The University of Nottingham

research paper series

Globalisation, Productivity and Technology

Research Paper 2004/41

Multinationals and Productivity Spillovers

by

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The Centre acknowledges financial support from The Leverhulme Trust under Programme Grant F114/BF

GEP Leverhulme Centre for Research on Globalisation and Economic Policy

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Acknowledgements

This paper is forthcoming as a chapter in David Greenaway, Holger Görg, and Richard Kneller (eds.), *Globalisation and Productivity Growth*, Palgrave. Financial support from the European Commission (Grant No. SERD-2002-00077) and the Leverhulme Trust (Grant No. F114/BF) is gratefully acknowledged. We would like to thank participants of the COMPPRESS workshop, 4-5 June 2004 in Ljubljana, Slovenia, for helpful comments and suggestions. All errors and omissions are our own.

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Abstract

In recent years the British government has spent substantial sums in order to attract foreign multiinationals to the UK. Amongst other things this has been motivated by the possibility that foreign multinationals bring with them new technologies which may "spill over" to the economy. The present paper discusses the evidence on productivity spillovers in the UK and provides further results. While the international evidence on productivity spillovers is far from conclusive on whether or not these benefits actually accrue to domestic firms, recent evidence based on micro level data for the UK is quite encouraging. Our empirical analysis, based on *OneSource* for the period 1988 to 1996, is in line with that evidence. However, spillovers depend on the market orientation of FDI, with export oriented FDI being more likely to generate positive spillovers, while domestic market oriented FDI seems to crowd out domestic firms and reduce their productivity. Also, the export orientation of domestic firms matters, in general, exporters appear to benefit most from spillovers than non-exporters.

JEL classification: F23

Keywords: foreign direct investment, productivity spillovers, exporting, absorptive capacity, competition

Outline

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2. *International evidence on productivity spillovers*
3. *Evidence for the UK*
4. *Emprical analysis for the UK*
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Non-Technical Summary

It has been estimated that the British government provided grants worth £50.75 million to Motorola to locate a production facility in Scotland in 1991, providing around 3,000 jobs. Also, Siemens received around £50 million in order to attract it to build a plant employing 1,000 workers in the North East of England in 1996. Apart from regional concerns in particular about direct job creation, the argument for such subsidisation frequently centres around the possibility that foreign multinationals bring with them new technologies which may "spill over" to the local economy, benefiting not only the region but the economy as a whole. This argument has become particularly important given policy makers' concerns that the UK is lagging behind its European and North American partners in terms of technology and productivity. Hence, an influx of foreign direct investment (FDI) associated with an inflow of new knowledge and technologies is seen as particularly advantageous.

The purpose of this paper is to discuss the evidence on productivity spillovers. We do this by starting with a brief overview of the literature, which has exploded in the last ten years or so. We then go on to discuss in more detail selected studies dealing in particular with the UK. This literature, in line with the overall trend, has also grown exponentially in the last five years. We then move on to an empirical analysis which illustrates the arguments developed in the paper. We firstly look at total spillovers, and then turn to examining the role of exporting, both by multinationals and domestic firms, for spillover benefits. Furthermore, we analyse the role of absorptive capacity - measured in terms of intangible assets - and the role of nationality of foreign multinationals for our understanding of productivity spillovers.

While the international evidence on productivity spillovers is far from conclusive on whether or not these benefits actually accrue to domestic firms, recent evidence based on micro level data for the UK is quite encouraging. All studies reviewed here do find evidence for productivity spillovers, although these may depend on the characteristics of domestic firms, in particular their levels of absorptive capacity, and whether or not they are located close to multinationals.

Our empirical analysis, based on *OneSource* for the period 1988 to 1996, is in line with that evidence. We find evidence for spillovers over a number of specifications of our empirical model. However, spillovers depend on the market orientation of FDI, with export oriented FDI being more likely to generate positive spillovers, while domestic market oriented FDI seems to crowd out domestic firms and reduce their productivity. Also, the export orientation of domestic firms matters, in general, exporters appear to benefit most from spillovers than non-exporters.

1 Introduction

It has been estimated that the British government provided grants worth £50.75 million to Motorola to locate a production facility in Scotland in 1991, providing around 3,000 jobs. Also, Siemens received around £50 million in order to attract it to build a plant employing 1,000 workers in the North East of England in 1996.[1] It seems reasonable to ask how such active policy can be justified. Apart from regional concerns in particular about direct job creation, the argument frequently centres around the possibility that foreign multinationals bring with them new technologies which may "spill over" to the local economy, benefiting not only the region but the economy as a whole. This argument has become particularly important given policy makers' concerns that the UK is lagging behind its European and North American partners in terms of technology and productivity (e.g., DTI 2001). Hence, an influx of foreign direct investment (FDI) associated with an inflow of new knowledge and technologies is seen as particularly advantageous.

Specifically, the inflow of foreign knowledge may benefit domestic firms as they may learn from the multinationals, allowing them to upgrade their own production process and as a result increase productivity. The theoretical argument for why one may expect such "productivity spillovers", as they are usually referred to, from foreign multinationals is straightforward. Given the multinationals' limited knowledge of the local market, and distance from their parent firm, they are generally at a disadvantage compared with local firms in the host country. Hence, multinationals will only be able to locate profitably abroad if they have some sort of offsetting advantage. This takes the form of a "firm specific asset" (FSA), such as superior production technique, know-how or management strategy, which has at least to some extent the characteristics of a public good and enables the firm to locate profitably abroad (Caves, 1996, Markusen, 2002). These FSAs can be transferred at low or zero cost between subsidiaries of the same firm.

The possibility of productivity spillovers arises because multinationals may find it difficult to protect a leakage of an FSA to other firms in the host country. The public

[1] These figures are taken from Haskel et al. (2002).

good characteristics imply that once the FSA is out on the external market it can be used by other firms as well, due to it being to some extent non-rival and non-excludable. The inability of the multinationals to protect the asset is due to a number of reasons. Firstly, labour may move from multinationals to domestic firms, taking with them some of the knowledge of the FSA. Secondly, domestic firms supplying to or purchasing inputs from multinationals may be exposed to the superior technology used in the foreign firm. Thirdly, domestic firms may be in competition with multinationals on the final product market, hence being able to learn from the foreign competitor.

The purpose of this chapter is to discuss the evidence on productivity spillovers. We do this by starting in the following section with a brief overview of the literature, which has exploded in the last ten years or so. We then go on to discuss in more detail selected studies dealing in particular with the UK. This literature, in line with the overall trend, has also grown exponentially in the last five years. We then move on to an empirical analysis which illustrates the arguments developed in the paper. We firstly look at total spillovers, as in Girma, Greenaway and Wakelin (2001). Then we turn to examining the role of exporting, both by multinationals and domestic firms, for spillover benefits (somewhat similar to the analysis by Girma, Görg and Pisu, 2004). Furthermore, we analyse the role of absorptive capacity - measured in terms of intangible assets - and the role of nationality of foreign multinationals for our understanding of productivity spillovers.

2 International evidence on productivity spillovers

Over the last thirty years, a large empirical literature has developed, starting with Caves (1974), Globerman (1979) and Blomström (1986) using data for Australia, Canada and Mexico, respectively. Since then, their empirical models have been extended and refined although the basic approach is still, by and large, similar. Most econometric analyses are undertaken in a framework in which labour productivity or total factor productivity of domestic firms is regressed on a range of independent variables. To measure productivity spillovers from multinationals a variable is included which proxies the extent of foreign firms' penetration, usually calculated as the share of employment or sales in multinationals over total industry employment/sales in a given

sector. In other words, the regression allows for an effect of FDI on productivity of domestic firms in the *same industry*. If the regression analysis yields a positive and statistically significant coefficient on the foreign presence variable, this is taken as evidence that spillovers have occurred from MNEs to domestic firms.[2,3]

Many papers, in particular early contributions, use cross sectional data which may lead to biased results, as pointed out by Görg and Strobl (2001). They argue that panels, using firm or plant level data are the most appropriate estimating framework for two reasons. Firstly, panel data allow one to investigate the development of domestic firms' productivity over a longer time period, rather than relying on one data point. Secondly, they allow one to investigate spillovers after controlling for other factors. Cross sectional data, in particular if they are aggregated at the sectoral level, fail to control for time-invariant differences in productivity across sectors which might be correlated with, but not caused by, foreign presence. Thus, coefficients on cross-section estimates are likely to be biased. For example, if productivity in the electronics sector is higher than, say, the food sector, multinationals may be attracted into the former. In a cross section, one would find a positive and statistically significant relationship between the level of foreign investment and productivity, consistent with spillovers, even though foreign investment did not cause high levels of productivity but rather was attracted by them.

A large body of evidence has been amassed in terms of studies of productivity spillovers for many developing, transition and developed countries. Much econometric work has been completed that provides, at best, mixed results as to the importance of spillovers. There is some supportive evidence from case studies of spillover benefits to domestic firms (e.g., Moran 2001) although there is, even at that level, disagreement in particular instances.[4] A number of explanations have been offered to explain these

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2 The interpretation of this coefficient of course hinges on the assumption that the FDI variable does not merely pick up the effect of other correlated factors on productivity, i.e., one needs to assume that there is a full vector of productivity augmenting activities included in the empirical model.

3 This approach, of course, treats the mechanism through which spillovers take place as a "black box". Hence, one does not know the channels through which spillovers actually occur. Görg and Strobl (2002a) present a first attempt at looking empirically at one of the channels in more detail, by measuring productivity spillovers through movements of workers from multinationals to domestic firms. Görg and Strobl (2002b, 2003) and Barrios et al. (2005) also provide alternative approaches to estimating the beneficial effects of FDI on local development, by looking at the impact of FDI on entry and survival of domestic plants.

4 For example, Larrain, Lopez-Calva and Rodriguez-Claré (2000) conclude that the location of Intel in Costa Rica has had positive effects on the local economy, Hanson (2000) argues that there is little

mixed results, including methodological differences (Görg and Strobl, 2001) and country characteristics (Lipsey and Sjöholm, 2004). Rather than reviewing all of these papers we focus on three particular econometric studies, which can serve to highlight the main arguments: Aitken and Harrison (1999) for Venezuela, Keller and Yeaple (2003) for the US and Smarzynska-Javorcik (2004) for Lithuania.[5]

Aitken and Harrison (1999) use plant level panel data for Venezuela covering the period 1976 to 1989. Estimating an augmented Cobb-Douglas production function and controlling for plant level fixed effects they find some evidence that the presence of foreign multinationals in the same industry has had negative effects on the productivity of domestic firms. They attribute this to a negative competition effect. Domestic firms compete with multinationals on domestic product markets. When multinationals enter, they capture business from domestic firms which due to increasing returns to scale reduces their output and forces them up their average cost curve, reducing productivity. They argue that these effects seem to have more than outweighed any potentially positive productivity spillovers.

In what appears to be the only study for the US to-date, Keller and Yeaple (2003) provide evidence that even in a high-income developed country, domestic firms are able to gain in terms of productivity improvements from the presence of foreign multinationals. They use firm level panel data for the years 1987 to 1996 and find evidence for substantial intra-industry spillovers from multinationals. One of their explanations for such large effects is their measurement of FDI activity in an industry, which is based on the industry classification of the activity of the affiliates' employees, rather than the classification of the affiliate as a whole (by its main line of business).

The paper by Smarzynska-Javorcik (2004) extends the standard approach by developing the idea that spillovers are more likely to occur through vertical relationships, rather than horizontally as has been the predominant view in the literature. Using firm level panel data for Lithuania for 1996 – 2000 she finds evidence consistent with her

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evidence for spillovers from Intel on domestic firms. Hanson (2000) also argues that the location of Ford and General Motors in Brazil have failed to show the expected spillover benefits.

[5] A more detailed discussion of a long list of spillover studies is provided by Görg and Greenaway (2004). See also Görg and Strobl (2001) for a meta-analysis of papers on productivity spillovers.

conjecture. Domestic firms in sector *j* increase their productivity following the establishment of multinationals in industries which are being supplied by *j*. She refers to this as spillovers through backward linkages. While the evidence on such backward linkages is robust to a number of amendments, there is no robust evidence that domestic firms benefit from horizontal spillovers from multinationals.

3 Evidence for the UK

The issue of productivity spillovers has attracted a large number of research papers over the last 5 years or so in the UK. One of the reasons may be policy interest: it is frequently argued that the UK is lagging behind its European and North American partners in terms of productivity performance (see DTI, 2001), and the influx of FDI is seen as one potential mechanism to catch-up with other countries. A second reason is the recent availability of micro level datasets, which have undoubtedly facilitated interest in analysing the effects of FDI in micro data. In what follows, we therefore focus our attention on studies using firm or establishment level data.[6]

Two main data sources have been used in micro level studies of productivity spillovers in the UK. The first is *OneSource*, a commercial database based on accounts that companies are legally required to deposit at Company's House. It provides data at the firm level, including information on all public limited companies, all companies with employees greater than 50, and the top companies based on turnover, net worth, total assets, or shareholders funds (whichever is largest) up to a maximum of 110,000 companies.[7] Amongst others, *OneSource* provides information on turnover, value-added, employment, wages, physical capital, and intangible assets in a consistent way across firms and time. Furthermore, the data set provides information on exporting activity at the firm level. These data have been used by Girma, Greenaway and Wakelin (2001), Girma and Wakelin (2002) and Girma, Görg and Pisu (2004).

[6] For example, Liu et al. (2000), Driffield (2001) and Driffield et al. (2002) use industry level data to analyse the effect of FDI on domestic productivity in the UK.
[7] See Hart and Oulton (1995) for a detailed description of the dataset.

The second is the Annual Respondents Database (ARD), which consists of individual establishment's records that underlie the Annual Census of Production and is available from the Office for National Statistics (ONS) under controlled conditions. Information in the ARD includes detailed production data and is available at the level of the "establishment", which is defined as the smallest unit deemed capable of providing information on the Census questionnaire. An establishment can consist of one or more plants (or 'local units' in the parlance of ARD).[8] This database has been used in a number of recent spillover studies (e.g., Girma and Wakelin, 2001, Girma and Görg, 2002, Haskel, Pereira and Slaughter, 2002, Harris and Robinson, 2004).

Which database is "better" in the sense of being more appropriate for the study of productivity spillovers? As with many issues, the answer is: it depends. The ARD is at a more disaggregated unit of observation than *OneSource*, although even the ARD is not, strictly speaking, at the plant, but at establishment level. However, if one measures productivity spillovers, i.e., in essence the diffusion of a technological asset in a local "enterprise" it is not clear why it should be more appropriate to look at the establishment rather than the firm level. After all, the knowledge would be assumed to transfer easily within the same firm, benefiting all plants within the same firm equally.

One advantage of the ARD is, however, that it has a clear sampling frame, the details of which are available to the researcher. Hence, it is fairly straightforward to get an idea about the population upon which the sample is based. This is not as clear-cut with *OneSource*, where one would need to revert back to published aggregate data in order to gauge the representativeness of the sample. The countervailing bonus of *OneSource* is that it includes more data that may be potentially relevant – in particular on exporting activities, as well as on the financial situation of firms. Such information is not given in the ARD.

A number of studies have used *OneSource* to examine productivity spillovers from FDI in the UK. Girma, Greenaway and Wakelin (2001) provide the first detailed micro level analysis of intra-industry productivity spillovers from FDI in the United Kingdom, for all manufacturing industries over the period 1991 – 1996. They find that foreign firms

[8] Barnes and Martin (2002) provide a very detailed and useful introduction to the ARD.

have higher productivity and wages than domestic firms, both in absolute levels and in growth rates. Secondly, in a pooled estimation they find no statistically significant evidence for productivity spillovers from FDI. In that estimation, foreign presence is defined at the 4 digit level and the coefficient on the spillover variable is constrained to be the same for all firms. They subsequently relax this assumption, allowing the level of spillovers to vary according to firm and industry characteristics. They find that the impact of FDI on the productivity of domestic firms increases with higher levels of import competition and skills in the industry. Also, they find evidence that firms with low initial productivity levels, which also have a high productivity gap relative to the industry leader, have a slower productivity spillover rate. Hence, one can conclude from their results that a firm's "absorptive capacity" is important. That is, a firm needs a certain level of expertise in order to be able to utilise the knowledge that spills over from multinationals usefully. Girma, Greenaway and Wakelin (2001) measure this absorptive capacity in terms of the productivity gap between the individual firm and the industry leader (defined as the 90th percentile total factor productivity (TFP) in the two digit industry).[9]

Girma and Wakelin (2002) extend this analysis by focussing on the regional dimension to spillovers. They calculate two measures of foreign presence, one being the share of employment in multinationals in the same region as the domestic firm, and the other foreign presence outside the region. Their findings point to an important regional component: domestic firms benefit from productivity spillovers from FDI within the same region, but are negatively affected by FDI outside their own region. This latter result may be evidence of a negative competition effect between foreign and domestic firms, while this negative effect may be outweighed by positive spillovers from FDI located close to the domestic firm.[10]

In a recent paper, Girma, Görg and Pisu (2004) broaden the scope of the previous analyses in two dimensions. Firstly, they allow for inter-industry (i.e., vertical) spillovers in addition to intra-industry spillovers. This is done in a manner similar to

[9] Girma (2002) also examines the importance of absorptive capacity for FDI spillovers using a threshold regression technique.

[10] It is interesting to note that, in contrast to UK studies, Sjöholm (1999) and Aitken and Harrison (1999) find on significant regional element to spillovers in their studies for Indonesia and Venezuela, respectively.

Smarzynska-Javorcik (2004) by calculating foreign presence indicators for industries which have forward or backward linkages with domestic firms. Secondly, they investigate what role export activity plays in determining spillovers. The export activity of domestic firms is seen as being an indicator of firms' absorptive capacity, with exporters being expected to be better able to benefit from spillovers due to their being linked into foreign networks through exporting activities. They also distinguish foreign presence of multinationals into domestic market and exporting presence (measured as the share of output in foreign firms devoted to the domestic market and exported, respectively). This is seen as a way of distinguishing competition effects from technology spillovers. The assumption is that the competition effect would manifest itself more strongly from domestic market oriented FDI than from export oriented FDI. Using *OneSource* data for the period 1992 to 1999 they indeed find these distinctions to be important. There is evidence that inter-industry spillovers appear more important than intra-industry spillovers, although there is substantial heterogeneity in the effects across domestic exporters and non-exporters and depending on whether FDI is domestic market or export oriented.

There have also been a number of micro level studies on productivity spillovers using the ARD. Girma and Wakelin (2001) use data for the electronics industry for 1980 to 1992.[11] They re-examine the regional dimension of spillovers, employing the Olley-Pakes (1996) approach to deal with selectivity and endogeneity in the production function. The results are in line with the earlier paper by the same authors based on *OneSource* for all manufacturing industries: there are positive spillovers from FDI, but these are mostly confined to the region in which the multinationals locate. A further interesting result regards the nationality of foreign multinationals: spillovers appear to be highest from non-EU, in particular Japanese firms.

The main justification for focussing on particular industries is the recognition that there is substantial heterogeneity in productivity across industries and even across firms within the same industries. Hence, to avoid inappropriate pooling over heterogeneous industries, Girma and Wakelin (2001) focus on a narrow set of sectors instead. Girma and Görg (2002) also confine their analysis to data for particular sectors, namely the

electronics industry, as well as mechanical and instrument engineering, using data covering the same time period. The emphasis is on studying in detail the role of domestic firms' absorptive capacity (ABC) for spillover benefits. Similar to Girma, Greenaway and Wakelin (2001) they measure absorptive capacity in terms of firms' relative productivity levels (relative to the industry leader). Using a quantile regression estimator they find clear evidence that absorptive capacity of domestic firms matters for productivity spillover benefits. Specifically, they find a u-shape relationship between absorptive capacity and spillovers from FDI. In order to determine in more detail the importance of absorptive capacity they determine the exact turning point for the quadratic relationship and evaluate the marginal effects of changes in ABC on productivity holding the FDI variables constant.

Haskel, Pereira and Slaughter (2002) study spillovers from FDI for the total sample of manufacturing establishments using ARD data for the period 1973 to 1992. Their paper is, hence, most akin to Girma, Greenaway and Wakelin (2001), which is based on *OneSource*, covering all manufacturing industries. One of the extensions of the paper is the focus on more lags of the foreign presence indicator. Most studies generally tend to use only a contemporaneous foreign presence indicator or at most one lag. They include up to three lags in their reported results in the paper. Based on their estimations they find evidence for positive productivity spillovers to domestic firms over a number of specifications and show that these benefits are not confined to contemporaneous definitions of the foreign presence variable, but also to longer lags. They also distinguish FDI according to its nationality and find the highest spillover benefits from US and French firms, while there are negative spillovers from Japanese firms. Note that this is in contrast with the findings by Girma and Wakelin (2001) for the electronics industry, who find that Japanese firms tend to bestow the highest spillover benefits for domestic firms.

In contrast to Haskel, Pereira and Slaughter (2002) who pool data over all manufacturing industries, Harris and Robinson (2003) allow for heterogeneity by estimating production functions for individual sectors. They also allow for inter-industry spillovers, by calculating foreign presence in industries that are linked via

[11] 1992 is a natural cut-off point as the UK's sectoral classification (SIC) changed after 1992. It is

input-output linkages to the industry in which the domestic firms operate. Their econometric analysis, using ARD data for 1974 to 1995, suggests that the incidence and magnitude of spillovers differ substantially across industries. Also, they find that inter-industry spillovers are generally more important than intra-industry spillovers.

4 Empirical analysis for the UK

In what follows, we extend the empirical literature on spillovers for the UK, focusing on the role of exporting and intangible assets for horizontal – i.e., intra-industry – spillovers. We use *OneSource*, as it allows us to investigate the nexus between exporting and productivity spillovers from FDI, and also includes data on intangible assets at the level of the firm. We concentrate on firms in UK manufacturing over the period 1988-1996.

A firm is defined as foreign if the country of origin of their ultimate holding company is not the UK. Information on foreign ownership is only available for 1996, while annual information specifies whether a firm is a subsidiary or independent. For the present purposes it is, therefore, assumed that ownership was constant over the sample period.[12] It is possible to increase the variability of the foreign ownership measure by using the subsidiary indicator. When a firm changed from being independent to a subsidiary *and* when its ownership status in 1996 was foreign, the year of the switch in the subsidiary indicator is interpreted as a takeover by a foreign firm.

The firms in the dataset were scrutinised for data availability on output, factors of production, exports and foreign ownership. All firms for which this information was incomplete were removed from the sample. Furthermore, firms that did not survive until 1996 were dropped. In order to take account of outliers the bottom and top percentile of the distribution of the growth in turnover of each year and (broadly defined) industry were also removed from the sample. This left an unbalanced panel of

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therefore complicated to link the micro data between 1992 and 1993.

[12] In cases where no ownership information was available for 1996 but there was for 1999, its ownership status in 1999 was assumed to apply to the whole sample period.

19,598 observations. This includes 3,207 firms out of which 670 were foreign-owned in 1996 (62 of those were taken over during the sample period).[13]

4.1 Descriptive Statistics

Table 1 provides summary statistics on a number of selected variables whilst distinguishing between domestic firms and foreign-owned multinationals (MNEs). Multinationals tend to be larger in terms of both employment and the value of output. They are also generally more capital intensive, have higher labour productivity and pay higher wages than domestic firms. Moreover, MNEs also appear to have faster output growth, wage growth and productivity growth suggesting that the gap between domestic firms and MNEs increases over time. These summary statistics are in line with a large number of studies which examine in detail productivity and performance differences between domestic firms and foreign multinationals – an issue that is discussed in detail in Chapter 5 by Girma, Thompson and Wright.

Finally, the export behaviour of MNEs appears to differ importantly from domestic firms. Not only do multinationals export more in absolute terms due to their being larger, they also export considerably more in terms of the value of their output: MNEs export on average 29 percent of their output, while the mean export ratio for domestic firms is 20 percent. In our sample, multinationals account for more than half of all exports (53%).

[insert Table 1]

Table 2 provides similar summary statistics but distinguishes firms not only by ownership status (domestic and foreign) but also by export activity. Three types of export behaviour are considered: firms that never export during the sample period, firms that always export, and firms that sometimes export.

[13] Nominal aggregates were deflated using 5-digit level industry deflators used from the ONS.

Comparing exporters with non-exporters reveals that the former are larger in terms of employment but smaller in terms of turnover. This is only partially in line with the literature pointing out that exporters are usually larger and more productive than non-exporters (see Chapter 8 by Greenaway and Kneller).[14] Capital-intensity, labour productivity and hourly wages as well as their respective growth rates do not seem to be significantly different. These variables, however, do appear to differ importantly between domestic firms and multinationals. Conclusions regarding performance differentials between different types of firms on the basis of the present summary statistics should, of course, be drawn with caution. An econometric analysis is necessary in order to gain a more in-depth understanding.

[insert Table 2]

Furthermore, it is interesting to decompose foreign ownership by nationality. We distinguish four groups: North America (mainly US), East Asia (dominated by Japan), Europe and the rest of the world. While all groups tend to be larger, more productive, pay higher wages, and grow faster in those categories than their domestic counterparts, accounting for nationality also reveals a significant degree of heterogeneity among foreign-owned multinationals. The most striking difference is perhaps between European and non-European firms. Non-European multinationals in the UK appear not to produce just for the local market but use the UK as an export-platform. Although no data are available on this in the present dataset it seems plausible that US and Japanese firms use the UK as a base to supply the European market. By contrast, EU firms in the UK maintain much smaller production levels.

[insert Table 3]

4.2 Econometric methodology

[14] For the full sample of non-exporters (NE) mean real turnover is 19.377 and for permanent exports (PE) 33.392. Controlling for nationality reduces the difference considerably to 19.491 for DNE and 21.403 for DPE. The sign reverses when only concentrating on firms that are present in 1996 the year for which our foreign ownership measure is available (22.472 for DNE and 18.459 for DPE).

To estimate intra-industry productivity spillovers due to the presence of foreign multinationals we choose, in line with the literature, a Cobb-Douglas specification of a production function for firm *i* in industry *j* at time *t*,

$$\ln y_{ijt} = \alpha_0 + \sum_{m=1}^{M} \beta_m \ln z_{ijt} + \sum_{f=1}^{F} \gamma_f FPI_{jt} + d_j + d_t + \varepsilon_{it} \qquad (1)$$

We assume three factors of production *z*: labour (L), capital (K) and materials (M).[15] Labour is measured by the number of employees, capital by fixed assets, and materials by the difference between turnover and value-added. The regression includes a full set of industry, region and time dummies. The error term consists of a time-invariant firm specific effect and a remaining white noise error term. The first error component is purged in a within transformation of equation (1). The regressions are only conducted for domestic firms.

The regression is extended with relevant indicators of foreign presence, constructed at the 2-digit level of disaggregation. The Foreign Presence Index (*FPI*) is obtained by dividing the sum of turnover produced by multinationals over total turnover in industry *j*.

$$FPI_{jt} = \frac{\sum_{i=1}^{F} y_{ijt}^{f}}{\sum_{i=1}^{N} y_{ijt}} \qquad (2)$$

The overview in the previous section concluded that the evidence on intra-industry spillovers is ambiguous. A potential explanation could be that foreign presence is associated with offsetting effects. In an effort to disentangle the different effects we construct a measure for foreign presence in the domestic market and one for foreign presence in the foreign market. The assumption is that a negative competition effect is strongest from domestic market oriented FDI, while export oriented FDI may be more likely to lead to positive spillovers.

[15] In alternative regressions we estimated production functions using value added, capital and labour. Results of these estimations are largely similar to those reported below.

The Foreign Presence Index in the domestic market (FPI^D) is given by

$$FPI_{jt}^{D} = \frac{\sum_{i=1}^{F} y_{ijt}^{f} - x_{ijt}^{f}}{\sum_{i=1}^{N} y_{ijt} - x_{ijt}} \tag{3}$$

where y is total output and x is total exports at the level of firm *i*. Similarly, the Foreign Presence Index in the export market (FPI^E) is calculated as

$$FPI_{jt}^{F} = \frac{\sum_{i=1}^{F} x_{ijt}^{f}}{\sum_{i=1}^{N} x_{ijt}} \tag{4}$$

4.3 Econometric results

Intra-industry spillovers and exporting

The results of the regression analysis of equation (1) using *OneSource* data are reported in Table 4. We present the regression pooled over all domestic firms (ALL) in column (1). We then estimate the model for different subsamples, according to domestic firms' export activity: those that never export (DNE), always export (DPE) or sometimes export (REST). One reason for doing so is that export activity of domestic firms can be seen as an indicator of firms' level of absorptive capacity (Girma, Görg and Pisu, 2004). Given that exporters have to compete on international markets, they may be expected to be more effective in absorbing the knowledge that spills over from foreign multinationals located in the UK.

[insert Table 4]

Overall, we find no statistically significant evidence for spillovers to all domestic firms (ALL) from column (1). However, the impact of multinational presence on domestic firms appears to differ across types of domestic firms. Whilst firms that always or sometimes export are not affected by foreign presence, domestic firms that never export are affected negatively. An explanation for this finding may be that foreign multinationals 'crowd out' domestic firms thereby moving domestic firms back up the average cost curve (Aitken and Harrison, 1999). This effect may be stronger for non-exporters which compete with multinationals on the domestic market.

It is therefore interesting to decompose the measure of foreign presence into its presence in the domestic and export market respectively. We are implicitly assuming that the competition effect is stronger from domestic market oriented multinationals and less so from export platform FDI (see also Girma, Görg and Pisu, 2004, for a discussion of this point). The results, which are reported in Table 5, indicate that foreign presence in the domestic market is harmful to all types of domestic firms, although it is only statistically significant for non-exporters. The presence of foreign firms in export markets has a positive impact on domestic firms within the same 2-digit industry, but is only statistically significant for permanent exporters.

[insert Table 5]

In conclusion, the ambiguous effect of foreign presence on the productivity of domestic firms in the literature on intra-industry productivity spillovers may be due to different offsetting effects related to the presence of multinational firms. Competition in the domestic market by foreign multinationals appears to affect negatively the productivity of domestic firms, especially if they do not export. This may happen because domestic firms are forced to reduce output thereby increasing average costs as suggested by Aitken and Harrison (1999). However, multinational presence in domestic export markets appears to benefit domestic firms, in particular if they are exporters.

It is worth highlighting that intra-industry spillovers do not only depend on the export behaviour of multinationals, but also on the export orientation of domestic firms so that spillovers are unevenly distributed across domestic firms. Thus, whilst the aggregate

spillovers on the domestic economy may be neutral, there are some firms that are likely to gain and some to suffer from multinational presence in their industry.

Intangible assets and the role of absorptive capacity

Much of the recent literature has stressed the importance of firms' absorptive capacity in order for them to benefit from spillovers from foreign multinationals (see Greenaway and Görg, 2004). Common proxies for this are firms' R&D expenditure, relative productivity levels of exporting activity. An interesting feature of *OneSource* is that it contains information on intangible assets. Intangible assets can be taken as a reflection of firm specific assets (FSAs) and hence, are a crucial aspect of multinationals' maintaining an international production network. Hence, intangible assets may also be a useful proxy for absorptive capacity, as it indicates how well endowed domestic firms are with FSAs.

In order to analyse the significance of intangible assets for firms' absorptive capacity we construct a measure of absorptive capacity somewhat similar to Girma and Görg (2002) as[16]

$$ABC_{ijt} = \frac{\text{int}_{ijt}}{\max_{i \in j} \text{int}_{jt}} \qquad (5)$$

Hence, absorptive capacity of firm *i* is measured by the distance in terms of intangible assets of firm *i* from the highest level of intangible assets in the industry. This distance is measured as the ratio of a firm's intangible assets to the industry's leader. In order to analyse to what extent spillover effects are related to absorptive capacity the foreign presence indicator is interacted with absorptive capacity in a quadratic specification to allow for additional flexibility.

From the results in Table 6 we observe an inverted U-shaped relationship between absorptive capacity and productivity spillovers for domestic exporters. This suggests that for a given level of foreign presence in a sector its impact is positive up to a threshold and then turns negative. An explanation for this finding could be that

[16] Note, however, that the ABC measure used by Girma and Görg (2002) is calculated using total factor productivity rather than intangible assets.

domestic firms are in closer competition with foreign firms as they build up their level of intangible assets. In order to gain more insight in these results it is useful to control again for the market orientation of multinationals.

The recurrence of an inverted U-relationship between the domestic market orientated of multinationals and absorptive capacity reinforces the conjecture that domestic firms with higher levels of absorptive capacity are in closer competition with multinationals. By contrast, however, a U-shaped relationship is observed between the presence of multinationals in export markets and absorptive capacity; a result that is consistent with the findings by Girma and Görg (2002). While the results are somewhat different the qualitative patterns is the same across different types of domestic firms. Domestic firms seem to be better equipped to benefit from foreign presence in exports markets when they have higher levels of intangible assets.

[insert Table 6]

The role of nationality

In this section we analyse to what extent intra-industry productivity spillovers are related to nationality of ownership. As before we distinguish four regions of ownership: North America (US), Europe, East Asia (Japan) and others. Our results in Table 7 suggest that there are positive spillovers from US, Japanese and EU multinationals for most groups of firms, although domestic non-exporters are affected negatively by the presence of Japanese MNEs. These results contrast somewhat with the evidence provided by Haskel, Pereira and Slaughter (2002) and Girma and Wakelin (2001) based on ARD data, who do not find much evidence for spillovers from European firms. However, the findings in these two papers are also at odds with each other, as we discussed in Section 3. This suggests that more research is needed to pin down the effects of multinationals from different countries in more detail.

[insert Table 7]

5 Conclusions

The British government has been quite pro-active in attempting to attract foreign multinationals to locate in particular regions of the UK. While there may be many reasons for doing so, one argument voiced quite frequently is that domestic firms may benefit from FDI in terms of productivity spillovers. This chapter reviews the evidence and presents some empirical work dealing with this issue.

While the international evidence on productivity spillovers is far from conclusive on whether or not these benefits actually accrue to domestic firms, recent evidence based on micro level data for the UK is quite encouraging. All studies reviewed here do find evidence for productivity spillovers, although these may depend on the characteristics of domestic firms, in particular their levels of absorptive capacity, and whether or not they are located close to multinationals. Our empirical analysis, based on *OneSource* for the period 1988 to 1996, is in line with that evidence. We find evidence for spillovers over a number of specifications of our empirical model.

However, there are a number of qualifications. First, spillovers depend on the market orientation of FDI, with export oriented FDI being more likely to generate positive spillovers, while domestic market oriented FDI seems to crowd out domestic firms and reduce their productivity. Second, the export orientation of domestic firms matters, in general, exporters appear to benefit most from spillovers. In extensions of our model we also find some evidence that spillovers appear to differ across firms of different nationalities, and that measuring absorptive capacity in terms of intangible assets may be a fruitful direction for further research.

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Table 1: Summary statistics

	Domestic firms			*Foreign-owned firms*		
	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.

Turnover*	15209	193.229	631.026	4389	421.957	1294.356
Employment	15209	243.223	585.571	4389	352.469	783.760
Hourly wage*	15209	0.150	0.045	4389	0.166	0.050
Labour productivity*	15209	0.240	0.166	4389	0.272	0.187
Capital intensity*	15209	0.159	0.272	4389	0.266	0.452
Exports*	15209	38.561	196.681	4389	153.088	786.974
Export propensity	15209	0.198	0.233	4389	0.289	0.257
Export share	15209	0.467	0.033	4389	0.533	0.033
%Δ Turnover	13568	0.050	0.218	4133	0.072	0.246
%Δ Hourly wage	13565	0.026	0.159	4164	0.033	0.180
%Δ Labour productivity	13567	0.012	0.321	4130	0.038	0.451

Note: *Times 100,000.

Source: own calculations using *OneSource* data

Table 2: Descriptive Statistics by Export Behaviour, 1988-1996

	Domestic			Foreign		
Never Exporter						
	Obs	*Mean*	*Std. Dev.*	*Obs*	*Mean*	*Std. Dev.*
Turnover*	1496	224.720	1009.918	285	249.265	683.235
Employment	1496	221.384	705.538	285	389.597	922.390
Hourly wage*	1496	0.147	0.049	285	0.157	0.041
Labour productivity*	1496	0.240	0.185	285	0.267	0.123
Capital intensity*	1496	0.189	0.474	285	0.236	0.247
Intangible assets*	1281	7.580	91.893	113	1.973	9.089
%Δ Turnover	1343	0.054	0.215	271	0.078	0.225
%Δ Hourly wage	1345	0.021	0.167	274	0.024	0.142
%Δ Labour productivity	1343	0.008	0.363	271	0.037	0.317
Always exporter						
Turnover*	10526	184.586	523.918	3583	453.885	1392.245
Employment	10526	250.143	569.580	3583	371.473	816.761
Hourly wage*	10526	0.151	0.043	3583	0.167	0.051
Labour productivity*	10526	0.240	0.121	3583	0.272	0.181
Capital intensity*	10526	0.148	0.213	3583	0.246	0.371
Intangible assets*	9025	1.741	26.213	885	4.972	26.950
Exports*	10526	49.097	208.601	3583	182.272	867.675
Export propensity	10526	0.262	0.238	3583	0.332	0.250
%Δ Turnover	9392	0.043	0.214	3370	0.065	0.241
%Δ Hourly wage	9387	0.027	0.154	3388	0.035	0.178
%Δ Labour productivity	9392	0.012	0.310	3367	0.037	0.448
Sometimes exporter						
Turnover*	3187	206.994	717.255	521	296.846	700.867
Employment*	3187	230.618	575.247	521	201.463	312.301
Hourly wage*	3187	0.150	0.050	521	0.164	0.048
Labour productivity*	3187	0.239	0.259	521	0.278	0.249
Capital intensity*	3187	0.183	0.310	521	0.418	0.847
Intangible assets*	2002	6.213	66.665	110	0.992	3.025
Exports*	3187	21.863	198.890	521	36.128	87.816
Export propensity	3187	0.077	0.162	521	0.152	0.219

%Δ Turnover	2833	0.072	0.228	492	0.119	0.286
%Δ Hourly wage	2833	0.028	0.171	502	0.031	0.213
%Δ Labour productivity	2832	0.012	0.333	492	0.047	0.532

Note: *Times 100,000.

Source: own calculations using *OneSource* data

Table 3: Summary Statistics by Nationality of Ownership

	North-America (n<=375)		East Asia (n<=108)		Europe (n<=541)		Other (n<=113)	
Turnover*	736.053	2654.551	757.093	1185.506	411.393	854.269	231.676	252.289
Employment	429.963	879.426	681.157	547.345	328.553	430.161	284.699	300.894
Hourly wage*	0.170	0.050	0.156	0.049	0.165	0.052	0.172	0.050
Labour productivity*	0.242	0.180	0.286	0.149	0.224	0.123	0.282	0.178
Capital intensity*	0.225	0.212	0.351	0.553	0.249	0.259	0.290	0.303
Intangible assets*	5.224	24.592	0.178	1.303	1.691	9.593	8.881	40.842
Exports*	397.408	1954.557	269.150	422.450	123.373	524.391	46.121	65.003
Export propensity	0.327	0.251	0.381	0.285	0.229	0.243	0.246	0.292
%Δ Turnover	0.071	0.267	0.100	0.280	0.070	0.233	0.069	0.281
%Δ Hourly wage	0.033	0.182	0.051	0.237	0.035	0.180	0.019	0.211
%Δ Labour productivity	0.012	0.332	0.057	0.398	0.052	0.468	-0.013	0.404

Note: * times 100,000, *n* refers to number of observations

Source: own calculations using *OneSource* data

Table 4: Basic regression results by export activity

	(1)	(2)	(3)	(4)
	ALL	DNE	DPE	REST
lnL	0.224	0.163	0.230	0.237
	(0.020)***	(0.034)***	(0.019)***	(0.044)***
lnK	0.013	-0.005	0.017	0.012
	(0.004)***	(0.008)	(0.006)***	(0.011)
lnM	0.722	0.785	0.707	0.737
	(0.022)***	(0.040)***	(0.016)***	(0.053)***
FPI	-0.031	-0.238	-0.006	-0.062
	(0.049)	(0.094)**	(0.055)	(0.072)
Constant	0.047	0.094	0.027	0.083
	(0.019)**	(0.027)***	(0.023)	(0.026)***
Obs.	14681	1427	10211	3043
R-squared	0.88	0.87	0.87	0.89

Notes: Robust standard errors in parentheses.

*, **, *** statistically significant at 10%, 5% and 1%.

Regressions include full set of industry, region and time dummies.

FPI indices at 2-digit industry.

Error terms are clustered around 2-digit industries.

Table 5: Regression results by export and domestic market orientation MNEs

	(1)	(2)	(3)	(4)
	ALL	DNE	DPE	REST
lnL	0.223	0.162	0.23	0.237
	(0.020)***	(0.033)***	(0.019)***	(0.044)***
lnK	0.013	-0.005	0.017	0.011
	(0.004)***	(0.008)	(0.006)***	-0.011
lnM	0.723	0.785	0.707	0.737
	(0.022)***	(0.040)***	(0.016)***	(0.053)***
FPI^D	-0.105	-0.256	-0.109	-0.07
	(0.066)	(0.098)***	(0.081)	(0.051)
FPI^X	0.078	0.030	0.111	-0.002
	(0.045)*	(0.084)	(0.046)**	(0.062)
Constant	0.044	0.089	0.022	0.086
	(0.018)**	(0.027)***	(0.022)	(0.027)***
Obs.	14681	1427	10211	3043
R-squared	0.88	0.87	0.87	0.89

Notes: Robust standard errors in parentheses.

*, **, *** statistically significant at 10%, 5% and 1%.

Regressions include full set of industry, region and time dummies.

FPI indices at 2-digit industry.

Error terms are clustered around 2-digit industries.

Table 6: Regression results with absorptive capacity and intangible assets

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ALL	DNE	DPE	REST	ALL	DNE	DPE	REST
lnL	0.226	0.159	0.234	0.243	0.225	0.158	0.234	0.243
	(0.020)***	(0.033)***	(0.020)***	(0.053)***	(0.020)***	(0.032)***	(0.020)***	(0.053)***
lnK	0.010	-0.010	0.015	0.006	0.010	-0.010	0.015	0.005
	(0.005)**	(0.009)	(0.006)**	(0.014)	(0.005)**	(0.009)	(0.006)**	(0.014)
lnM	0.718	0.798	0.703	0.730	0.719	0.798	0.703	0.731
	(0.022)***	(0.039)***	(0.016)***	(0.059)***	(0.022)***	(0.039)***	(0.016)***	(0.059)***
FPI	-0.043	-0.255	-0.012	-0.129				
	(0.051)	(0.095)***	(0.058)	(0.081)				
*FPI*abc1*	0.196	-1.253	0.248	0.240				
	(0.108)*	(1.290)	(0.106)**	(0.139)*				
*FPI*abc2*	-0.189	1.305	-0.225	-0.378				
	(0.123)	(1.288)	(0.119)*	(0.159)**				
FPI^D					-0.122	-0.241	-0.127	-0.105
					(0.068)*	(0.100)**	(0.080)	(0.066)
FPI^D*abc1					0.745	-0.758	0.712	1.328
					(0.191)***	(1.459)	(0.265)***	(0.421)***
FPI^D*abc2					-0.623	0.807	-0.583	-1.368
					(0.218)***	(1.403)	(0.308)*	(0.608)**
FPI^X					0.080	0.000	0.121	-0.058
					(0.048)*	(0.076)	(0.044)***	(0.084)
FPI^X*abc1					-0.415	-0.411	-0.353	-0.698
					(0.147)***	(0.942)	(0.216)	(0.260)***
FPI^X*abc2					0.322	0.421	0.267	0.627
					(0.177)*	(1.084)	(0.258)	(0.429)
Constant	0.048	0.105	0.032	0.090	0.044	0.101	0.027	0.101
	(0.023)**	(0.029)***	(0.023)	(0.027)***	(0.021)**	(0.028)***	(0.021)	(0.028)***
Observations	11763	1210	8695	1858	11763	1210	8695	1858
R-squared	0.87	0.86	0.87	0.88	0.87	0.87	0.87	0.89

Notes: Robust standard errors in parentheses.

*, **, *** statistically significant at 10%, 5% and 1%.

Regressions include full set of industry, region and time dummies.

FPI indices at 2-digit industry.

Error terms are clustered around 2-digit industries.

Table 7: Regression results by nationality

	(1)	(2)	(3)	(4)
	ALL	DNE	DPE	REST
lnL	0.222	0.201	0.217	0.252
	(0.012)***	(0.052)***	(0.016)***	(0.028)***
lnK	0.018	-0.020	0.019	0.030
	(0.005)***	(0.014)	(0.004)***	(0.013)**
lnM	0.695	0.736	0.695	0.686
	(0.020)***	(0.072)***	(0.016)***	(0.043)***
FPI	-0.299	-0.788	-0.266	-0.563
	(0.108)***	(0.357)**	(0.110)**	(0.394)
FPI^{US}	0.835	1.090	0.878	0.947
	(0.098)***	(0.475)**	(0.104)***	(0.352)***
FPI^{JP}	0.180	-0.629	0.305	0.170
	(0.050)***	(0.173)***	(0.069)***	(0.240)
FPI^{EU}	1.510	3.110	1.531	1.535
	(0.614)**	(1.215)**	(0.657)**	(0.821)*
Constant	0.065	0.109	0.049	0.233
	(0.031)**	(0.130)	(0.027)*	(0.179)
Observations	6721	528	4968	1225
R-squared	0.88	0.84	0.88	0.90

Notes: Robust standard errors in parentheses.

*, **, *** statistically significant at 10%, 5% and 1%.

Regressions include full set of industry, region and time dummies.

FPI indices at 2-digit industry.

Error terms are clustered around 2-digit industries.