panel	Firms	? + (IIS)

Notes:

1) Aggregation: Industry or firm level data.

2) ? : Non significant results.

3) Mixed: Positive and negative effects.

4) () : Depending on:

AC: Absorptive capabilities.

FDI: Foreign direct investment motivation.

FOR: Alternative measure of industry foreign presence.

IIS: Inter-industry spillovers.

IND: Industry (high tech or low tech).

PG: Productivity gap.

R&D: Research and development expenditures.

TG: Technological gap.

Annex 2. The indices of absorption capabilities and technological behavior

The Absorption Capabilities Index (ACI) was built on the basis of different variables related to quantitative, qualitative and qualitative-quantitative technological factors that the firms answered in the survey. Following Yoguel and Rabetino (2002), for each variable a ranking was constructed with values ranging between 1 and 5, and then the index was calculated weighting those values³⁷. In this way, a firm with an ACI near to 5 has high absorption capabilities, while its capabilities are low if the ACI is close to 1 (which are, respectively, the maximum and the minimum value for the index):

$$ACI = (0.3 * Quantitative) + (0.5 * Qualitative) + (0.2 * Quantitative \& Qualitative) \quad ; 1 \leq ACI \leq 5$$

In the case of foreign firms, we built an Index of Technological Behavior (ITB) taking into account only the quantitative variables (the procedure was similar to that described above for the ACI index).

1) Quantitative aspects

	Weight	Level 1	Level 2	Level 3	Level 4	Level 5
R&D employees relative to total employment	0.30	0	Until 4%	4% - 7.8%	7.8% - 11.9%	Higher than 11,9%
Expenditures in consultancy relative to sales	0.15	Non-existent	Until 0.5%	Until 1%	Until 5%	Higher than 5%
Expenditures in innovations activities relative to sales	0.25	Non-existent	Until 0.1%	Until 0.3%	Until 1%	Higher than 1%
Payments for technology transfer relative to sales	0.05	Non-existent	Until 0.3%	Until 0.4%	Until 0.5%	Higher than 0.5%
Expenditures in capital goods related to new process or new products relative to sales	0.25	Non-existent	Until 1%	Until 2.5%	Until 5%	Higher than 5%

³⁷. In order to test the sensibility of the index, we used another set of weights (also proposed by Yoguel and Rabetino), finding that the distribution of the firms was very similar in all cases.

2) Qualitative aspects

	Weight	Level 1	Level 2	Level 3	Level 4	Level 5
Degree of formalization of R&D activities	0.35	Neither formal nor informal	Informal	Formal	-	Formal and Informal
Use of modern organizational techniques	0.10	None	One or two techniques not included in the following combinations	<i>Manufacturing Resources Planification</i> (MRP) and <i>Just in Time</i> (JIT) or both and one of those include in level 4	Production cells and/or U shaped lines and teamworks	<i>Manufacturing Resources Planification</i> (MRP), <i>Just in Time</i> (JIT), production cells and/U shaped lines and teamworks
Importance assigned to product innovation in firms' strategies	0.35	Until 1	2	3	4	5 and 6
Use of information technology in the relationships with customers and suppliers	0.05	Non-existent	-	Internet	Internet and connection with suppliers OR clients	Internet and connection with suppliers AND clients
The importance of tacit and codified sources of technological information	0.15	0	Until 0.35	Until 0.45	Until 0.55	Higher than 0.55

3) Quantitative-Qualitative aspects:

	Weight	Level 1	Level 2	Level 3	Level 4	Level 5
Expenditures in training activities relative to sales	1	No training activity	Training activity without expenditures	Training expenditures lower than 0.5%	Training expenditures lower than 5%	Training expenditures higher than 5%