

FOREIGN DIRECT INVESTMENT AND PRODUCTIVITY SPILLOVERS IN THE IRISH MANUFACTURING INDUSTRY: EVIDENCE FROM FIRM LEVEL PANEL DATA

Frances Ruane and Ali Uđur*

Department of Economics, Trinity College Dublin

1. Introduction:

Over the past two decades direct investment across national borders by international firms – primarily multinational corporations (MNCs) has grown significantly in the world economy, especially into developed countries.¹ Increasingly such foreign direct investment (FDI) is seen as an important channel for obtaining access to resources for development and the emerging positive attitudes to FDI are reflected in policy changes that increasingly facilitate direct investment.²

The analysis of the effects of FDI on host countries in the literature implicitly distinguishes between its *direct* and *indirect* effects. *Direct effects* are reflected in capital formation, employment and trade associated with the FDI project.³ Although the direct effects of foreign investment may be more important for certain countries, it

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¹ This development is evident in the fact that in the past decade global output and sales of foreign affiliates have grown faster than either world gross domestic product or world exports. In 1999, the ratio of foreign affiliates' sales to global GDP was almost 50 per cent, with the sales value being over twice as high as the value of world exports of goods and services. (See World Investment Report, 2001)

² According to the World Investment Report (2001), many countries in different regions of the world have increasingly adopted FDI-specific regulatory frameworks to support their investment-related objectives over the past four decades. Out of the 150 regulatory changes relating to FDI made during 2000 by 69 countries, 98 per cent were in the direction of creating more favourable conditions for FDI.

³ For example, many developing countries have sought FDI in the manufacturing sector in order to acquire crucial capital to develop the local manufacturing industry sector.

is increasingly accepted that FDI is likely to have important indirect *effects* on host economies by giving local companies (LCs) access through contact with the FDI companies to the technology and management practices of the home country. Indeed, Blomstrom and Kokko (1998) argue that the most important reason behind many countries' efforts to attract more foreign investment today is a desire to acquire modern technology. They and others suggest that the investments of MNCs generate important externalities that enhance the productivity of indigenous firms in the economy. These externalities, which are typically referred to as "positive productivity spillovers", are seen as helping to improve the comparative advantage of the economy over time.⁴ It is also argued in the literature that foreign presence can reduce productivity of domestic firms, i.e., generate "negative productivity spillovers" especially if the foreign firms are producing for the local market. For example, Aitken and Harrison (1999) show that foreign entry, by disturbing the existing market equilibrium in the host country, could force domestic firms to produce less output; this in turn could push them up their average cost curves⁵ and hence lower the productivity of these firms. If this decline in the productivity of domestic firms is large enough, net domestic productivity can decline despite the technology transfer from foreign firms.

In terms of FDI, Ireland is one of the most globalised economies in the world, having pursued a strategy of promoting green-field investment in the manufacturing sector by foreign companies for over forty years. The focus and incentive structure of the policies adopted to promote such FDI has meant that these companies established plants to produce for export, primarily to other countries within Europe. This aspect of industrial policy has contributed significantly to Ireland's exceptionally high growth rates during the last decade, and has facilitated considerable restructuring in the manufacturing sector of the Irish economy.⁶ The scale of such FDI is evident in data from Central Statistics Office (CSO), which show that in 1998, foreign firms accounted for **82** per cent of net output and **47** per cent of employment in the Irish manufacturing sector. In 1998 these foreign firms exported approximately **92** per cent

⁴ In addition to productivity spillovers, Blomstrom and Kokko (1998) also examine "market access spillovers", which focus on the effect of the export operations of foreign firms on domestic firms.

⁵ This would be the case if average cost curves were downward sloping due to substantial fixed costs.

⁶ For an overview, see Barry (1999).

of their output, which in turn accounted for **87** per cent of all manufacturing exports from Ireland.⁷

From a domestic policy perspective, the *direct effects* of FDI, and particularly employment creation have been the main focus of attention in Ireland for most of the past forty years.⁸ Since the mid-1990s the focus has begun to shift to the indirect impact of FDI on the manufacturing sector, especially as unemployment rates have declined; consequently the direct benefits of additional employment in the MNC sector are seen as having reduced value. This emphasis is evident in the policy of building linkages between MNCs and local companies (LCs), as well as in the policy of building manufacturing agglomerations in targeted sectors, especially in electronics and healthcare products.⁹ The linkage programmes were directly concerned with building up supply chains between MNCs and LCs, which were both intra-sectoral and inter-sectoral.¹⁰ There is much anecdotal evidence that the presence of MNCs has also had a positive effect on the Irish economy through the training of managers who have moved from the MNC to the LC sector.¹¹ There is also evidence of product imitation having taken place, in some cases facilitated by the movement of skilled labour into the LC sector.¹² If such impacts are important, then they should be reflected in the different productivity levels in LCs, depending on the degree to which they are exposed to MNCs.

The objective of this paper is to examine empirically whether there is any evidence that FDI has had a positive impact on productivity performance in Irish-owned companies in the manufacturing sector, i.e., whether there is evidence of positive productivity spillovers from MNCs to individual LCs. In the context of the experience of other countries, one might expect that the net impact of FDI spillovers in Ireland would be positive for several reasons: Ireland's long history of promoting FDI and of seeking to encourage it to build (positive) connections with LCs; the export orientation of MNCs, which means that there is little likelihood of competitive

⁷ One has to be careful when interpreting net output and export figures for foreign firms in Irish manufacturing industry due to transfer pricing activities of foreign firms.

⁸ See Ruane and Görg (1997).

⁹ Görg and Ruane (2001) analysed backward linkages in the Irish electronics industry for the period 1982 to 1995. They found that foreign firms in downstream sectors had relatively higher linkages and that these tended to increase relatively over time.

¹⁰ See Ruane (2001)

¹¹ See Bradley (2001)

¹² The scale of R&D activities has been much greater in the MNC than in the LC sector.

pressures on LCs (positive) while at the same time little risk of crowding out (negative) in local product markets; over much of the past 20 years there has been high unemployment, making crowding out in the labour market less likely (not negative); the common language and shared culture with the dominant source of FDI into Ireland, namely, the USA, means that there is easy mobility of labour between MNCs and LCs and fewer impediments to imitation than might be found elsewhere (positive).

This paper builds on preliminary work by Ruane and Uđur (2000), which examined, using 2-digit and 4-digit sector level data, the effects of FDI on the productivity levels of domestic firms in the Irish manufacturing industry. The remainder of the paper is organised as follows. Section 2 discusses some of the growing literature on productivity spillovers from FDI. In Section 3 we look specifically at the existing evidence on Ireland and describe the data set that we use to estimate spillover effects. In Section 4 we use the standard model in the literature to estimate such productivity spillovers and present the results obtained. We also look at the sensitivity of results to assumptions made about the sectoral aggregates across which spillovers are expected to occur. In Section 5 we consider the impact of using an alternative approach to determining the method of measuring the source of potential FDI spillovers. We present some concluding remarks in Section 6.

2. International Evidence on Productivity Spillovers:

The general approach in the literature to examining the productivity spillovers from foreign to local firms has been to relate the productivity of domestic firms to some measure of foreign presence, while controlling for industry and firm characteristics. One of the earliest empirical studies on productivity spillovers from FDI to host countries is Caves (1974). Applying econometric techniques to Australian industry level data on 22 industries at 2-digit level for 1962 and 1966, he finds that the coefficient for the foreign firms' presence is positive and significant. This leads him to conclude that relatively high subsidiary shares in Australian manufacturing sectors are associated with higher productivity levels in competing domestic firms. Globerman (1979), applying a similar approach to data on the Canadian

manufacturing sector, concludes that differences in labour productivity levels are associated with spillover efficiency benefits associated with foreign direct investment. There have been several studies focusing on developing countries, including Blomstrom and Persson (1983) who examine the relationship between foreign investment and spillover efficiency in the Mexican manufacturing industry using 4-digit industry level data for 1970. The empirical evidence from their study confirms the findings of the developed country studies, namely, that there are efficiency spillovers from foreign-owned to domestically-owned plants.

One drawback of these early studies was their use of cross section data sets at the sectoral level, which made it impossible to control for firm characteristics in different industries. More recently, Haddad and Harrison (1993), using firm level data find that while sectors with a large foreign presence have less deviation from maximum productivity levels, there is no evidence of significant positive effect of foreign investment on the productivity growth of domestic firms in Moroccan manufacturing industries. Aitken and Harrison (1999) study the productivity spillovers from MNCs to local firms in the Venezuelan manufacturing sector using a firm-level panel data set. They find that increases in foreign equity participation are correlated with increases in productivity for recipient plants with less than 50 employees. However, by contrast with earlier studies, their overall results show that increases in the foreign presence negatively affect the productivity of domestically-owned firms in the same sector.

Flores *et al.* (2000) examine the impact of foreign direct investment on the productivity of domestic firms in Portugal. They find a positive relationship between domestic firms' productivity and foreign presence only when a proper account is taken of the technology differences between the foreign and domestic producers and these spillovers are within the modern sectors. They use data at 2-digit sectoral level as this was the only basis on which the authors had access to the data used.

A recent paper in the literature by Konings (2000) investigates empirically the effects of foreign direct investment on the productivity performance of domestic firms in three emerging economies of Central and Eastern Europe, namely, Bulgaria, Romania

and Poland. Konings finds that there are negative spillovers to domestic firms in Bulgaria and Poland, while there are no spillovers to domestic firms in Poland.

In the past two years there have been several UK studies, using newly-available data on the UK manufacturing sector. Liu *et al.* (2000), using 48 3-digit UK industries for the period 1991-96, find that the presence of multinational firms has a significant positive impact on the productivity in the local UK manufacturing firms. Using 2-digit industry level panel data for 1983-92, Hubert and Pain (2001) investigate the impact of direct investment by foreign firms on the technical progress and labour productivity in the UK and find that foreign firms have a significant positive effect on the level of technical efficiency in domestic firms. Girma *et al.* (2001) investigate whether the presence of foreign firms in a sector raises the productivity of domestic firms using a firm-level panel data set in the UK manufacturing industry for the period 1991-96. They find no evidence of productivity spillovers on average. However their results show evidence of spillovers where firms are in industries with high levels of import competition or skills.

Overall, the empirical evidence on productivity spillovers is mixed, with some studies finding positive spillovers effects, while others find negative effects or no spillovers at all. However, a careful analysis of the pattern of results, as set out in Görg and Greenaway (2001), shows that in the case of panel data, the preponderance of results indicate negative rather than positive spillovers, while the results from sectoral studies and especially cross sectional studies suggest positive spillovers. In the context of theory, the results of the panel level data are a better test of the productivity spillover phenomenon. Thus these results overall suggest that negative rather than positive spillovers might be expected.

Before turning to look at the Irish data, it is helpful to note that the theory, such as it is, is quite vague on how one might measure foreign presence, as the source of spillovers. The majority of studies either use the share of employment or net output accounted for by foreign firms to measure foreign presence. This begs the question of whether the share really captures the likely source of the impact. For example, does the scale matter? Is the impact of foreign presence similar for all levels of FDI in a sector? When we think in terms of sectors, over what sectoral domain do we expect

spillovers to occur? Early studies have tended to use relatively high levels of sectoral aggregation, namely 2 or 3-digit NACE sectors, while more recent studies have looked at lower levels of sectoral aggregation when seeking to link LC productivity to foreign presence. It is also suggested implicitly that all of these spillovers are horizontal, with inter-sectoral spillovers being assumed to arise from vertical linkages. This is an issue that we address below using Irish data.

3. Productivity Spillovers in Ireland¹³

Thus far there have been just two studies available that have examined the impact of FDI on the productivity of Irish companies.¹⁴ As noted above, Ruane and Uđur (2000) examined, using 2-digit and 4-digit sector level data from the Central Statistics Office, the effects of FDI on the productivity levels of LCs in the Irish manufacturing industry. They estimated a labour productivity Equation for the period 1991-1997 for domestically-owned manufacturing plants in the Irish manufacturing sector, controlling for capital intensity and labour quality of these plants. Their results, based on sectoral aggregations across over 3,700 Irish companies and 750 foreign-owned companies showed no evidence of significant productivity spillovers from FDI.

In the same year, Kearns (2000) examined productivity spillovers from FDI in Ireland conducting a firm-level analysis. In his study Kearns uses data from a large sample of companies collected by Forfás, the Irish industrial policy agency, and published as the Forfás Irish Economy Expenditures Survey (FIEES). The sample is not balanced and under-represents the numbers of Irish companies operating in that period. It is likely that the more successful, i.e., higher-productivity companies, are more represented in the sample of over 1,300 indigenous plants covered in the analysis, which covers the period 1984-1998. Estimating labour productivity Equations for these, he finds that indigenous plants have higher productivity levels in those sectors where there is a higher share of foreign employment, which suggests that there are positive productivity spillovers from MNCs to LCs.¹⁵

¹³ In general we follow the nomenclature used above to discuss spillovers, viz, from foreign to domestic is described as being from MNCs to LCs.

¹⁴ We are aware of a further study by Barry et al (2001), but have not yet had sight of it.

¹⁵ Kearns extends his analysis by using the same approach on different sub-samples of the data set defined according to productivity gap and R&D activity of domestic firms. He finds no evidence that

The results of another study of the impact of FDI on Irish manufacturing by Görg and Strobl (2000) should also be noted. They examine the effect of the presence of MNCs on plant survival using plant-level data for the Irish manufacturing industry for the period 1973 to 1996, using the employment survey conducted annually by Forfás.¹⁶ Their results show that the presence of MNCs has a life-enhancing effect on LCs in high-tech industries but not on those in low-tech sectors.¹⁷

The present paper extends the analysis in Ruane and Uđur (2000) by using data at the plant level. This allows us to investigate whether the findings of our earlier paper may be due to the use of data aggregated at the 2 and 4-digit industry level, and whether same result is obtained from plant level data, which allow us to control for company-specific factors that can influence the productivity levels of Irish plants.

The data used in this paper are from the Irish Census of Industrial Production (CIP).¹⁸ This census is carried out annually by the Central Statistics Office of Ireland and covers **all** industrial local units with 3 or more persons engaged. As such it is the only fully representative survey of plants in Ireland. The data available are those standard for such Censuses – output (gross and net), sales, employment, wages, capital additions, sectoral and regional classification as well as nationality of ownership. In the CIP the classification by nationality of ownership is determined by the nationality of the owners of 50 per cent or more of the share capital. There are no details recorded on the extent of foreign ownership within a given company and thus it is not possible to determine the impact of different shares of foreign ownership, as done in several panel level data studies for other countries¹⁹.

productivity gap has any effect on the productivity spillovers from foreign to domestic firms. He also finds that there were relatively greater productivity spillovers to domestic R&D active plants.

¹⁶ They postulate that an increase in productivity through technology spillovers will reduce a host country firm's average cost of production and hence increase the plant's probability of survival, all other things being equal.

¹⁷ The classification of sectors into high tech and low tech is based on an OECD classification used by Kearns and Ruane (2000).

¹⁸ Because of the small number of companies in Ireland and in line with a strong emphasis on confidentiality in the Irish statistical office, the data can only be accessed under "safe-setting" conditions at the Central Statistics Office.

¹⁹ FDI policy in Ireland does not require minimum domestic equity participation as is the case in many developing countries, and most FDI is in the form of green-field investment with 100% foreign ownership.

The analysis is for the period 1991-98, and covers an average of 4,600 companies, of which more than 3,800 are Irish-owned.²⁰ Table 1 presents a summary of some of the main variables: number of firms, total net output and total employment together with the percentage accounted for by foreign firms. There was a net increase in total employment of 23% during the period. Foreign firms increased their share of total employment from 44% in 1991 to 47% in 1998- an increase of 7% in the share of total employment accounted for by them. Although the increase in share of manufacturing employment in MNCs was moderate, the absolute employment accounted by foreign firms rose by 35% during the same period. As the number of foreign firms decreased by 5%, the average size of MNCs in the Irish manufacturing sector increased over the 1990s. Labour productivity levels of the domestic part of the industry have risen by 21% during the period in real terms.²¹ We note in passing that the quality of the data is particularly high – they cover companies virtually from birth as company registration records for Ireland are well maintained.²²

4. Empirical Model and Methodology:

We follow the approach commonly used in this literature which hypothesises that the labour productivity of local firms can be estimated by the function

$$(Q/L)_{ijt} = f \{ (K/L)_{ijt}, (L_s/L_u)_{ijt}, (FO)_{jt} \} \quad (1)$$

where labour productivity of firm i in sector j in year t $(Q/L)_{ijt}$ is measured by the ratio of net output (Q) to total employment (L) in Irish owned plants. Plant level labour productivity is influenced by the current physical capital intensity of the plant $(K/L)_{ijt}$. Since the capital stocks of plants are not recorded for the Census of Industrial Production (CIP) we use a proxy for capital, namely, fuel and power consumption by the plant. Thus our capital intensity variable is measured by the ratio of fuel and power consumption to total employment.²³ We measure the labour quality variable $(L_s/L_u)_{ijt}$ as the ratio of skilled workers (L_s) to unskilled workers (L_u). Following the nomenclature of the CIP, we define technical and administrative workers as skilled,

²⁰ The data series, distinguishing company ownership goes back before 1991, but the data available to us only covers the period since 1991, when the new NACE classification was introduced

²¹ We do not look at the trend in labour productivity of foreign companies as the data inevitably incorporate some degree of transfer pricing.

²² One effect of having a proactive industrial policy is that there is a very early recording of all new industrial establishments.

²³ In some studies with the unavailability of capital stock data, investment or consumption of energy is used as a proxy for capital assets. See Sjöholm (1998) and Kearns (2000).

and industrial workers as unskilled. In line with existing studies, the foreign presence variable $(FO)_{jt}$ is measured by the share of employment accounted by all foreign-owned plants in the sector which the plant operates.

We expect a positive relationship between the dependent variable and both capital intensity and labour quality. The main interest of our study lies in the coefficient on the foreign presence variable: if there are positive productivity spillovers from MNCs to LCs, this variable should have a significant and positive effect on the labour productivity levels of Irish LCs.

We estimate Equation (1) in logs with plant level data, using both Fixed Effects (FE) and Random Effects (RE) models. These allow us to account for the unobservable heterogeneity and to control for unobserved time invariant factors which might affect productivity.²⁴

As noted in Section 2, early studies in this literature have tended to use relatively high levels of sectoral aggregation in measuring the potential spillover effects of foreign presence, namely 2 or 3-digit NACE sectors. More recent studies have looked at lower levels of sectoral aggregation when trying to link LC productivity to foreign presence. The choice of sectoral aggregation is typically not discussed, despite the fact that it is crucial to interpreting the spillovers. The lower levels of aggregation effectively restrict the range over which productivity spillovers can occur. In order to examine the sensitivity of our results to different levels of sectoral aggregation of the foreign presence variable, we estimate Equation (1) using foreign presence variable aggregated at 2, 3 and 4-digit sector levels.

Table 3 presents the results from estimation of Equation (1) for all LCs in Irish manufacturing industry using both FE and RE approaches. Both approaches show that capital intensity and labour quality have a positive and significant effect on the productivity levels of LCs. The foreign presence variable has a positive but insignificant effect in both models at 2 and 4-digit sectoral aggregation. The coefficient of foreign presence variable is negative for 3-digit estimation using the FE

²⁴ The descriptive statistics are shown in Table 2 in levels rather than logs.

model and positive for the RE model, but both results are statistically insignificant. Overall, the results from Table 3 indicate that there are no significant productivity spillovers from FDI in the Irish manufacturing sector and these results are insensitive to the scale of sectoral aggregations for the foreign presence variable. As such, the Irish results obtained are in line with the majority of results reported in Görg and Greenaway (2001), which show either negative or no significant spillovers from FDI at plant level across a range of countries.

In line with other papers, we also check if the results are sensitive to whether the relationship between the dependent and independent variables is estimated in terms of growth rates. So we modify Equation (1) as

$$\Delta (Q/L)_{ijt} = f \{ \Delta (K/L)_{ijt}, \Delta (L_s/L_u)_{ijt}, \Delta (FO)_{jt} \} \quad (2)$$

Equation (2) is a first difference equation and relates the change in labour productivity of domestic firms to changes in capital intensity and skill level within the firm and to changes in the foreign presence measure in each corresponding sector. Labour productivity, skill level and foreign presence are defined as above. As plants provide data on investment for the CIP, we can measure the change in capital intensity in the standard way, namely as the ratio of net investment to the change in total employment. The estimation technique used is simply Ordinary Least Squares on the first differenced equation.²⁵ As in Table 3 we check to see whether results are sensitive to the degree of sectoral aggregation of the foreign presence variable.

Results from Table 4 show that when variables are expressed in terms of growth rather than levels there are no significant positive productivity spillovers from foreign firms when foreign presence variable is measured as a share. We also see that these results are not sensitive to the sectoral aggregation of foreign presence variable.

²⁵ First differencing enables us to control for firm-specific factors and also we can use sector dummies directly to control for sector-specific effects. We also specify in the estimation that the observations are

5. Productivity Spillovers in Ireland- An Alternative Approach

The approach used in Section 4 follows that in most studies in the literature. In particular it measures foreign presence as the share of employment accounted for by foreign companies in the corresponding sector. This ignores the fact that there may be a critical mass in terms of the actual scale of FDI, which could affect productivity spillovers. In effect it does not take account of the possibility that the absolute levels of employment, rather than shares, accounted for by MNCs could be important. In the Irish case this is particularly relevant because during the period of our study, employment in both foreign and domestic segments of the manufacturing sector have grown substantially, while the shares have changed only marginally. (See Table 1.) In a recent study, Castellani and Zanfei (2002) argue that using the share of employment accounted for by foreign firms as the foreign presence variable assumes that changes in the same proportion of foreign and aggregate activity have no effect on the productivity of local firms and can cause a downward bias in the results.²⁶ They propose that foreign presence should be measured by the absolute level of employment in foreign firms rather than by the share. Noting that the use of total employment levels alone in the regressions would cause a bias through a sector-size effect, Castellani and Zanfei (2001) suggest that employment in domestically-owned firms (DO) be included as a control variable, where (DO) is measured by the total employment of domestic firms in the corresponding sector.

Table 5 present the results when foreign presence is measured as the actual level of employment in MNCs rather than shares, using FE and RE models. In order to check for the sensitivity of sectoral aggregation in foreign presence variable, we again present results for 2,3 and 4-digit levels of aggregation. Capital intensity and labour quality have positive and significant effects on the labour productivity levels of domestic firms, a pattern similar to that of Table 3. In contrast to our results in Table 3, the foreign presence variable has a positive and significant effect on the domestic firms' productivity levels in this specification, suggesting the presence of positive productivity spillovers from FDI in the Irish manufacturing industry. We also see

independent between groups, but not necessarily within groups. In other words, we specify the model so that it takes the fact that we have multiple observations from the same firms into account.

from the regression results that spillovers from FDI are sensitive to the sectoral aggregation of the foreign presence variable. At 2-digit sectoral and 4-digit sectoral aggregation, the foreign presence variable shows a significant and positive relationship with LC productivity levels, although the results are not significant when 3-digit sectoral aggregation is used.

Table 6 presents the estimation results for Equation (2) where all variables are expressed in first differences and the foreign presence variable is measured as the employment level accounted for by foreign firms in the corresponding sectors. These results show that foreign presence variable has a positive and significant effect only at the 4-digit sectoral aggregation level, which suggests that results are sensitive to the degree of sectoral aggregation specified.

6. Summary and Conclusions

Uniquely within Europe, Ireland has promoted FDI in its manufacturing sector for over 40 years. As noted in the introduction, this has resulted in MNCs in the sector playing a major role in terms of net output, employment and exports.

In terms of likely spillovers from FDI companies to LCs, there are several arguments which would suggest that, if these are significant in any country, they should be evident in Ireland. The arguments favourable to net positive spillovers include: a policy regime which has increasingly fostered connections between MNCs and LCs; a shared language and culture with the major home country for FDI in Ireland (USA), both of which favour product imitation and labour movement; and the absence of direct competition from MNCs in the home market. Our analysis, using panel data on all companies in the Irish manufacturing sector and covering the period 1991-98, finds no evidence of such spillovers when the standard measure of foreign presence adopted in most of the literature is used, viz., MNC employment as a percentage of total employment. In effect, LC labour productivity is no higher in sectors with a larger foreign share of employment. However, when we follow Castellani and Zanfei (2001) by using an alternative measure, namely, employment in foreign companies in

²⁶ They find positive spillovers from FDI when they use this new specification, using data on the Italian

the relevant sector, a different picture emerges – at both the 2- and 4-digit NACE sector levels, the coefficient of employment is positive and significant. The difference in the results suggests that we need to look in more detail at what it is we believe actually leads to the spillover, and whether the absolute rather than the relative size of the MNC sector is important. In the Irish case the 1990s saw a rapid increase in the presence of multinationals (32% change in employment), but since the LC sector was also growing quickly, there is relatively small variation in the FDI share of employment. This may explain in part the difference in the results obtained here from those obtained by Kearns (2000), who using the employment share measure to capture foreign presence finds evidence of spillovers in the Irish case. The difference may be due to the fact that his analysis is based on data that are more limited in terms of plant coverage, but it may also be due to the fact that the data cover a longer time period, during which there was more variation in the share of FDI employment. (The change in the share of employment accounted by foreign firms between 1984 and 1998 was nearly 26%, whereas this change is only 7% for the period 1991-1998)

One further issue that arises from this paper is what the appropriate sectoral measure for FDI presence should be for this type of analysis. For data reasons, much of the early analysis of spillovers at plant level has used 2- or 3-digit level – mirroring the analyses undertaken at sectoral levels before plant level data became available. In this paper we used 2-, 3- and 4-digit and found, in the case where FDI presence is measured in levels, that the results are sensitive to the choice of level of aggregation. But this begs the question of what the level should be. The lower the level of aggregation, the more likely the spillovers are to be horizontal – but if we lower the level too much, we miss out on the possible spillovers which can occur as a result of FDI in neighbouring sectors. Furthermore, while some authors suggest that all such spillovers are horizontal rather than vertical, this is not plausible even at 4-digit²⁷. It points to our need to explore in more detail the conduits for such spillovers, and to give direct attention to differences in the capacity of LCs to exploit spillover potentials and the likelihood that MNCs will generate these.²⁸

manufacturing firms.

²⁷ There is a tendency to use linkages when intra-firm relationships are vertical, and to limit the term “spillovers” to horizontal relationships.

²⁸ See Kearns and Ruane (1999)

TABLES

	Total Plants	Foreign Plant Share (%)	Total Net Output * (£000)	Foreign Output Share (%)	Total Employment	Foreign Employment Share (%)	Domestic Labour Productivity * (£000)
1991	4,546	16.3	8,889,788	68.4	196,878	44.1	25.56
1992	4,542	15.9	9,488,818	69.5	198,954	44.0	25.97
1993	4,544	15.2	10,139,901	70.8	200,003	44.4	26.60
1994	4,603	15.8	11,398,702	73.7	205,421	46.6	27.34
1995	4,602	15.7	13,553,398	76.9	220,578	47.1	26.79
1996	4,599	15.8	15,037,708	77.1	226,634	46.9	28.69
1997	4,739	15.5	17,690,030	79.1	240,454	47.4	29.35
1998	4,702	15.4	21,921,440	81.9	242,772	47.5	31.07
1991-98	3.43	-5.52	146.59	19.73	23.31	7.70	21.57
% D							

Source: CSO: Census of Industrial Production, 1991-98

*In 1985 prices

	Mean	Std. Deviation
Net output	£3,633,108	3.19e+07
Lab Prod	£28,534.93	37870.57
Total engaged	30.45	66.89
Proportion of Skilled Labour	0.488	1.057
Foremshare4*	28.41	30.57
Foremshare3*	32.43	28.33
Foremshare2*	38.16	20.96
Forem4	732.86	1,549.99
Forem3	1,592.30	1,958.95
Forem2	5,848.83	4,138.99

*Unweighted averages

Foreign presence measured as Employment Shares						
	2-digit		3-digit		4-digit	
	FE (1)	RE (2)	FE (3)	RE (4)	FE (5)	RE (6)
\tilde{K}/L	0.013*** (2.76)	0.011*** (2.54)	0.013*** (2.77)	0.011*** (2.56)	0.013*** (2.77)	0.011*** (2.56)
L_s/L_u	0.077*** (11.96)	0.086*** (15.83)	0.077*** (12.14)	0.086*** (15.58)	0.077*** (12.14)	0.086*** (15.58)
FO	0.027 (1.29)	0.023 (1.35)	-0.001 (-0.05)	0.001 (0.19)	0.004 (0.65)	0.003 (0.59)
YEAR DUMMIES	Yes	Yes	Yes	Yes	Yes	Yes
SECTOR DUMMIES	-	Yes	-	Yes	-	Yes
No. Of observations	26286	26286	26286	26286	26286	26286
Prob>F	0.000		0.000		0.000	
Prob>Chi2		0.000		0.000		0.000

Notes: 1) t-ratios for Fixed Effects and z-values for Random Effects are in brackets
2) ***=Significant at 1%, **=significant at 5%, *=significant at 10%

Foreign presence measured as shares						
	2-digit		3-digit		4-digit	
	(1)	(2)	(3)	(4)	(5)	(6)
$\ddot{A} (K/L)$	0.019*** (6.56)	0.022*** (7.40)	0.019*** (6.55)	0.022*** (7.40)	0.019*** (6.56)	0.023*** (7.42)
$\ddot{A} (L_s/L_u)$	0.072*** (7.93)	0.071*** (7.37)	0.072*** (7.93)	0.071*** (7.36)	0.072*** (7.94)	0.071*** (7.37)
\ddot{A} FO	-0.002 (-0.13)	-0.007 (-0.32)	0.002 (0.25)	0.003 (0.37)	0.008 (1.42)	0.008 (1.29)
YEAR DUMMIES	-	Yes	-	Yes	-	Yes
SECTOR DUMMIES	-	Yes	-	Yes	-	Yes
R^2	0.07	0.08	0.07	0.08	0.09	0.11
No. Of observations	15455	15455	15455	15455	15455	15455
Prob>F	0.000	0.000	0.000	0.000	0.000	0.000

Notes: 1) t-ratios are in brackets
2) ***significant at 1%, **=significant at 5%, *=significant at 10%

Foreign Presence measured as levels of employment accounted by foreign firms						
	2-digit		3-digit		4-digit	
	FE (1)	RE (2)	FE (3)	RE (4)	FE (5)	RE (6)
\tilde{K}/L	0.013*** (2.77)	0.011*** (2.85)	0.012*** (2.70)	0.011*** (2.80)	0.013*** (2.77)	0.013*** (2.83)
L_s/L_u	0.077*** (12.18)	0.086*** (15.60)	0.077*** (12.20)	0.087*** (15.62)	0.077*** (12.19)	0.086*** (15.59)
FO	0.016* (1.67)	0.009* (1.66)	0.004 (0.76)	0.004 (0.57)	0.005* (1.68)	0.004* (1.74)
DO	0.073*** (2.30)	0.043 (1.42)	0.053*** (2.94)	0.027 (1.61)	0.023 (1.49)	0.004 (0.33)
YEAR DUMMIES	Yes	Yes	Yes	Yes	Yes	Yes
SECTOR DUMMIES	-	Yes	-	Yes	-	Yes
No. Of observations	26286	26286	26286	26286	26286	26286
Prob>F	0.000	-	0.000	-	0.000	-
Prob>Chi^2	-	0.000	-	0.000	-	0.000

Notes: 1) t-ratios for FE and z-values for RE are in brackets

2) ***=Significant at 1%, **=significant at 5%, *=significant at 10%

Foreign presence measured as levels						
	2-digit		3-digit		4-digit	
	(1)	(2)	(3)	(4)	(5)	(6)
$\tilde{A} (K/L)$	0.019*** (7.23)	0.022*** (7.61)	0.019*** (7.29)	0.022*** (7.64)	0.019*** (7.29)	0.023*** (7.66)
$\tilde{A} (L_s/L_u)$	0.072*** (10.06)	0.071*** (9.85)	0.072*** (10.04)	0.071*** (9.83)	0.072*** (10.05)	0.071*** (9.83)
$\tilde{A} FO$	0.001 (0.06)	-0.003 (-0.16)	0.004 (0.64)	0.004 (0.63)	0.0075* (1.67)	0.0076* (1.68)
$\tilde{A} DO$	0.045 (1.56)	0.044 (1.36)	0.012 (0.71)	0.004 (0.24)	-0.009 (-0.67)	-0.015 (-0.94)
YEAR DUMMIES	-	Yes	-	Yes	-	Yes
SECTOR DUMMIES	-	Yes	-	Yes	-	Yes
R ²	0.12	0.13	0.09	0.11	0.11	0.13
No. Of observations	15455	15455	15455	15455	15455	15455
Prob>F	0.000	0.000	0.000		0.000	0.000

Notes: 1) t-ratios are in brackets

2) ***=Significant at 1%, **=significant at 5%, *=significant at 10%

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