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Abstract

The analysis of the existence and the nature of spillover effects of foreign direct investment on the activity and efficiency of domestic firms experienced a major qualitative step forward thanks to the availability and recent incorporation of firm-level data. This permitted performing methodologically more robust types of analysis. The results of these analyses, however, were not always according to expectations. Several researchers did not find the expected positive spillover effects. In some studies, even negative spillovers were found. This was the case, for example, in the work done by Aitken and Harrison (1999), using data from Venezuelan firms for the 1976-1989 period. They found a negative relationship between the presence of FDI at the industry level and total factor productivity of local firms, although positive intra-firm effects were detected. This was a particularly important result given the historically high degree of scepticism vis-à-vis FDI in the region and the current debate on the optimal level of economic openness in the context of globalisation, in general, and the Free Trade Area of the Americas, in particular. In this contribution we present new results on productivity spillovers using Colombian manufacturing firm-level panel data for the 1995-2000 period. We tested (i) whether foreign ownership is associated with an increase in productivity at the plant level, and (ii) whether foreign ownership in an industrial sector affects the productivity of domestically owned firms in the same industry. The results show no or very weak (and not significant) spillover effects. If positive effects on the productivity of domestic firms are found at all, they are apparently completely absorbed by the most productive domestic firms.

Key words: foreign direct investment, multinational enterprises (MNE), productivity spillovers, Colombian manufacturing industry, Andean region.

JEL Codes: F21, F23

1. Introduction

In recent years, research on FDI spillovers in host countries has undergone substantial qualitative progress with the transition from industry-level to firm-level data. Interesting thereby was that these studies often relied on developing country data, not only because of the fact that the productivity gap between domestic and foreign companies is expected to be greater there, but also for the (perhaps unexpected) reason that these countries often publish superior statistical data for this kind of research. From an academic point of view, however, the results have been rather deceiving. Whereas the previous cross-section estimations based on aggregate industry-level information tended to show evidence of positive effects of the presence of foreign firms and to confirm mainstream theory on FDI and MNCs in the tradition of Caves and Dunning[3], more recent econometric studies using firm-level panel data have generally, and unexpectedly, not revealed sufficient evidence that allows us to state that domestic firms in developing countries increase their productivity levels in the presence of foreign firms. In some cases, even negative effects have been shown.

This was the case, for example, in the work done by Aitken and Harrison (1999), using data from Venezuelan firms for the 1976-1989 period. They found a negative relationship between the presence of FDI at the industry level and total factor productivity of local firms, although positive intra-firm effects were detected.

This is a particularly important result given the historically high degree of scepticism vis-à-vis FDI in the region and the current debate on the optimal level of economic openness in the context of globalisation, in general, and the Free Trade Area of the Americas, in particular. In the following sections we will present a short overview of the recent empirical

[3] These studies include: Caves (1974) with data for Australia's manufacturing sector in 1966; Globerman (1979), with Canadian data for 1972; Blomström and Persson (1983) and Blomström and Wolff (1994), with data on the Mexican manufacturing sector for the 1970-1975 period; and Nadiri (1991), with data on North-American investment in France, Germany, Japan and the UK (see also, Blomström and Kokko, 1996).

research on productivity spillovers in developing countries, place this in the context of FDI policies in the Andean region, and present new results on productivity spillovers using Colombian manufacturing firm-level panel data for the 1995-2000 period. We will test (i) whether foreign ownership is associated with an increase in productivity at the plant level, and (ii) whether foreign ownership in an industrial sector affects the productivity of domestically owned firms in the same industry.

2. FDI Productivity spillovers

The hypothesis of positive productivity spillovers is based on a set of arguments. Caves (1974) argued that domestic firms might benefit from inward FDI because of positive effects (i) from increased competition on resource allocation efficiency, especially in industries characterized by high barriers-to-entry, (ii) on the technical efficiency of local firms through backward or forward linkages with the foreign companies, and (iii) on the adoption of new technologies.[4] Blomström and Kokko (1998) considered two broad modalities of spillover effects: (i) those related to factor productivity increases, and (ii) those related to accessing third markets.

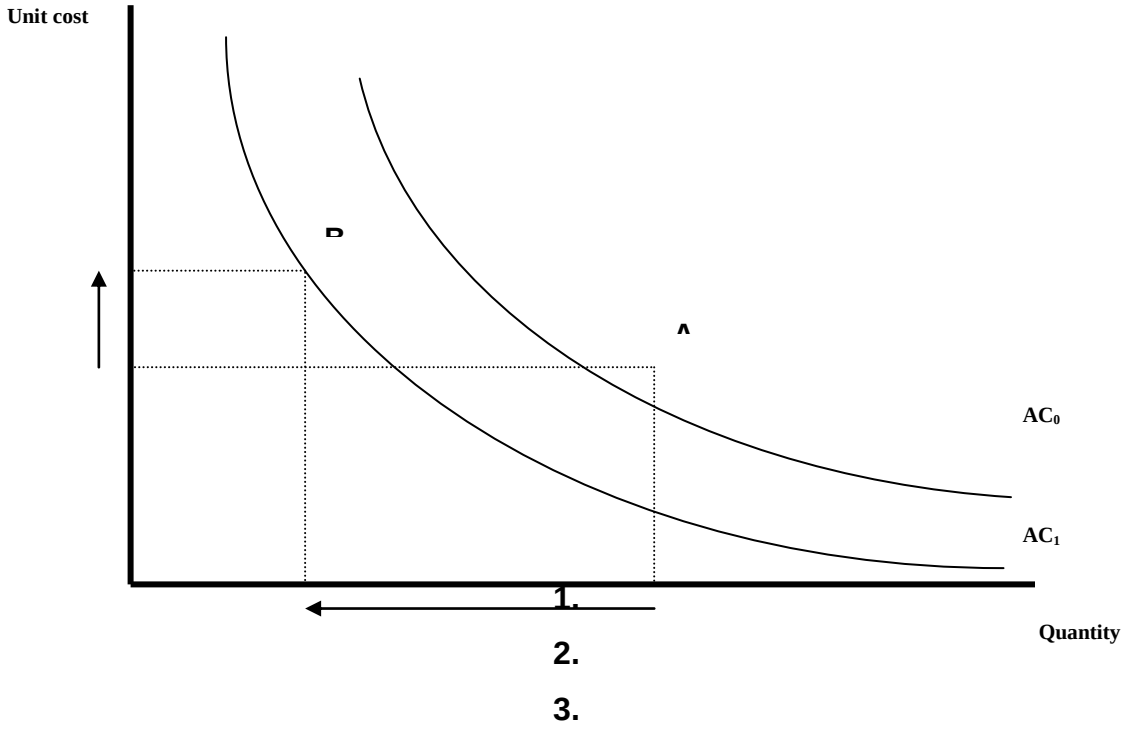
Productivity spillover effects are transmitted through various channels: (i) the effects generated by backward and forward linkages, (ii) the effects of labour mobility from foreign to domestic firms, (iii) demonstration effects, and (iv) the competition effect (Blomström and Kokko, 1998).

As an ex post rationalization of their findings, Aitken and Harrison (1994) pointed to the possibility for foreign owned companies to have a negative effect on the productivity levels of domestic firms. They showed that when in imperfect competition, domestic firms are facing fixed production costs, foreign companies can conquer part of the local demand,

[4] On the latter point, see also, Blomström and Wolf (1994).

forcing the local firms to diminish their production and spread their fixed costs over a smaller market. As a consequence, if the negative effect on the domestic firms' productivity is greater than the benefits of knowledge and technology transfers from the foreign-owned companies, the net effect on productivity will be negative. This is shown in figure 1. With the entrance of foreign companies, the average cost curve of the domestic plants falls from $\mathbf{AC_0}$ to $\mathbf{AC_1}$, because of positive spillovers. But, at the same time, the increased competition forces the domestic firms to reduce the scale of production, thus moving along the $\mathbf{AC_1}$ curve back upward. The net effect of FDI in the case shown in figure 1, moving from **A** to **B**, is an increase in the average output cost.

Figure 1: Output Response of Domestic Firms to Foreign Entrants



Source: Aitken and Harrison (1999).

In general, the more recent studies, using firm-level panel data, seem to suggest that indirect effects of FDI on productivity levels are not important or, at least, that they do not occur in all industries.

Using data from Venezuelan firms for the 1976-1989 period, Aitken and Harrison (1999) found a negative relationship between the presence of FDI at the industry level and total factor productivity of local firms. However, they concluded that there are positive intra-firm effects given the fact that the productivity of foreign owned firms seems to increase with the volume of foreign capital. These results varied systematically with plant size, the effect being more robust for small firms.

The results in the Venezuelan case are interesting to the extent that the authors controlled for inter-industry productivity differentials. Given the possibility (hypothesis) that foreign firms tend to prefer industries with higher productivity levels, the authors included this correlation in order no to bias the conclusions. In addition, estimations were performed in order to determine whether the effects of FDI were observable at the regional level. Again, they reached the conclusion that no important effects were caused by the presence of foreign firms.

Kokko (1994), using data for the Mexican manufacturing sector for 1970, suggested that the characteristics of the host country and host industry influence the generation of the spillover effects. According to the author, it is important to distinguish between industries where the foreign firms compete directly with the local firms, and where positive spillovers can be expected, and industries with enclave characteristics and few linkages with other firms. Kokko found positive spillovers in industries with moderate levels of FDI and moderate technology gaps between foreign and local firms.

In a study on the manufacturing industry in Uruguay, Kokko et al. (1996) obtained similar results. In contrast with previous work (Kokko, 1994), the authors established that the

technological capacity at the firm-level is crucial for having positive spillovers. Kokko et al. (2001) showed further the importance of the trade regime for assessing FDI spillovers and found that productivity spillovers are more likely with FDI in periods of inward oriented trade policies; whereas export spillovers are more likely with FDI in periods of outward orientation.

Other studies done outside Latin America include Haddad and Harrison (1993), Barrios (2000), Barrios and Strobl (2002) and Sembenelli and Siotis (2002).

Haddad and Harrison (1993) analysing manufacturing firms in Morocco over the period 1985-1989, concluded that there is no evidence of a positive effect of FDI on productivity growth of domestic firms. However, they found a smaller dispersion of productivity levels vis-à-vis the most productive firm in the industries with a greater presence of foreign firms. Sjöholm (1997) examined the manufacturing industries in Indonesia, and demonstrated that local firms benefited from FDI, especially in sectors characterised by high levels of domestic competition. According to the author, it is in these cases that overseas headquarters decide to transfer more technology to their affiliates, which can give rise to more spillovers.

Barrios (2000), using Spanish data for the 1990-1994 period, concludes that it is not possible to identify positive effects for local firms and that they might even be negative for in industries with low levels of R&D activity. Barrios and Strobl (2002) confirm that the absorptive capacity of local firms is crucial for positive spillover effects. Sembenelli and Siotis (2002) identify however positive spillovers in knowledge intensive industries in Spain.

Summing up, there is no consensus (yet) on FDI productivity spillovers to local firms, nor on the driving factors and the channels through which they are transmitted. It is clear that

the specificities of the host economies, the industries and the local firms should be taken into account.

Most of the studies have focused on intra-industry effects. An exception to this rule is Katz (1969)[5], who demonstrated that FDI in Argentina provoked technological changes, not only in the industries that received FDI but also in other industries. The reasons behind this were related to the specific quality standards, price, and delivery of the products imposed by the multinationals.

More recent studies have also focused on vertical spillovers through vertical (usually backward) linkages. Kugler (2000) shows evidence of positive inter-industry spillovers for Colombia; López-Córdova and Mezquita (2002) show positive spillovers for Mexico but negative for Brazil. Schoors and van der Tol (2001) for Hungary, and Smarzynska (2002) for Lithuania, also find evidence on positive inter-industry spillovers.

These studies still leave us, however, with a number of questions: Why is it that significant vertical spillovers can be found in the absence of horizontal spillovers? Is it that the evidence available so far on inter-industry spillovers is biased towards cases with moderate technology gaps and, therefore, relatively high absorption capacity? Are the likely positive effects for the domestic competitor, also sourcing from the same industry, not captured by the analysis? Is it because of the use of the productivity measures? Should we use competitiveness indicators instead?[6], Should the institutional arrangements, like exclusive contracts between related firms, be analysed?[7], etc.

[5] See also, Blomström and Kokko (1996).

[6] Using competitiveness indicators would allow to consider and capture situations in which domestic competitors indirectly benefit from vertical spillovers through backward linkages of the foreign firm, improving their competitiveness (lower prices thanks to cheaper inputs), while leaving their productivity levels unchanged or even worse off (because of the combination of lower prices and unchanged factor costs and technologies).

[7] On the role of financial institutions as catalysts of knowledge spillovers for FDI, see Alfaro et al. (2003).

Finally, the ambiguous results of econometric studies based on firm-level data have been reflected also in cross-country estimations of the relationship between FDI and economic growth (Borensztein et al., 1998; Carkovic and Levine, 2000).[8]

The fact that spillovers are not automatic consequences of foreign direct investment, is the main reason why investment incentives focusing exclusively on foreign companies is usually not to be recommended, from national welfare point of view (Blomström and Kokko, 2003). At least, accompanying measures will be needed, oriented towards strengthening the capacity to absorb technological knowledge and skills.

3. FDI Policies in the Andean region

Post-war FDI policies in the Andean region have followed a pendular movement between the open (liberal) and closed (protectionist, nationalist) models. From initially rather restrictive policies there was a move towards more open policies in the first phase of import substitution policies when FDI was seen as complementary to industrial policy and a source of financial and technological resources to sustain the industrialization processes. This was followed by a more sceptical and nationalist view of FDI policies towards the end of the sixties. Right from the start of the Andean integration process, the countries involved have interestingly opted for a common FDI policy, which adds to the interest of this case. The common regime was made possible because of a *de facto* convergence of the economic policy models in the different countries. The larger countries of the subcontinent (Argentina, Brazil, Mexico, Colombia) had already engaged in inward looking policies, the smaller countries followed later. Towards the end of the eighties, finally, policies moved back in the direction of liberal policies.[9]

[8] Borensztein et al. (1998) point also to the crucial role of the absorption capacity in the host countries.
[9] See e.g. Bulmer-Thomas (1998:chapter IX). See also, Van Den Bulcke (1988) for a general perspective.

Both in the protectionist period of the seventies, as in the liberal period of the nineties, the region developed regulatory models that were copied by other developing countries. The legislation that has been produced, was at the forefront of rule making in a developing country context.

The Cartagena Agreement was signed in 1969 when the dominating development model, followed by the Latin American countries since the end of the fifties, pursued industrialization through import substitution (ISI). The agreement sought a common industrialisation strategy for the member countries, consisting of a harmonization of trade, exchange rate, monetary, fiscal and foreign investment policies.

Decision 24 of the Council of the Cartagena Agreement of 1971 established a common foreign investment regime.[10] The principle elements of this regime were the following:

- Obligatory authorization and register of each investment project by the competent national authority;
- Prohibition of FDI in communications, infrastructure, electricity, public services, waste collection and the financial sector;
- Restrictions on the authorization of FDI in those sectors where foreign firms would enter to compete with the domestic ones;
- Prohibition of take-overs of existing national firms, except for very specific circumstances like, e.g. risk of bankruptcy.
- Restriction of access to official long-term credits for foreign companies.
- Principle of forced and programmed transformation of foreign companies into national or mixed companies in a time span of 15 years (the rule) or 20 years (the exception, applying to Bolivia and Ecuador); for existing companies foreign

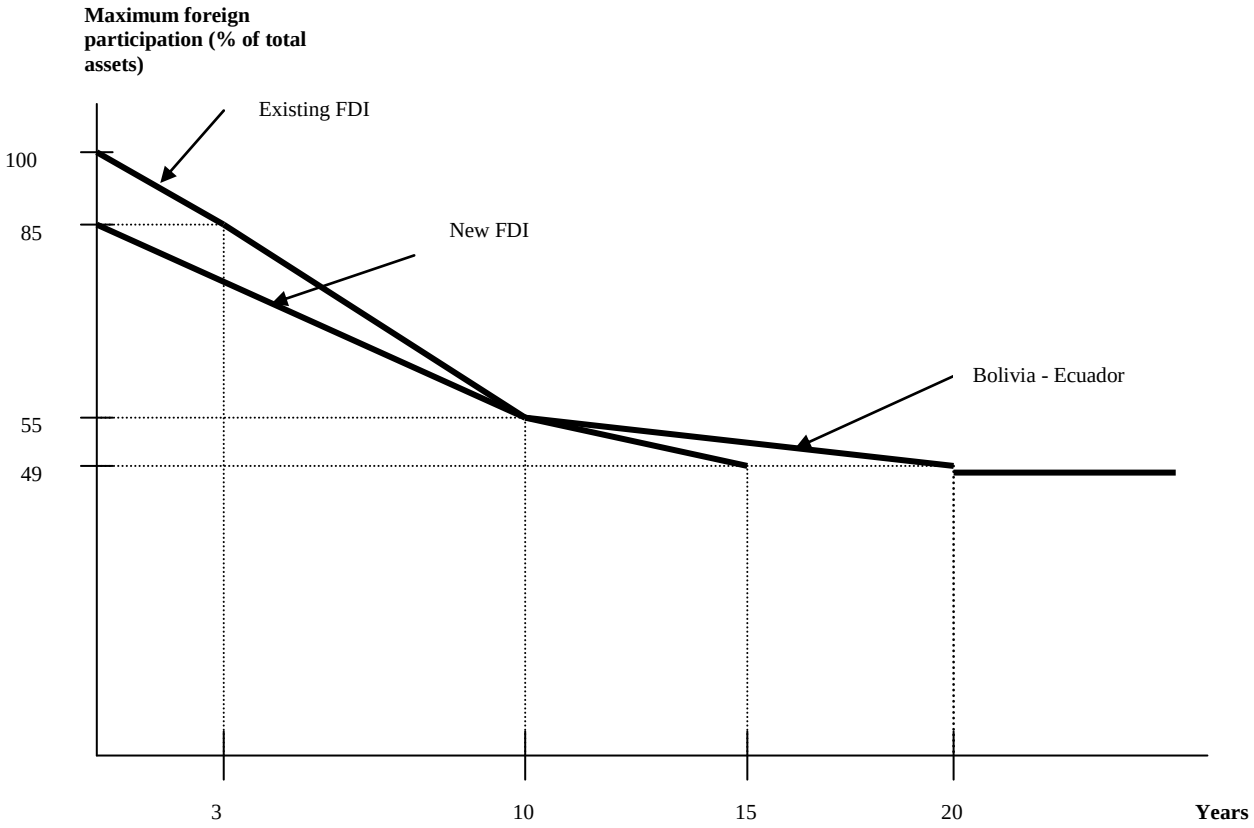
[10] Foreign firms were defined as firms with foreign ownership of total capital of more than 49%. Mixed companies were defined as companies with a participation of foreign shareholders between 20 and 49%, and national companies as those with 20% or less of foreign participation. For an early discussion of the common FDI regime incorporated in Decision 24, see Tironi (1978).

participation had to be brought down to maximum 85% within three years, and maximum 55% within ten years; new companies should have minimum 15% of national capital at the moment of their creation (see Figure 2);

- Non-application of trade preferences derived from the Agreement to goods produced by foreign companies, for those companies that fail to comply with the programmed ownership transformation plan;
- Free repatriation of utilities up to 14% of the invested capital[11], and free repatriation of capital.

[11] Later, this percentage has been raised to 20% by Decision 103.

Figure 2: Programmed transformation of foreign firms – Decision 24 of Andean Pact



Colombia implemented this Decision through Decree-Law 1900 of 1973, and complemented it with the "Exchange Statute" (Decree 444 of 1967). The latter decree established strict exchange controls and intervention mechanisms for FDI and in other areas.

In 1971, a specific regime was also established for Andean multinationals by Decision 48 of the Andean Group. This regime provided for certain benefits for multinational companies with capital from Andean countries, with the objective of supporting the import substitution process in sectors such as: chemicals, petrochemicals, fertilizers, automobiles, electronics and metallurgy. The Latin American Economic System (SELA) broadened this regime towards Latin American multinationals in 1975. The Andean regime was replaced by the Uniform Regime for Andean Multinational Companies as stated in Decision 292 in the framework of the Cartagena Agreement of 1991. A number of companies have been set up under this regime but its relative benefits were strongly diluted. All in all, these specific regimes have not been very important for the development of Latin American multinational companies (Franco and De Lombaerde, 2003).

A confluence of factors in the eighties led to a reorientation of FDI policies in the region. Countries faced massive capital outflow and sharp foreign exchange restrictions. In addition, it became clear that the integration process, as a development strategy, showed poor results (Reina and Zuluaga, 1998).

Decision 220 of 1987 replaced Decision 24 and related decisions. It gave each country a certain autonomy in the design of its FDI policies. The requirements, according to which foreign firms could associate themselves with local firms and benefit from the trade liberalization programme, were made more flexible. The list of restricted industries for FDI

was abolished and it was left for the consideration of each member state to take measures related to profit remittances.[12]

By the end of the eighties and the beginning of the nineties, the Andean region adopted a new development model based on the opening up ("*apertura*") of the economy and the implementation of structural reform programmes. It is in this context that investment regimes, foreign capital markets and exchange markets were liberalised (OECD, 1999; Agosín, 1996; Anzola, 1997).

Decisions 291 and 292 adopted in 1991 by the Andean countries liberalised the FDI regime and eliminated the discrimination between foreign and national investors. Goods produced by foreign firms were entitled to fully benefit from the trade liberalization programme.

The Andean rules left the individual countries with the possibility to further deepen the liberalization of the FDI regime. Colombia decided to reform its legislation in 1991 in order to attract more investment from abroad (Law 9 of 1991 on the Exchange Regime, further regulated by the Statute of Foreign Investment, Resolution 51 of 1991).

Among the more recent measures that have been taken in this field, Decree 2080 of 2000 might be mentioned. This Decree seeks to further expand FDI, facilitating capital mobility and simplifying administrative procedures, especially in the area of financial investment and the operation of investment funds in Colombia. The general principle of the new Statute is that of equal treatment of foreign and national capitals (Cubillos and Navas, 2000; De Lombaerde and Lizarazo, 2001).

The Decree establishes the possibility to invest in all sectors of the economy, with the exception of defence, national security and toxic wastes. Authorisation is only needed in

[12] In Colombia, this Decision was adopted through Resolution 49 of 1989.

the financial sector, the stock market and oil. The only obligation for most of the FDI is registering before the central bank (*Banco de la República*) (DNP, 2001).

The change in the FDI regime has had a visible impact on FDI inflows from the rest of the world (table 1).[13] If we compare the second half of the eighties with the second half of the nineties, FDI inflows as a percentage of GDP, almost double in CAN. Colombia is the exception here, for two reasons: first, an important rise in FDI was registered just before 1995, and second, the presence of the continuing internal conflict in Colombia. The figure for Chile is relatively high but stable. This is explained by the fact that Chile liberalized its FDI policy already in the seventies. Argentina is a similar case.

Given the depth of the restructuring policies and *apertura* programme, on the one hand, and the particular history of FDI policies in the region, on the other, it is timely to further analyse the effects of FDI on economic development. The ambiguous effect of liberalising trade and investment on industry concentration might represent an additional argument in favour of not neglecting the possibility of negative spillovers (De Lombaerde, 2004).

Table 1: FDI Inflows in Latin America (% of GDP)

	1985-1990	**1995-2000**
Andean Community (CAN)	1,08	1,96
Bolivia	*0,71*	*4,57*
Colombia	*2,70*	*1,61*
Ecuador	*1,31*	*1,79*
Peru	*0,17*	*2,21*
Venezuela	*0,28*	*2,00*
CARICOM	0,71	3,16
CACM	1,55	1,22
MERCOSUR	0,73	1,37

[13] See also, Agosín (1996).

Mexico	1,68	1,59
Chile	3,76	3,69

Source: Stein et al. (2002:225).

4. Empirical evidence on FDI spillovers for Colombia, using firm-level data

In this section, new econometric results will be presented on the existence of (positive) productivity spillovers in the Colombian manufacturing industries, using firm-level data.

4.1. Comparing productivity levels: foreign affiliates versus local firms

As an initial assessment, we compared productivity indicators of foreign and domestic companies, using firm-level data from the DANE Annual Manufacturing Survey (AMS) for the 1995-1999 period. We calculated labour productivity, capital/labour ratios, unit remuneration, and the unit labour cost.[14]

The results are presented in table 2.[15] They are shown as ratios of the average indicator for the foreign firms over the average for the local firms.[16] A value of 2,0 for labour productivity, for example, indicates that the foreign affiliates obtained productivity levels twice higher than the competing local firms. The general conclusion is that foreign affiliates are more productive than local ones. Foreign affiliates are more capital intensive than local firms, which confirms previous studies on Colombia's manufacturing industry (Misas, 1993; Agudelo and Silva, 1996). Likewise, foreign affiliates show higher average levels of labour productivity. Only for the Leather sector, local firms seem to be more productive than their foreign counterparts. Foreign affiliates also exhibit higher unit remuneration,

[14] The indicators were calculated by manufacturing establishment, but because of the statistical secrecy obligation, we were not given access to the results at that level. It was necessary to aggregate the results by industrial sector at the 3-digit level ISIC Rev 2.

[15] For a discrimination of the comparisons by firm size, see Pedraza (2003).

[16] Foreign firms were defined here as companies with a positive (> 0%) ratio of foreign capital.

consistent with Misas' observations (Misas, 1993). Finally, foreign owned companies operate with lower unit labour costs than local companies.

This general result of higher productivity levels for foreign affiliates suggests that there might be scope for positive productivity spillovers. This will be tested in the following sections.

Table 2: Comparison of productivity indicators, 1995-1999

ISIC	Manufacturing sectors	PL[a]	UR[a]	K/L[a]	ULC[a]
311	Food	1.73*	1.22	1.46	0.77*
312	Other food	2.50*	1.39*	3.11*	0.84
313	Beverages	1.49	1.01	1.76*	0.62*
321	Textiles	1.72*	1.22*	1.29	0.71*
322	Garments	1.57*	1.24*	1.74	0.95
323	Leather products	0.68*	1.18	1.10	1.82*
324	Footwear	1.32*	1.41*	1.71*	1.07
331	Wooden products	1.21	1.24*	1.10	1.18
332	Furniture etc.	2.35*	1.49*	2.84*	0.62*
341	Wood pulp, paper and cardboard	1.40*	1.28*	1.60	0.94
342	Printing and editorials	1.51*	1.10	1.13	0.80*
351	Industrial chemical substances	2.66*	1.38*	2.98*	0.58*
352	Pharmaceuticals, soaps	2.27*	1.68*	2.80*	0.84
354	Derivatives of oil and coal	1.66	2.02*	2.36*	1.37
355	Rubber products	2.00*	1.54	3.23	0.74*
356	Plastic products	1.94*	1.31	2.65*	0.69*
361	Objects of clay, porcelain, etc.	1.23	1.08	1.77*	0.63
362	Glass	3.37*	1.85*	4.54*	0.55*
369	Non-metal mineral products	1.89*	1.30*	2.24*	0.59*
371	Basic iron and steel industry	2.65*	1.63*	3.69*	0.57*
372	Basic manufacturing of non-ferrous metals	1.07	1.27*	1.52	0.92
381	Metal products, except machines and equipment	2.01*	1.37*	1.91*	0.74*
382	Machines, except electrical	1.62*	1.31*	1.93*	0.87
383	Electrical machines and equipment	2.23*	1.87*	2.42*	0.93
384	Transportation material	2.76*	1.44*	1.66*	0.47*

385	Professional and scientific material	3.71*	1.49*	2.22*	0.51*
390	Other manufacturing industries	1.60*	1.47*	1.19	0.99

Source: Annual Manufacturing Survey (AMS) DANE 1995-1999. Calculations of the authors.
PL = productivity of labour, UR = unit remuneration, K/L = capital/labour ratio, ULC = unit labour cost.
[a] Ratio of average performance of foreign affiliates over average performance of local firms.
* = differences between averages statistically significant at 5% level.

4.2. Sample

The firm-level data used for the estimations were obtained from the *Superintendencia de Sociedades* (Superintendence of Companies) for the period 1995-2000. The information from this source was accounting information, therefore it was necessary first to calculate the economic variables to be included in the econometric model.[17]

Starting with an initial sample of about 2000 firms, due to problems of availability and consistency of the data, finally 1533 manufacturing firms were selected. We defined the foreign firms as those firms that register a fraction of foreign ownership superior to 0%.[18] This discrimination was done using the same data source. According to this definition, 23% of the firms in the sample were called "firms with FDI" or "foreign firms", the remaining 77% "local firms".

The sample of the *Superintendencia de Sociedades* has certain particularities. First, the companies included are mostly large, given the fact that the Superintendence has a controlling function over large companies[19]. Second, the companies included have mainly

[17] The firm-level data from the Annual Manufacturing Survey (DANE) are not available for the public, only on an aggregated level. This would however be an interesting alternative source of information on firms, and would also permit to analyse spillover effects via vertical linkages. A disclosure of the information by the authorities is a necessary prerequisite.
[18] This definition of foreign firms was also used in Aitken and Harrison (1999) for Venezuela. However, other criteria for foreign ownership have also been used (> 5% or > 10% of total assets); without altering the conclusions. See, Pedraza (2002).
[19] See, Decree 3100 of 1997.

legal personality as "sociedad limitada" or "sociedad anónima", and exclude companies with financial activities.

Using the AMS criteria to classify the companies by size, 19% are considered as large companies ($\geq$ 200 employed), 47% as medium-sized (51-199 employed), and 34% as small (10-50 employed). The most important subsectors (ISIC Rev 2) represented in the sample, were: Pharmaceuticals (18,44% of total number of companies), Industrial Chemical Substances (8,07%), Food (7,49%), Plastic Products (7,49%), and Metal Products, except Machines and Equipment (6,34%). Of the 346 firms with FDI, the majority (65.5%) shows a majority stake for foreign capital (> 50% of assets).[20]

The representativity of the sample is relatively high. The 1533 firms represent on average 65% of total sales registered in the AMS for the 1995-1999 period.

4.3. Model estimation

The econometric model that we estimated is similar to those estimated by Haddad and Harrison (1993), Aitken and Harrison (1999), and Barrios (2000). A log-linear production function has been estimated, in which the production level is modelled as a function of its inputs (capital and labour) and variables that measure the presence of FDI within the firm and in each manufacturing subsector. Answers to two questions are sought:: (i) Is foreign ownership of a firm positively associated with its productivity?, and (ii) Is foreign ownership in a sector related to productivity levels of local firms competing in the same sector through positive spillover effects? Both hypotheses can be tested estimating the following equation with balanced panel data.[21]

[20] See also, Misas (1993) and Steiner and Giedion (1995).
[21] The principle advantage of panel estimation is its capacity to control for the presence of specific (individual or group) effects, which is not the case in cross-section estimations. In all estimations that were performed here, specific firm effects were detected.

$$Y_{ijt} = C + B_1 FDI\_Firm_{ijt} + B_2 FDI\_Sector_{jt} + B_3 L_{ijt} + B_4 K_{ijt} + e_{ijt} \quad [1]$$

Where, **Y_{ijt}** : (logarithm of) production (sales + change in stocks,) of firm i in sector j in year t;

FDI_Firm_{ijt} : foreign participation in total assets of firm i in sector j in year t;

FDI_Sector_{jt} : foreign participation in sector j;

K_{ijt} : stock of fixed assets of firm i in sector j in year t;

L_{ijt} : number of employed, both permanent and temporal, in firm i in sector j in year t.

FDI_Sector was calculated as the participation of foreign investment in total fixed assets of the sector:

$$FDI\_Sector_{jt} = \sum_i FDI\_Firm_{ijt} * Fixed\_Assets_{ijt} / \sum_i Fixed\_Assets_{ijt} \quad [2]$$

The use of alternative variables to measure the presence of FDI at the sectoral level did not reveal important changes in the estimation results.[22]

All nominal values were deflated by the sectoral 3-digit PPI (base year = 2000). In addition, all estimations with panel data included time dummies to capture business cycle effects.

[22] In the empirical literature there does not seem to exist a consensus on which is the "right" variable to measure sectoral foreign participation. Assets, value added, production, sales and employment have all been used. We performed also estimations with assets and employment.

Confirmation of our hypotheses would require significant positive coefficients for variables **FDI_Firm** and **FDI_Sector** in equation [1].

The results of the estimations with fixed effects model are presented in table 3. It contains results for the totality of the firms and for the subgroup of local firms.[23]

Table 3: Impact of FDI on total productivity

	All firms		**Only local firms**	
	Fixed effects (FDI_Sector with Assets variable)	**Fixed effects** (FDI_Sector with Sales variable)	**Fixed effects** (FDI_Sector with Assets variable)	**Fixed effects** (FDI_Sector with Sales variable)
FDI_Firm	0.0003049 (0.0007259)	0.0003411 (0.0007163)		
FDI_Sector	0.0044238* (0.0010281)	0.0041646* (0.0013347)	0.0047066* (0.0012399)	0.0022916 (0.001616)
Log_ L	0.5418639* (0.0180778)	0.5432312* (0.0180934)	0.5561922* (0.020538)	0.5567935* (0.0206077)
Log_K	0.118925* (0.0143952)	0.1189663* (0.0145093)	0.1101904* (0.0179037)	0.1110921* (0.0180986)
R^2	0.66	0.65	0.60	0.60
F-test for firm-specific effects	33.27 (0.0000)	33.15 (0.0000)	30.98 (0.0000)	30.93 (0.0000)
Hausman test	423.67 (0.0000)	448.92 (0.0000)	230.40 (0.0000)	241.66 (0.0000)
Number of observations	9198	9198	7122	7122

Estimation period: 1995-2000. All estimations included time dummies and intercept terms, not reported here. Standard errors (between brackets) are corrected for heteroscedasticity. * = significant at 1% level. The F-test suggests that specific firm-level effects exist. The Hausman test compares the fixed effects model with the variable effects model.

The coefficient for **FDI_Firm** suggests that an increase of foreign ownership in a firm, from 0 to 100%, increases its production in 0,03%. However, the coefficient is not

[23] Fixed effects models assume that specific effects for each group can be modelled as a specific constant term for each group in the regression model. The variable effects approach considers specific error terms per group (Green, 1999). Equation [1] has been estimated with the two approaches (fixed and variable effects). Hausman tests revealed that all estimations with the variable effects model were statistically inconsistent (evidence of correlation between explanatory variables and specific firm-level effects); consequently, estimations with the fixed effects model were preferred.

statistically significant so that there is very weak evidence that firms that receive FDI benefit from it.

On the other hand, the coefficient for **FDI_Sector** is positive and statistically significant, although very small. An increase of 10% in foreign participation in a sector, would augment the production of local firms in 0,04%, *ceteris paribus*.

The coefficients for the variables **Log_L** and **Log_K** have the expected positive signs and are statistically significant.

The effects of **FDI_Sector** continue to be positive and small if we limit the estimation to local firms without FDI. The value of the coefficients is very similar although it is only statistically significant when the assets variable is used for the measurement of the sectoral FDI presence.

The low value and lack of statistical significance of the **FDI_Firm** variable is surprising, given the evidence of superior productivity of foreign affiliates (see above). Nevertheless, other empirical studies also revealed mixed and unclear results. For example, whereas the value for this coefficient was 10,5% and statistically significant for Venezuela, in Spain it was 0,1% and not significant.[24]

One possible explanation for these differences in the results might be related to the differences between the type of samples that were used. As we mentioned before, our sample of firms controlled by the *Superintendencia de Sociedades* is biased in terms of scale and legal type of company. The results might be explained also by the way in which foreign involvement is measured. Instead of using foreign ownership (expressed as a percentage of total assets), it might be necessary to measure directly foreign involvement in

[24] Blömstrom and Sjöholm (1999), and Haddad and Harrison (1993) also failed to find significant positive coefficients for the **FDI_Firm** variable.

the management of the affiliate (flows of knowledge and experience), and the type and intensity of institutional arrangements and/or technological dependence between affiliates and headquarters. Finally, it might also be necessary to consider longer periods of time so that learning curves may become visible.

As far as the FDI spillover effects are concerned, the studies performed with aggregate data and cross-section estimations found evidence that the presence of foreign companies is beneficial for the domestic firms. On the other hand, the estimations with firm-level panel data revealed less optimistic conclusions. The study on Venezuela found a significant negative coefficient for the **FDI_Sector** variable (-2,67%), the one on Morocco a negative but not significant coefficient (-0,3%), whereas the study on Spain revealed a small but not significant effect, with changing signs according to the model specification (around 0,001% in absolute terms). Our results seem thus to confirm the weak evidence of positive productivity spillovers from FDI.

These results were confirmed by separate estimations for subsamples of firms, classified according to size. These estimations, which will not be presented in detail here, did never result in statistically significant coefficients for the **FDI_Firm** variable. They were positive for large and medium-sized firms, but negative for small firms.

The coefficients showing the spillover effects (**FDI_Sector**) continue to be significant in most cases, although they are not important in magnitude. Certain variation has been observed with varying measurements of foreign participation (assets *versus* sales).[25]

"Better" results with the sales variable suggest that the effect of FDI on competition levels might be crucial for explaining positive spillovers. Further research, involving direct

[25] See, Pedraza (2002).

measurements of the effect of FDI policies on the level and nature of competition, would be needed on this point.[26]

A number of authors have pointed to the fact that positive FDI spillovers are more likely when the local firms have the management and production capacity to absorb them, and/or when the technological knowledge gap is not too important (Kokko, 1994; Kokko et al., 1996; Barrios, 2000). In order to confirm these results, separate estimations were performed for subsamples with high and low labour productivity levels. We found that the existence of significant positive spillovers is limited to the case of sectors with higher productivity levels. The value of the coefficient for **FDI_Sector** (0,006) was close to the one in table 3 and appeared to be statistically significant.

Finally, our results showing the small magnitude of the spillovers are consistent with the conclusions obtained by Steiner and Giedion (1995) in their qualitative assessment of FDI in Colombian manufacturing industries.[27] They found that the manufacturing firms with foreign participation make apparently little effort to transfer and diffuse technology, not even internally, in spite of the fact that foreign affiliates consider that one of their principle advantages vis-à-vis local firms is the possession of technological resources.

5. Conclusions

FDI policies have been much debated in the Andean region. The post-war period shows a pendular movement of FDI policies between the open liberal model, on the one hand, and the inward-looking nationalist model, on the other. The change in the FDI policy regime in

[26] On the nexus between *apertura* and industrial concentration in Colombia, see, De Lombaerde (2004).
[27] Steiner and Giedion (1995) report on the results of a questionnaire among foreign-owned firms based in Colombia, they analysed the determinants of FDI and the contribution of foreign firms to development and the transfer of technology.

the Andean region in the beginning of the nineties, has had a clear positive impact on the volume of incoming FDI flows in the region. And although there are good theoretical reasons to believe that FDI generates positive spillover effects for domestic firms, estimations with firm-level panel data do not always reveal their existence. This, in turn, might foster again a more critical stance towards FDI and capital flows in the region. This is of particular importance in the light of the ongoing negotiations of the Free Trade Area of the Americas.

As previous estimations with Venezuelan data have suggested, negative spillovers are not impossible. When Colombian data are used, the econometric results show no or very weak (and not significant) spillover effects. If positive effects on the productivity of domestic firms are found at all, they are apparently completely absorbed by the most productive domestic firms.

Positive productivity spillovers should thus not be taken for granted, or at least not be overestimated.

From our estimations, including the estimations with sub-samples, the following conclusions can be drawn:

- The informative and explanatory capacity of other measures of the importance of FDI at the firm or industry level, instead of stakeholder participation, should be explored.
- Both the empirical and theoretical work on inter-industry spillovers in the supply chain should be continued and refined.

- Related to this, international (border-crossing) supply chains and international spillovers deserve specific attention.[28]
- Further analysis is required on the determinants of the absorption capacity of (local) firms.
- Further analysis is also required on the macro-institutional context of spillovers: contractual relations between companies, intellectual property rights regimes, financial markets, …
- The same holds for the micro-institutional context: implications of new organisation principles and the tendency towards more flexible production networks working on a project basis with short time horizons.
- Qualitative variables might be used to capture institutional characteristics in the econometric models.
- Further analysis is still required on the policy context: trade and FDI policy regimes, … at the national, regional and multilateral levels.
- Cross-section and panel data approaches should be combined with approaches based on longer time series, so that learning effects can be detected.
- Few things have been said about the policy implications of the findings: Should/can measures be taken to maximise positive spillovers? Given the fact that FDI spillovers are apparently mostly absorbed by the relatively productive domestic firms, should policies that seek to close the widening gap between high and low technology-intensive firms (and sectors) be considered?
- Finally, the future role of the macro-regional level in governing capital flows, in general, and FDI, in particular, should be discussed. This is of particular interest to the Andean region where different strategic options in terms of regional integration, all with implications for the FDI regime, are still open (CAN, CAN-Mercosur, G-3, FTAA, CAN-EU, …).

[28] Lall (1995:17) suggests that spillover effects might be reduced by the expansion of globally integrated production patterns.

6. References

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