TECHNOLOGICAL EFFORTS IN BRAZIL, ARGENTINA AND MEXICO: THE ROLE OF FOREIGN COMPANIES.

Fernanda De Negri (IPEA)

Mariano Laplane (UNICAMP)

ABSTRACT

This paper aims to analyze technological efforts in the three major countries in Latin-America and the role played by transnational corporations in the knowledge production in these countries. For this purpose, we have used the micro data of innovation surveys in the three selected countries and calculated several indicators, some of them disaggregated by capital origin. The results show a strong heterogeneity among the countries as in terms of technological efforts as in terms of the contribution of multinational companies to the local knowledge production. These differences cannot be attributed to the sectoral composition of the industrial product neither to the openness degree of the selected economies. Thus, the contribution of foreign companies to technological development of these countries may be evaluated taking into account the environment and the innovation systems of these countries and the specific characteristics of the subsidiaries using specific econometric procedures.

1 INTRODUCTION

In general, developing countries show less innovation effort and lower innovation rates than developed countries. Specifically, in Latin-American countries, the explanation for this fact was related to the industrialization processes in theses countries, which generated an industrial sector with low propensity to innovate. Other arguments try to explain the lower innovation rates through lower trade openness of these countries or through the strong presence of multinational companies in their industrial sectors.

This paper intends to observe the technological efforts in Latin-American countries more than one decade after the trade openness process in these countries using the micro data of innovation surveys in Brazil, Argentina e Mexico.

It's possible to argue that there are significant differences even among the Latin-American countries under study, concerning both investments on innovation activities and the potential contribution of foreign direct investment to improve their technical basis. Thus, besides characterizing the sample chosen, this paper aims to present some general indicators of technological effort in these countries and in their companies, stressing some specificity that differentiates them. To assess the multinational companies' contribution to local technological efforts, some indicators were disaggregated according to the origin of the capital of companies. Moreover, we will also approach methodological aspects related to the treatment of databases used in this study.

2 UNIVERSE OF ANALYSIS: CHARACTERISTICS AND METHODOLOGICAL ISSUES

First of all, it is necessary to circumscribe our universe of analysis and raise some methodological issues that will important during this study. To contextualize our object of study properly, table 1 shows some general indicators of R&D expenditures in the analyzed countries compared to the whole of Latin America and to Spain and the United States.

We observe that, in Latin America and the Caribbean as a whole, about 0.5% of the GDP is spent on research and development, whereas expenditures incurred by more developed countries are higher: 1.07% in Spain and 2.66% in the United States. However, the analysis of the three countries under study shows that Brazil seems to be closer to more developed countries, such as Spain, than to other Latin-American

countries. In Brazil, 0.91% of the GDP (0.97% according to data from the Ministry of Science and Technology) is spent on R&D, while Mexico and Argentina spend 0.41% and 0.44%, respectively.

TABLE 1. R&D EXPENDITURES AS A PERCENTAGE OF GDP AND BUSINESS SHARE IN R&D EXPENDITURES IN SELECTED COUNTRIES: 2004.

COUNTRY / INDICATOR	R&D / GDP (%)	BUSINESS SHARE IN R&D EXPENDITURES (%)
Argentina	0,44	30,7
Brazil[1]	0,91	39,9
Mexico	0,41	35,6
Latin America and Caribbean	0,53	37,3
Spain	1,07	48,0
USA	2,66	63,8

Source: Rede Iberoamericana de Indicadores de Ciência e Tecnologia (RICYT). Indicator available in: http://www.ricyt.edu.ar/ . (1) in Brazil, Ministério da Ciência e Tecnologia (MCT) data for 2003 show values slightly different: R&D expenditures as a percentage of GDP is 0,97% and business share in R&D expenditures is 41,3%.

One of the problems of Latin-American innovation systems[1] is the small share companies have in the financing of R&D activities. That is, most of the R&D carried out in these countries still derives from government and university investments. In this respect, although Brazil has a larger business share in R&D expenditures (39.9%) than Latin America as a whole (37.3%) and than Mexico (35.6%) and Argentina (30.7%), it is still much lower than that of developed countries. In the US, more than 60% of R&D expenditures are financed by companies, whereas in Spain they amount to 48%.

This study is based largely on microdata from the National Innovation Surveys of Argentina, Brazil and Mexico. That is, we will analyze 30% or 40% of the technological effort of these countries that is financed and undertaken by companies, particularly by industrial companies. Despite the specificity of each innovation survey, we discuss that they are for the most part comparable. All three surveys are based on the Oslo Manual, which has as one of its objectives precisely that of enabling cross-country comparability.

The Argentine survey, specifically, follows some of the principles of the Bogotá Manual as well, which make it a little more comprehensive than the Brazilian and Mexican ones. Practically speaking, it means that Argentina incorporates some other issues besides those included in the other two surveys, such as the issue about organizational innovations and some indicators of companies' technological balance of payments. In spite of that, the main concepts adopted to measure innovation activities in the three

[1] See, for example, Freeman (1995).

countries, such as product and process innovation[2] and R&D are fully compatible. Indeed, as the very Argentine institute of statistics argues, the survey tried to respect some basic characteristics: i) indicators must be comparable to the first Argentine survey; ii) they must be comparable internationally, especially to the CIS III[3] of European countries and to other Latin-American countries, i.e., they must correspond conceptually to criteria adopted in the Oslo, Frascati and Bogotá Manuals (INDEC, 2001).

In this sense, our sampling criteria too follow the standards established in the Oslo Manual. In all three surveys, sampling is random, stratified by sector of activity and groups of company size – according to people employed and income –, and represents all industry. In Mexico, besides the manufacturing industry, we take into account mining, construction, and services. In Brazil and Argentina, the target population consists of industrial companies only. Therefore, the first necessary frame to guarantee the comparability of surveys was the sectoral frame. This study will analyze only companies in the manufacturing industry of the three countries.

A relevant aspect is the size group of sampled companies. The Brazilian and Argentine surveys represent all companies with more than ten employees, whereas the Mexican one concerns companies with more than fifty employees. The latter was, therefore, the cutoff criterion for the Brazilian and Argentine surveys. In Brazil, for instance, the original sample has 11,300 companies with more than ten employees, representing 84,300 industrial firms. In the sample reduced to be compatible with the Mexican criterion, there are little more than 6,100 companies with more than fifty employees – representing a universe of 16,746 industrial firms (table 2). The same cutoff procedure was adopted for the Argentine survey.

Another important difference is the period covered by each survey. The Mexican survey was carried out in 2001 and covers 1999 and 2000. Qualitative questions – such as whether the company has innovated or not – refer to the whole period, whereas quantitative questions refer to the year 2000, and some of them to both years separately. As to the Brazilian survey, it covers the period 2001-2003; its qualitative questions refer to the whole period and its quantitative questions exclusively to 2003. The Argentine survey covers the period 1998-2001, with quantitative questions in the

[2] Innovation, according to the Oslo Manual and the innovation surveys, is defined by the introduction of a technologically new or substantially improved product in the market or by the introduction of a technologically new or substantially improved production process in the company.

[3] The Community Innovation Survey (CIS) is the innovation survey applied to the European Union countries, and follows the Oslo Manual as well.

years 2001 and 1998, and qualitative questions once again referring to the whole period.

This is one of the limitations to compare these three surveys. The question about whether a company has innovated or not, for example, refers to a two-year period in the Mexican survey, to three years in the Brazilian survey, and to four in the Argentine one. In view of this fact, a simple comparison of variables such as innovation rate[4] might be jeopardized by the different stretch of time in each survey. When we discuss the concept of innovation, we observe that, because it is a rather broad concept, it is reasonable to expect that, in a long enough period of time, most of the companies will develop at least some sort of innovation. Thus, the time span may contribute to magnify the differences observed among innovation rates in the three countries: 28% in Mexico, 42% in Brazil, and 59% in Argentina.

Because of that, and of other questions our work focus on companies' R&D expenditures and not on their decision to innovate. The different periods covered in each survey do not affect the variable R&D expenditures, given that it relates to a single year. It is worth observing that this study adopted the last year surveyed as a reference for measuring R&D expenditures and the number of companies that allocate resources in innovation activities.

These considerations having been made, table 2 shows a description of the sample used, which contains approximately 9,000 companies representing a universe of 28,667 companies with more than fifty employees in the manufacturing industry in the three selected countries[5]. Of them, about 17,000 companies are in Brazil, 8,000 in Mexico, and about 3,800 in Argentina. With regard to insertion in foreign markets, an average of 40% of companies in these countries are exporting. This proportion is higher in Argentina, followed by Mexico and finally by Brazil, where the percentage of exporting companies is 37%.

Regarding the origin of the capital, the Mexican and Argentine surveys have a question about the amount of foreign capital in the total capital of companies. In the Brazilian survey, on its turn, companies inform whether they are national, mixed or foreign. In Brazil, the definition of foreign company corresponds to a company with foreign

[4] Defined as the number of product/process innovative firms in relation to the total.

[5] Of the original sample with 8,806 observations, we removed ten outliers that could bias the results. The numbers in this table are already shown without these ten companies. The criteria to remove outliers were: R&D expenditures higher than 30% of net sales income (nine observations removed) and a very high sample weight associated to high R&D expenditures (one observation removed from the Mexican database). Concerning countries, one outlier was removed from the Argentine database, seven from the Brazilian, and two from the Mexican.

majority interest. Therefore, this was the criterion adopted for the other countries. There are 2,568 companies with foreign majority interest or 9% of the total. The largest foreign share regarding the number of companies is in Argentina, where they represent 15% of the companies and 52% of the sales (table 5) in the manufacturing industry. In Mexico, they are 10% and, in Brazil, 7% of the total of industrial companies, representing 36% and 35% of the industry sales (table 5), respectively.

TABLE 2. NUMBER OF FIRMS IN MANUFACTURING WITH MORE THAN 50 EMPLOYEES INCLUDED IN NATIONAL INNOVATION SURVEYS

NÚMBER OF:	TOTAL	ARGENTINA (2001)	BRAZIL (2003)	MEXICO[2] (2000)
Firms in sample	8.796	1.038	6.151	1.607
Total of Firms	28.667 (100%)	3.853 (100%)	16.746 (100%)	8.069 (100%)
Exporting Firms[1]	11.441 (40%)	1.952 (51%)	6.224 (37%)	3.265 (40%)
Multinational[1]	2.568 (9%)	574 (15%)	1.170 (7%)	824 (10%)
Firms with R&D investments[1]	4.486 (16%)	1.089 (28%)	2.453 (15%)	944 (12%)
Innovative firms[1]	11,556 (40%)	2,285 (59%)	7,031 (42%)	2,240 (28%)

Source: National Innovation Surveys of Argentina (INDEC), Brazil (IBGE) and Mexico (INEGI), in 2001, 2003 and 2000, respectively. (1) Percentage share of each group (exporting firms, multinational firms, firms that invested in R&D and innovative firms) in the total number of Firms is shown below the quantity. (2) Maquilas not included.

An important consideration to be made concerns Mexican maquilas. The Mexican survey stresses the fact that, in the production sense, maquilas are not part of the survey. However, it does not mean that a maquila cannot be included in the draw back regime. For the Mexican survey, maquilas in the production sense are those companies that, besides being included in the draw back regime, export more than 90% of their production. From the point of view of technological efforts, the absence of maquilas in the Mexican technology survey does not have relevant implications, given that these companies practically do not invest in R&D. Even though some studies emphasize the emergence of the so-called "third generation maquiladoras" – which would employ highly qualified labor in more knowledge-intensive activities – the fact is that they still invest very little in R&D: less than 0.01% of sales (Bendenski *et al*., 2004).

With regard to innovation activities, these countries' industry has approximately 4,500 firms (or 16% of the total) reporting expenditures on research and development in the

last year of the period covered in the innovation surveys[6]. Of them, more than 2,400 are in Brazil, little more than 1,000 in Argentina, and about 1,000 in Mexico. It means that, in Brazil, 15% of companies invest in R&D against 12% in Mexico and 28% in Argentina.

The last relevant comment regarding the comparability of innovation surveys is a restriction about Argentina's technological effort indicators. The period covered by the Argentine survey, from 1998 to 2001, coincides with one of the worst recessions in the history of that country, and the last year surveyed was the worst of all. Between 1998 and 2001, there was a sharp fall in sales and investments in the Argentine industry. Likewise, total expenditures on innovation activities dropped markedly – but only in the last year of the series[7]. However, contrary to what one might think, R&D expenditures were not greatly affected by the unfavorable macroeconomic conjuncture. As an evidence of that, sales dropped 11% and total expenditures on innovation activities fell 28%, whereas R&D expenditures increased 21%. Taking that into consideration, R&D expenditures as a proportion of sales increased from 0.19% in 1998 to 0.26% in 2001 (INDEC, 2001; table 3).

[6] Investments in R&D include creative work carried out systematically and bound for increasing knowledge stock, and its use in new applications, according to what is defined in the Oslo and Frascati Manuals.

[7] As we will see in the next section, expenditures on innovation activities include, besides expenditures on R&D, acquisition of machinery and equipment for innovation; acquisition of external technology; software for innovation activities; training; projects; and industrial design.

TABLE 3. TOTAL EXPENDITURES IN INNOVATION ACTIVITIES AND R&D EXPENDITURES AS A PERCENTAGE OF SALES VALUE IN ARGENTINIAN INDUSTRY: 1998 AND 2001 .

Pesos

Year	Sales Value	Expenditures in Innovation Activities	Innovation Activities /Sales Value (%)	R&D Expenditures	R&D / Sales Value (%)
1998	96.894.725.139	1.983.284.925	2,05	182.027.480	0,19
2001	86.558.864.836	1.418.881.410	1,64	221.079.847	0,26

Source: INDEC (2001)

One can advance several hypotheses to explain this behavior. First, the existence of sunk costs in research activities may have led companies to maintain their investments in R&D, despite the unfavorable macroeconomic conjuncture. The second hypothesis, derived from the first: possibly, there is a time lag between the impact of the economic crisis and of the fall in sales on R&D activities. Third, given the deep recession the country suffered at that moment, it is reasonable to expect a large number of bankruptcies and closings. Probably, the companies that remained active were the largest and the most competitive, which are also those more inclined to spend in R&D. However, whatever the reason for increased expenditures on R&D as a proportion of industry sales in a period of recession, it is important to take into account that R&D expenditures – and innovation rates as well – of Argentine companies in 2001 can be overestimated.

3 TECHNOLOGICAL EFFORTS IN THE SELECTED COUNTRIES

Expenditures on innovation activities are composed of a broad group of expenses, besides R&D expenditure. In general, the three surveys allow for the same items in these activities, with two main exceptions. First, the Argentine survey includes management and consulting activities, which does not happen in the Brazilian and Mexican surveys. Second, both the Brazilian and the Mexican surveys include expenditures related to introducing innovations in the market, which does not occur in the Argentine survey. This being the case, we decided to consider as expenditures on innovation activities only elements common to the three surveys[8], namely:

[8] These elements in common represent from 93% (in Brazil) to 94% (in Mexico and Argentina) of the total expenditures on innovation activities, that is, most of these expenditures are covered by the classification adopted.

i) Acquisition of machinery and equipment (including hardware[9]). In the three surveys, this type of expense is considered innovation only when related to the acquisition of goods to innovate or improve products and/or processes. According to the Oslo Manual, the mere change of equipment for other with similar features does not typify innovation.

ii) Expenditures on R&D, defined in the three surveys according to the Oslo and Frascati Manuals. Thus, investments in R&D are resources allocated in "creative work undertaken on a systematic basis in order to increase the stock of knowledge […] and the use of this stock of knowledge to devise new applications" (OECD, 1997). Expenditures on R&D are disaggregated in internal R&D activities – those developed within the company by specific departments or not – and external R&D acquisition.

iii) Acquisition of other external knowledge. These expenditures are composed mainly of technology transfer agreements, license purchasing, acquisition of know how and software for developing innovations in the company.

iv) Industrial projects and technical preparations for production, delivery and/or implementation of product and process innovations.

v) Expenditures on training. These expenditures are considered innovation activities when oriented to new products and/or processes development. Routine training or initial training of new staff in methods and/or production processes already existing in the company are not considered innovation activities.

[9] The Argentine survey is the only that shows expenditures on machinery and equipment apart from expenditures on hardware and software. To harmonize the concept in the three surveys, expenditures on hardware were classified as machinery and equipment, whereas expenditures on software were included in "acquisition of other external knowledge".

TABLE 4. EXPENDITURES IN INNOVATION ACTIVITIES BY TYPE OF ACTIVITY AND OWNERSHIP: ARGENTINA (2001), BRAZIL (2003) E MEXICO (2000).

US$ thousand (PPP)[10])

COUNTRY / TYPE OF EXPENDITURE		LOCALLY OWNED		FOREIGN*		TOTAL	
		VALUE	%	VALUE	%	VALUE	%
ARGENTINA	Equipament and machinery	827.526	72%	445.504	55%	1.273.030	65%
	External knowledge aquisition	93.513	8%	126.984	16%	220.498	11%
	Industrial Proyects	53.594	5%	51.361	6%	104.954	5%
	Training	23.382	2%	27.650	3%	51.032	3%
	R&D	157.347	14%	162.108	20%	319.455	16%
	Total expenditure in innovation	1.155.362	100%	813.608	100%	1.968.970	100%
BRAZIL	Equipament and machinery	5.237.744	51%	4.167.321	52%	9.405.065	51%
	External knowledge aquisition	378.500	4%	327.214	4%	705.714	4%
	Industrial Proyects	1.812.848	18%	1.006.499	13%	2.819.347	15%
	Training	202.257	2%	171.035	2%	373.292	2%
	R&D	2.661.636	26%	2.335.428	29%	4.997.064	27%
	Total expenditure in innovation	10.292.984	100%	8.007.497	100%	18.300.481	100%
MEXICO	Equipament and machinery	1.314.914	75%	450.686	65%	1.765.600	72%
	External knowledge aquisition	61.353	4%	88.410	13%	149.762	6%
	Industrial Proyects	178.331	10%	62.665	9%	240.995	10%
	Training	28.541	2%	39.191	6%	67.731	3%
	R&D	163.087	9%	53.732	8%	216.819	9%
	Total expenditure in innovation	1.746.225	100%	694.683	100%	2.440.907	100%

*Source: National Innovation Surveys of Argentina (INDEC), Brazil (IBGE) and Mexico (INEGI), in 2001, 2003 in 2000, respectively. All data from firms with more than 50 employees. *Foreign firms are those with more than 50% foreign share in equity ownership.*

The analysis of the structure of expenditures on innovation activities – carried out in table 4 – may contribute to assess the different technology strategies adopted by companies in the three countries and how these strategies can differ among foreign and domestic firms.

In general, in the three countries, investments in R&D represent a small part of expenditures on innovation activities. Most of these expenditures are composed of machinery and equipment acquisition: 65% in Argentina, 51% in Brazil, and 72% in Mexico. The highest share in R&D expenditures in the total expenditures on innovation activities is in Brazil: 27% of innovation activities are investments in research and development. In Argentina, this share amounts to 16% and, in Mexico, to less than 9%. Expenditures on industrial projects also represent a not negligible part of expenditures on innovation activities in Brazil (15%) and in Mexico (10%). In Argentina, on its turn,

[10] Amounts were converted from original currencies to American dollar, using the exchange rate, according to the purchasing power parity available in the World Bank database (International Comparison Programme Database). The exchange rate of domestic currency per US$ was: 0.623 in Argentina, 1.101 in Brazil, and 6,29 in Mexico.

the acquisition of external knowledge is the third most important item in expenditures, with 11% of the total. Therefore, it seems that the technology strategies adopted by Brazilian companies are more strongly oriented to knowledge production than in the Mexican and Argentine firms, where the acquisition of external knowledge – incorporated or not to capital goods – seems to play a more relevant role.

If we look at the structure of expenditures on innovation activities from the point of view of the origin of the capital of companies, we can see that, in Brazil, multinational companies allocate these expenditures in a way quite similar to that of domestic companies (table 4). In Mexico and Argentina, however, there are important differences. The portion of expenditures assigned to purchase machinery and equipment is smaller among the foreign than among the domestic companies. On the other hand, another expenditure item – acquisition of external knowledge – takes on greater relevance among the multinationals.

These numbers suggest that, in Mexico and Argentina, there are differentiated innovation strategies between the two groups of companies. Innovations carried out by domestic firms in these countries seem much more related to the acquisition of embodied technology, that is, the purchase of machinery for innovation. Conversely, foreign firms direct their innovation activities more to the acquisition of licenses, software and know-how and to technology transfer agreements. Probably, in this case, the company that supplies technology to a local subsidiary is its parent company or another affiliate of the same corporation. In Brazil, on its turn, the multinationals' technology strategies seem closer to those adopted by domestic companies: they are not so strongly based on machinery acquisition – as they are in the other two countries – and more based on their own production of technology.

The diversity of technology strategies adopted by foreign companies has already been confirmed by Franco (2004) in the Brazilian case. The author tried to map these strategies based on multinationals' expenditures on innovation activities, and segmented the Brazilian affiliates according to their different strategies. Here, the difference is in observing – in a generic and less profound way[11] – the diversity of strategies across the three largest Latin-American countries and across transnational and domestic companies, instead of observing the diversity of strategies within each country. These differences have implications for countries that receive foreign direct

[11] In her study, the author conducts a factor analysis of expenditures on innovation in Brazilian affiliates to characterize their different technology strategies. Given that this is not the final objective of this study, we are considering only the average distribution of such expenditures to make some inferences about these strategies.

investment, especially from the point of view of the contribution this investment can give to building technology capacity in these countries. Probably, a technology strategy based on knowledge production has higher potential to generate externalities for the rest of the economy than a strategy based on the acquisition of technology from third parties.

TABLE 5. PERCENAGE DISTRIBUTION OF INNOVATION ACTIVITIES BY TYPE OF ACTIVITY AND TECHNOLOGICAL INTENSITY OF MANUFACTURING BRANCHES: ARGENTINA (2001), BRAZIL (2003) E MEXICO (2000).

COUNTRY / TYPE OF EXPENDITURE		TECNNOLOGICAL INTENSITY OF BRANCHES			
		LOW	MEDIUM-LOW	MEDIUM-HIGH	HIGH
ARGENTINA	Equipament and machinery	71%	79%	60%	38%
	External knowledge aquisition	10%	5%	14%	18%
	Industrial Proyects	7%	5%	4%	5%
	Training	3%	2%	3%	3%
	R&D	9%	9%	20%	36%
	Total expenditure in innovation	100%	100%	100%	100%
BRAZIL	Equipament and machinery	68%	47%	52%	26%
	External knowledge aquisition	2%	5%	3%	7%
	Industrial Proyects	20%	20%	10%	14%
	Training	2%	2%	2%	3%
	R&D	8%	26%	32%	50%
	Total expenditure in innovation	100%	100%	100%	100%
MEXICO	Equipament and machinery	78%	64%	73%	77%
	External knowledge aquisition	7%	3%	8%	3%
	Industrial Proyects	10%	21%	5%	2%
	Training	1%	1%	5%	1%
	R&D	4%	11%	9%	17%
	Total expenditure in innovation	100%	100%	100%	100%

Source: National Innovation Survey of Argentina (INDEC), Brazil (IBGE) and Mexico (INEGI), in 2001, 2003 and 2000, respectively. All data from firms with more than 50 employees.

Predominance of one strategy or the other may be influenced by different sectoral innovation standards and by the technology intensity of the sector under analysis. In this sense, it is important to emphasize how the distribution of expenditures on innovation activities changes according to the sector surveyed. In more technology-intensive sectors[12], the part of such expenditures allocated in R&D is much higher in relation to less technology-intensive sectors (table 5). In Brazil, R&D expenditures in more technology-intensive sectors come to represent half of what companies spend on innovation activities in general. In Argentina and Mexico, this amount is rather inferior to that of Brazil, but much higher than that observed in other sectors: 36% and 17%, respectively.

[12] The sectoral classification adopted, according to technology intensity, corresponds to that proposed by OECD (2001). In the next section, we detail the procedures adopted in this classification.

Concurrently with the increase in R&D expenditures in more technology-intensive sectors, one observes a reduction of that part of expenditures on innovation activities directed to machinery and equipment. In other words, in these sectors, the technology strategies of companies seem to be based more on knowledge production, by means of R&D, and less on the acquisition of embodied technology. Mexico, once again, shows a different pattern, in which even in technology-intensive sectors the acquisition of machinery and equipment represents almost 80% of the expenditures on innovation activities.

Now we proceed to the analysis of R&D expenditures strictly speaking. The Brazilian industry is the one that has the highest ratio between R&D expenditures and total sales in the manufacturing industry (table 6). The Brazilian industrial companies spend, in aggregate terms, 0.64% of their sales[13] in research and development activities, whereas the Argentine industry spends 0.26% and Mexico only 0.08% of sales on R&D. Even the Brazilian effort, which is the strongest of the three countries, is still very modest when compared to that of developed countries, which spend some 2% of their sales in this activity[14]. Yet, the stronger innovation effort of the Brazilian industry, associated with its size, results in more than 90% of US$ 5,5 bi in industrial investments in R&D in the three main Latin-American economies being made in Brazil. This share is larger, for instance, than the Brazilian share in the industry sales of these three countries, which is close to 66%.

In the three countries, most of the research and development is carried out within the firms: more than 80% (in Argentina) and approximately 90% (in Brazil and Mexico) are internal R&D (table 6). Between domestic and foreign, there are no significant differences in the percentage of R&D conducted internally *versus* the percentage bought from other companies[15].

Table 6 shows that the relevance of multinational companies in the total volume of expenditures on R&D in the Brazilian and Argentine industries is unquestionable. About half of the industry's technological effort in the two countries derives from these corporations. In Brazil, these companies' share in research expenditures (47%) is larger even than their share in the industry's sales (35%). Besides, both the percentage of companies that invest in R&D, which is of 38% among the foreign against 13% of the domestic firms, and the aggregate relation between R&D and sales is higher in the foreign group than among domestic companies.

[13] Measured as Net Sales in the three countries.
[14] To mention just a few examples, in Germany this number is 2.7% and, in France, 2.5%.
[15] Thus, in the remainder of this paper, we will analyze the companies' total expenditures on R&D, without concerning about the separation of internal R&D and external R&D.

In Argentina, in spite of 51% of expenditures on R&D be incurred by foreign companies, this share is not larger than their share in sales (52%). The percentage of companies with investments in R&D is the same in the two groups of companies and the amount of such expenditures, as a percentage of sales, is slightly higher among domestic companies.

However, in Mexico, multinationals' contribution to that country's technological effort is at least questionable. While these companies answer for 36% of the industry's sales, their share in R&D expenditures is of 25%. In spite of the proportion of foreign companies with investments in R&D being higher, 21% against 12% of domestic companies, their expenditures on research as a proportion of sales are lower (0.05%) than the average of Mexican domestic companies (0.09%).

TABLE 6. INNOVATION EFFORT, BY OWNERSHIP: ARGENTINA (2001), BRAZIL (2003) E MEXICO (2000).

US$ thousands (PPP)

COUNTRY	VARIABLES	LOCALLY OWNED	FOREIGN*	TOTAL
ARGENTINA	R&D expenditures (internal+external) (1)	157.347 (49%)	162.108 (51%)	319.455 (100%)
	Internal R&D / total R&D	81,7%	84,1%	82,9%
	Sales value** (2)	58.925.310 (48%)	64.166.171 (52%)	123.091.481 (100%)
	R&D / Sales value (1 / 2)	0,27%	0,25%	0,26%
	Proportion of firms that invest in R&D	28%	28%	28%
BRAZIL	R&D expenditures (internal+external) (1)	2.661.636 (53%)	2.335.428 (47%)	4.997.064 (100%)
	Internal R&D / total R&D	88,4%	87,8%	88,1%
	Sales value ** (2)	513.536.798 (65%)	271.131.319 (35%)	784.668.117 (100%)
	R&D / Sales value (1 / 2)	0,52%	0,86%	0,64%
	Proportion of firms that invest in R&D	13%	38%	15%
MEXICO	R&D expenditures (internal+external) (1)	163.087 (75%)	53.732 (25%)	216.819 (100%)
	Internal R&D / total R&D	88,8%	86,2%	88,1%
	Sales value ** (2)	179.871.457 (64%)	101.808.141 (36%)	281.679.598 (100%)
	R&D / Sales value (1 / 2)	0,09%	0,05%	0,08%
	Proportion of firms that invest in R&D	11%	21%	12%

*Source: National Innovation Surveys of Argentina (INDEC), Brazil (IBGE) and Mexico (INEGI), in 2001, 2003 and 2000, respectively. All data from firms with more than 50 empolyees. * Foreign firms are those with more than 50% foreign share in equity ownership. **Net Sales Value in the three national surveys.*

The main conclusions to be drawn from the analysis of these numbers are that the three major economies of Latin America seem rather different in their technological efforts. Likewise, the contribution of multinational corporations to technology production in these countries is also substantially different. It seems that Brazil is the country where the technological efforts of foreign companies are more significant. Argentina is

in an intermediate position, and Mexico is the country where multinationals are less committed to knowledge production.

One can argue that these differences derive from several factors, both related to the firm's characteristics and to these countries' industrial structure. The following sections try to analyze some of these characteristics in more depth.

4 PRODUCTION AND TRADE SPECIALIZATION

Some authors argue that the industrial structure and the production specialization of a country impose limits to its technological development and to the intensity with which new technology is used in industry (Erber, 2000). There is clearly a correlation between production specialization and knowledge generation. Incidentally, this correlation can be inferred from the higher proportion of R&D expenditures over the total expenditures on innovation activities we observed in table 5 for the most knowledge-intensive sectors.

The study by Cimolli *et al*. (2005) has also observed, in a sample of 17 countries, a positive correlation between the share of knowledge diffusion sectors in industry and the technological variables, such as R&D in relation to GDP and the number of patents granted. They stress that, among Latin American countries, Mexico and Brazil were those which showed a more marked growth in the share of dynamic sectors in the industry: a sign of a structural change in this sector. The role of the so-called "structural change" in growth and technological development of countries is emphasized by Katz (2006) as well. According to this author, "a growing economy is one that becomes more complex and sophisticated through time by the creation of new sectors of economic activity and the entry of new, more-knowledge-intensive, forms of production organization" (our translation). In other words, what the authors of this tradition try to demonstrate is that an economic development process is a production structure transformation process, marked by the emergence of new, more knowledge-intensive, activities and companies.

The same author points to structural change indicators for some countries in Latin America. He shows that, in the last 30 years in Brazil, labor-intensive sectors lost ground in the industrial structure of the country, whereas engineering-intensive sectors gained ground. A similar movement occurs in Mexico, where natural resources-intensive sectors lose ground to engineering-intensive ones – especially the automotive sector. These structural changes observed in Brazil and Mexico would supposedly

have an important influence on the technology capacity of their production structure[16]. However, it is good to remember that, in Mexico, even in the most technology-intensive sectors, technology strategies still seem based more in embodied technology than in knowledge production through R&D (table 5).

To assess the differences in the production structures of the three countries under analysis, table 7 shows the sectoral distribution of industry sales in each one of them. To check the differences in specialization of foreign and domestic companies, this table was designed disaggregating the two groups of companies. According to Ruiz (2005), if multinationals are concentrated in sectors in which host countries are already competitive, and given that, in the case of Latin-American countries, these are little dynamic areas from the point of view of technology, these companies would contribute to widen the distance between these countries and the developed countries. However, if they invest in technical areas in which the country is not specialized, these companies would contribute to create new competencies and, consequently, to shorten the distance that separates them from the developed countries.

The sectoral classification adopted for this analysis was the classification of technology intensity proposed by OECD (2001). This classification is based on the technology intensity of the sectors of economic activity of the International Standard Industrial Classification (ISIC)[17]. Their technology intensity is inferred from R&D expenditures as a proportion of these sectors' sales in the OECD countries. There are four categories in this classification: sectors of low, medium-low, medium-high, and high technology intensity[18].

[16] For Furtado (2004), "*it is common to attribute innovation behaviors to the most technologically advanced sectors, in quite a linear association, which extracts from science and pictures to reach technology development and innovation rapidly. However, this association between advanced sectors and innovation is little suitable in general and totally unsuitable for the Brazilian situation*."

[17] Classifications of economic activities for the three countries are based on ISIC. In spite of that, the Mexican classification has some peculiarities. However, it was possible to make the three countries' classifications compatible with ISIC at a two-digit level. For higher levels of disaggregation, it was not possible to reconcile them.

[18] Some observations about applying this classification to the available data. In Argentina, it was not possible to disaggregate the sector "other transport equipment" (ISIC 35). The whole sector was classified as a medium-high technology-intensive sector, although aerospace industry is classified as high technology-intensive and shipbuilding industry as medium-low. The same limitation was found in the Mexican survey and the same procedure was adopted.

TABLE 7. SALES VALUE OF FIRMS WITH MORE THAN 50 EMPLOYEES BY OWNERSHIP AND TECHNOLOGICAL INTENSITY OF MANUFACTURING BRANCHES: ARGENTINA (2001), BRAZIL (2003) E MEXICO (2000).

US$ thousands (PPP)

	COUNTRY / BRANCHES	Low Intensity	Medium low intensity	Medium high intensity	High intensity	TOTAL
ARGENTINA	Locally owned	35.878.526	9.689.444	8.877.760	4.479.580	58.925.310
		61%	16%	15%	8%	100%
	Foreign	22.413.078	21.131.778	15.222.638	5.398.677	64.166.171
		35%	33%	24%	8%	100%
BRAZIL	Locally owned	215.193.252	181.688.114	94.044.921	22.610.510	513.536.798
		42%	35%	18%	4%	100%
	Foreign	58.400.465	36.076.655	141.290.710	35.363.489	271.131.319
		22%	13%	52%	13%	100%
MEXICO	Locally owned	82.373.312	48.428.520	37.878.242	11.191.383	179.871.457
		46%	27%	21%	6%	100%
	Foreign	13.410.130	7.437.279	48.921.409	32.039.324	101.808.141
		13%	7%	48%	31%	100%

Source: National Innovation Surveys of Argentina (INDEC), Brazil (IBGE) and Mexico (INEGI), in 2001, 2003 and 2000, respectively. All data from firms with more than 50 employees.

We can observe that, in the three countries, domestic companies' sales are mostly concentrated on low and medium-low technology-intensive sectors. However, the distribution of foreign companies across the sectors shows some peculiarities. In Argentina, most of multinationals' sales is in low technology-intensive sectors, following and somehow reinforcing that country's own production specialization.

On the other hand, in Brazil and mainly in Mexico, foreign companies are mostly concentrated on more technology-intensive sectors. Sixty-five per cent of foreign companies' sales in Brazil are in high and, especially, medium-high technology-intensive sectors (52%). In Mexico, this concentration is even greater, with virtually 80% of foreign companies' sales in these two groups of sectors.

Well, then, despite foreign companies established in Mexico belong, for the most part, to technology-intensive sectors, their technological efforts are more modest than those we observe in countries like Brazil and Argentina. In Brazil, we could argue that the concentration of multinationals in more technology-intensive sectors might explain the contribution of foreign direct investment to the technological effort made in the country *vis-à-vis* other countries. However, Mexico has a sectoral distribution of multinationals very similar to that of Brazil, and a much smaller share of these companies in the country's technological effort. Moreover, in Argentina, multinational companies have a

larger share in technological effort than in Mexico, even with foreign direct investment concentrated on low technology-intensive sectors.

Parallel to sectoral distribution of sales, we can also observe trade specialization in the industrial companies with more than 50 employees in the three countries (table 8). As well as the Mexican production structure, its exports are rather concentrated on more technology-intensive sectors: 80% of exports of Mexican industrial companies are from medium-high and high technology-intensive sectors. In Argentina, these sectors' share in exports is of 24% and, in Brazil, of 37%.

This differentiated pattern of trade specialization led Mortimore and Peres (2001) to define two types of commercial insertion for Latin-American countries. Mexico and the Caribbean – which gained market share in the international trade recently and increased the technology level of their exports – are specialized in assembling manufactured products for the North American market. On the other hand, South American countries would have specialized mainly in natural resources.

TABLE 8. PERCENTAGE SHARE OF EXPORTS OF MANUFACTURING FIRMS WITH MORE THAN 50 EMPLOYEES BY OWNERSHIP AND TECHNOLOGICAL INTENSITY OF MANUFACTURING BRANCHES: ARGENTINA (2001), BRAZIL (2003) E MEXICO (2000).

US$ thousand (PPP)

	COUNTRY / BRANCHES	Low intensity	Mediun low intensity	Medium high intensity	High intensity	TOTAL
ARGENTINA	Locally owned	4.883.603	1.511.058	1.595.552	585.405	8.575.618
		57%	18%	19%	7%	100%
	Foreign	9.083.519	6.309.764	3.991.183	660.196	20.044.661
		45%	31%	20%	3%	100%
	Total	13.967.122	7.820.822	5.586.735	1.245.601	28.620.280
		49%	27%	20%	4%	100%
BRAZIL	Locally owned	46.880.014	28.452.599	9.828.467	6.428.643	91.589.724
		51%	31%	11%	7%	100%
	Foreign	14.619.557	9.267.844	33.955.787	7.595.739	65.438.927
		22%	14%	52%	12%	100%
	Total	61.499.571	37.720.444	43.784.255	14.024.382	157.028.651
		39%	24%	28%	9%	100%
MEXICO	Locally owned	6.148.350	5.920.326	11.142.771	1.656.156	24.867.603
		25%	24%	45%	7%	100%
	Foreign	1.455.709	3.110.561	25.120.217	27.470.041	57.156.527
		3%	5%	44%	48%	100%
	Total	7.604.058	9.030.887	36.262.988	29.126.197	82.024.130
		9%	11%	44%	36%	100%

Source: National Innovation Surveys of Argentina (INDEC), Brazil (IBGE) and Mexico (INEGI), in 2001, 2003 and 2000, respectively. All data from firms with more than 50 employees.

Another aspect emphasized by the authors is also evident in the indicators of table 8: the fact that domestic companies in these countries are specialized in homogeneous products. Indeed, in the three countries, a large part of domestic companies' exports is composed of low and medium-low technology-intensive products. On the other hand, most of the foreign companies' exports in Brazil and Mexico are concentrated on more technology-intensive sectors. In Argentina, on its turn, as we observed in sales, multinationals' exports are concentrated on low technology-intensive sectors, as well as the domestics' exports.

These data suggest, first, that sector is not the only factor to explain multinationals' technological behavior in host countries. Obviously these are just preliminary considerations, since it would be necessary to estimate econometric models for companies' R&D expenditures, which should separate sectoral effects from other relevant factors to explain companies' (both domestic and foreign) technological effort in these countries. However, we would like to argue that there are other relevant factors in foreign companies' investment decision in R&D, both specific locational factors in host countries/sectors and, possibly, variables internal to the firms.

Second, trade specialization in more technology-intensive products alone is not a good indicator of technological dynamism. An evidence of this is Mexico, which has a structure of production and exports rather concentrated on technology-intensive sectors that does not reflect internally on knowledge production through R&D nor even in heavier investments in technology activities in general.

5 CHARACTERISTICS OF COMPANIES

As we have already analyzed the technological efforts of industry in the three countries in aggregate terms, it is time to assess some issues from a microeconomic point of view. To what extent are the companies of the three countries different in efficiency, size, and technological effort? What are the differences between domestic and foreign companies in each one of them? Some average indicators of these countries' companies, disaggregated by the origin of the capital, are shown in table 9.

Size is one of the important factors to explain different technology strategies and different R&D intensity across companies. According to table 9, we see that the average size of Brazilian companies is slightly larger than that of Mexican companies, and both are much larger on average than the Argentine ones. In Argentina, companies have about 166 people employed and sales of US$ 32 millions against an average of approximately 240 employees per company in Brazil and Mexico. As to Brazilian and Mexican companies' sales, they are on average US$ 47 and US$ 35 millions, respectively. Concerning efficiency, indicators of labor productivity are higher for the whole of Argentine companies, followed by Brazil and, finally, by Mexico. The same indicators show marked differences across domestic and foreign companies, larger and more productive in the three countries. Again, within the group of foreign companies, those established in Brazil are larger and more productive.

With regard to insertion in foreign markets, as we had already observed in the proportion of exporting companies, Brazil is the country where companies show poorer export insertion (with an average export coefficient of 16.85%). Companies in Argentina and Mexico, on their turn, show higher export coefficients on average: 21.6% in Argentina and 22.9% in Mexico. In Argentina, domestic and foreign companies are not substantially different in relation to this indicator, which does not occur in the other two countries, where the average export coefficient of foreign companies is rather higher than that of domestic companies. However, the most significant difference is in Mexico, where the foreign companies sampled export about 32% of their total sales against little more than 20% in domestic companies. In spite of maquiladoras in the

sense of production being not sampled, in the survey there are foreign companies under the draw back regime, which may explain this high export coefficient in foreign subsidiaries in Mexico.

TABLE 9. FIRM AVERAGE INDICATORS BY OWNERSHIP: ARGENTINA (2001), BRAZIL (2003) E MEXICO (2000).

Valores monetários em US$ (PPP)

Country/ Ownership		Number of Employees	Net Sales Value (NSV)	R&D Expenditures*	Labor Produtivity **	Exports Value	Export Coefficient	R&D/ NSV*
ARGENTINA	Total	166	31.951.017	82.921	135.028	7.429.003	21,66	1,01
	National	150	17.972.878	47.993	106.104	2.615.659	21,45	1,08
	Foreign	261	111.799.912	282.449	300.252	34.924.811	22,52	0,62
BRAZIL	Total	241	46.857.826	298.408	111.093	9.377.240	16,85	2,01
	Nacional	210	32.970.767	170.886	93.033	5.880.364	16,27	2,20
	Foreign	652	231.695.908	1.995.745	351.467	55.920.989	19,74	1,15
MEXICO	Total	237	34.908.861	26.871	92.893	10.165.340	22,89	0,74
	Nacional	215	24.826.978	22.510	81.621	3.432.381	20,56	0,79
	Foreign	429	123.553.570	65.208	191.996	69.364.717	32,14	0,52

Source: National Innovation Surveys of Argentina (INDEC), Brazil (IBGE) and Mexico (INEGI), in 2001, 2003 and 2000, respectively. All data from firms with more than 50 employees. (*)Average value reported by firms that invested in R&D in the last year covered by the survey. (**) Net sales value per employee.

Finally, we proceed to analyze technological effort indicators. Those Brazilian companies that reported R&D expenditures in 2003 spent, on average, in that year, US$ 298,000 on research and development activities. This amount is quite higher than the US$ 83,000 spent by Argentine firms in 2001 and than the US$ 27,000 spent by Mexican companies in 2000. In spite of the fact that Brazilian companies are larger, which explains part of the difference, one should observe that the intensity of technological effort across companies that spend on R&D in the three countries is higher in Brazil as well – both among domestic companies and foreign ones. The Brazilian companies that reported R&D expenditures in 2003 invested about 2% of their sales in this activity, whereas the Argentine and Mexican companies allocated, respectively, 1% and 0.7% of their sales for such purpose. In sum, concerning differences between Brazil and Argentina, despite the latter showing a higher percentage of companies involved in R&D activities, the intensity of R&D expenditures is lower than in Brazil. In Mexico, both the percentage of companies involved in these activities and the technological effort intensity is rather lower than in the other two countries.

Foreign companies show average annual R&D expenditures much higher than domestic companies in the three countries. However, in Mexico, this difference is not as considerable (about three times higher) as in Brazil and Argentina. In Brazil, foreign companies spend, on average, approximately US$ 2 millions on R&D per year, whereas domestic companies spend about US$ 170,000 – one tenth less than the foreign ones. The larger size of multinationals plays a major role in this difference, given that comparatively foreign companies spend 1.15% of sales on R&D and domestic companies, 2.2%. By the way, in the three countries, technological effort intensity is lower among foreign than among domestic companies.

Regarding technology production, the indicators presented in this paper show relevant differences across the Latin-American countries analyzed. Similarly, it is clear how relevant foreign direct investment may be, at least potentially, to expand the technological effort in these countries, either by the large foreign share in the industry of the three economies or by the global leadership exercised by international corporations in technology production. The simple fact that half of R&D investments made by two of these countries come from foreign companies is already a strong reason along the same line. However, the lower intensity of multinationals' technological effort in these countries suggests that there is room to expand international corporations' R&D expenditures in the selected countries.

It is also possible to conclude that the technological behavior of foreign companies is not consistent across the analyzed countries. Several factors may contribute to explain this inconsistent behavior, among them economic and institutional environments more or less favorable to innovation activity, different production specialization in the countries, market size, or even a more or less dense and diversified industrial structure. All these factors may help to explain the differences observed among the Latin-American selected countries.

6 FINAL REMARKS

The results of this paper suggest that the three analyzed countries are very different regarding their productive structures as well their technological efforts. In aggregated terms, Brazilian industry invests a higher share of its sales in research activities than Argentina and, specially, Mexico. In Argentinean industry, there is a higher proportion of firms that develop research and development activities. However, among firms that conduct such activity, the R&D intensity is higher in Brazil. As far as Mexico is concerned, it is the country where there is less knowledge production among the

selected countries: a smaller proportion of firms invest in R&D and these investments are a lower share of the industrial revenue,

This result is particularly relevant if we observe that Mexico has a productive specialization concentrated in knowledge intensive sectors that could suggest a higher degree of knowledge production that, in fact, doesn't happen. In fact some studies have stressed a positive correlation between productive specialization and knowledge production, the results presented in this paper suggest that this correlation can not be necessarily generalized. The high participation of knowledge intensive sectors in the Mexican productive structure is strongly based on assemblage of final products, mainly to the North-American market. This sort of activity hasn't resulted in higher investments on knowledge creation. Argentina, for example, has a higher proportion of production concentrated in low technology sectors and invests much more in R&D then Mexico although less then Brazil that is the one with more local technology production among the three selected countries.

Parallel to differences in terms of technological effort, we can also observe different technological strategies among firms of the selected countries. As it is common in developing countries, also in the countries we have analyzed, a great part of innovation activities is related to the acquisition of embodied technology such as capital goods. This innovation standard is more related to the capacity of using advanced technologies than to develop new technologies inside the firm. Thus, an important part of innovation implemented by firms in these countries comes from external sources, a fact that can be noticed by the amount of resources devoted to the external technology acquisition (including machinery and equipment). There are a plenty of evidences showing that the innovation inputs are complementary and that the capacity to absorb and modify – not only to use– new technologies also requires own technological efforts. If it is true, innovation strategies based only on the acquisition of external technology would have minor potential to generate long run competitive advantages to the firms than those based on both internal R&D expenditures and external technology acquisition[19].

In Argentina and Mexico, firms' innovation strategies are more based on external technology acquisition than in Brazil. In Mexico, the strategy based on acquisition of embodied technology is the most relevant even in high technology intensive sectors. In Brazil and Argentina, on the other side, R&D investments are greater in these sectors, reaching, respectively, something like 50% and 36% of total innovation expenditures.

[19] Lugones, Suárez and Le Clech (2007), for example, have shown that, in Argentina, balanced technological strategies result in a better economic performance of enterprises.

Regarding the role played by transnational corporations in the knowledge production in the selected countries, we can say that the research and development investments made by these firms are very relevant. Approximately a half of all the industry of these countries invest in R&D is made by multinational corporations, except for Mexico where R&D investments of multinational firms are 25% of total R&D. Moreover, the share of multinational firms that invest in R&D is greater than in domestic companies. That is, multinational firms have assumed a proeminent role in the national innovation systems of the selected countries. However, the R&D intensity is lower among multinational firms than among domestic ones, if we look only at firms that have positive R&D spending.

Despite this general picture, there are important differences among the selected countries regarding the commitment of transnational companies with knowledge production. In Brazil, 38% of multinational companies have R&D investments compared to 28% in Argentina end 21% in Mexico. Probably, the size of subsidiaries in Brazil has an important role to explain this difference, since foreign firms in Brazil are greater than in Mexico and Argentina. In this sense, the Brazilian economy provides a superior scale of production which is an important determinant of innovative activities.

These facts seem to suggest the existence of a positive correlation between domestic technological efforts and those conducted by multinational companies. One can formulate several hypothesis to explain this positive relation: spillover effects, for example. We can also argue that the same exogenous variables affect both domestic R&D investment and those made by foreign firms. In this sense, it would be valuable to perform econometric tests to verify if some locational factors could explain the propensity of foreign firms to invest in R&D in Latin-American countries.

7 REFERENCES

Bendensky, L.; De La Garza, E.; Melgoza, J. ; Salas, C. “La Industria Maquiladora de Exportación en Mexico: mitos, realidades y crisis”. Em *Estudios Sociologicos XXII*, 65, p. 283:314, 2004.

Cimoli, M. Porcile, G. Primi, A, y Vergara, S “Cambio Estructural, Heterogeneidad Productiva y Tecnología en América Latina”, en Mario Cimoli (ed) *Heterogenedidad Estructural, Asimetrías Tecnológicas y Crecimiento en América Latina*. BID-CEPAL, 2005.

Erber, F. S. “O Padrão de desenvolvimento industrial e tecnológico e o futuro da indústria brasileira”, *Revista de Economia Contemporânea*, Rio de Janeiro, RJ: IE-UFRJ, Vol. 4, número especial: 2000 (a).

Franco, E. C. “Estratégias tecnológicas de empresas multinacionais no Brasil: diversidade e determinantes”. Tese de doutorado apresentada ao Instituto de Geociências – UNICAMP: Campinas, 2004.

Freeman, C. “The ‘National System of Innovation’ in historical perspective”. *Cambridge Journal of Economics*, v. 19, p. 5-24, 1995.

Furtado, J. “Padrões de inovação na indústria brasileira”. Seminário no Instituto Fernando Henrique Cardoso, São Paulo, 2004.

IBGE. Pesquisa Industrial de Inovação Tecnológica, 2003.

INDEC. Encuesta Nacional de Innovación y Conducta Tecnológica de las Empresas Argentinas: 1998-2001, 2001.

INEGI. Encuesta Nacional de Innovación en el sector manufacturero, 2001.

Katz, J. “Cambio estructural y capacidad tecnológica local”. *Revista de la CEPAL*, n. 89, pg. 59-73: agosto, 2006.

Mortimore, M.; Peres, W. “La competitividad empresarial en América Latina y el Caribe”. *Revista de la CEPAL*, n. 74, pg. 37-59, agosto, 2001.

OCDE, Eurostat. “Oslo Manual - The Measurement of Scientific and Technological Activities: Proposed Guidelines for Collecting and Interpreting Technological Innovation Data”. Organization for Economic Co-Operation and Development: Paris, 1997.

OCDE “Science, Technology and Industry Scoreboard: towards a knowledge-based economy”, 2001. (disponível em: http://www1.oecd.org/publications/e-book/92-2001-04-1-2987/index.htm)

Ruiz, A. U. “Empresas multinacionales, especialización tecnológica y convergencia en países ‘catching-up’: América Latina”. *Economia e Sociedade*, v. 14 n. 1 (24), pg. 1-23: Campinas, 2005.