Foreign Direct Investment and Productivity Spillovers

Evidence from the Spanish Experience*

by

Salvador Barrios**

DOCUMENTO DE TRABAJO 2000-19

October, 2000

* This work has benefited from comments received during visits to the Fundación de Estudios de Economía Aplicada (FEDEA, Madrid), University College Dublin and the Institut d'Etudes Politiques de Paris. I acknowledge the help of Oscar Bajo, Frank Barry, Lionel Fontagné, Mario Izquierdo, Holger Görg, Jacques Mélitz, Patrick Messerlin, Eric Strobl, Ellen Voigt and seminar participants at FEDEA. The data was supplied by Fundación Empresa Publica (Madrid) and the Ministerio de Industria y Energía (MINER) to whom I am also grateful. This research has benefited from financial support through the "Evolving Macroeconomy" programme of the Economic and Social Research Council, (ESCR grant No L138251002) and the European Commission Training and Mobility of Researchers Programme (TMR No ERBFMRXCT980215). Any errors are mine alone.

** School of Economic Studies. University of Manchester.

Contact address: School of Economic Studies,Dover St. Building, University of Manchester, Manchester M13 9PL Email: salvador.barrios@man.ac.uk

Abstract

The aim of this paper is to analyse the impact of Foreign Direct Investment (FDI) on firm productivity using an establishment-level panel of Spanish manufacturing industry that spans the period 1990-1994. The key question concerns the elements that enable domestic firms to capture the positive spillovers associated with the presence of foreign firms. We use Research and Development (R&D) expenditure and trade data to represent the capacity of local firms to reap the benefits from FDI. Our results fail to identify positive spillovers for local firms while a negative correlation is detected in low R&D activities. Further evidence shows that positive externalities have been mainly captured by foreign affiliates. Overall, the general effects of FDI remain very limited in absolute terms compared to similar studies of developing countries.

Keywords: Foreign Direct Investment, Spillovers, Productivity, Spanish Manufacturing Industry.
JEL codes: F21, F23.

Non-technical summary

Foreign Direct Investment (FDI) is often seen as a major element for host country industrial development and growth. Foreign affiliates generally use modern production techniques and are more competitive than their local counterparts. They also benefit from a global organization of their activity and can exploit increasing returns at the firm level embodied in R&D services provided by their headquarters; Markusen (1995). The rationale behind the existence of positive spillovers and FDI is that indigenous firms may be able to reap some benefits from foreign presence since they may adopt similar production techniques or, more directly, they can be chosen by foreign firms to provide intermediates goods and services. Following Blomström and Kokko (1998) we consider that the potential spillovers related to FDI are more likely the higher is the level of technological capability of local firms. We relate the technological capability with elements such as expenditure in Research and Development (R&D) and trade activities using a panel of 1400 firms of the Spanish manufacturing industry during the period 1990-94. First R&D is used to represent the acquaintance of firms with the most modern and innovative production methods. Second we use trade indicators considering that international markets are generally more competitive than national markets. As a consequence, local exporters will be more able to cope with foreign competition than non-exporting firms and eventually benefit from positive spillovers.

The Spanish experience is especially relevant for countries aiming at future membership in the European Union (EU). This is because the large share of recent FDI inflows has taken place during the years following the accession of this country to the European Community; Duce (1995). Spain had traditionally had a highly protected economy and even in 1985, when the final agreement on Spanish accession was signed, significant barriers to trade still remained; De la Dehesa et al. (1991). Important FDI inflows appeared together with a growing trade deficit raising the need for Spanish manufacturing to restructure and to adapt to the new challenges raised by globalization.

Our results fail to identify FDI-related positive spillovers during the period under study. We show that for sectors with high R&D/output ratios, indigenous firms have generally not benefited from FDI while, in the other hand, for low R&D sectors (the "traditional sectors" of the Spanish economy) foreign presence is negatively correlated with productivity. Further results show that the competition effect of FDI is dominant for Spanish exporting firms, strengthening the precedent argument. In fact, our study tends to show that positive externalities have been mainly captured by foreign affiliates based in Spain giving some support to the existence of agglomeration

economies. This result must be related to a recent study by Barrel and Pain (1999) who shows that an initially high level of specialisation in certain activities may attract more investment and give rise to agglomeration economies. From a political perspective, the later results illustrates the fact that FDI must be considered as a major element for development policy and can significantly contribute to the specialisation process of new EU entrants.

Introduction

Positive spillovers represent one of the main elements justifying the effort made by governments to attract foreign investors. Spillovers arise when the production level of one firm is influenced by the actions of other firms in the same or in related industries. Foreign affiliates may be expected to influence domestic firms' productivity by using modern technologies, purchasing local inputs or hiring local skilled workers. There is considerable empirical evidence concerning positive spillovers arising from Foreign Direct Investment (FDI). Blomström and Kokko (1998) provide a review of the literature. Their main conclusion is that spillovers depend mainly on the sector and the country under consideration. They argue that *"the positive effects of foreign investment are likely to increase with the level of local capability and competition*" (p.247). In fact, a simple positive correlation between foreign presence and local firms' productivity does not tell us why spillovers exist. To explain the way in which spillovers arise one must identify the determinants of the ability of local firms to adapt to the technological changes or innovations introduced by foreign firms as well as to respond to their intermediate input requirement or the increased competition they represent.

Those determinants may be synthesised as representing the *technological capability of local firms*, i.e., *the factors that may enable local firms to reap the benefits from foreign presenc*e. Our basic assumption is that the technological capability is directly related to elements such as Research and Development (R&D) and trade intensities. First, we consider that R&D reflects the acquaintance of firms with the most modern and innovative production methods so that one should expect a positive correlation between productivity and foreign presence when local firms are able to capture the technological externalities related to FDI in high R&D activities. This is directly related to the notion of *"absorptive capacity"* developed by Cohen and Levinthal (1990) who consider absorptive capacity as a *"by-product of a firm R&D investment"*[1]. Here we consider this element in an explicit way using data on R&D both at the firm and branch level.

Second, we also consider international trade activities in order to take account of the fact that international markets are generally more competitive than strictly national markets. The technological externalities related to international trade have been extensively discussed in the literature[2]. Our hypothesis is that firms or branches directly facing foreign competition through international trade must be expected to be able to cope with foreign competition and, eventually, benefit from any positive externality arising from

[1] See Cohen and Levinthal, p.128.
[2] See Gustavsson et al. (1999) for recent evidence.

foreign presence. This hypothesis is alternative to the one suggested by Blomström and Sjöholm (1999) who consider that non-exporting firms will benefit more from FDI spillovers through competitive pressure.

There is still little evidence concerning the impact of FDI in large EU countries as noted by Barrell and Pain (1999, p.932). The bulk of FDI in Spain is related to the accession of this country to the European Community (EC) in 1986 and to the implementation of the Single Market Program[3]. The enhanced macroeconomic stability together with the economic growth prospects of its relatively large market compared to other peripheral countries made Spain a particularly attractive place for foreign investors; Bajo Rubio and Sosvilla Rivero (1994). This makes the Spanish experience a good case study of the role played by FDI in enhancing the integration and the competitiveness of new entrants to the European Union, with a particular interest for the Eastern European countries. These countries have generally a crucial need to modernize their industry and improve their efficiency to face the challenges raised by a greater openness to Western economies and FDI is seen as a major way to reach these objectives.

In the present paper we try to shed some light on these issues using a panel of around 1,400 Spanish manufacturing firms during 1990-1994. Our results show that for sectors with high R&D/Output ratios, indigenous firms have generally not benefited from FDI positive spillovers. On the other hand, for low R&D sectors like Textiles, Leather and Food, the *"traditional sectors"* of the Spanish economy, foreign presence is negatively correlated with total factor productivity. Hence, the study suggests that FDI has influenced the transformation of Spanish industry by increasing competition in traditional sectors, while no clear evidence emerges of positive spillovers in modern sectors. We also find that the competition effect of FDI is dominant for Spanish exporting firms, strengthening the precedent argument. Further results reveal that positive externalities have been mainly captured by foreign affiliates based in the country giving support to the existence of agglomeration economies. This result is in line with recent evidence in Europe provided by Barrell and Pain (1999) who show that an initially high level of specialisation in certain activities may attract more investment and give rise to agglomeration economies.

The rest of the paper is organised as follows. In the first section, we present some basic ideas and results on other countries. In the second section, we provide preliminary results comparing the characteristics of foreign firms with those of domestic producers in Spanish manufacturing, and in a third section we present the findings of econometric tests of FDI-related spillovers.

[3] For example, during the period 1988-92, FDI inflows into Spain represented 2.4% of GDP while for countries like France, Germany, the United Kingdom, Italy and Benelux considered together, FDI inflows represented only 1.2% of GDP (Source: IMF and author's computations).

The final section summarises the main findings of the study and discusses some possible extensions.

1. Basic ideas and empirical evidence on Spillovers related to FDI.

Following Blomström and Kokko (1998) we can identify three main spillovers related to FDI: those related to "*backward-forward"* linkages, the demonstration effects and the effects concerning the local market structure, the so-called "*competition effect"*[4].

The *"backward-forward"* effects are related to the input-output structure of the industry. The *"backward"* effects arise if local firms furnish intermediate goods to foreign firms. This kind of effect is more important if foreign firms are intensive users of local intermediates; Rodríguez-Clare (1996). Hence, foreign presence allows local firms to expand their production scope and reduce their average cost through increasing return to scale. Furthermore, the quality standards required by multinational companies (MNCs) may have indirect effects by revealing to local firms the need to adapt to new standards. In some cases, domestic firms may develop their export activity as shown by Aitken and al. (1994) in the case of Mexico. The role of Japanese MNCs in East Asia is a further case in point. This process has sometimes provoked the exit of MNCs as domestic firms may in turn compete successfully with foreign affiliates in their own products; Markusen and Venables (1999). The *"forward"* effects are due to the fact that MNC production may be used as intermediates by local firms. FDI increases competition, which may further improve product diversity and consequently benefit to domestic firms. The *"backward-forward"* linkages are then directly related to market access spillovers. In presence of increase returns, foreign presence may allow local firms to overcome market-size constraints, making it easier to surmount the potentially high fixed cost of producing certain goods and, in some cases, develop their export activity.

Demonstration effects represent one of the main influences of FDI on local firms following Blomström (1986). It is common for MNCs to use more modern technologies than domestic firms. Foreign affiliates may therefore induce local competitors to adopt these technologies in order to cope with foreign competition.

[4] A fourth kind of effect, not referred to there, is represented by labour mobility. The idea is that multinational firms are likely to use more highly-skilled labour than their local counterparts. During their MNC experience these workers get acquainted with more modern technologies and improve their human capital. Local firms are then keen to hire them, while the workers reap the benefits of the corresponding rewards. No empirical evidence is available on this effect to our knowledge but a theoretical account can be found in Fosfuri et al. (1998).

In fact, the competition effect of FDI may precede positive spillovers for those local firms not efficient enough to compete with MNC. We could logically conceive that the competition effect of FDI is potentially important, especially in cases in which foreign affiliates introduce a new product that may be a close substitute for local varieties. Broadly speaking, the competition effect depends on local market structure. Whether the structure is the cause or the consequence of FDI is of concern however. We could think, for example, that if local industry is highly competitive, FDI will not be attracted, because there is an important risk for foreign affiliates to obtain reduced margins and exit the market after a short period. That is less true if we consider the case of a relatively large and innovative market. MNCs may consider investing in this market to be a good way to acquire those technologies even if their margins are lower. In the polar scenario, the local market may be controlled by a limited number of national firms, in which case the competition effect of FDI can improve domestic resource allocation by reducing local firms' markup. These ideas are reflected in the study by Knickerbocker (1976), which showed that MNC entry in countries like the United States, Canada, Italy, France and Germany improved competition during the 1960s.

The preceding ideas have generally been studied through the impact of FDI on local firms' productivity. But precisely because those arguments are broad enough the causality between FDI and productivity spillovers is hard to disentangle. Similar results can be interpreted in different ways and sometimes, drive one to opposite conclusions. We could consider for example that FDI spillovers benefit domestic firms through enhanced productivity and, in the case where local firms' productivity is negatively related to foreign presence conclude that the competition effect offsets any positive externality. In the latter case foreign competition would deteriorate local firm productivity through reduced margins and ultimately provoke the exit of the less efficient firms. In fact, it is not so clear why exactly the competition effect would lead domestic firms to have lower productivity. It could also go in the opposite direction, since we could equally expect the lowest productivity firms to be wiped out. Another possibility, documented in the Irish case[5], is that domestic firms could retreat into the remaining non-traded sectors, which could possibly be lower productivity sectors. We will refer to this result later on in the study. In more general terms, the potential effects of FDI are quite diverse, though all should impact directly or indirectly on the efficiency of local firms. One must then admit that the effect of foreign presence is theoretically ambiguous and can only be resolved with empirical evidence. This will be our main concern in the remainder of the paper.

[5] See O'Malley (1989) for a discussion.

Foreign presence is generally measured by MNC share in local employment or value added. This element is then included as an explanatory variable for level and growth in value-added. Through this procedure, empirical studies like Caves (1974), Globerman (1979), in the case of Canada and Australia in the 1960s, and Blomström and Persson (1983), for Mexico in the 1970s, show the existence of positive spillovers from FDI using aggregated industry data. The results of studies using individual firm data are more subtle however. Illustrative studies of this kind are Haddad and Harrison (1993) for Morocco between 1985 and 1989, Farinha and Mata (1996) for Portugal between 1982 and 1992, Aitken and Harrison (1999) for Venezuela between 1976 and 1989, Djankov and Hoekman (1998) for the Czech Republic during 1992-96, Blomström and Sjöholm (1999) for Indonesia in 1991 and Merino and Salas (1995) for Spain in 1991. The latter study uses the same data set as the present one. However, the absence of any temporal effect compromises their results. Blomström and Sjöholm study also concerns one year but they provide evidence of positive FDI-led spillovers. The rest of the studies including time effect, like Farinha and Mata do not find a significant relationship between local firms' productivity and foreign presence while Djankov and Hoekman find a negative correlation between both variables. Here the very low level of indigenous firms' productivity let believe that local firms cannot reach the potential FDI-spillovers.

Our approach is closer to that of Haddad and Harrison (1993) and Aitken and Harrison (1999). In particular, Haddad and Harrison show that foreign presence implies lower productivity dispersion in sectors with low technological content. This result means that local firms are able to capture positive spillovers related to foreign presence when they have sufficient technological ability to do so. This constitutes our starting point in order to explain why spillovers arise in some industries and not in others. We use the notion of *technological capability* making explicitly reference to a large set of factors directly related to R&D expenditure such as innovative production techniques, marketing methods, sales networks, know-how, i.e., *all the innovative elements that make local firms highly efficient and adapt to the changes introduced by foreign investors*. We also consider international trade to provide evidence concerning any FDI spillovers related to trade activities at the firm level and also to examine whether traded and non-traded sectors have experienced different productivity pattern in the Spanish case.

2. The case of Spanish manufacturing

As we have seen before, studies using firm level data are generally concerned with developing countries. The case of the Spanish economy may be quite different: first, because Spain is an industrialised country, and local firms are supposed to be more able to react efficiently to foreign direct investment, i.e., to capture positive spillovers; second because a large share of recent FDI inflows has taken place during the years following the accession of this country to the European Community; Duce (1995). The last point is of special interest to understand how FDI has contributed to the integration process of this country.

Spain had traditionally had a highly protected economy and even in 1985, when the final agreement on Spanish accession was signed, significant barriers to trade still remained; De la Dehesa et al. (1991). Trade liberalisation has been taking place together with a growing trade deficit, in part due to the lack of competitiveness of Spanish manufacturing firms symbolised by low productivity levels, alongside important capital inflows, predominantly of the FDI-type[6]. The growing trade deficit appears to have partially constrained Spanish economic growth as recently showed by Alonso (1999). Productivity level of Spanish manufacturing has partially filled the gap with other major European countries as shown by table 1 bellow, but significant differences still remain. Therefore, Foreign Investment seems a way to improve competitiveness and to boost growth if positive spillovers arise.

Table 1: Indices of labour productivity in manufacturing industry for selected European countries

	1986	1992
Spain	78.5	86.5
EU (France + UK + Italy)	100.0	100.0
France	110.7	106.6
United Kingdom	93.4	96.9
Italy	94.4	95.3

Sources: Unido and author computations.

FDI have been especially pronounced in manufacturing industry, it represents 54% of total FDI inflows in this country during the period 1990-1994[7]. Foreign firms have a strong position in modern activities with increasing return to scale (IRS), such as Chemicals, Transport equipment and

[6] See Herce et al (1998) for a comparison of FDI inflows with other capital movements during this period.

[7] In the other side, services represented 45.4% and agriculture only 0.6 %; Martín and Velázquez (1997).

Electrical goods; Martín and Velázquez (1993). The typical example is the car industry, where no local producer exists but for which Spain is the third producer in the EU after Germany and France, and is both a large exporter and importer; OECD (1999b).

One of the expected outcomes of foreign investment is to provide this country with modern production techniques and eventually pave the way for future Spanish firms exports. In more general terms, FDI represent a double challenge for Spanish manufacturing firms: they must face increased competition on their own domestic market in relatively protected activities until the early eighties and FDI also exacerbates the need to improve competitiveness through higher productivity level. It is thus arguably essential for domestic firms to be able to internalise the kinds of positive externalities generally associated with foreign investment described in section 1. The following sections provide evidence to what extent this occurred in Spain in the early 1990s.

2.1 Data description and preliminary results.

We use data from a panel of approximately 1,400 Spanish manufacturing firms for the period 1990 to 1994[8]. The data is not exhaustive and covers around 22% of total Spanish employment in manufacturing industry. The unit of observation is the individual plant with more than 10 employees for which the number of employees at the end of the year is reported. Data on capital, value added, external trade and R&D are also used. Capital is represented by capital stock reported by individual firms and value added is represented by the value of sales less changes in inventories, the difference between external services purchased by the firm and those sold to other firms, and less raw materials used for production. R&D is defined as firm expenses concerning scientific and technical information, quality control, the assimilation of imported technologies, market studies related to design and commercialisation of new products. Trade activities concern import and exports, also reported by each firm at the end of the year. All the variables are deflated using sectoral price indices. Data were originally available at three digits of CNAE74 which is a derived version of the European Nace 70. We obtain 107 branches using this sectoral breakdown.

We take *"foreign firms"* to be those with more than 10% of capital owned by non-residents. This definition is related to that used by the OECD and the IMF; OECD(1999a). However, a detailed analysis of our dataset

[8] The database is the "Encuesta Sobre Estrategias Empresariales" from the *Ministerio de Industria y Energia* (MINER) and the *Fundación Empresa Pública*. The original dataset covers around 1800 firms for the period 1990-94 but we have only considered those firms with continuous observations during the sample. Available information did not provide us with a satisfactory reason for any discontinuity in the data over the period so that we opted for a complete panel. We reckon that this may entail sample selection bias but we preferred this option in order to get more coherent data on productivity.

reveals that foreign firms have rarely less than 30% of capital owned by non-resident. This latter percentage is high enough to consider foreign firms, as defined here, to be effectively controlled from abroad.

Following the ideas introduced in section 1, we consider two questions in order to introduce the key characteristics that may influence spillovers related to FDI. The first one is the relationship between foreign presence and local market structure. The second one is the analysis of the differences existing between foreign and domestic firms in aspects such as labour productivity, trade performance or R&D expenditure.

First, we allow the effect of FDI to depend on the level of host market competition. As previously argued, the structure of the local market may reflect the ability of domestic producers to respond to the increased competition associated with FDI. Moreover, sectoral import penetration may be relevant in determining whether local firms are already exposed to foreign competition, which is usually higher in international than in domestic markets. Conversely, FDI may also affect the local market structure. Foreign firms are usually considered to be more efficient than domestic ones since they benefit from global organization. Their activity is usually co-ordinated by headquarters in order to benefit from economies of scale at the firm level in activities like R&D or intrafirm trade in intermediate inputs[9]. In Table 2 below, we illustrate these points comparing foreign presence with two other variables. The first one is the Herfindahl index, representing the concentration level of sales, a lower index that market shares are dispersed, i.e., a higher competition level in the product market; the second one is an indicator of import penetration, i.e., the ratio between the value of imports and the value of total sales for each branch of the manufacturing industry.

[9] See Markusen (1995) for a general discussion of the comparative advantages of MNC.

Table 2: Foreign presence, import penetration and market structure (by sectors)

	1990			1994		
	Foreign presence	imports/ sales	Herfindahl index	Foreign presence	imports/ sales	Herfindahl index
22.Basic metals	0.12	0.2	0.1	0.21	0.23	0.11
24. No-metallic minerals	0.53	0.05	0.04	0.61	0.04	0.03
25.Chemicals	0.64	0.17	0.02	0.70	0.28	0.02
31.Misc. metal articles	0.25	0.11	0.02	0.19	0.16	0.02
32.Mechanical engineering	0.54	0.14	0.04	0.69	0.25	0.04
33.Office, and precision instruments	0.7	0.41	0.21	0.79	0.39	0.23
34.Electric and electronic engineering	0.64	0.22	0.08	0.65	0.22	0.09
36. Motor vehicles	0.91	0.16	0.1	0.95	0.34	0.08
38. Other transport equipment	0.28	0.23	0.27	0.22	0.24	0.31
41. Food and tobacco	0.42	0.06	0.02	0.53	0.12	0.02
42. Beverage	0.82	0.04	0.06	0.87	0.07	0.06
43 Textiles and clothing	0.22	0.13	0.06	016	0.16	0.08
44. Leather goods and footwear	0.13	0.15	0.1	0.0	0.17	0.17
46. Timber and furniture	0.08	0.06	0.03	0.30	0.05	0.05
47. Paper and printing	0.24	0.1	0.03	0.33	0.15	0.03
48. Rubber and plastics	0.62	0.11	0.04	0.65	0.16	0.06
49.Miscellaneous manufactures	0.37	0.13	0.06	0.30	0.13	0.07
Spearman rank correlation	1990			1994		
Foreign pres.-Herfindahl index	-0.08 (0.73)			-0.15 (0.5)		
Foreign pres.-import/sales	0.22 (0.34)			0.38 (0.08)		

Notes: "Foreign presence" is the value added produced by firms with 10%, or more of foreign capital owned by non-resident, "Imports/ Sales" is the ratio between the value of imports and the value of total sales and the Herfindahl index is defined by the sum of squared firm market shares in each sector. For the Spearman rank correlation coefficient, we indicate between parenthesis the probability of independence between the variables.

The relationship between the aforementioned variables is examined through a Spearman rank correlation coefficient for 1990 and 1994[10]. We observe that the Herfindahl index is negatively correlated with foreign presence and that the amplitude of this relationship has increased over the years. Conversely, the import penetration rate is positively related to foreign presence and, as previously, the absolute value of the Spearman rank coefficient increases between the beginning and the end of the period. These results suggest that FDI and local market competition are positively related. However, they do not tell us the causality between foreign presence and local

[10] The Spearman rank correlation coefficient has been computed using data at the three digit level of CNAE.

competition. In fact, in relatively protected sectors where the Herfindahl index is high, like *"Other transport equipment"*, FDI is not significant and other elements such as government regulation may determine the level of local competition. Hence, the nature of the relationship between competition and FDI seems to be sector-specific. Further investigations are clearly needed in this regard. For our purpose, it is sufficient to bear in mind the positive relationship between the level of local competition and foreign presence.

The second issue we want to address concerns differences between foreign and domestic firms that may influence the general outcome on spillovers. Following our basic assumption local capability may be represented by key indicators like labour productivity, R&D expenditures and export performance. Results reported in table 3 show that labour productivity in foreign firms is generally superior. In fact foreign affiliates are of larger size than their local counterparts so that the weighted means reported on table 3 may capture these differences in size only partially. Moreover, this table uses a relatively aggregated classification which may suffer from aggregation bias since the figures reported here may be comparing very different activities and a unique indicator for labour productivity may be grouping firms together that are not direct competitors. These biases are also relevant for the R&D and exports measures.

For exports, foreign affiliates seem to have a greater presence than domestic firms in branches where economies of scale and product differentiation are traditionally important like *"Office and precision equipment"*, *"Electric and electronic engineering"* and *"Motor vehicles"*. However, concerning the R&D measure, local firms seem to invest more than foreign affiliates. In fact, it is generally recognised that multinational companies carry out a large part of their R&D activities in headquarters and distribute their R&D services to their affiliates around the world. These activities are thought to be associated with high fixed costs so they are concentrated in the FDI source country in order to achieve economies of scale. That is why R&D services are generally considered as a public good within the firm, i.e. the distribution of an additional unit does not suppose a significant marginal cost; Markusen (1995).

Table 3: Comparison of labour productivity, outward orientation and R&D expenditure between foreign and domestic firms (ratios Foreign/local firms, using weighted means)

	Output per worker	R&D expenditure per worker	Exports as % of sales
22. Basic metals	1.6	1.3	1.5
24. No-metallic minerals	1.7*	1.4	0.8
25. Chemicals	1.4*	0.6*	0.6
31. Misc. metal articles	1.2	1.1	1.0
32. Mechanical engineering	1.8*	0.9	0.9
33. Office and precision instruments	2.8	0.3	1.8
34. Electric and electronic engineering	1.5	2.3	2.2
36. Motor vehicles	1.6	4.0*	1.7
38. Other transport equipment	1.1	0.1*	0.4
41. Food and tobacco	1.6	1.6	0.6*
42. Beverage	2.1	2.5*	0.4*
43. Textiles and clothing	1.3	0.9	1.4
44. Leather goods and footwear	N-A	N-A	N-A
46. Timber and furniture	2.0	0.9	1.8
47. Paper and printing	0.8	0.9	2.0
48. Rubber and plastics	1.2	0.5	0.9
49. Miscellaneous manufactures	1.2	0.5	1.2

Notes: Foreign firms are defined as firms with 10% (or more) of capital owned by non-resident. All indicators are weighted means where the weights are employees (output per workers and R&D expenditures) and sales (export performance). (*) indicates difference in means is statistically significant at the 10% level. The figures concern 1994 only.

We now need to go further in order to test through a more general model the relationship between domestic firms' efficiency and FDI. As a starting step we analyse the general relationship between labour productivity and foreign presence while in the next section we will conduct a more general discussion based on total factor productivity.

We consider first the impact of FDI on labour productivity dispersion by estimating the following equation:

$$pd_{ijt} = a_1 .\ PART_{it} + a_2 .\ PRES_{jt} + a_3 .\ HERF_{jt} + a_4 .\ SIZE_{ijt} + a_5 .\ Dt + a_6 .Sj + \varepsilon_{it} \quad (1)$$

where subscripts indicate firm i, branch j and time t. The dependent variable is pd_{ijt}, i.e. the deviation of firm-level labour productivity from the sector's best practice frontier with:

$$pd_{ijt} = (p_{ij} - p_{jt}^{*})/p_{jt}^{*}$$

p_{ij} is the firm-level labour productivity and p_{jt}^{*} is the best practice frontier represented by the maximum of p_{ijt} at the sector level. The maximum value for pd_{ijt} is then zero and the higher pd_{ijt} is, the lower will be labour productivity dispersion. This specification is similar to the ones employed by Blomström (1986) and Haddad and Harrison (1993).

$PART_{it}$ represents the share of capital owned by non-residents and $PRES_{jt}$ is the share of value added produced by foreign firms at the sector level. The expected sign for $PART_{it}$ is positive given our hypothesis about the higher efficiency of foreign affiliates. For $PRES_{jt}$ we expect a positive sign if positive spillovers arise. $HERF_{jt}$ represents the Herfindahl index, i.e., a measure of industry concentration. This variable will have a negative coefficient if a less concentrated industry implies a lower dispersion of labour productivity. The sign of this variable can also be positive since a highly concentrated industry may imply the coexistence of a limited number of firms with similar productivity. $SIZE_{ijt}$ represents the relative size of each firm with respect to the larger firm in the sector. This variable must capture the fact that the larger the firm is, the higher will be labour productivity in the presence of increasing returns to scale, the size being represented by the number of employees. We include also time dummies (Dt) and sectoral dummies (Sj) to capture non-observable sectoral effects[11]. The results of the test of equation (1) are shown in Table 4[12].

[11] From now onward, the sectoral classification used is CNAE three digits.
[12] Econometrics techniques are not discussed in this section. A more detailed account is given in the next section.

Table 4: FDI impact on labour productivity dispersion[a]

Dependant variable: pd_{ijt}

	All firms		Domestic firms	
	OLS	*1st Diff*	*OLS*	*1st Diff*
PART	0.001** (0.00001)	0.0005 (0.003)	-	-
PRES	-0.0004 (0.0003)	-0.0002 (0.0003)	-0.0007 (0.0003)	-0.0006** (0.0003)
HERF	0.14** (0.06)	0.19** (0.04)	0.15** (0.06)	0.18** (0.04)
SIZE	0.11** (0.013)	0.06 (0.04)	0.13** (0.016)	0.07 (0.043)
Nobs	7145	5716	5465	4372
F test	22.36 (0.00)	8.72 (0.00)	18.84 (0.00)	8.83 (0.00)

Notes: Estimates are for 1990-1994. Standard errors (denoted in parentheses) are corrected for heteroskedasticity using White specification. OLS estimates include a non-repoted constant term. Time dummies are included for OLS and first differences. OLS also includes sectoral dummies. Symbol ** means that the corresponding variable is significant at 5% significance level while a * corresponds to a 10% significance level. Probability of acceptance of the null hypothesis for the F-test is indicated in parentheses.

First, foreign presence at firm level (*PART*) seems to be positively correlated with labour productivity if one looks at the OLS estimates. However, the elasticity of output with FDI at the firm level is very low, 0.001, suggesting that, with a rise of 100% of foreign participation in firm equity output would rise by 0.1% only. In addition, this result does not hold for the first differences estimates, the value for PART dropping to 0.0005 and becoming insignificant. Foreign presence at the branch level displays a negative and significant coefficient for the first differences estimate, but the absolute value of the estimated elasticity is even lower, reaching –0.06%. The more robust estimates are clearly for *HERF* and *SIZE* with positive and generally significant coefficients. As expected, *SIZE* plays a positive role towards labour productivity while the coefficient for *HERF* deserves further consideration. One could argue that in a competitive industry with a low level of industrial concentration firms have very similar labour productivity because they use similar technologies while the less efficient firms must leave the market. The opposite effect occurs here since the Herfindahl index has a positive and significant coefficient, thus supporting the hypothesis that in relatively concentrated sectors labour productivity dispersion is lower.

What conclusions can be drawn from Table 2, 3 and 4? Descriptive results suggest that foreign firms have a superior productivity than their local counterparts, thus implying that the competition effect of FDI is potentially important. This is partially confirmed by the fact that there is a negative relationship between foreign presence and concentration. However, the results of table 4 do not allow us to confirm this hypothesis. The absolute value of point estimates both for PRES and PART are quite low, suggesting that FDI

has a weak effect on local firm productivity. Finally, co-linearity naturally exists in equation (1) between the exogenous variables, such as foreign presence at branch level and the Herfindahl index if, as we have argued before, FDI has a direct impact on market structure. As a consequence the conclusions that could be drawn from this model are necessarily limited. The preceding results are also limited due to the partial measurement of productivity used. A more general approach using total factor productivity is needed and this is the purpose of the following section.

2.2 Total Factor Productivity.

We start the analysis from a standard production function where individual output depends on the quantity of inputs used and on foreign presence both at firm and sector level. We test the presence of FDI spillovers using similar methods to those employed by Haddad and Harrison (1993) and Aitken and Harrison (1999). Let us assume a production function of the Cobb-Douglas type where value added is represented by *Y* and depends on two inputs, capital (*K*) and labour (*L*).

The values of *Y*, *L* and *K* are observed at the firm level. The subscripts used in the previous section also apply here. Taking the natural logarithm of output we test the following equation:

$$\text{Log Yijt} = \alpha + \beta_l \log L_{it} + \beta_k \log K_{it} + A_{ijt} + \xi_{it} \qquad (2)$$

The Sollow residual can be decomposed as:
$A_{it} = b\ PART_{it} + c\ PRES_{jt} + d\ D_t$

Variables *PART* and *PRES* are the same as before; *PART* represents the share of capital owned by non-residents, *PRES* is the share of value added produced by foreign firms at the branch level, D_t is a time dummy, α is a constant term, and ξ_{it} is an error term. Note that several options were possible for *PART* and *PRES*: for example for *PART* we could have used a dummy variable taking the value 1 if a firm is *foreign owned* and zero if not; we could also choose the share of employment by foreign firms to consider the impact of foreign presence. These alternatives were investigated, but gave similar results to those presented below.

We consider the period 1991-1994 since data concerning capital were not available in 1990. We test (2) using different techniques. First we run an OLS with time and sectoral dummies. Given that the business cycle has a direct impact on output, time dummies must be included in all estimates to capture this. The rationale for sectoral dummies is more directly related to our main question: we must consider that foreign investors could be attracted to

more productive sectors. In fact FDI in developed countries tends to flow into highly productive sectors with an important R&D content. This partly showed up in the preceding sections, and data on FDI flows by sector over the last decade support this[13]. A positive sign for *PRES* could therefore simply capture the positive correlation between foreign presence and productivity without implying any causality link between both variables. We then include sectoral dummies in order to capture non-observed sectoral specific effects that could explain the evolution of productivity.

We also test equation (2) using weighted least squares (WLS) where the weights are given by each firm´s share in total employment. This allows us to give more emphasis to large plants. As mentioned earlier, FDI generally concerns large firms and, for similar sizes, domestic and foreign firms may behave in a similar fashion. One should thus expect large local firms to compete directly with (usually large) foreign firms[14].

The preceding methods fail to capture individual firm effects, that is, the share of productivity explained by non-observable characteristics like entrepreneur's ability, know-how, etc. Moreover, foreign investors could also acquire the most productive firms. That certainly represents a positive bias towards the impact of FDI without implying that FDI causes productivity to rise, as mentioned by Aitken and Harrison (1999). We consider these individual effects by estimating equation (2) using first differences; this allows us to test the impact of FDI on productivity growth and also to purge our model of any non-observable time invariant individual and sector specific effects; in addition, we estimate the same equation using *within estimates* by transforming each variable by subtracting individual mean over time; this is the so-called fixed-effects model[15]. All estimates are corrected for heteroskedasticity using White (1980) specification.

[13] See OECD (1999a).

[14] We performed a Hausman test between WLS and OLS and, the former method being generally preferred.

[15] We also estimate the random effect model and compare both models through the Hausman test. In most cases, the fixed-effect model provides better estimates.

Table 5: FDI impact on value added: general results.

	All				local			
	OLS	*WLS*	*1st Diff.*	*Within*	*OLS*	*WLS*	*1st Diff.*	*Within*
log(L)	0.883** (0.014)	0.889 ** (0.013)	0.436** (0.079)	0.589** (0.029)	0.890** (.0167)	0.896** (0.015)	0.447** (0.096)	0.602** (0.339)
log(K)	0.173** (0.009)	0.169 ** (0.009)	0.057** (0.017)	0.061** (0.014)	0.169** (0.011)	0.165** (0.011)	0.047** (0.017)	0.047** (0.0161)
PART *foreign ownership- firm level*	0.001** (0.0002)	0.001** (0.0002)	0.0003 (0.0006)	0.0001 (0.0006)	—	—	—	—
PRES *foreign ownership-sector level*	- 0.00004 (0.0008)	-0.0001 (0.0008)	0.0000 (0.0007)	0.0001 (0.0005)	-0.0005 (0.0009)	-0.001 (0.0009)	-0.0007 (0.0009)	-0.0005 (0.0006)
Nobs	5352	5352	4014	5352	4144	4144	3108	4144
Wald test on sect. dum.	11.97 (0.00)	13.49 (0.00)	—	—	10.49 (0.00)	11.86 (0.00)	—	—
Hausman-test, $\chi 2$	—	251.0(1) (0.00)	—	218.5(2) (0.00)	—	287.25(1) (0.00)	—	168.3(2) (0.00)

Notes: Estimates are for 1991-1994. PART is the percentage of equity held by non-resident. PRES is the share of value added produced by foreign owned firms. Standard errors (denoted in parentheses) are corrected for heteroskedasticity using White specification. All specifications include time dummies and a non-reported constant term excepting first differences. OLS and WLS also include sectoral dummies. Symbols * and ** mean that the corresponding variable is significant at 10% and 5% level respectively. Wald test reports null-hypothesis for sectoral dummies, a value close or equal to zero indicates a rejection of the null hypothesis. Hausman (1) compares OLS with WLS and Hausman (2) compares fixed effect with non-reported random effect model. The probability for test rejection is in parentheses; for (1), a probability equal or close to zero means that WLS provide better estimates; for (2), the Within estimators have to be preferred in this case.

Table 5 presents general results for all firms and just local firms. Foreign presence at the firm level seems to play a positive role toward productivity if one looks at the OLS and WLS estimates. However, the absolute value of the coefficient for *PART* is quite low in comparison with other studies. For example, the value for the *OLS* estimates suggests that an acquisition equal to 100% of a domestic firm by a foreign investor should increase its output by only 0.1%. Using a similar technique for a panel of Venezuelan plants, Aitken and Harrison (1999) found a coefficient equal to 10.5% while the same coefficient for Morocco reached 3% in Haddad and Harrison (1993). These contrasting results could be attributed to the differences in the development level of host countries. This suggests that, *the impact of foreign investment on local firms productivity is lower the lesser is the difference in the development level of both host and home country of FDI*. More evidence concerning other country-case using similar data would be needed in order to confirm this.

As mentioned previously, we have run all regressions replacing *PART* by a dummy variable indicating the presence of foreign capital both at the firm and branch levels, and similar results emerged. This means that the value of the coefficient should be interpreted not strictly as an elasticity of output with

respect to the *scope* of foreign presence but more as the elasticity of output with respect to the *presence* of foreign investment. This idea is line with Blomström and Sjöholm (1999) who show that the degree of foreign ownership does not affect, by itself, labor productivity in Indonesian manufacturing. Table 5 also reveals that foreign presence at the sector level displays negative values for all firms and domestic firms, while this variable is far from being significant in both cases.

Within and first differences estimates depict a different picture. In those cases, both *PART* and *PRES* fail to have a significant impact on firms' productivity. The value of *PRES* is now near to zero and *PART* become insignificant. The last result suggests that foreign ownership does not influence firms' productivity when we consider that highly productive firms may attract foreign investors and that a wide range of others non-observable factors explain both productivity level and growth. Those factors are firm specifics, as shown by the difference of result between within and OLS-WLS estimates, and sector specifics, as demonstrated by the joint significance of sector dummies revealed by the Wald test statistic.

Alternatively, table 6 presents results dividing firms following their size, which is represented by the number of employees. We do this because the WLS used in table 5 may correct size effect imperfectly and separate estimates by groups of firm size may provide different results. However, we also find only weak support for FDI-related spillovers.

Table 6: FDI impact on value added, by firm size.

	All			local		
Large firms (over 200 employees)	*OLS*	*1st Diff.*	*Within*	*OLS*	*1st Diff.*	*Within*
PART *foreign ownership- firm level*	0.001** (0.0002)	0.0002 (0.0008)	0.0001 (0.0006)	—	—	—
PRES *foreign ownership- sector level*	0.0008 (0.001)	0.0009 (0.001)	0.0002 (0.0008)	-0.003 (0.001)	-0.0006 (0.0014)	-0.003** (0.001)
Nobs	1937	1417	1937	1029	747	1029
Wald test on sect. dum.	119.68 (0.00)	—	—	277.3 (0.00)	—	—
Hausman-test, $\chi 2$	—	—	81.61(2) (0.00)	—	—	80.5(2) (0.00)
Medium firms (50-200 employees)	*OLS*	*1st Diff.*	*Within*	*OLS*	*1st Diff.*	*Within*
PART *foreign ownership- firm level*	0.001** (0.0005)	-0.001 (0.001)	-0.0006 (0.001)	—	—	—
PRES *foreign ownershi-sector level*	-0.001 (0.001)	-0.002 (0.001)	-0.001 (0.001)	-0.0009 (0.001)	-0.002 (0.001)	-0.0007 (0.001)
Nobs	835	649	835	609	466	609
Wald test on sect. dum.	538.7 (0.00)	—	—	2737.6 (0.00)	—	—
Hausman-test, $\chi 2$	—	—	24.65 (2) (0.00)	—	—	28.9 (2) (0.00)
Small firms (less than 50 employees)	*OLS*	*1st Diff.*	*Within*	*OLS*	*1st Diff.*	*Within*
PART *foreign ownership- firm level*	0.003** (0.0008)	0.002 (0.004)	0.001 (0.002)	—	—	—
PRES *foreign ownershi-sector level*	-0.0003 (0.0012)	0.0001 (0.001)	0.00009 (0.0008)	-0.0002 (0.0012)	0.00002 (0.001)	0.0002 (0.0008)
Nobs	2580	1948	2580	2505	1888	2505
Wald test on sect. dum.	9.94 (0.00)	—	—	10.52 (0.00)	—	—
Hausman-test, $\chi 2$	—	—	84.9(2) (0.00)	—	—	85.37(2) (0.00)

Notes: Estimates are for 1991-1994. PART is the percentage of equity held by non-resident. PRES is the share of value added produced by foreign owned firms. Standard errors (denoted in parentheses) are corrected for heteroskedasticity using White specification. All specifications include time dummies and a non-reported constant term excepting first differences. OLS and WLS also include sectoral dummies. Symbols * and ** mean that the corresponding variable is significant at 10% and 5% level respectively. Wald test reports null-hypothesis for sectoral dummies, a value close or equal to zero indicates a rejection of the null hypothesis. Hausman (1) compares OLS with WLS and Hausman (2) compares fixed effect with non-reported random effect model. The probability for test rejection is in parentheses; for (1), a probability equal or close to zero means that WLS provide better estimates; for (2), the Within estimators have to be preferred in this case.

The preceding results are far from satisfactory. Following our basic assumptions we need to go further, splitting branches into modern and traditional activities in order to see whether domestic firms are more responsive to foreign presence when they are akin to modern production techniques. As we have mentioned before, Spanish experience is characterised by the fact that both international trade and foreign investment have been important in IRS sectors with a high content in R&D activities. Generally, IRS and high R&D sectors refer to the same activities; Barry and Bradley (1997). Table 3 showed that Spanish firms displayed higher level of R&D expenditure per worker in IRS sectors like Chemicals, Mechanical engineering, Other transport equipment and Office and precision instruments[16]. Other computations measuring R&D expenditure in percentage of value added for domestic and foreign firms give similar results (table 7).

Table 7: R&D expenditure in percentage of Value Added [a]

Branches	***Local***	***Foreign***	***All***
22. Basic metals	1.5	1.2	1.5
24. No-metallic minerals	1.0	1.4	1.3
25. Chemicals	7.9	4.9	5.8
31. Misc. metal articles	2.2	1.4	2.0
32. Mechanical engineering	6.3	2.7	3.9
33. Office and precision instruments	12.9	4.6	5.2
34. Electric and electronic engineering	5.5	9.5	8.3
36. Motor vehicles	2.4	9.7	9.2
38. Other transport equipment	17.1	4.9	13.7
41. Food and tobacco	0.9	1.1	1.0
42. Beverage	0.5	0.4	0.4
43. Textiles and clothing	1.7	1.1	1.5
44. Leather goods and footwear	1.4	0.2	1.2
46. Timber and furniture	1.1	0.5	1.0
47. Paper and printing	0.8	0.6	0.8
48. Rubber and plastics	3.8	2.4	2.9
49. Miscellaneous manufactures	2.7	1.4	4.3

Notes: Computations have been made for the cumulated real values of R&D and VA during the period 1991-1994.

[a] weighted means, weights given by value added.

[16] For a ranking of the branches by economies of scale, see Pratten (1988), p.82.

Hence, we estimate equation (2) distinguishing between high and low R&D branches. We use as benchmark a ratio R&D/Value added higher than 3% to characterize high R&D branches[17]. An alternative definition, grouping branches with a ratio higher than 2% does not change the results displayed in table 8. In table 9, we control the estimates by internalising R&D at the firm level. For high R&D activities (table 8) PART is positively associated with total factor productivity level as OLS and WLS estimates reveal. However, as for table 5, this result does not hold for first differences and within estimates. The same result holds when we look at low R&D activities and evidence provided in the preceding section suggests a similar conclusion using labour productivity. PRES provides more instructive results since we get an opposite sign for the two groups of activities: always positive for high R&D branches and always negative for low R&D branches. The second set of results is even more striking because estimates are significant for the four techniques we use and show that foreign presence at branch level has lowered local firms productivity by 0.2% over the period. Concerning high R&D activities, PRES is positively correlated with productivity growth, the elasticity being now equal to 0.3%. However, when we use OLS, WLS and fixed-effect model, the same variable is no longer significant.

The difference between high and low-R&D activities is itself very appealing. This gives some support to our idea that local firms capture positive spillovers if they have the technological ability to do so. Moreover, the negative coefficient for PRES in low R&D sectors is statistically more robust. Can one infer that the competition effect is dominant for these activities? We certainly need to be cautious in doing bearing in mind the discussion of Section 1. However, the positive relationship between competition and FDI found in the preliminary results provides some support to this view.

The preceding results concern R&D at the branch level only. An objection could be that R&D is, by itself, a factor of production and should be included in the production function. In table 9 we estimate the impact of foreign presence on productivity controlling for R&D expenditures at the firm level.

[17] The 2-digits codes of these branches are 25, 32, 33, 34, 36 and 38 as shown by table 7.

Table 8: FDI impact on value added by R&D expenditure at branch level.

	All				local			
High R&D branches	***OLS***	***WLS***	***1st Diff.***	***Within***	***OLS***	***WLS***	***1st Diff.***	***Within***
PART *foreign own.- firm level*	0.002** (0.0003)	0.002** (0.0003)	0.001 (0.001)	0.0007 (0.0009)	—	—	—	—
PRES *foreign own.-branch level*	0.0001 (0.001)	0.002 (0.001)	0.003** (0.001)	0.002* (0.001)	0.002 (0.001)	0.0007 (0.001)	0.003** (0.001)	0.001 (0.001)
Nobs	1645	1645	1235	1645	987	987	741	987
Wald test on sect. dum.	11.79 (0.00)	12.74 (0.00)	—	—	6.98 (0.00)	8.11 (0.00)	—	—
Hausman-test, $\chi 2$	—	88.55(1) (0.00)	—	36.74(2) (0.00)	—	63.06 (1) (0.5)	—	23.65(2) (0.00)
Low R&D branches	***OLS***	***WLS***	***1st Diff.***	***Within***	***OLS***	***WLS***	***1st Diff.***	***Within***
PART *foreign ownership- firm level*	0.001** (0.0005)	0.002** (0.0005)	-0.001 (0.001)	0.0002 (0.001)	—	—	—	—
PRES *foreign ownershi-sector level*	-0.0017 (0.0013)	-0.001 (0.001)	-0.002* (0.001)	-0.001* (0.0009)	-0.002* (0.001)	-0.002* (0.001)	- 0.002** (0.001)	- 0.002** (0.001)
Nobs	1049	1049	787	1049	892	892	667	892
Wald test on sect. dum.	7.69 (0.00)	7.67 (0.00)	—	—	11.71 (0.00)	11.83 (0.00)	—	—
Hausman-test, $\chi 2$	—	19.64(1) (0.84)	—	29.99(2) (0.00)	—	7.33 (1) (0.99)	—	23.78(2) (0.00)

Notes: High R&D branches are those with a R&D/VA ratio greater than 3%.

Estimates are for 1991-1994. PART is the percentage of equity held by non-resident. PRES is the share of value added produced by foreign owned firms. Standard errors (denoted in parentheses) are corrected for heteroskedasticity using White specification. All specifications include time dummies and a non-reported constant term excepting first differences. OLS and WLS also include sectoral dummies. Symbols * and ** mean that the corresponding variable is significant at 10% and 5% level respectively. Wald test reports null-hypothesis for sectoral dummies, a value close or equal to zero indicates a rejection of the null hypothesis. Hausman (1) compares OLS with WLS and Hausman (2) compares fixed effect with non-reported random effect model. The probability for test rejection is in parentheses; for (1), a probability equal or close to zero means that WLS provide better estimates; for (2), the Within estimators have to be preferred in this case.

Table 9: FDI impact on value added controlling by R&D expenditure at the firm level.

	All				local			
	OLS	***WLS***	***1st Diff.***	***Within***	***OLS***	***WLS***	***1st Diff.***	***Within***
RD-*firm level*	0.01** (0.001)	0.012** (0.002)	0.008** (0.001)	0.007** (0.001)	0.013** (0.002)	0.001** (0.002)	0.009** (0.001)	0.009** (0.001)
PART *foreign own.- firm level*	0.001** (0.0002)	0.001** (0.0002)	0.00002 (0.0006)	-0.0001 (0.0006)	—	—	—	—
PRES *foreign own.-branch level*	0.00004 (0.0008)	0.00002 (0.0008)	0.0001 (0.0007)	0.0002 (0.0005)	-0.0004 (0.0009)	-0.0009 (0.0009)	-0.0004 (0.0009)	-0.0004 (0.0006)
Nobs	5352	5352	4014	5352	4143	4143	3101	4143
Wald test on sect. dum.	1137 (0.00)	13.03 (0.00)	—	—	10.58 (0.00)	11.82 (0.00)	—	—
Hausman-test, $\chi 2$	—	126.14(1) (0.09)	—	242.05(2) (0.00)	—	25.4 (1) (1.00)	—	175.79(2) (0.00)

Notes: Estimates are for 1991-1994. PART is the percentage of equity held by non-resident. PRES is the share of value added produced by foreign owned firms. Standard errors (denoted in parentheses) are corrected for heteroskedasticity using White specification. All specifications include time dummies and a non-reported constant term excepting first differences. OLS and WLS also include sectoral dummies. Symbols * and ** mean that the corresponding variable is significant at 10% and 5% level respectively. Wald test reports null-hypothesis for sectoral dummies, a value close or equal to zero indicates a rejection of the null hypothesis. Hausman (1) compares OLS with WLS and Hausman (2) compares fixed effect with non-reported random effect model. The probability for test rejection is in parentheses; for (1), a probability equal or close to zero means that WLS provide better estimates; for (2), the Within estimators have to be preferred in this case.

As expected, R&D expenditure plays a significant role toward firm productivity but this is not the main concern of the present discussion. Our results now reveal an opposite sign for FDI at branch level between all firms and local firms estimates, this was not the case in table 8. This drives us to think that foreign firms may have captured part of the spillovers related to FDI. Table 10 shows that this is effectively the case: PRES has a positive and significant impact on foreign firm productivity using the whole set of techniques as before. Thus*, foreign presence seems to play a positive role in the productivity growth of foreign firms.* This is an unexpected result. The direct consequence is that there is a risk that foreign investment gives rise to a kind of dualism in Spanish industry since local firms are excluded from positive spillovers traditionally expected from FDI. However, the low value of the elasticity found for FDI at branch level suggests that this effect is potentially limited. The point estimate for PRES is equal to 0.2% and significant at 5% level for the first differences estimates and 10% for OLS, WLS and fixed effects model.

Table 10: FDI impact on foreing firms' value added controlling by R&D expenditure at the firm level.

	OLS	*WLS*	*1st Diff.*	*Within*
RD-*firm level*	0.004* (0.002)	0.004* (0.002)	0.005** (0.002)	0.004** (0.002)
PRES *foreign own.-branch level*	0.003* (0.001)	0.003* (0.001)	0.002** (0.001)	0.002* (0.001)
Nobs	1201	1201	908	1201
Wald test on sect. dum.	16.54 (0.00)	16.13 (0.00)	—	—
Hausman-test, $\chi 2$	—	12.25(1) (1.00)	—	25.79(2) (0.00)

Note: Estimates are for 1991-1994. PRES is the share of value added produced by foreign owned firms. Standard errors (denoted in parentheses) are corrected for heteroskedasticity using White specification. All specifications include time dummies and a non-reported constant term excepting first differences. OLS and WLS also include sectoral dummies. Symbols * and ** mean that the corresponding variable is significant at 10% and 5% level respectively. Wald test reports null-hypothesis for sectoral dummies, a value close or equal to zero indicates a rejection of the null hypothesis. Hausman (1) compares OLS with WLS and Hausman (2) compares fixed effect with non-reported random effect model. The probability for test rejection is in parentheses; for (1), a probability equal or close to zero means that WLS provide better estimates; for (2), the Within estimators have to be preferred in this case.

Let now consider the differences between traded and non-traded activities. Following our basic assumption, foreign trade activity may be an indicator of the ability of local firms to capture potential FDI spillovers. Here we consider that firms directly facing foreign competition may be more adapted to cope with foreign affiliates competition and reap the benefit from FDI. However, a negative correlation between foreign presence and local firm productivity must be interpreted carefully. Local firms could remain in the non-traded sectors that could correspond to low-productivity activities. As shown by O'Malley (1989), during the opening of the Irish economy in the early 1970s, indigenous firms were drawn into the non-tradable activities because of the high barriers they faced in international markets in term of high fixed costs. Exports were progressively concentrated into MNC affiliates, mainly in IRS activities. Irish firms were excluded from those sectors also characterized by a rapid productivity growth. Is a similar scenario plausible for Spanish manufacturing? Our dataset does not allow us to provide a direct answer beacause we consider only continuous observations, i.e., firms that exist during the whole period. Therefore we cannot observe any crowding out of local firms due to FDI. As a consequence, local firms' response to competition from foreign affiliates should necessarily be reflected in lower production levels and eventually in reduced prices and/or employment.

We then try to identify different reactions to foreign investment according to the division of branches between tradable and non-tradable activities. Table 11 introduce this point by comparing foreign presence

together with the degree of openness in manufacturing. The positive relationship between openness and foreign investment at branch level is not immediately apparent from this table. This is mainly due to the high degree of sectoral aggregation so we preferably used the sectoral breakdown at three digits to obtain the following results.

Table 11: Trade activity at the firm and branch level, and labour productivity.

Branches	*Foreign presence* [a]	*Openness branch level* [b]	*Output per worker* [a]	*% of exporting firms*		*Weighted % of exporting firms* [c]	
				Local	Foreign	Local	Foreign
22. Basic metals	0.21	0.57	1.6	76.0	87.5	94.6	92.4
24. No-metallic minerals	0.61	0.07	1.7	9.0	66.6	28.1	96.1
25. Chemicals	0.70	0.44	1.4	62.5	87.5	87.4	92.3
31. Misc. metal articles	0.19	0.27	1.2	37.5	66.6	68.6	98.7
32. Mechanical engineering	0.69	0.41	1.8	53.7	92.3	95.5	99.3
33. Office and precision instr.	0.79	0.53	2.8	42.8	100	92.6	100
34. Electric and electronic engin.	0.65	0.54	1.5	64.7	82.7	77.9	96.1
36. Motor vehicles	0.95	0.60	1.6	74.1	94.7	93.4	98.4
38. Other transport equipment	0.22	0.83	1.1	50.0	100	99.6	100
41. Food and tobacco	0.53	0.09	1.6	46.6	70.0	77.6	85.1
42. Beverage	0.87	0.20	2.1	41.3	91.6	88.9	96.4
43. Textiles and clothing	016	0.33	1.3	51.0	80.0	43.9	96.9
44. Leather goods and footwear	0.0	0.35	N-A	57.1	80.0	85.7	86.9
46. Timber and furniture	0.30	0.20	2.0	52.9	100.0	80.5	100
47. Paper and printing	0.33	0.19	0.8	40.0	100.0	92.1	100
48. Rubber and plastics	0.65	0.45	1.2	53.4	96.0	67.6	91.9
49. Miscellaneous manufactures	0.30	0.40	1.2	68.1	100.0	84.0	100

Notes: Computations concern 1994 only.
[a] results have been taken from table 1.
[b] Openess is represented by the current value of the ratio (export+import)/output.
[c] weights given by sales value.

We have computed the Spearman rank correlation coefficient between openness and PRES and we found a highly significant coefficient of 0.32, which is comparable to the 0.38 found in table 2 when we used import as an

indicator of international trade. We have also computed the same correlation coefficient between openness and total productivity and found a higher value of 0.44, which is also strongly significant. Firms in traded activities are then more productive. As a consequence, one could conjecture that the distinction between traded and non-traded sectors is relevant in order to test the existence of FDI spillovers. In table 12 we present results for those two groups of activities separately[18].

Table 12: FDI impact on value added: traded and non-traded branches.

	All				local			
Traded branches	***OLS***	***WLS***	***1st Diff.***	***Within***	***OLS***	***WLS***	***1st Diff.***	***Within***
PART *foreign ownership- firm level*	0.002** (0.0003)	0.002** (0.0003)	0.0005 (0.0009)	0.0008 (0.0009)	—	—	—	—
PRES *foreign ownership-sector level*	-0.0001 (0.001)	-0.0001 (0.001)	0.0009 (0.001)	0.00006 (0.001)	-0.0009 (0.002)	-0.001 (0.002)	-0.0002 (0.001)	-0.001 (0.001)
Nobs	1540	1540	1340	1540	1002	1002	870	1002
Wald test on sect. dum.	—	13.9 (0.00)	—	—	85.54 (0.00)	303.5 (0.00)	—	—
Hausman-test, $\chi 2$	—	74.8 (1) (0.03)	—	67.9 (2) (0.00)	—	85.4(1) (0.00)	—	67.39 (2) (0.00)
Non-traded branches	***OLS***	***WLS***	***1st Diff.***	***Within***	***OLS***	***WLS***	***1st Diff.***	***Within***
PART *foreign ownership- firm level*	0.001** (0.0002)	0.001** (0.0002)	0.0001 (0.0009)	-0.0003 (0.0008)	—	—	—	—
PRES *foreign ownership-sector level*	0.0002 (0.0009)	0.0001 (0.0009)	-0.0005 (0.0009)	0.0001 (0.0006)	0.00004 (0.001)	-0.0004 (0.001)	-0.0008 (0.001)	-0.0005 (0.0007)
Nobs	3812	3812	2674	3812	3140	3140	2231	3140
Wald test on sect. dum.	21.0 (0.00)	20.36 (0.00)	—	—	49.4 (0.00)	53.71 (0.00)	—	—
Hausman-test, $\chi 2$	—	146.1 (1) (0.00)	—	217.7 (2) (0.00)	—	53.71 (1) (0.00)	—	117.1 (2) (0.00)

Notes: Traded branches are represented by an openness ratio superior to 40% while non-traded branches have a ratio inferior to 40%. Estimates are for 1991-1994. PART is the percentage of equity held by non-resident. PRES is the share of value added produced by foreign owned firms. Standard errors (denoted in parentheses) are corrected for heteroskedasticity using White specification. All specifications include time dummies and a non-reported constant term excepting first differences. OLS and WLS also include sectoral dummies. Symbols * and ** mean that the corresponding variable is significant at 10% and 5% level respectively. Wald test reports null-hypothesis for sectoral dummies, a value close or equal to zero indicates a rejection of the null hypothesis. Hausman (1) compares OLS with WLS and Hausman (2) compares fixed effect with non-reported random effect model. The probability for test rejection is in parentheses; for (1), a probability equal or close to zero means that WLS provide better estimates; for (2), the Within estimators have to be preferred in this case.

Accordingly, there is essentially no strong difference between them. FDI at branch level is not significant and its relation with productivity negligible. Therefore, the Irish experience mentioned before cannot be transposed to the Spanish case. The weighted percentages of exporting firms depicted in table 11 give support to this view by showing that excepting some

[18] We consider as non-tradable those branches with an openess ratio lower than 40%. This is a very imperfect benchmark but alternative definitions do not affect the nature of our results.

branches like Non-Metallic Minerals or Textiles and Clothing, Spanish firms have generally comparable export activities to those of foreign affiliates. However, when we split our panel between exporting and non-exporting firms we unveil different evidence (table 13).

Table 13: FDI impact on value added: exporting and non-exporting firms.

	All				local			
Exporting firms	***OLS***	***WLS***	***1st Diff.***	***Within***	***OLS***	***WLS***	***1st Diff.***	***Within***
PART *foreign ownership- firm level*	0.0014** (0.0002)	0.0015** (0.0002)	0.0006 (0.0007)	-0.00007 (0.0006)	—	—	—	—
PRES *foreign ownershi-sector level*	-0.0007 (0.001)	-0.0004 (0.001)	-0.0003 (0.001)	-0.0008 (0.0007)	-0.002* (0.001)	-0.002* (0.001)	-0.0016 (0.001)	-0.002** (0.001)
Nobs	3012	3012	2302	3012	1943	1943	1486	1943
Wald test on sect. dum.	17.06 (0.00)	19.33 (0.00)	—	—	11.18 (0.00)	11.8 (0.00)	—	—
Hausman-test, $\chi 2$	—	25.58(1) (0.00)	—	147.8 (2) (0.00)	—	166.5 (1) (0.00)	—	121.1(2) (0.00)
Non-exporting firms	***OLS***	***WLS***	***1st Diff.***	***Within***	***OLS***	***WLS***	***1st Diff.***	***Within***
PART *foreign ownership- firm level*	0.001** (0.0005)	0.001** (0.0005)	-0.0002 (0.001)	0.001 (0.001)	—	—	—	—
PRES *foreign ownershi-sector level*	0.0004 (0.001)	-0.0001 (0.001)	0.0005 (0.001)	0.00006 (0.0009)	0.0000 (0.001)	-0.0005 (0.001)	0.0002 (0.001)	0.00002 (0.0009)
Nobs	2340	2340	1712	2340	2200	2200	1615	2200
Wald test on sect. dum.	26.7 (0.00)	29.5 (0.00)	—	—	23.8 (0.00)	26.4 (0.00)	—	—
Hausman-test, $\chi 2$	—	146.3 (1) (0.00)	—	75.5 (2) (0.00)	—	83.63(1) (0.00)	—	80.3 (2) (0.00)

Notes: Estimates are for 1991-1994. PART is the percentage of equity held by non-resident. PRES is the share of value added produced by foreign owned firms. Standard errors (denoted in parentheses) are corrected for heteroskedasticity using White specification. All specifications include time dummies and a non-reported constant term excepting first differences. OLS and WLS also include sectoral dummies. Symbols * and ** mean that the corresponding variable is significant at 10% and 5% level respectively. Wald test reports null-hypothesis for sectoral dummies, a value close or equal to zero indicates a rejection of the null hypothesis. Hausman (1) compares OLS with WLS and Hausman (2) compares fixed effect with non-reported random effect model. The probability for test rejection is in parentheses; for (1), a probability equal or close to zero means that WLS provide better estimates; for (2), the Within estimators have to be preferred in this case.

Foreign presence at branch level is now negatively correlated with the productivity level of local exporting firms. The elasticity turns around 0.2% and is significant at 10% level for OLS and WLS and at 5% using the fixed-effects model. This result indicates that Spanish firms operating in international markets face stronger competition from FDI than their non-exporting counterparts. However, our general result is still valid here: the absolute value of estimated elasticity reflects the fact that FDI impact on Spanish firms productivity is very limited.

Conclusion

The Spanish experience is especially relevant for countries aiming at future membership in the EU. Spanish productivity appeared to be well behind other major EU countries and is often cited as a major constraint for firm competitiveness. The present paper tries to assess the real contribution of foreign affiliates towards local firms productivity in the aftermath of Spanish accession to the European Community.

Our results give some support to the competition effect of FDI. In addition, firms with a significant level of foreign presence display higher labour productivity and are located in more trade-oriented sectors. On this basis, we test the existence of externalities through a total factor productivity approach, drawing a distinction between modern and traditional sectors, and taking R&D expenditure as the distinguishing feature. This variable is used to reflect the technological capability of local firms. The idea is that, if technological capability is insufficient, then the competition effect of FDI will dominate and foreign presence at the sectoral level would display a negative correlation with total factor productivity. In the opposite case, if domestic firms are efficient enough and *"technologically"* able to cope with foreign competition, then the positive spillovers generally associated to FDI will hold. Our results show that the first scenario is the correct one for the low R&D sectors. However, no clear evidence appears about the role of FDI as a positive factor for value added growth in high R&D sectors. In particular, an unexpected result appeared: for foreign firms, both the level and growth of value added were positively correlated with foreign presence. This result suggests that foreign affiliates capture the larger part of positive FDI-related spillovers. This point merits further research, including the need to look for evidence on foreign clustering and economies of agglomeration in particular activities. For instance, the case of the Spanish motor vehicle industry is generally considered as an example of the way in which FDI can influence a country's specialisation and raise the attractiveness of a location for new foreign investors.

We also found a negative correlation between FDI and productivity for Spanish exporting firms. This result is in line with the fact that Spanish firms competing on the international market must also face foreign competition through FDI. Finally the distinction between traded and non-traded activities failed to give credit to an *Irish Scenario* for Spanish manufacturing in which indigenous firms would be excluded from traded activities and remain in low-productive non-traded branches.

From a broader perspective, our results show that the difference in productivity levels between foreign and indigenous firms is very limited compared to other studies using the same kind of data for developing countries. Other case studies using firm data would be needed in order to confirm the differences existing between developing and developed countries in this field. Further extensions concerning the location dimension of FDI spillovers also suggest themselves. In this paper, we have not considered the role played by the geographical location of firms. For example, location may be particularly important in high-tech or high input requirement activities. It is clear that the closer local firms are to foreign affiliates, the higher will be the likelihood of their capturing positive spillovers. Moreover, the present study covers only five years, which is a clear limitation given the possibility that spillovers take longer to appear than does the competition effect identified in the paper.

References

Aitken, B. and Harrison, A.E, 1999. Do domestic firms benefit from direct foreign investment? Evidence from Venezuela, American Economic Review 89 (3), 605-618.

Aitken, B., Hanson, G.H. and Harrison, A.E., 1997. Spillovers, Foreign Investment and Export Behaviour, Journal of International Economics 43 (1-2), August, 103-132.

Alonso, J.A., 1999. Growth and the external constraint: lessons from the Spanish case, Applied Economics, 31 (2), 245-253.

Bajo Rubio, O. and Sosvilla Rivero, S., 1994. An econometric analysis of foreign direct investment in Spain, 1964-89, Southern Economic Journal 61 (1), 104-120.

Barry, F. and Bradley, J., 1997. FDI and Trade: the Irish Host-Country experience, The Economic Journal 107 (445), 1798-1811.

Barrell, R. and Pain, N., 1999. Domestic institutions, agglomerations and foreign direct investment in Europe, European Economic Review 43, 925-934.

Blomström, M. and Persson, H., 1983. Foreign investment and spillover efficiency in an underdeveloped economy: evidence from the Mexican manufacturing industry, World Development 11, 493-501.

Blomström, M., 1986. Foreign Investment and Productive Efficiency: The case of Mexico, Journal of Industrial Economics 15, 97-110.

Blomström, M. and Kokko, A., 1998. Multinational corporations and spillovers, Journal of Economic Surveys 12, 247-277.

Blomström, M. and Sjöholm, F., 1999. Technology transfer and spillovers: Does local participation with multinationals matter? European Economic Review 43, 915-923.

Caves, R.E., 1974. Multinational firms, Competition and Productivity in Host-Country Markets, Economica, 41, 176-193.

Cohen, W.M and Levinthal, D.A., 1990. Absorptive Capacity: A New Perspective on Learning and Innovation, Administrative Science Quaterly 35, 128-152.

De la Dehesa, G; Ruiz, J.J.; Torres, A., 1991. Liberalizing Foreign Trade: Spain.. Liberalizing foreign trade. In: Liberalizing Foreign Trade. The experience of New Zealand, Spain, and Turkey. Papageorgiou, D.; Michaely, Mi.; Armeane M., (eds.), Cambridge, Mass. and Oxford: Blackwell. pp.137-262.

Djankov, S. and Hoekman, B., 1998. Avenues of technology transfer: Foreign Investment and Productivity Change in the Czech Republic, Centre for Economic Policy Research Discussion Paper 1883.

Duce, M., 1995. El impacto de la integración en la UE sobre la inversión internacional directa en España, Papeles de economía española 63, 192-208.

Farinha, L and Mata, J., 1996. The impact of Foreign Direct Investment in the Portuguese Economy, Banco de Portugal Working Paper 16-96.

Fosfuri, A., Motta, M. and Ronde, Th., 1998. Foreign direct investment and spillovers through workers´ mobility, Universitat Pompeu Fabra Economic Working Papers 258, Barcelona.

Globerman, S., 1979. Foreign Direct Investment and Spillover Efficiency Benefits in Canadian Manufacturing Industries, Canadian Journal of Economics 12, 42-56.

Gustavsson, P., Hansson P., and Lundberg, L., 1999, Technology, Resource Endowments and International Competitiveness European Economic Review, 43 (8), 1501-30.

Haddad, M. and Harrison, A.E., 1993. Are there positive spillovers from direct foreign investment? Evidence from panel data for Morocco, Journal of Development Economics 42, 51-74.

Herce, J.A., Jimeno, J.F. and Sosvilla, S., 1998. Flujos de capital e integración financiera: el caso de España, FEDEA (Ed.), Madrid.

Knickerbocker, F.T., 1976. Market Structure and Market Power Consequences of Foreign Direct Investment by Multinational Companies, Centre for Multinational Studies Occasional Paper 8, Washington, D.C.

Markusen, J.R., 1995. The boundaries of Multinational Enterprises and the Theory of International Trade, Journal of Economic Perspectives 9 (2), 169-189.

Markusen, J.R. and Venables, A., 1999. Foreign Direct Investment as a Catalyst for Industrial Development, European Economic Review 43(2), 335-56.

Martín, C. and Velázquez, F.J., 1993. El capital extranjero y el comercio exterior de las empresas manufactureras, Papeles de Economía Española 56, 221-34.

Martín, C. and Velázquez, F.J., 1997. The determining factors of foreign direct investment in Spain and the rest of the OECD: lessons for the CEECs CEPR Discussion Paper 1637.

Merino de Lucas, F. y Salas Fumás, V., 1995. La empresa extranjera en la manufactura española: sus efectos directos e indirectos, Fundación Empresa Pública, Documento de Trabajo 9507, Madrid.

Organisation for Economic Co-Operation and Development, 1999a. Measuring Globalisation. The role of Multinationals in OECD Economies, OECD Paris.

Organisation for Economic Co-Operation and Development, 1999b. Foreign Trade by Commodities - 1999 Edition, Volume 5, OECD Paris.

O'Malley, E., 1989. Industry and Economic Development: the challenge for the latecomer. Gill & Macmillan (Ed.), Dublin.

Pratten, C., 1988. A survey of the Economies of Scale, in: Commission of the European Communities, Research on the Cost of Non-Europe 2: Studies on the Economics of Integration, Luxembourg.

Rodríguez-Clare, A., 1996. Multinationals, linkages, and economic development, American Economic Review 86 (4), 852-873.

White, H., 1980. A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. Econometrica 48, 817-830.

RELACION DE DOCUMENTOS DE FEDEA

COLECCION RESUMENES

98-01: "Negociación colectiva, rentabilidad bursátil y estructura de capital en España", **Alejandro Inurrieta.**

TEXTOS EXPRESS

2000-02: "El tipo de cambio Euro/Dolar. Encuesta de FEDEA sobre la evolución del Euro", **Simón Sosvilla-Rivero y José A. Herce**.

2000-01: "Recomendaciones para controlar el gasto sanitario. Otra perspectiva sobre los problemas de salud**", José A. Herce**.

DOCUMENTOS DE TRABAJO

2000-19: "Foreign Direct Investment and Productivity Spillovers", **Salvador Barrios**.

2000-18: "Female Employment and Occupational Changes in the 1990s: How is the EU Performing Relative to the US?, **Juan J. Dolado, Florentino Felgueroso y Juan F. Jimeno**.

2000-17: "Do tobacco taxes reduce lung cancer mortality?**, José Julián Escario y José Alberto Molina.**

2000-16: "Solution to Non-Linear MHDS arising from Optimal Growth Problems", **J. R. Ruiz-Tamarit y M. Ventura-Marco.**

2000-15: "El sistema de pensiones contributivas en España: Cuestiones básicas y perspectivas en el medio plazo", **Juan Francisco Jimeno**.

2000-14: "Assessing the Credibility of the Irish Pound in the European Monetary System", **Francisco Ledesma-Rodríguez, Manuel Navarro-Ibáñez, Jorge Pérez-Rodríguez y Simón Sosvilla-Rivero**

2000-13: "La utilidad de la econometría espacial en el ámbito de la ciencia regional", **Esther Vayá Valcarce y Rosina Moreno Serrano**.

2000-12: "The role of the minimum wage in the welfare state: An appraisal", **Juan J. Dolado, Florentino Felgueroso y Juan F. Jimeno**.

2000-11: "Modelling evolving long-run relationships: The linkages between stock markets in Asia", **José L. Fernández-Serrano y Simón Sosvilla-Rivero.**

2000-10: "Integration and Inequality: Lesson from the Accessions of Portugal and Spain to the EU", **Juan F. Jimeno, Olga Cantó, Ana Rute Cardoso, Mario Izquierdo y Carlos Farinha Rodrigues**.

2000-09: "Explaining Youth Labor Market Problems in Spain: Crowding-Out, Institutions, or Technology Shifts", **Juan J. Dolado, Florentino Felgueroso y Juan F. Jimeno**.

2000-08: "Distributional aspects of the quality change bias in the CPI: Evidence from Spain", **Javier Ruiz-Castillo, Eduardo Ley y Mario Izquierdo**.

2000-07: "Testing chaotic dynamics via Lyapunov exponents", **Fernando Fernández-Rodríguez, Simón Sosvilla-Rivero y Julián Andrada-Félix**.

2000-06: "Convergencia: Un análisis conjunto de los sectores. Aplicación al caso de las regiones españolas", **Pablo Álvarez de Toledo, Jaime Rojo, Álvaro Toribio y Carlos Usabiaga**.

2000-05: "The Laspeyres bias in the Spanish consumer price index". **Javier Ruiz-Castillo, Eduardo Ley y Mario Izquierdo**.

2000-04: "Evaluación de los efectos del Plan Prever a partir de un modelo de simulación de reemplazos del parque español de automóviles", **Omar Licandro y Antonio R. Sampayo**.

2000-03: "Minimum consumption, transitional dynamics and the Kuznets curve", **María José Alvarez y Antonia Díaz.**