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Foreign Direct Investment and Export Spillovers: How Do Export Platforms Fare?

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Abstract

Should economies that promote themselves as export platforms for FDI be expected to experience relatively high levels of export spillovers from foreign to host-country enterprises? To investigate how export decisions of host-country enterprises are associated with the presence and export intensity of foreign-owned enterprises (FOEs) in an export-platform economy we use enterprise-level data for the manufacturing sector in Ireland. We postulate that export spillovers from FOEs are dependent upon the sectoral presence and export intensity of FOEs, so that third-country export-platform FDI may not result in positive export spillovers to host-country enterprises. We find that the decision by host-country enterprises to enter the export market is positively associated with the presence of FOEs in their sector. However, the export intensity of host-country enterprises is negatively associated with the export sales ratios of FOEs, a result that contrasts with evidence of positive FOE export intensity spillovers in most previous empirical studies.

KEY WORDS: FDI, export spillovers, export platforms.
JEL Classification: F14, F23.

1.   Introduction

Trade policy reform by countries often involves extensive investment by governments in order to attract FDI, partly because of a perceived link between FDI and the improved export competitiveness of the host country.[1] The potential importance of the export-enhancing role of FDI for host countries has been recognized in a number of country-based studies, but these generally focus on the export behaviour of foreign-owned enterprises (FOEs) themselves, ignoring any impact FOEs have on the export behaviour of host-country domestic-owned enterprises (DOEs).[2] In this paper we examine the proposition that FOEs transmit "export spillovers" to DOEs by transferring their knowledge and experience about export markets and conditions, and that these FOE export spillovers enhance the ability of DOEs to both enter the export market and to export intensively, i.e., export a larger share of their output.[3]

Most recent studies (Aitken, Hanson, and Harrison, 1997; Kokko, Zejan, and Tansin, 2001; and Greenaway, Sousa, and Wakelin, 2004) suggest that the presence of FOEs contributes to the export propensity of host-country enterprises both directly and indirectly. FOEs are assumed to be characterized by enterprise-specific advantages that enhance their ability to locate in foreign markets, overcoming any location-specific advantages held by DOEs, thus making the FOE decision to invest directly in the host country profitable (Markusen, 1995; Helpman, Melitz, and Yeaple, 2003). FOE-specific advantages can be summarized as knowledge-based assets that include information

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[1] See UNCTAD (2003) for a review of FDI investment and host-country export competitiveness.
[2] For example, the United Kingdom (Blake and Pain, 1994), Portugal (Cabral, 1995), and Ireland (Barry and Bradley, 1997).
[3] We define foreign-owned enterprises as those that are majority-owned by foreign shareholders (CSO, 1998a). Although we acknowledge the strict definitions of the terms "firm", "company", "plant", and "enterprise", the term enterprise is used synonymously throughout the paper.

pertaining to product and process technology, and managerial, marketing and promotional ability. Moreover, FOEs typically have a presence in many markets, making them a potential source of information about foreign markets, consumers, and technology. The intangible nature of such enterprise-specific and knowledge-based assets is most efficiently exploited by FOEs in both international and domestic markets by retaining these assets within the enterprise. However, such assets can have public-good characteristics that make it difficult to fully protect them from exploitation by DOEs in the host country. If FOEs fail to internalise fully their export-related assets then externalities may "spill-over" to DOEs, positively influencing the decision by DOEs to enter the export market or increase their export volumes, as a result of FDI presence.[4]

However, the likelihood that FOEs are a source of positive export spillovers for DOEs is more questionable where the host-country acts as a *third-country export platform* for FDI. Elkohm, Forslid, and Markusen (2003) define "third-country export-platform FDI" as FOE affiliate production for sale in third countries rather than in the parent or host countries, where the host and third countries are located inside a free-trade area and the parent is outside. Using data on sales by foreign affiliates of US multinationals broken down into local sales in the host market, export sales back to the US, and export sales to third markets, Elkohm *et al* (2003) summarise the results of various empirical studies to show that small EU countries such as Ireland, Belgium, and Holland display the characteristics of third-country export-platform hosts.

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[4] An extensive literature focuses on the productivity enhancement spillover effects generated by FOEs in a host country. See Görg and Greenaway (2002) for a survey of the evidence on productivity spillovers. Ruane and Uğur (2002) investigate FDI and productivity spillovers in Irish manufacturing industry using plant-level data.

The consequences of third-country export platform FDI for the nature of export spillovers from FOEs to DOEs could be significant, primarily because FOEs located in countries such as Ireland tend to operate in isolation from DOEs, providing little opportunity for the development of the type of links that are necessary for export spillovers to occur. For example, existing research suggests that a high concentration of FOEs relative to DOEs in host-country sectors enhances the efficiency of DOEs, by inducing productivity gains through increased competition between DOEs and FOEs servicing the domestic marketplace. Such productivity enhancements are especially likely where FOEs invest in sectors with high barriers to entry and oligopolistic market structures. The presence of more productive foreign enterprises can force DOEs to adapt their production methods and adopt new technology in order to survive the increased competition for domestic consumers, as well as facilitate their entry into foreign markets because of the resulting efficiency improvements (Kokko, 1996). Thus export spillovers from FOEs to DOEs are traditionally thought to be greater in sectors where there is a strong concentration of FOEs, usually proxied by employment or output share.

However, where FOEs use the host-country as a third-country export platform, market competition is unlikely to impact positively on the export propensity of DOEs because FOEs are overwhelmingly export-orientated and competition with DOEs on local product markets is limited or non-existent. When countries act as third-party export platforms for FDI, dualistic production and exporting systems tend to develop, with DOEs supplying the domestic market and FOEs exporting practically all of their locally-produced output.

In this case it seems less likely that the links between FOEs and DOEs required to facilitate export spillovers will develop.

In this paper we examine empirically export spillovers from FOEs to DOEs, focusing on the possibility that FOE export spillovers do not positively influence the export propensity of DOEs in host countries which act as FDI export platforms.[5] We investigate two specific propositions. Firstly, is the *concentration* of FOEs in the host country positively associated with the export decisions of DOEs? Secondly, is the *export intensity* of FOEs positively associated with the export decisions of DOEs? We estimate a two-stage empirical model of the *export intensity* of DOEs, given their *export decision*. Our study uses an enterprise-level data set of Irish manufacturers between 1991 and 1998, a period of significant and concentrated FDI growth in Irish manufacturing.

The remainder of this paper is structured as follows. Section 2 reviews previous empirical evidence of export spillovers from foreign to domestic enterprises in the host-country, while Section 3 outlines the foreign ownership pattern of enterprises in Irish manufacturing. Section 4 presents and develops the general empirical model while Section 5 presents the empirical results and Section 6 concludes the paper.

2. International Evidence of Export Spillovers

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[5] The focus of our empirical study is on the possibility of intra-sectoral export spillovers from FOEs to DOEs. We recognise the possibility of intra-sectoral FOE to FOE, DOE to DOE, and DOE to FOE spillovers, as well as inter-sectoral spillovers of each of these. Moreover, it is likely that one area of the economy, e.g. manufacturing, receives spillovers from other areas of the economy, e.g. services.

Enterprise-level studies for Mexico, Uruguay, and the UK indicate that export spillovers from FOEs to DOEs may be significant. Each of these studies incorporates at least one spillover channel, proxied by FOE employment, exports, or technology, into their search for export spillovers at the sectoral level using either cross-section or panel data.[6] The various analyses also take account of the influence of enterprise heterogeneity on the exporting decisions of DOEs.

The study of Mexican manufacturing enterprises between 1986 and 1990 (Aitken, Hanson and Harrison, 1997) includes two measures of FOE presence: a general measure of FOE output (production) in Mexico and a separate measure of FOE export activity.[7] The results of a probit specification using the full sample of DOEs show that the export decision of Mexican enterprises is positively correlated with both measures of FOE activity. This suggests that both the local concentration of FOE activity in Mexican manufacturing and the export activity of FOEs are sources of FOE export spillovers to DOEs in Mexico.

The association between FOE export spillovers and the export behaviour of domestic enterprises in Uruguay in 1998 is examined using cross-sectional enterprise-level data by Kokko, Zejan, and Tansin (2001). The presence of FOEs in each sector is proxied by the share of FOE output in total sectoral output. There is no variable used to account for the

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[6] These studies include measures of spillovers from specific types of DOEs as well as FOEs at the sectoral level, on the export performance of domestic enterprises. Some studies also measure the impact of spillovers from FOEs and DOEs on the export performance of FOEs in the host country.
[7] FOE domestic production is measured as 'the share of state-industry FOE domestic shipments in national industry domestic shipments, relative to the state share of national domestic manufacturing shipments'. FOE export activity is calculated as 'the share of state-industry FOE exports in national industry exports, relative to the state share of national manufacturing exports' for three-digit ISIC industries (Aitken *et al*, 1997).

sectoral export activity of FOEs. The econometric results suggest that domestic enterprises are more likely to export if they operate in a sector where the presence of foreign enterprises is relatively high.

The study also searches for export spillovers generated by FOEs distinguished by the time period in which FOEs established in Uruguay. The variable for foreign presence is initially redefined to include only those FOEs established in Uruguay prior to January 1973, a period of industrialisation characterised by traditional import substitution policies. No evidence is found of export spillovers from these older FOEs to DOEs. Next, foreign presence is redefined to include only FOEs established after January 1973, a period of increasingly outward-orientated trade policies in Uruguay. The estimated coefficient for foreign presence becomes positive and highly significant for this period, suggesting that spillovers from outwardly orientated FOEs are associated with DOE exports. These results indicate that the type of trade regime within which FOEs operate may influence their potential to generate positive export spillovers (Görg and Greenaway, 2001).

A study of the export behaviour of Spanish manufacturing enterprises between 1990 and 1998 (Barrios, Görg, and Strobl, 2001) focuses on export spillovers from FOEs that influence both the initial decision of domestic enterprises to enter the export market or not and their export intensity once in the export market. The channels for FOE export spillovers are proxied by the average export-to-sales ratios of FOEs in a sector and the average ratio of FOE research and development (R&D) spending-to-sales in each sector.

Using a probit model to estimate the export decision of DOEs and a tobit model to estimate the determinants of DOE export intensity, the authors find no evidence that either the patterns of export/sales or R&D/sales ratios of FOEs affect the decision of Spanish enterprises to enter the export market or not. The tobit estimations indicate that the patterns of R&D spend to sales of FOEs do influence the export intensity of DOEs, but fail to detect any impact of export/sales ratio of FOEs on DOE export intensity.

Greenaway, Sousa, and Wakelin (2004) search for evidence of FOE export spillovers in UK manufacturing for the period 1992 to 1996 by assuming domestically-owned enterprises maximise profits by choosing to serve the domestic (d) market, the foreign (f) market, or both. The standard profit function is dependent on prices (p), quantities sold in each market (q), and costs, as show in equation (1).

$$\max_{q_d q_f} p_d p_f + p_f q_f - h(q_d + q_f) - m_d(q_d) - m_f(q_f)$$
$$s.t. q_d q_f \geq 0$$
(1)

Costs are divided into production costs (h) and distribution costs for domestic (m_d) and foreign (m_f) markets. Production costs are represented by

$$h(q_d + q_f) = (q_d + q_f)^2 + g(q_d + q_f) \text{ (2)}$$

and distribution costs to both markets $(i = f, d)$ are represented by

$$m_i(q_i) = b_i q_i^2 + c_i q_i \qquad (3)$$

where

$$g = g(X, \Omega, \Psi)$$
$$c_d = c_d(X, Z_d)$$
$$c_f = c_f(X, Z_f, \Gamma_{EX}, \Gamma_{MNE})$$

Some costs (X) are common to both markets but others (Z_i) are specific to either the domestic of foreign market. Production costs are related to the relative importance of FOEs in the domestic market (Ω) and total innovation activities by FOEs (Ψ). Foreign distribution costs are related to total export activity (Γ_{EX}) and FOE export activity (Γ_{MNE}). Scalar parameters b_i, c_i and g are included in both cost functions.

The production and distribution cost functions of DOEs thus incorporate three measures of export spillovers from FOEs which can impact on DOE decisions. FOE export activity (Γ_{MNE}) reflects export *information spillovers* associated with the export behaviour of FOEs; the higher the concentration of FOE export activity the more DOEs benefit from information externalities which help to reduce the distribution costs associated with exporting. *Competition spillovers* are reflected in the relative importance of FOEs in the domestic market (Ω); the greater the importance of FOEs in the domestic market the stronger the competitive pressure they exert on DOEs to reduce production costs. *Demonstration spillovers* are reflected in the innovation activities carried out by FOEs (Ψ); the more technologically intensive FOE activity is, the larger the potential is for imitation by DOEs to improve productive efficiency and reduce production costs.[8]

Greenaway, Sousa, and Wakelin (2004) use a two-step Heckman selection model to determine whether or not FOE spillovers affect the *export decision* of DOEs and the

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[8] Information effects = [(FOE sector exports/Total sector exports) / (Total FOE exports/Total exports)]. Competition effects = (FOE employment/Total employment) at the 5-digit (SIC) level. Demonstration effects = (FOE R&D expenditure) at the 2-digit (SIC) level. Thus the three FOE spillover variables specified by Greenaway *et al* (2004) are a mixture of actual expenditure, relative sectoral importance, and the sectoral importance of FOEs relative to total FOE presence.

export intensity of DOEs that export. Their results indicate positive spillover effects on the probability of a UK domestic enterprise being an exporter through each of the three FOE spillover channels. Empirical support is also found for competition and demonstration spillovers on the export intensity of UK enterprises, but there is no evidence of FOE information spillovers impacting on UK export intensity. The authors suggest that information spillovers help DOEs to overcome sunk costs associated with and hence the probability of exporting, but not necessarily the intensity with which they export.[9]

In all of the previous studies described above, a number of enterprise-level characteristics are included in order to account for enterprise heterogeneity. Enterprise variables such as size, average wages, capital intensity, and technological intensity, are found to be positively associated with the export decision of DOEs.[10]

Thus all previous studies indicate that, with the exception of the results for Spain, export spillovers have a positive and significant impact on the export propensity of DOEs. It should be noted however, that positive evidence for the existence of export spillovers from FOEs to DOEs has been found in countries that do not act as third-country export-

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[9] The Greenaway *et al* (2004) study controls for spillovers from 'general' export activity, measured as the relative importance of each sector in total domestic exports, capturing the export structure of the host country and controlling for factors that affect the overall export profile of the sector. Average wages and fixed assets per employee are found to have a significant positive and negative relationship respectively with the probability of a domestic UK enterprise being an exporter. Enterprise size, average production costs, and average wages are positively and significantly associated with export propensity.

[10] Several enterprise-specific determinants have been identified in empirical studies of the performance of exporters. For example, Bernard and Jensen (1999) note that exporters are larger, more productive, more capital intensive, and pay higher wages than non-exporters. Ruane and Sutherland (2004), using the same data set of Irish manufacturers used in this paper, find that exporting DOEs are, on average, larger, more productive, more capital intensive, use more skilled labour, and pay higher wages relative to non-exporting DOEs in Irish manufacturing between 1991 and 1998.

platforms for FDI. In order to determine if the nature of export spillovers differ in third-country export platforms, we examine empirically FOE export spillovers in the Irish manufacturing sector.

3.   Application to Ireland

The promotion of Ireland as a FDI export platform for over thirty years has been especially successful since the creation of the single European market in 1992, with FOEs from outside the European Union (EU), particularly those from the United States, using Ireland as a production base from which to export to the increasingly integrated EU market. Resulting changes in the structure of Irish manufacturing during the 1990s are reflected in employment and export growth, which illustrate the increasingly dualistic nature of Irish manufacturing.[11] Between 1991 and 1998 FOE employment in Irish manufacturing rose by more than 31 per cent and by 1998 comprised almost 50 per cent of total manufacturing employment.[12] FOEs accounted for 95 per cent of the 250 per cent growth in Irish manufacturing exports in the same period and by 1998 accounted for 88 per cent of total manufacturing exports (Forfás, 2000, p.24). While exports by domestic Irish enterprises rose over the period, their share of total exports fell by 14 percentage points (Forfás, 2000, p.9). Moreover, as Table 1 shows, the proportion of Irish manufacturers who exported remained constant at 60 per cent over the period and the

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[11] See Ruane and Görg (1999) for a review of Irish manufacturing during the 1990s.
[12] We use the share of employment of FOEs to reflect their relative importance in Irish manufacturing as turnover figures reported by FOEs in Ireland may be artificially inflated to the extent that FOEs engage in profit-switching transfer pricing.

export intensity of DOEs averaged less than 38 per cent across all sectors, a proportion that also remained unchanged between 1991 and 1998.[13]

The relatively poor export performance of DOEs, in conjunction with the significant increase in export-orientated FDI in Irish manufacturing during the 1990s, raises questions about whether or not highly export-orientated FOEs can enhance, directly or indirectly, the export propensity of DOEs in third-country export platforms such as Ireland. Moreover, the dominance of FOEs in certain sectors and the proliferation of US-owned FOEs in Irish manufacturing allows us to examine empirically several FDI characteristics, notably the export intensity and concentration pattern of FOEs, which possibly affect the nature of export spillovers from FOEs to DOEs.[14]

Table 1 shows that FOEs are heavily concentrated in the high-tech *Chemicals* and *Electronics* sectors, accounting for more than 80 per cent of all employment in these sectors; in all other sectors the proportion of employment in FOEs is less than one-third. Although more than 95 per cent of all FOEs across all sectors in Irish manufacturing export part of their Irish-produced turnover, FOEs in the chemicals and electronics sectors are also distinguished by their export intensity, which exceeds 90 per cent of turnover. These differences in the employment and export intensity of FOEs allow us to

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[13] Even across Irish manufacturing sectors, the export intensity of DOEs is similar; DOEs in Chemicals and Electronic export an average 38 per cent of their turnover, only slightly above the 35 per cent of turnover exported by all other sectors, reflecting the consistent domestic market orientation of DOEs.

[14] Several enterprise-specific determinants have been identified in empirical studies of the performance of exporters. For example, Bernard and Jensen (1999) note that exporters are larger, more productive, more capital intensive, and pay higher wages than non-exporters. Ruane and Sutherland (2004), using the same data set of Irish manufacturers used in this paper, find that exporting DOEs are, on average, larger, more productive, more capital intensive, use more skilled labour, and pay higher wages relative to non-exporting DOEs in Irish manufacturing between 1991 and 1998.

distinguish two distinct sectors with contrasting FOE presence in Irish manufacturing. The "modern" sectors, comprising chemicals and electronics industries, host highly export-orientated and high-tech FOEs, and can be described as third-party export-platform FDI sectors. In contrast, the "traditional" sectors host FOEs that are more domestic-market orientated and low-tech manufacturing enterprises. Although the traditional sectors are host to a relatively large proportion of FOEs, of whom almost 95 per cent are exporters, their export intensity is significantly less than FOEs in the modern sectors, so that FOEs in the traditional sectors compete with DOEs in the domestic Irish marketplace.

In the modern sectors of third-country export platform host countries such as Ireland, where FOEs dominate production in a sector and export practically all of their output, there may be few competition and information externalities from FOEs, and the subsequent effects on DOE production and distribution costs may not be the same as described in models such as those of Greenaway *et al* (2004).[15] Equation (2) in Section 2 above shows DOE production costs are negatively associated with the relative importance of FOEs in a sector because FOEs enhance the efficiency of DOEs through increased competition, which in turn reduces production costs of DOEs. However, where export-intensive FOEs locate in countries for the purpose of exporting and do not compete on any significant scale with DOEs in the host market, there may be few if any opportunities for competitive pressures to reduce production costs of DOEs.

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[15] Girma and Wakelin (2001), in a study of UK manufacturing, show that the nationality of the FDI may affect whether or not there are productivity spillovers. Their results indicate that productivity spillovers are strongest from Japanese FDI and absent from US FDI. This is attributed to the latter being of generally older vintage and using older, more established production techniques compared to Japanese enterprises.

Similarly, DOE distribution costs associated with exporting are thought to be negatively associated with the proportion and intensity of FOE export activity in the host-country, as given by the DOE distribution cost equation (3). But in third-country export platforms relationships between DOEs and FOEs that enhance spillovers are unlikely to develop and there may be little opportunity for information about foreign markets to spillover in sectors where there are no real conduits between FOEs and DOEs. We examine the possibility that FOE spillovers in third-country export platforms are determined by the scale and nature of FDI in the host country, and thus may differ from the types of spillovers that occur when FDI is primarily domestic-market focussed.

In Ireland, the sectoral concentration and export intensity of FOEs reflects to a large degree differences in the ownership pattern of FOEs. A feature of FDI in Irish manufacturing during the 1990s has been the growth and dominance of US-owned enterprises, particularly in the modern sectors. Table 2 shows that FOE employment growth of approximately 30 per cent between 1991 and 1998 was accounted for almost exclusively by US FOEs.[16] While practically all FOEs in Ireland, regardless of ownership, export a significant portion of their output, Table 2 also highlights that the export intensity of US-FOEs averaged 96 per cent, compared with a maximum of 72 per cent for Non-US FOEs in 1998.

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[16] Moreover, US-FOEs produced more than half of total Irish manufacturing output in 1998, but the proportion of total manufacturing output produced by Non-US FOEs fell to 20 percent between 1991 and 1998.

The higher employment and export intensity of US-FOEs relative to Non-US FOEs reflect differences in their respective production, exporting, and technological characteristics. If the nature and volume of export spillovers to DOEs is enhanced by the presence and export intensity of FOEs, then US-FOEs in Irish manufacturing should be better able to generate information and competition spillovers to DOEs relative to Non-US FOEs. Thus our model of export spillovers in Irish manufacturing distinguishes export spillovers on the basis of FOE *ownership*. Because FOEs operating in Irish manufacturing differ in terms of enterprise characteristics, export intensity, and nationality of ownership, *a priori*, we do not expect all FOEs to generate necessarily the same manner of spillovers to DOEs.

4 Empirical Methodology

The empirical model used to analyse any possible influence of FOEs on the export behaviour of DOEs in Irish manufacturing is based on the theoretical approach of Aitken *et al* (1997) and empirical methodology of Greenaway *et al* (2004). We consider the export behaviour of domestic enterprises and test whether (a) FOEs influence the *decision* of DOEs to export or not, and (b) given that DOEs export, whether FOEs influence the *intensity* of exports by DOEs. This approach incorporates two equations, an export decision equation (4) and an export intensity equation (5):

$$
\begin{aligned}
Export_{ijt} &= \alpha + \beta_1 FOEemplt_{jt} + \beta_2 FOEexport_{jt} + \beta_3 Sectemplt_{jt} + \beta_4 Sectexport_{jt} \\
&+ \beta_5 Emplt_{ijt} + \beta_6 Wage_{ijt} + \beta_7 RD_{ijt} + \beta_8 GVA_{ijt} + \beta_9 Year + v_{ijt}
\end{aligned}
\tag{4}
$$

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$$Expint_{ijt} = \alpha + \beta_1 FOEemplt_{jt} + \beta_2 FOEexport_{jt} + \beta_3 Sectemplt_{jt} + \beta_4 Sectexport_{jt}$$
$$+ \beta_5 Emplt_{ijt} + \beta_6 Wage_{ijt} + \beta_7 RD_{ijt} + \beta_8 Year + \mu_{ijt} \tag{5}$$

where $Export_{ijt}$ is a dichotomous variable that takes the value of 1 if the enterprise (i) in

sector (j) exports during year (t), 0 otherwise, and $v_i \sim N(0,1)$. $Expint_{ijt}$ is the

proportion of turnover exported by enterprise (i) in sector (j) during year (t), and

$u_i \sim N(0,\delta)$.[17] The explanatory variables included in equations (4) and (5) can be

divided into three broad categories: (a) FOE "spillover" variables, (b) sectoral scale

variables, and (c) DOE characteristic variables. The variables are detailed in Table A.1,

Appendix A.

Spillover Variables

The FOE spillover variables are measured at the NACE Rev.1, 2-digit sector level (j) on

an annual basis (t).[18] $FOEemplt_{jt}$ uses total FOE employment as a proxy for the sectoral

presence of FOEs, in order to reflect spillovers resulting from the concentration of FOEs.

The expected coefficient of $FOEemplt_{jt}$ for both the export decision and export intensity

equations is uncertain because of the virtual absence of a competition effect since so

much FDI is almost exclusively export orientated. $FOEexport_{jt}$ reflects export

information spillovers from FOEs to DOEs and while it is generally expected that

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[17] Additionally, $corr(v_i, u_i) = \rho$ and $(v_i, u_i) \sim bivariate\ normal\ [0,0,1,\delta\rho]$.

[18] Export spillover proxies are measures of the FOE sectoral influence relative to the total influence of FOEs for the year, thus taking into account both the relative importance of FOEs within the sector as well as the importance of the FOE sectoral presence relative to the total presence of FOEs in Irish manufacturing.

information about exporting will be greater where the sectoral FOE export intensity is relatively higher, this may not occur with export platform FDI, especially in the modern sector. The coefficient of $FOEexport_{jt}$ is thus uncertain.[19]

Sectoral variables

Two sectoral variables are included. $Sectemplt_{jt}$ is employment in each sector as a proportion of total manufacturing employment each year, and is included in the model to control for sectoral size. $Sectexport_{jt}$ captures the export intensity of each sector and is defined as total exports in the sector as a proportion of exports in all Irish manufacturing.[20]

Enterprise characteristic variables

We include a number of variables to reflect domestic enterprise heterogeneity. Enterprise employment ($Emplt_{ijt}$) is a proxy for the size of the enterprise. It is expected that relatively larger enterprises are more capable of absorbing any fixed costs associated with entering an export market and to exploit economies of scale in the exporting process. Average wages ($Wage_{ijt}$) are included to control for labour skill, which, through its links with high value added production, is thought to be an important determinant of indigenous exports in a developed country such as Ireland.[21] R&D expenditure per employee (RD_{ijt}) is included to indicate the ability of the local enterprise to capture

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[19] Although our empirical spillover model follows that of Greenaway *et al* (2004) by including measures of FOE presence and export intensity, we are unable to include a measure of the R&D intensity of FOEs in Irish manufacturing because our data set does not contain a robust measure for FOE R&D expenditure.
[20] Spillover and sectoral variables are measured annually at the 2-digit (Nace Rev. 1) level.
[21] Empirical evidence shows that average wages have a mixed influence on the determinants of exporting, depending on whether high wages are due to scarcity or skill composition.

spillovers, on the basis that enterprises with a high R&D spend may be better able to absorb information externalities related to exporting that may flow from FOEs.[22] Capital stock per employee (Cap_{ijt}) accounts for the capital intensity of the enterprise and is expected to be positively associated with both the decision to export and export intensity. Gross value added (GVA_{ijt}) is used as a proxy for enterprise profitability to reflect the ability of the enterprise to meet the fixed costs associated with entering the export market. A set of year dummies ($Year_t$) is included in order to capture inter-temporal effects.

Equation (4) is estimated on the full sample of DOEs, both exporting and non-exporting, and effectively acts as the sample selection for equation (5), which estimates the influence of FOE export spillovers on the *export intensity* of DOEs. The empirical approach taken allows us to examine the influence of FOE spillovers on the export behaviour of all DOEs and not just exporting enterprises. Additionally, as Greenaway *et al* (2004) note, the Heckman methodology avoids any selectivity biases that may be associated with focusing solely on the influence of FOEs on the export propensity of DOEs. The spillover model is extended to capture the possibility that spillovers are expected to differ across sectors; we divide our data set into modern and traditional sectors and estimate equations (4) and (5) on these two separate sets of data. Table 3 reports descriptive statistics for DOEs in these two sectors.

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[22] Only DOEs that perform a certain amount of in-house R&D may have a sufficient absorptive capacity enabling them to benefit from superior technology introduced by FOEs. If the technological capabilities between FOEs and DOEs are too great, DOEs may not be able to benefit from the introduction of new technology. Alternatively, if the technology gap is too small, FOEs may transmit few benefits to DOEs. See Bleaney and Wakelin (2002).

In order to determine if the nature and volume of spillovers generated by FOEs differ on the basis of ownership, we redefine the FOE spillover variables to reflect US and Non-US ownership. The export spillover variable ($FOEemplt_{jt}$) is redefined as $USemplt_{jt}$ and $NUSemplt_{jt}$ in order to reflect the employment intensity of US and Non-US owned FOEs by sector and year. Similarly, the spillover variable ($FOEexport_{jt}$) is redefined as $USexport_{jt}$ and $NUSexport_{jt}$, in order to reflect the export intensity of US and Non-US owned FOEs. All other variable definitions are unchanged. Thus our adjusted model based on FOE ownership consists of equations (4a) and (5a):

$$\begin{aligned}
Export_{ijt} &= \alpha + \beta_1 USemplt_{jt} + \beta_2 NUSemplt_{jt} + \beta_3 USex_{jt} + \beta_4 NUSex_{jt} \\
&+ \beta_5 Sectemplt_{jt} + \beta_6 Sectex_{jt} + \beta_7 Emplt_{ijt} + \beta_8 Wage_{ijt} + \beta_9 RD_{ijt} \\
&+ \beta_{10} GVA_{ijt} + \beta_{11} Year + v_{ijt}
\end{aligned} \qquad (4a)$$

and the export intensity equation becomes

$$\begin{aligned}
Expint_{ijt} &= \alpha + \beta_1 USemplt_{jt} + \beta_2 NUSemplt_{jt} + \beta_3 USex_{jt} + \beta_4 NUSex_{jt} \\
&+ \beta_5 Sectemplt_{jt} + \beta_6 Sectex_{jt} + \beta_7 Emplt_{ijt} + \beta_8 Wage_{ijt} + \beta_9 RD_{ijt} \\
&+ Year \beta_{10} + \mu_{ijt}
\end{aligned} \qquad (5a)$$

Equations (4a) and (5a) are estimated on the data set of all DOEs in Irish manufacturing.

5   Econometric Results

Our empirical analysis is based on enterprise data collected as part of the annual Census of Industrial Enterprises (CIE) of Irish manufacturing. The census data set covers years 1991 to 1998 inclusive and consists of 18,733 observations relating to 3,561 enterprises.[23]

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[23] The Census contains data for all enterprises with three or more persons engaged; "small" enterprises are defined as those with fewer than 14 persons engaged. We omit small enterprises from the final data set used in the analysis because of reliability issues with the Census responses by small enterprises to questions about exporting. The exclusion of small enterprises has little impact on the final data set used; enterprises

All monetary values of enterprise variables are measured in Irish pounds and deflated to 1985 constant prices using sectoral price indices.[24] The Census data are maintained with individual enterprise codes, permitting identification of each enterprise across years, and are categorised at a sectoral level using the 4-digit NACE Rev. 1 nomenclature (CSOa).[25]

Equations (4) and (5) are estimated using a two-step Heckman selection model, which estimates the probability of exporting in the first step and the factors that affect the export intensity of the enterprise in the second step (Heckman, 1979). Maximum likelihood estimates are obtained for all equations. Wald tests are used to test the overall significance of the models and the reported results indicate that, taken jointly, the coefficients of the regressors are significant. Likelihood-ratio tests validate the choice of the Heckman selection model.

Table 4 (Columns 1 and 2) reports the regression results for equations (4) and (5) estimated on the data set of all DOEs. The *export decision* of DOEs is positively and significantly related to the presence of FOEs ($FOEemplt_{jt}$) implying that DOEs are more likely to enter the export market if they are in a sector with a relatively strong FOE presence. Moreover, once in the export market, the *export intensity* of DOEs is greater in FOE-dominant sectors than sectors with a weak FOE presence. In contrast, both the

with 14 or more employees employ 92 per cent of all enterprise employees and produce on average more than 96 per cent of all enterprise turnover.

[24] All variables with the exception of capital intensity are deflated using Table 2: Industrial Producer Price Index (CSO, 1991b-1998b) at the two and three-digit level. The capital intensity variable is deflated using Table 5: Wholesale Price Indices for Energy Products (CSO, 1991c-1998c).

[25] Lower levels of sectoral aggregation effectively restrict the range over which export spillovers may occur. Ruane and Uğur (2002) search for productivity spillovers in Irish manufacturing between 1991 and 1998 at 2-, 3-, and 4-digit Nace Rev. 1 aggregation and find that their results are stronger at the 2-digit level of sectoral aggregation.

decision to export and the export intensity of DOEs are negatively associated with the export intensity of FOEs ($FOEexport_{jt}$). Information about export markets from exporting FOEs does not appear to filter through to DOEs, so that DOEs in sectors where FOEs are intensive exporters, are themselves relatively poor exporters. Thus both the *export decision* and *export intensity* of DOEs in Irish manufacturing are positively associated with the presence of FOEs and negatively associated with the export intensity of FOEs.

Next, we divide our data set of Irish manufacturers into those operating in the modern sectors, which can be described as third-country export-platform sectors, and those operating in the traditional sectors, where FOEs are relatively less dominant and less export orientated. Equations (4) and (5) are estimated separately for the modern and traditional sectors and the results are presented in Columns 3, 4, 5, and 6 of Table 4. The positive association between the intensity of FOE presence ($FOEemplt_{jt}$) and the DOE decision to export occurs only in traditional sectors; FOE presence has no significant impact on the decision to export by DOEs in modern sectors. However, those DOEs located in modern sectors who do become exporters tend to export relatively more intensively than DOEs in the traditional sectors. The negative association between the export intensity of FOEs ($FOEex_{jt}$) and the export decision and intensity of DOEs occurs in traditional sectors, where the presence of relatively more intensive FOE exporters appears to discourage DOEs from both exporting and exporting more intensively. In contrast, FOE export intensity has no significant association with the export decision or intensity of DOEs in the modern sectors. The dominance of export-

orientated FOEs in modern sectors appears to prevent the creation of links between FOEs and DOEs that lead to competition and information spillovers that enhance the ability of DOEs to enter the export market. However, once they are in the export market, the presence of FOEs is associated with DOEs who export more intensively.

Finally, we examine whether or not export spillovers differ on the basis of FOE ownership by dividing our set of FOEs in to those that are US-owned and those that are Non-US owned. We use equations (4a) and (5a) to re-estimate the two-step Heckman model on the data set of DOEs across all sectors. US-owned FOEs in Irish manufacturing are intensive exporters who overwhelmingly dominate the modern sectors, reflecting their use of Irish manufacturing as a third-country export platform. In contrast, Non-US owned FOEs are significantly less export-intensive and do not dominate the traditional sectors where they tend to locate, reflecting their use of Ireland for both a third-country export-platform and a domestic market in which to sell their product. Table 5 shows that the presence of US-FOEs $\left(USemplt_{jt}\right)$ generates a larger positive spillover effect on the export decision of DOEs than does the presence of Non-US FOEs$\left(NUSemplt_{jt}\right)$. Moreover, only the presence of US-FOEs is associated with the positive export spillover effect on the export intensity of DOEs.

The negative association between the export intensity of FOEs and both the export decision and export intensity of DOEs found in our initial analysis is generated by US-FOEs only $\left(USex_{jt}\right)$. This negative association may once again be a consequence of the failure of highly export-orientated US-FOEs to develop significant export knowledge

links with DOEs. It may also reflect the fact that US-FOEs tend to concentrate in high-tech, export-orientated areas where DOEs located in these same sectors simply concentrate on servicing the local market.

The dominance of US-FOEs is thus reflected by the generation of export spillovers to DOEs. The concentration of US-FOEs is associated with nearly all of the positive export spillovers on the export propensity of DOEs, as well as the negative association between FOE export intensity and the export propensity of DOEs.

In all of the models estimated we include a number of sectoral and enterprise level variables that may influence the export profile of DOEs. Our results indicate that the employment sectoral scale variable ($SECTemplt_{jt}$) has no significant association with the export decision of DOEs. However, this insignificant aggregate result is a combination of a positive association between relative sector size and the DOE decision to export in traditional sectors, and a negative association in modern sectors. DOEs in larger modern sectors tend to concentrate on servicing the domestic Irish market instead of exporting, whilst DOEs in larger traditional sectors are more likely to become exporters. Sectoral scale has a strong positive association with the export intensity of DOEs across all manufacturing sectors, so that DOEs in larger sectors tend to export relatively more. Most of this positive association occurs in the traditional sectors; DOEs which belong to relatively large modern sectors tend to service the domestic Irish market, but if they do export they do so more intensively.

The overall export intensity of sectors ($Sectexport_{jt}$) is negatively associated with the DOE decision to export, with DOEs in less-export intensive sectors being more likely to enter the export market than those in more export-intensive sectors. This aggregate association is again the combination of diverse sectoral patterns; DOEs in relatively export intensive traditional sectors are unlikely to enter the export market, whereas DOEs in export intensive modern sectors are more likely to be exporters. The export intensity of sectors has no significant association with the export intensity of DOEs generally, although DOEs in relatively more export-intensive modern sectors are likely to export less intensively.

Enterprise heterogeneity is strongly associated with the decision to export or not. We find that large DOEs are relatively more likely to export ($Emplt_{ijt}$). Higher average wages ($Wage_{ijt}$) are associated with a higher probability of exporting, a result consistent with export production being relatively skill-intensive.[26] However, export propensity appears to have no association with higher wages. The R&D intensity of the enterprise (RD_{ijt}) is positively associated with both the decision to become an exporter and export intensity, a finding consistent with various studies emphasising the role of technology in determining the export status of enterprises (Bleaney and Wakelin, 2002). Finally, our measure of

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[26] Aitken *et al* (1997) argue that wages might be interpreted as a measure of the skill intensity of enterprise production. Barrios *et al* (2001) check this assumption by replacing wages per head by more direct measures of skill, using the ratio of non-production to total employees and the percentage of technical employees. They find that only the coefficient of percentage of technical employees is significant. This result is similar to the finding of Bernard and Jensen (2001) that provides only weak evidence for a positive effect of skill on the decision of US firms to export.

enterprise profitability (GVA_{ijt}) indicates that profitability is not a necessary condition for becoming an exporter.

6.   Summary and Conclusion

Our study has concentrated on searching for evidence of export spillovers from FOEs on the export decision and intensity of DOEs in third-country export platforms. The results confirm that the intensity of FOE presence in Irish manufacturing is associated with a higher probability of Irish DOEs becoming exporters and exporting more intensively. Moreover, the concentration of US-FOEs in Irish manufacturing generates most of these export spillovers across, suggesting that the strong and increasing presence of US-FOEs during the 1990s had a positive impact on the competitive nature of DOEs, indirectly improving their export propensity.

In contrast to previous empirical studies, the export intensity of FOEs is negatively associated with the export decision and export intensity of DOEs in Irish manufacturing. Although the concentration of US- and Non-US-owned FOEs in traditional sectors are similar, nearly all export spillovers are generated by US-FOEs. Moreover, the extremely high export intensity of US-FOEs creates negative spillovers in these traditional sectors, reinforcing the view that highly export-orientated FOEs may not generate positive export spillovers to the same degree as FOEs which supply a significant proportion of their turnover to the host-country market, creating pathways for export spillovers to DOEs.

Our analysis disaggregated export spillovers by sector and FOE ownership patterns, the results having two specific implications, particularly for policy makers promoting inward FDI as a vehicle to encourage domestic exporting. Firstly, policymakers must ensure that the 'right' sectoral mix of export-orientated FOEs and DOEs is obtained. If FOEs are using the host-country almost exclusively as a platform for exporting, then the pathways between FOEs and DOEs required to transmit information about export markets and encourage productivity improvements in DOEs may not develop. Our results suggest that if there are to be positive export spillovers from FOEs to DOEs a significant proportion of FOE output produced in the host-country needs to be sold in the host-country market. Secondly, the characteristics of FOEs themselves are relevant to the nature of export spillovers. FOE characteristics which are tangible, such as their size, production techniques, and source country, as well as intangible enterprise features, such as management style, may impact directly on the extent and nature of export spillovers available to DOEs.

Given the contrasting impact of export spillovers generated by the sectoral and export intensity of FOEs on the export propensity of host-country enterprises in a third-party export platform, further investigation is warranted into policies that can be implemented in order to maximise the benefit of hosting FOEs. Görg and Greenaway (2001) list a number of trade related investment measures (TRIMS) that may be used to specifically encourage export spillovers. Our study has highlighted the need to consider the concentration of FOEs and DOEs ownership by sector and the specific characteristics of FOEs themselves in order to achieve positive export spillovers. Further, given the

variation in export spillovers depending upon the sectoral concentration of FOEs, a focus

on the spillover absorptive capacity of DOEs seems warranted.[27]

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[27] Girma and Wakelin (2000) find that there are regional spillovers from FDI to indigenous enterprises in the UK. However, there is some evidence that spillovers from FOEs are relatively lower in less-developed regions. The authors suggest that his may be due to enterprises in these regions not having the necessary knowledge and skills to benefit from the presence of FOEs. Thus policies designed to attract FOEs to less-developed areas may limit their potential spillover benefits.

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Table 1　　　　**Sectoral Features of Irish Manufacturing**

1991-1998 Average	Annual Employment	Employment FOEs	Exporting DOEs*	Exporting FOEs*	Export Intensity** Total	Export Intensity** DOEs	Export Intensity** FOEs	FOE Exports as % of Total Exports
		(%)	(%)	(%)	(%)	(%)	(%)	(%)
Modern [a]	59,967	82.3	71.6	97.8	88.5	38.0	92.3	96.7
Traditional [b]	141,794	34.4	58.8	94.7	51.9	34.8	71.0	64.6
Total	201,761	48.6	60.0	96.0	69.5	35.1	85.0	84.3

Source: Own estimates derived from the *Census of Industrial Enterprises* (CSO).
[a] Nace Rev. 1 Sectors (24+30+31+32+33).
[b] Nace Rev. 1 Sectors (15-37) less (a).
The *Chemicals* sector (Nace Rev. 1: 24) includes the *Pharmaceutical* sub-sector (Nace Rev.1: 244). The *Electronics* sector is composed of Nace Rev.1 sectors: *Office Machinery and Computers* (30); *Electrical Machinery and Apparatus* (31); *Radio, Television and Communication Equipment* (32); and *Medical, Precision and Optical Instruments* (33).
* Exporting enterprises is the proportion of total enterprises who export part of their turnover.
** Export intensity is defined as turnover exported as a proportion of total turnover.

Table 2   **Foreign Enterprise Ownership and Exporting Trends, 1991-1998**

Ownership	1991	1998	1991-1998 % change
Foreign-Owned Enterprises			
Enterprises	589	581	-1.3
Employment	86,486	112,966	30.6
% of exporting enterprises	95.4%	97.2%	
% of output exported [a]	82.2%	90.5%	
Output as % of total mfg output	58.8%	76.9%	
Exports as % of total mfg exports	77.0%	89.4%	
US FOEs			
Enterprises	214	250	14.4
Employment	38,612	64,968	68.2
% of exporting enterprises	98.1%	98.4%	
% of output exported [a]	96.9%	96.4%	
Output as % of total mfg output	33.0%	58.1%	
Exports as % of total mfg exports	51.0%	72.0%	
Non-US FOEs			
Enterprises	375	331	-11.7
Employment	47,874	47,998	0.3
% of exporting enterprises	93.9%	96.4%	
% of output exported [a]	63.3%	72.2%	
Output as % of total mfg output	25.8%	18.8%	
Exports as % of total mfg exports	26.0%	17.4%	

[a] Export intensity is defined as the proportion of turnover exported.
Source: Own estimates derived from the *Census of Industrial Enterprises* (CSOa).

Table 3   **Descriptive Statistics of Irish-owned Enterprises by Sector**

1991-1998 Average	Mean	Standard Deviation
1. All DOEs		
(14,065 observations)		
Employment	59	114
Skill	23.9%	16.2%
Average Wages	£10,073	£4,635
Turnover	£5,317,577	£16,400,000
Turnover per employee	£69,719	£97,115
GVA per employee	£19,176	£21.409
Capital intensity	£1,326	£2,343
1. Modern sector enterprises		
(1,423 observations)		
Employment	60	81
Skill	35.6%	23.0%
Average Wages	£13,878	£7,398
Turnover	£6,209,203	£15,100,000
Turnover per employee	£100,323	£160,659
GVA per employee	£19,821	£20,371
Capital intensity	£1,438	£4,187
2. Traditional sector enterprises		
(12,642 observations)		
Employment	59	117
Skill	22.5%	14.7%
Average Wages	£9,645	£3,991
Turnover	£5,217,215	£16,600,000
Turnover per employee	£66,274	£86,441
GVA per employee	£18,073	£19,532
Capital intensity	£1,313	£2,033

Source: Own estimates derived from the *Census of Industrial Enterprises.*
        All monetary values in 1985 constant £IR.

Table 4   **FOE Spillovers for the Export Decision and Export Intensity**

Model 1	All Mfg		Traditional Sectors		Modern Sectors	
	Export Decision *(1)*	*Export Intensity* *(2)*	*Export Decision* *(3)*	*Export Intensity* *(4)*	*Export Decision* *(5)*	*Export Intensity* *(6)*
$FOEemplt_{jt}$	.7371*** (.0392)	.1487*** (.0220)	.8430*** (.0501)	.0612** (.0277)	.2038 (.3747)	.5544*** (.1136)
$FOEex_{jt}$	-.6611*** (.0638)	-.1912*** (.0282)	-.5965*** (.0671)	-.2073*** (.0288)	-.1880 (.6090)	.3075* (.1762)
$Sectemplt_{jt}$	-.3966 (.3283)	.8408*** (.1098)	1.6219** (.6729)	.3269 (.2496)	-2.6428*** (.5240)	3.2980** (1.6150)
$Sectex_{jt}$	-.9856*** (.2843)	-.1374 (.0955)	-3.0992*** (.6983)	.3416 (.2684)	2.8670*** (.6859)	-1.0121*** (.2103)
$Emplt_{ijt}$	.0039*** (.0002)	-.0001** (.0000)	.0039*** (.0002)	-.0001** (.0000)	.0045*** (.0009)	-.0001 (.0000)
$Wage_{ijt}$	.0001** (.0000)	.0001 (.0000)	.0001*** (.0000)	.0001* (.0000)	-.0001 (.0000)	.0001 (.0000)
RD_{ijt}	.0001*** (.0000)	.0001*** (.0000)	.0001*** (.0000)	.0001*** (.0000)	.0001*** (.0000)	.0001 (.0000)
Cap_{ijt}	.0001** (.0000)	-.0001*** (.0000)	.0001*** (.0000)	-.0001*** (.0000)	.0001 (.0000)	-.0001 (.0000)
GVA_{ijt}	-.0001** (.0000)	..	-.0001 (.0000)	..	-.0001 (.0000)	..
Year Dummies	Yes		Yes		Yes	
Observations	14,065		12,642		1,423	
Censored Obs.	5,593		5,195		398	
Uncensored Obs.	8,472		7,447		1,025	
Wald χ^2	1,241.11		1,126.25		198.27	
Rho	-.86136		-.86416		-.85138	
LR test of independent equations $\chi^2 (1)$	-12,920.19		-12,462.71		-594.83	

Note: Summary regression results derived from equations (4) and (5).
Robust standard errors in parentheses.
Statistically significant at *** 1 per cent, ** 5 per cent, * 10 per cent.

Table 5   **FOE Export Spillovers for the Export Decision and Export Intensity: US- and Non-US Owned FOEs**

Model 2	*Export Decision*	*Export Intensity*
	EQUATION (2a)	EQUATION (3a)
$USemplt_{jt}$	.3351***	.1218***
	(.0293)	(.0124)
$NUSemplt_{jt}$	.1477***	-.0166
	(.0381)	(.0140)
$USex_{jt}$	-.4516***	-.1696***
	(.0457)	(.0200)
$NUSex_{jt}$	.0156	-.0182
	(.0314)	(.0109)
$SECTemplt_{jt}$	-.4174	1.0355***
	(.3426)	(.1136)
$SECTex_{jt}$	-.4016***	-.1198
	(.2935)	(.0957)
$Emplt_{ijt}$	.0039***	-.0001**
	(.0002)	(.0000)
$Wage_{ijt}$	.0001***	-.0001
	(.0000)	(.0000)
RD_{ijt}	.0001***	.0001***
	(.0000)	(.0000)
Cap_{ijt}	.0001*	-.0001***
	(.0000)	(.0000)
GVA_{ijt}	-.0001**	..
	(.0000)	
Year Dummies	Yes	
Observations	14,065	
Censored Obs.	5,593	
Uncensored Obs.	8,472	
Wald χ^2	1,318.87	
Rho	-.86748	
LR test of independent equations χ^2 (1)	-12,968.47	

Note: Summary regression results derived from equations (4a) and (5a).
           Robust standard errors in parentheses.
           Statistically significant at *** 1 per cent, ** 5 per cent, * 10 per cent.

Appendix A
Table A.1   Variable Definitions

Dependent Variables	
$Export_{ijt}$	Dichotomous variable taking the value of 1 if the DOE exports, 0 otherwise.
$Expint_{ijt}$	Proportion of turnover exported (export intensity) by DOE
FOE Spillover Variables	
$FOEemplt_{jt}$	(FOE Employment $_{jt}$)/(Employment $_{jt}$) (FOE Employment $_{t}$)/(Employment $_{t}$)
$FOEexport_{jt}$	(FOE Exports $_{jt}$)/(Exports $_{jt}$) (FOE Exports $_{t}$)/(Exports $_{t}$)
Sectoral Scale Variables	
$Sectemplt_{jt}$	Employment $_{jt}$ / Employment $_{t}$
$Sectexport_{jt}$	Exports $_{jt}$ / Exports $_{t}$
DOE Variables	
$Emplt_{ijt}$	Employment $_{ijt}$
$Wage_{ijt}$	Average wage $_{ijt}$
RD_{ijt}	R&D expenditure per employee $_{ijt}$
Cap_{ijt}	Capital intensity per employee* $_{ijt}$
GVA_{ijt}	Gross value added per employee $_{ijt}$
$Year_{t}$	Year dummies, 1991-98
US and Non-US FOE Ownership	
$USemplt_{jt}$	(US Employment $_{jt}$)/(Employment $_{jt}$) (US Employment $_{t}$)/(Employment $_{t}$)
$USexport_{jt}$	(US Exports $_{jt}$)/(Exports $_{jt}$) (US Exports $_{t}$)/(Exports $_{t}$)
$NUSemplt_{jt}$	(NUS Employment $_{jt}$)/(Employment $_{jt}$) (NUS Employment $_{t}$)/(Employment $_{t}$)
$USexport_{jt}$	(NUS Exports $_{jt}$)/(Exports $_{jt}$) (NUS Exports $_{t}$)/(Exports $_{t}$)

Note: All variables are derived from the *Census of Industrial Enterprises*, 1991-1998, where:
       i = enterprise, j = sector, and t = year.
* We use "purchases of fuel and power" as a proxy for capital stock.