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Foreign Multinationals and domestic innovation: intra-industry effects and firm heterogeneity

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Abstract

This paper looks at foreign Multinational Enterprises (MNEs) investing in the UK and at their impact on the innovation performance of domestic firms active in their same sector. By employing data on Foreign Direct Investments matched with firm-level information the paper develops a direct measure of capital inflows at a three-digit industry level. In order to capture innovation in both manufacturing and services the paper relies on a broader proxy for firm innovativeness based on the Community Innovation Survey (CIS). The results suggest that domestic firms active in sectors with greater investments by MNEs show a stronger innovative performance. However, the heterogeneity across domestic firms in terms of internationalisation of both their market engagement and ownership structure is the main driver of this effect.

Keywords: Multinational Enterprises, Innovation, Technological change, Intra-industry knowledge diffusion, Community Innovation Survey, United Kingdom.

JEL Codes: O33, F22

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1. Introduction

Over the last few decades the importance of Multinational Enterprises (MNEs) in the global economy has grown substantially, stimulating the attention of scholars and policy makers. MNEs are amongst the main 'creators' of new technology – see among other Cantwell (1994) and Cantwell and Iammarino (2000) – since they represent the largest source of technology generation, transfer and diffusion in the world economy (Iammarino and McCann, 2013).

Countries increasingly compete to attract MNEs on the ground of the potential benefits that may stem from their presence and activities in the host economies. Scholars have long debated the rationale of these policies by investigating the effects of MNE investments on the recipient economies. However, the empirical evidence on the impact of MNEs on local firms in advanced economies is still mixed and inconclusive (see, for example, the reviews in Rodrik, 1999 and Smeets, 2008).

The aim of this paper is to provide new empirical evidence on the impact of MNEs investments in the UK. By building on a novel database that merges data on foreign direct investments (FDI) with firm-level information, we test whether the innovation capacity of domestic firms operating in the same industrial sector as foreign enterprises benefit from their presence and activities. The paper contributes to the existing literature in a number of ways. First, we look at the impact of MNEs on the probability that domestic firms carry out innovation by employing a measure of innovativeness that accounts also for innovation in services. Previous studies have mainly focused on productivity or patent outputs, failing to grasp the full impact on recipient economies – such as the UK – characterised by a strong relevance of services. Second, we measure the impact of MNEs also in terms of the magnitude of their investments, rather than only on the basis of their mere physical presence as in the majority of existing studies. Third, and more importantly, we shed light on how the heterogeneous characteristics of domestic firms shape their capability to benefit from MNEs' activities. In so doing the paper aims to contribute to the (still) scant literature modelling spillover mechanisms as two-way relationships rather than as unidirectional flows (Barnard and Cantwell 2007).

A large body of existing literature has looked at impact of MNEs with inconclusive findings, in particular with respect to intra-industry effects (Harris and Robinson 2003). Our analysis suggests that foreign firms are indeed carriers of positive externalities in the recipient

industries, but their effect varies significantly across typologies of domestic firms. We find that the positive impact of MNEs' investments is particularly strong for less internationalized firms, that is those serving regional and national markets (as opposed to firms active also on international markets). Consistently, domestic firms that are part of multinational groups are less affected by the positive externalities originating from other MNEs: such firms have arguably already access to capabilities and infrastructure channelling the diffusion of global knowledge.

The paper is organized as follows: the next paragraph briefly reviews the recent empirical literature on the impact of MNE investments with the aim of identifying some key gaps in the existing studies. Sections 3 and 4 discuss respectively the data and the methodological approach adopted to estimate the effect of the activities carried out by foreign enterprises in the recipient industrial sectors. Section 5 presents the results and robustness checks, while Section 6 concludes with some remarks on policy implications and further steps for future research.

2. Background literature

There is a wide empirical literature on the impact of MNEs' investments on the economic performance of domestic firms, investigating the existence of positive externalities associated to the presence of foreign enterprises. The motivation behind this expectation arises from the long-standing assumption that MNEs possess more advanced technology due to their access to superior knowledge (Caves, 1974; Dunning, 1980; Cantwell 1989).

The view that attracting foreign subsidiaries of MNEs will generate advantages for the host economies builds on the belief that positive pecuniary and knowledge externalities arise from foreign activities and spread out to domestic firms. The benefits of MNE's presence for host locations have been broadly classified into two types: productivity-enhancing externalities and market access externalities. The former kind of effect is the result of tougher competition following foreign entry, which may create incentives for local firms to introduce new technologies and organizational practices in order to compete with the new entrants. In addition, MNEs make it possible for local firms to access new technologies and skills by means of backward and forward linkages, as well as personnel exchanges, R&D collaborations, and a number of other knowledge channels. Market access externalities come from the experience

and knowledge that MNEs have of global and geographically distant markets, international R&D, commercialization and marketing, distribution networks, institutional diversity and political and lobbying power. As a result of their own operations, MNEs may therefore pave the way for local firms with relatively limited capabilities to enter the same export markets, either because of the infrastructure created or because of the diffusion of knowledge and information (McCann and Acs, 2011). These positive effects have found broad support in recent empirical analyses, suggesting that foreign owned enterprises tend to be more productive, invest more in R&D and generate more knowledge (Castellani and Zanfei, 2007a; Dicken, 2007; Criscuolo et al., 2010) that can potentially be transmitted to or spill over into domestic firms.

A number of alternative mechanisms mediate the impact of MNEs on domestic firms and the existing literature has identified intra-industry and inter-industry channels. The former category encompasses demonstration, competition and labour market effects. Demonstration effects rely on the benefits arising from the exposure of domestic firms to the superior technology of MNEs subsidiaries (Girma et al., 2001; Gorg and Greenaway, 2004; Crespo and Fontoura, 2007; Smeets, 2008). Competition effects are triggered by the entry of foreign firms that push domestic firms to use available resources and existing technology more efficiently (Blomstrom and Lipsey, 1989; Wang and Blomstrom, 1992). Finally, labour market effects are mainly mediated by inter-firm labour and human capital mobility within the sector (Driffield and Taylor, 2000; Fosfuri et al., 2001; Gorg and Strobl, 2005). Inter-industry interactions between foreign and domestic enterprises are instead reliant mainly upon the existence of backward and forward linkages. Firms operating in different vertically connected industrial sectors are more likely to benefit from positive externalities (Ernst and Kim, 2002; Javorcik, 2004; Crespo and Fontoura, 2007; Javorcik and Spatareanu, 2008 and 2009; Blalock and Gertler, 2008).

Despite the economic rationale underlying the likelihood of positive effects of MNEs activities on domestic firms, a number of critical views have emerged in the empirical literature. In the case of intra-industry dynamics perverse effects may derive from problems for domestic firms in absorbing of the latest technologies (Castellani and Zanfei, 2002), market-stealing effects by MNE subsidiaries (Aitken and Harrison, 1999; Crespo et al., 2009), and limited labour mobility due to higher wages paid by foreign enterprises. More univocal are instead the predictions about inter-industry interactions: except for some caveats regarding the net effect on upstream sectors (Javorcik, 2004; Bitzer et al., 2008), general agreement emerges on the central role of

backward linkages. The positive impact of foreign enterprises seems in fact to be more pronounced in related industries rather than within the highly competitive industry in which MNEs operate (Harris and Robinson, 2003; Harris and Moffat, 2013).

The lack of conclusive results on the impact of foreign enterprises in particular in the intra-industry case has stimulated further research. In this context, the heterogeneity across foreign enterprises with respect to the nature and characteristics of their internationalization strategies has been regarded as a key determinant of the lack of clear-cut results (Greenaway and Kneller, 2007). The literature has increasingly looked at MNEs as firm-specific portfolios of locational attributes pursuing knowledge augmentation strategies that are aimed at sourcing strategic resources in recipient economies (Chen and Chen, 1998; Luo and Tung, 2007; Crescenzi et al., 2014). Thus, MNEs differ widely in terms of accumulation of technological capabilities due to endogenous choices to invest in knowledge (Castellani and Zanfei, 2007b) as well as in their attitude towards cooperation and interest to access external knowledge to enrich internal competencies (Cantwell and Iammarino, 2000).

In a complementary perspective, technological learning and the development of innovative capabilities – and therefore the impact of MNEs on host economies, particularly in advanced industrial systems – are strongly dependent on the characteristics of domestic actors and their environment, that are highly diversified within national boundaries. As a consequence, the potential heterogeneity across domestic firms also deserves a thorough investigation. Some contributions in this direction have suggested that the likelihood of benefitting from external knowledge is inversely related to the cost of its acquisition (Harris and Robinson, 2003), implying a key role of firms' absorptive capacities (Borensztein et al., 1998; Blomstrom and Kokko, 2001; Glass and Saggi, 2002; Liu and Buck, 2007).

This view, despite highly reasonable, seems to provide only a partial explanation of the recent efforts to model externality mechanisms as bidirectional exchanges. It remains debatable whether firm-specific conditions such as the possession of superior knowledge by MNEs and the existence of adequate absorptive capacity by domestic firms, are both necessary and sufficient conditions to determine the emergence and effectiveness of positive externalities. Even if knowledge originates elsewhere or is carried by external actors, the receiving node has to play an active role to animate and recreate that knowledge in a new context (Barnard and Cantwell, 2006). This implies that both characteristics and deliberate market strategies of

domestic firms may shape the degree to which they absorb and exploit external knowledge. When reviewing the evidence on the distribution of the costs and benefits of FDI between home and host economy, Lipsey (2004, p. 1) concludes that "Much of the impact is from the transfer of knowledge of world markets and of ways of fitting into worldwide production networks, not visible in standard productivity measurements." As in the case of foreign enterprises, therefore, also domestic firms may be characterized by different attitudes and choices towards market strategies and engagement, and this dimension may affect the likelihood and intensity of their links with MNEs. Nonetheless, after controlling for absorptive capacity, local firms have been often considered as passive technological recipients in the process of technology transfer, which in turn is seen as strictly unidirectional (Iammarino and McCann, 2013). This is at odds with evidence suggesting that knowledge flows and diffusion depend on the position of MNEs towards local competitors (McCann and Mudambi, 2004) and on the perceived advantage from cooperation.

Knowledge flows and technology transfer, in fact, are influenced by domestic firms' heterogeneity not only in terms of the scope of their markets of reference but also in terms of the national or international extent of their investments. UK-owned firms with affiliates or subsidiaries abroad have generally higher total factor productivity than other domestic firms (Simpson, 2011). In addition evidence on US firms investing abroad suggests that foreign investments are associated with greater domestic investments and compensation of domestic employees (Desai et al., 2009). The skill-intensity of domestic firms may also increase as a result of investing abroad (Barba-Navaretti et al., 2010; Hijzen, 2011). All these factors reduce the gap between internationalised domestic firms and foreign MNEs, diminishing the potential for a catching-up effect. In addition, when domestic firms progressively expand their operations nationally and internationally their knowledge management also evolves, rebalancing the centre of gravity of their knowledge flows and the combination of tacit versus codified knowledge (Keller, and Yeaple, 2013; Egger et al., 2014). Internationalized firms, having incurred in knowledge re-organisation (sunk) costs already, are more likely to scan globally for the most appropriate sources of knowledge rather than rely on incoming foreign MNEs as a source of knowledge (or imitation).

As a result of the forces discussed above, the degree of internationalization, the ownership structure and the overall competitive strategies may be relevant pre-conditions for domestic firms to take advantage of MNE knowledge flows and spillovers. Domestic firms that have

already access to global knowledge through ownership advantages or strong involvement in international markets and linkages may have fewer incentives to cooperate with foreign firms and to interact with the localized networks in which MNEs engage to tap into indigenous expertise and complement their internal capabilities. For these segments of the population of domestic firms – whose internal organizational structures may be designed to avoid the sharing of knowledge (Arita and McCann, 2002) – competitive dynamics with foreign enterprises operating in the same industry are likely to outpace the emergence of cooperative patterns, lowering the probability and effectiveness of potential externalities associated to MNEs (Cantwell and Santangelo, 1999; Alcácer, 2006)

3. Data and variable definitions

The database for the empirical investigation of the impact of MNE investments on the innovative performance of domestic firms in the UK is constructed by merging different micro data sources. Data on investments by MNEs come from the Annual Inquiry into Foreign Direct Investment (AFDI), which has been complemented by firm-level information from the Annual Respondent Database (ARD), while information on the innovative performance of local firms refers to the Fifth Community Innovation Survey (CIS5).

AFDI provides data on net investment flows of foreign MNEs into the UK for the period 1996-2005, coming from the balance of payment and available from the UK Office of National Statistics (ONS). The AFDI inward inquiry section concerns the subsidiaries/associates of foreign firms operating in the UK.[1] Net investment flows are reliable measures of companies' investment in capital (by subtracting non-cash depreciation from capital expenditures) and disinvestments, giving a sense of how much a company is spending on capital items (such as property, plants and equipment) which are used for operations.

Firms are sampled from a register based on a variety of sources including HM Customs & Revenue, Dunn & Bradstreet's "Worldbase" system, and ONS inquiries on Acquisitions & Mergers. The sampling is based on a stratified design; the largest firms all receive the survey form, while only a share of the smaller firms is directly involved. The survey is generally filled

[1] If a foreign firm owns more than 50% of the equity share capital of another firm, it is identified as a foreign *subsidiary*. If only 10% to 50% of capital is foreign-owned, then the firm is labelled as a foreign *associate*. Unfortunately the data files do not differentiate between associates and subsidiaries - they are both classified as *'foreign subsidiaries'*, implying that the definition employed in this study will take into account both categories.

in by the head of the enterprise group in the UK providing information for the entire group. This implies that the unit of observation in the AFDI survey is the enterprise group.

Responses to AFDI can be linked to firm level information from the Annual Business Inquiry (ABI), the largest and most comprehensive ONS business survey: information from the ABI is held in the Annual Respondents Database (ARD).[2] In performing the merging procedure it should be borne in mind that while AFDI information is reported at the enterprise group level, the reporting unit level of the ARD is the enterprise. Linking the two databases requires a consistent enterprise group identification code between the two surveys. We followed the procedure adopted by Criscuolo and Martin (2011) to define a common enterprise group identifier.[3]

Over the period 1998-2005[4] it is possible to identify 93,438 enterprise groups in AFDI and among these, 64,447 (approximately 70% of the total) correspond to a single enterprise in ARD. In this case the attribution of financial flows to each enterprise is univocal. The remaining 18,442 enterprise groups (19.7% of the full sample) are matched with more than one observation in ARD, meaning that the enterprise group includes more than one enterprise located in the UK. Almost 50,500 enterprises correspond to these 18,442 enterprise groups. For 7,717 enterprises (about 15.2% of this sub-sample) it is possible to attribute the annual investment flow directly because, despite being part of an enterprise group involving more than one enterprise in the UK, each of them appears only once in a year, allowing to identify the recipient of the financial flow. For the remaining 42,745 enterprises (accounting for almost 84.6% of the sub-sample) there is no possibility to attribute automatically the net investment flows, making it necessary to rely on a weighting scheme. As a consequence, on the basis of

[2] Note that despite being the most reliable and representative source of business data currently available in UK, the ABI is not a census of all businesses and smaller reporting units are sampled. As a consequence in ARD there are two types of enterprises. For some enterprises information is based directly on their ABI survey returns and held in the 'selected files' of the ARD. For other enterprises - that are still part of the ABI survey universe but which are not covered by the survey in a given year - records are held in the `non-selected' files. By considering information from both the 'selected' and 'non-selected' ARD files, the coverage of the ARD is extended considerably. However the range of data items available for the two groups of enterprises are different, since the 'non-selected' files only include information on the sector of activity, turnover and employment rather than the full range of available ARD data fields. Despite this limitation, sample size remains a primary concern given that the purpose of this step of the merging procedure is the identification of MNEs in the full sample of UK-based firms.

[3] Observations for 1996 and 1997 were excluded from the analysis due to a major coding change in AFDI data for waves before 1998.

[4] In order to maximize the number of observations in the sample, all FDI inflows from 1998 to 2005 are used in the regression. However, the key results remain qualitatively unchanged when alternative lags and time windows are taken into account to compute the MNEs investment variable (see Table A.4 in Appendix A1).

the information available for all enterprises in ARD, two different criteria have been alternatively applied: either employment or turnover of each enterprise as a share of the total for its group is used to attribute enterprise group financial flows to each enterprise belonging to the same group. In the end, the turnover weight has been used as the preferred option to compute the explanatory variable of interest; however, the employment-based weight has been also adopted as a robustness check without any evidence of systematic changes in the results.

The merging procedure allows recovering the sector of activity at the three-digit level (based on the SIC92 classification) for each enterprise. This is particularly relevant in the case of enterprise groups consisting of more than one enterprise, for which the sectoral identifier provided by AFDI is not reliable. Having available precise and detailed information on the industrial sector of activity is in fact crucial for our analysis since data on investment flows by MNEs are linked to data on the innovative performance of local firms from the Community Innovation Survey (UK CIS5) based on the sectoral dimension.

In addition, it should be noted that the standard measure of foreign investment based on the count of MNEs – extensively employed in recent studies – is complemented by an additional variable accounting for the amount of financial resources invested by foreign enterprises. The availability of both measures allows making a substantial step forward with respect to the existing literature. The customary MNEs' count variable exacerbates measurement bias problems: different typologies of investments – both major plans and minor improvements to existing establishments – are likely to be equally weighted. Furthermore, the presence of MNEs in a certain area or sector may reflect investments carried out in the past with declining impacts due to depreciation that is not accounted for by simple investment counts. Conversely, data on financial flows make it possible to control for both the actual magnitude and relevance of different typologies of investments and for their vintage year, accounting for the current value of MNEs' activities after depreciation and disinvestments.

The CIS5, the source of our main dependent variable and key controls, is a firm-level database containing information on innovative performance and related activities for the period 2005-2007, for both manufacturing and services. The final sample available in the UK CIS5 includes

8,813 firms[5] which are used in the empirical analysis. Given the strong concentration in services of FDI in the UK (as confirmed by the analysis of the descriptive statistics below) traditional proxies – such as patenting activities or total factor productivity (TFP) – would be unable to capture the complexity of innovation dynamics. Other measures available in the CIS, such as for example product or process innovation, may also lead to a partial picture (see appendix A1 for further details).[6]

In order to deal with these problems our dependent variable is based on the definition provided by the Office of National Statistics (ONS) for 'Innovation Active Firms' as enterprises that have:

- Introduced new significantly improved products or processes;
- Engaged in innovation projects completed or ongoing;
- Introduced new and significantly improved forms of organisation, business structures or practices and marketing concepts or strategies.

This broader measure of innovative performance, accounting also for activities other than product or process innovation, has been proposed in the context of the CIS and recently applied in a number of studies (e.g. Cereda et al., 2005; Johansson and Lööf, 2008; D'Este et al., 2012) to cope with the progressive importance of innovation in services.[7] Data from the CIS-5 are

[5] The original CIS5 sample includes 13,791 observations of which 1,623 are excluded from the analysis because present also in the AFDI-ARD dataset (i.e. they are foreign subsidiaries); additional observations are dropped due to lacking information about key regressors (e.g. investments in R&D, employment etc.). In our preferred specification the analysis is also restricted to those sectors experiencing positive net investment inflows. In this case, 859 additional observations are dropped from the CIS5 sample: these are firms operating in sectors where net investment flows are either negative or zero (this being mainly the case of investment in the Construction industry and some compartments of Hotels and Restaurants and Manufacturing of Fuel).

[6] Table A.1 in Appendix A1 compares the shares of innovative firms defined on the basis of the categories 'Product or Process Innovation' and 'Innovation Active'. As expected the former category is more narrowly defined and innovation in services seems to be particularly underestimated. This evidence is further supported by the regression analysis reported in Table A.2. When a more restrictive measure of innovativeness is applied we find no effect of MNEs' investments with the results being driven by the lower magnitude in the coefficient. We interpret this finding as additional supportive evidence for the poor explanatory power of a more restrictive measure of innovativeness especially when innovation in services represents a relevant phenomenon (as in the UK).

[7] The existing literature has extensively emphasised the difficulty of fully capturing innovation in services (Windrum, 2007) and different approaches to the problem have emerged (Coombs and Miles, 2000). The 'assimilation' approach extends concepts and measures of innovation developed for manufacturing to the analysis of services. Conversely, the 'demarcation' approach calls for new theories and measures to be specifically developed to capture innovation in the service sector. Finally a 'synthesis' approach has suggested that that service innovation brings into light innovation dynamics that are relevant for both manufacturing and services (Drejer, 2004). In this context the CIS has traditionally been considered as an example of a survey based on the 'assimilation approach' (Drejer, 2004): even if (since the CIS2) service firms have been included in the sample, the CIS conceptualisation of innovation remains highly technology- focused and "too narrow for understanding the dynamics of services as well as manufacturing" (Drejer, 2004, p. 552). While it remains crucial to be aware of

also used to recover information on firm size, skilled employment and degree of internationalization in terms of main market of reference. These are key controls accounting for differences in domestic firms' characteristics, absorptive capacity and market strategies. A more detailed description of the variables used in the empirical analysis is reported in Table 1.

[Insert Table 1 here]

3.1 Stylised facts on inwards FDI and domestic firms' innovative performance in the UK

Figure 1 shows the number of MNEs by main sector of activity (based on one-digit SIC92 classification), while Figure 2 presents the financial value of MNEs' investments in each sector. Although providing us with a converging picture of the sectoral distribution of foreign activities, the two figures uncover the potential measurement problems associated with MNE counts: as an example foreign activities in 'Wholesale Trade' and 'Retail' are significantly overestimated when measured by the count variable, while the opposite is true for large infrastructural investments in 'Electricity, Gas and Water supply'. Conversely, 'Real Estate, Renting and Business Activities' and 'Financial Intermediation' show similar patterns with both measures.

[Insert Figures 1 and 2 here]

In addition, the most striking feature of the sectoral distribution of both the number of MNEs and the value of their investments is the concentration in the service industry. This is not surprising given the time frame under analysis and the characteristics of the UK economy that has undergone a process of deindustrialization over the 80s and 90s (Turok and Edge, 1999). This evidence confirms the importance to rely on a measure of innovative performance able to account also for innovation in services.

Figure 3 shows the number of domestic firms by sector of activity from the CIS5 sample. The UK domestic specialization profile is clearly skewed towards the service sector with a significant share of firms operating in 'Real Estate, Renting and Business Activities'. This sectoral structure recalls very clearly the inward FDI sectoral profile presented in Figure 2 and

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these intrinsic limitations of any CIS-based measure of innovation, the descriptive statistics presented in this paper confirm that the proposed focus on 'innovation active' firms makes it possible to (at least partially) mitigate the under-estimation of innovation in services otherwise associated with the standard CIS-based product/process innovation measures (see Table A.1 in Appendix A1).

provides additional support for a measure of innovativeness able to account more carefully for service innovation.

[Insert Figures 3 here]

Table 2 reports additional descriptive statistics on the CIS5 sample in order to provide further details on the innovative performance of UK firms by sector. In general manufacturing industries show larger shares of innovation active firms than services (this is particularly true for 'Manufacturing of electrical and optical equipment' where 80% of firms are innovation active). Among service industries 'Financial Intermediation' and 'Real Estate, Renting and Business Activities' show an above-average innovative performance: these are the most dynamic and internationalised sectors in the UK economy. Conversely, 'Hotels and Restaurants' show the smallest share of innovative firms, confirming the well-known lack of innovative dynamism of this sector in the UK (Shaw and Williams, 2009). These statistics also confirm the capacity of the adopted innovation measure to capture innovation dynamics in both manufacturing and services.

[Insert Table 2 here]

4. Methodology

The estimation of the relationship between MNEs investments and the innovative performance of local firms poses a number of methodological challenges from measurement issues to endogeneity concerns. The proposed model of empirical analysis looks at the impact of recent investments carried out over the 1998-2005 period on the subsequent performance of domestic firms in 2005-2007[8], allowing for a sufficient time lag between the localization of MNEs activities and the emergence of positive spillovers in favour of domestic firms active in the same sector.

The estimated equation is specified as a firm-level Knowledge Production Function (KPF) (Griliches, 1979; Jaffe, 1986; and Charlot et al., 2014 for a critical review), augmented by the regressor of interest, and it takes the following form:

$$Innovation\ Active_{ist} = \beta_0 + \beta_1 MNEs_{s,t\ (t-T)} + \beta X_{ist} + \varepsilon_{ist} \qquad (1)$$

[8] Note that the CIS has in principle a panel dimension: however the number of observations drops substantially (by approximately 50%) when the previous wave is considered (implying a time lag of almost 2 years), and by 2/3 when waves further back in time are taken into account.

Where $Innovation\ Active_{ist}$ is a dummy variable taking value 1 if firm i operating in the three-digits sector s is 'innovation active' at time t, and 0 otherwise; $MNEs_{s,t(t-T)}$ is the regressor of interest, namely investments carried out by MNEs operating in the three-digit sector s over the period (t, t-T); X_{ist} is a vector of controls including information on the share of skilled employment and firm size. Our full specification also includes a control for productivity growth over the period 1995-2005 at the two-digit sector level. The latter is a key regressor since in absence of a panel structure it can still capture general business cycle effects that can drive the emergence of industry-specific trends in the innovative performance of domestic firms. Finally sectoral dummies (defined at the one-digit level) and area dummies (defined at the level of Governmental Office regions) are also included in the regression in order to control for industry and regional fixed effects.

The estimation is performed adopting a standard *Linear Probability Model* (LPM), given the primary importance of potential endogeneity bias and to the possibility to deal with this problem more reliably in a linear context.[9] Robustness checks using alternative estimation methodologies that account for non-linearity in the relation of interest have been also performed without evidence of qualitative changes in the results.

4.1 Identification Strategy

The key hypothesis of this paper is that investments carried out by MNEs affect the innovative performance of UK firms operating in the same three digits sector of activity, generating positive spillovers through virtuous cycles of cooperation and competition. However, despite the inclusion of regressors aiming at capturing a number of potential omitted variables, the causal relationship between the two dimensions needs particular attention.

MNEs may be more willing to invest in sectors characterized by distinctive domestic technological capabilities and more successful innovative performance, justifying concerns of reverse causality. Alternatively, "foreign firms may be attracted to slow-growing industries to gain a greater competitive advantage" (Haskel et al., 2007, p. 488). This latter explanation has

[9] Note that in the case of any misspecification of the first stage the 2SLS approach will lose efficiency while the ML or control function estimators will generally become inconsistent (see Lewbel et al., 2012). The LPM is then preferred for the baseline specification. IV Probit techniques are employed to check the robustness of results against model specification issues.

found general support in previous studies in the UK, implying that we expect a certain degree of downward bias in our baseline estimates.

A number of recent contributions have tried to deal more efficiently with endogeneity concerns. Most of them take advantage of the availability of panel data to control for time invariant omitted components. However, it remains difficult for them to control also for other sources of bias associated to time variant omitted variables and reverse causality. Only a few papers try to overcome this key limitation going beyond static panel data, exploiting GMM techniques to control for the endogeneity of the regressor of interest (Benfratello and Sembenelli, 2006; Driffield, 2006; Crespo et al., 2009). Two existing contributions adopt an instrumental variable approach to tackle endogeneity. Haskel et al. (2007) use world-wide investments targeting the US as an instrument for investments in the UK. They argue that changes in inward investments by foreign MNEs in the UK are correlated with variation in inward investments in the US, since both are driven by world shocks such as liberalisation faced by MNEs. Nevertheless, it is worth noting that the exogeneity condition proposed by the authors remains questionable, since it is based on the assumption that international shocks affecting MNEs strategies do not impact UK domestic firms' productivity directly: "this would assume, for example, that the liberalizations are not driven by technology innovations that are sufficiently global in scope to influence these domestic firms" (Haskel et al., 2007, p. 489). More recently Ascani and Gagliardi (2013), addressing the impact of inward investments on the innovative performance of Italian provinces, build on the "shift-share" methodology proposed by Bartik (1993) and recently applied by a number of contributions in different fields (Card, 2007; Moretti, 2010; Faggio and Overman, 2013). The initial shares of employment by sector in each province and the average of FDI inflows at the national level by sector are used to instrument the FDI that each province received during the same time interval. The rationale behind this instrumental variable builds on the idea that in the absence of area-specific shocks, each province would benefit from a share of national FDI inflows proportional to its initial share of employment by sector taken as a measure of specialization.

This paper develops an alternative instrumental variable approach based on international trade flows data from the World Bank COMTRADE Database. Inward investments in the UK at the three-digit SIC-level are instrumented by a measure of sectoral export orientation based on

international trade flows in the 1989-1990[10] period. The rationale behind this instrumental variable approach relies on a well-documented literature on the locational determinants of FDI. While differences in unit labour costs are often major drivers of MNEs' investment decisions in developing countries, investment strategies in advanced economies often follow a different logic. In these contexts foreign MNEs aiming to penetrate local markets may have an incentive to serve local market through exports only until the initial proprietary knowledge of the firm is gradually diffused and lower-cost local competitors emerge (Vernon, 1966). This explains why exports is often considered a way of serving a foreign market in a first stage turning out to be a significant predictor of subsequent FDI (Culem, 1988)[11].

Based on this rationale the instrument is defined as follows:

$$Export\_Orientation_{s(t-T)} = \frac{Export_{s(t-T)} - Import_{s(t-T)}}{Export_{s(t-T)} + Import_{s(t-T)}}$$

Where $Export\_Orientation_{s(t-T-8)}$ is an index that captures the export orientation of sector s at time (t-T) and $Export_{s(t-T)}$ and $Import_{s(t-T)}$ are total export/import flows in sector *s* from the United States (US) to the rest of the world (excluding the UK) and vice versa. This feature reinforces both the exogeneity and significance of our instrument. First, large countries such as the US represent a more reliable and reasonably exogenous indicator of international trade flows with respect to the UK industry dynamics. Second, tighter cultural links between the US and the UK have been traditionally considered as relevant factors to explain US activities in the UK. Previous research shows that FDI by US firms in Europe (and in the UK in particular) are stimulated by previous exports and that they are not crowed out – but indeed reinforced – by large pre-existing export flows (Culem 1988). Following this line of reasoning the degree of sectoral trade openness based on US flows is used as a predictor of subsequent global MNEs investments in the UK.

5. Results and Robustness Checks

[10] Note that the COMTRADE database provides information on trade flows by sector based on the NACE Rev1 Classification that has then been converted to SIC92 in order to compute the instrumental variable.

[11] Although it could be argued that there is a two-way relationship between contemporaneous FDIs and exports in terms of complementarity vs. substitution effects, the adoption of lagged measures of export and import clarifies the rationale of our instrumental variable approach.

5.1 Baseline Results and Robustness Checks

Results for the main specification are reported in Table 3, where the impact of investment inflows by MNEs is related to the innovative performance of local firms operating in the same three-digit sector[12], controlling for industry dummies.

Column 1 shows that investment inflows are positively and significantly correlated to firms' innovation at 5% level. However, the significance level of the regressor of interest lowers substantially when additional controls for firms' absorptive capacity – i.e. the number of skilled employees –, firm size and productivity growth by industry are included in the regression[13].

[Insert Table 3 here]

The modest magnitude of the coefficient of interest is not fully consistent with previous studies on the UK. Liu (2000), adopting an industry-level fixed effect specification, shows a positive effect of the presence of foreign enterprises on domestic firms' productivity. Haskel et al. (2007), using firm-level data and controlling for fixed effects and further endogeneity concerns, find that the presence of MNEs investments is positively and significantly associated to domestic firms' total factor productivity in recipient industries. Despite the use of different measures of innovativeness preventing the possibility to fully compare results across these studies, our baseline estimates deserve more in-depth investigation: as mentioned in Section 4 above, our cross sectional estimation may exacerbate endogeneity concerns in the analysis. If, and as suggested by previous studies, reverse causality in the case of the UK tends to lead to a downward bias in the coefficient (Haskel et al., 2007), we can expect a significant underestimation of the true magnitude of the effect of interest in the OLS regression.

In order to address this problem the instrumental variable (IV) approach previously discussed has been adopted to tackle potential endogeneity. Table 4 (column 1) reports the results for the IV estimation. The impact of MNE investments on domestic firms' innovation is now significant at 5% and the coefficient is about 0.09. As expected, the instrument is positively

[12] As discussed above, the analysis is restricted to those sector experiencing positive net FDI inflows. This implies the exclusion of 859 firms operating in three-digit sectors characterized by negative net flows during the period under analysis (see footnote 5). Results on the full sample of firms using the number of foreign enterprise as proxy for MNEs activities show qualitatively similar results.

[13] Note that results are partially different when the MNEs count (as customary in the literature) is adopted as a proxy for their activities (Table A.3, Appendix A1). The impact of MNEs seems to be much larger in terms of both magnitude of the coefficient and significance level and this evidence remains consistent also when additional controls are included in the specification. These findings suggest a certain degree of measurement error in existing studies adopting the count of foreign firms as a proxy for their activities.

correlated with the regressor of interest, MNE investment inflows, and the first stage regression (column 2, Table 4) confirms that the correlation is strongly significant ruling out any risk of weak instrument bias. Finally, first stage statistics reported in Table 5 support the reliability of our IV approach through a F statistics that is in line with the 'rule of thumb' proposed by Staiger and Stock (1997) and the Stock and Yogo (2005) threshold values.

[Insert Tables 4 and 5 here]

The robustness of our findings has been tested against a number of relevant concerns. In the first instance it is important to check whether the specification of the model affects our result. The preferred specification has been re-estimated eliminating progressively all relevant regressors. The results reported in Table 6 (columns 1 to 4) show that the magnitude and significance level of the coefficient of MNEs investment flows is generally consistent. Second, it is worth to check whether the impact associated to foreign firms is dependent on the functional form adopted to model the relation of interest. The Linear Probability Model has been preferred due to its greater efficiency in dealing with endogeneity concerns, despite alternative estimation models being possibly more appropriate in the case of binary dependent variables in the context of nonlinear specifications. To test whether this affects our results, the main estimates have been re-run using a probit estimation approach[14] (Table 6, column 5). The results confirm our main findings regarding the positive impact of MNE investments on local firms' innovative performance.

[Insert Table 6 here]

5.2 Extensions: Domestic firms' market engagement and internationalization

As discussed in Section 2 above, the analysis of the impact of MNEs' activities on domestic firms has been a widely debated issue and a number of studies have suggested the emergence of potential heterogeneous effects. While much attention has been devoted to differences in the characteristics of foreign firm – from country of origin, as in Haskel et al. (2007), to R&D intensity of foreign affiliates, as for instance in Castellani and Zanfei (2007a) – the analysis of domestic firms' heterogeneity has been more limited and focused mainly on differences in terms of absorptive capacity as expressed by employee skills (Borensztein et al., 1998; Glass and Saggi, 2002; Castellani and Zanfei, 2002; Durham, 2004; Liu and Buck, 2007). Limited attention has been placed on the market engagement of domestic firms and the extent to which

[14] The estimation is computed using the *ivprobit* routine in STATA.

their strategies are mainly focused on internal demand or more internationalized. Domestic firms with an intense engagement in global markets may have smaller incentives to interact with local subsidiaries of foreign firms and their innovation networks, therefore being less sensitive to the process of knowledge diffusion originating from MNEs.

To test for this source of potential heterogeneity the main equation has been re-estimated for different sub-samples of firms classified on the basis of their geographical market of reference. From the CIS questionnaire it is possible to distinguish between firms operating mainly on the regional, national, European or international market.[15] The results reported in Table 7 show that the impact of MNEs investments remains significantly and positively correlated to the innovative performance of domestic firms only for those firms that are mainly oriented towards serving regional and national markets (columns 1 and 2 respectively) and this finding is robust to the inclusion of controls for firms' absorptive capacity. In addition, the magnitude of the impact is lower the wider the geographical scope of domestic firms' commercial strategies and the 'distance' to their target markets, providing indirect support for the localized nature of knowledge externalities (Patel and Pavitt, 1991; Jaffe et al., 1993; Acs et al., 1992, 1994; Almeida and Kogut, 1997; Maurseth and Verspagen, 2002; Gagliardi, 2014). Table 8 reports the first stage statistics for each sub-sample confirming the reliability of our instrumental variable approach.

[Insert Tables 7 and 8 here]

The emergence of heterogeneous effects associated to domestic firms' market engagement and internationalization is also supported by an additional test performed on the sub-samples of firms belonging to multinational enterprise groups.[16] Affiliates of multinational groups may have little incentive to exploit localized linkages and interactions with other MNEs with the aim of accessing their superior knowledge, since they already benefit from a substantial degree of global connectivity. This is particularly important when considering the intra-industry dimension given that the effect of competition is likely to prevail over collaboration with MNEs in the same industry. Table 9 shows that the impact of MNEs activities is much smaller (and indeed not significant) for firms that are part of MNEs groups (column 2) after controlling

[15] The four categories are not mutually exclusive because the same firm can indicate different markets as relevant for its business activities. Therefore, firms operating mainly on European and world markets may be active on national and regional markets as well.

[16] Multinational enterprise groups in our sample of domestic firms are either UK-owned MNEs or foreign MNEs locating their affiliates in the UK prior to the period covered in the database (i.e. before 1998).

for their absorptive capacity. Also in this case first stage statistics reported in Table 10 confirm the reliability of the results.

[Insert Tables 9 and 10 here]

Over and above the capability to absorb external knowledge flows from MNEs, market strategies and the degree of internationalization of domestic firms seem to play a key role in determining the emergence of heterogeneous effects in exploiting the potential channels of knowledge exchange with foreign firms. Domestic firms focusing on regional and national markets are likely to benefit the most from the presence of MNEs; at the same time, the involvement in global networks and the ownership structure can be in their turn indicators of advanced absorptive capacity. These findings seem to be in line with, and even reinforce, the results of previous analyses on the positive effects of foreign MNEs on local firms' innovativeness in advanced recipient economies.

6. Conclusions and tentative policy implications

The attraction of Multinational Enterprises is at the center of the policy agenda in both advanced and emerging economies. Foreign firms are seen as a means to revitalize declining economies and foster economic development in lagging regions. This belief takes stance from the wide consensus on the idea that MNEs possess superior knowledge and that this knowledge may eventually benefit domestic firms. Recently, a growing body of literature has suggested the need of a more comprehensive view in modeling this knowledge exchange as a two-way relationship rather than as a one-way flow. In this context, domestic firms as something more than passive recipients of foreign knowledge and technologies have gained momentum.

The empirical literature has pointed out that diverging results on MNEs' impacts may stem from unobserved firm heterogeneity. However, in the large majority of the studies this dimension has been qualified only with reference to MNEs characteristics and their internationalization strategies. Although these studies have helped overcome the traditional scholarly focus on the impact of FDI as aggregate financial flows, with no attention to the underlying firm-level dynamics, scant attention has so far been devoted to domestic firms' features and heterogeneity.

This paper has shown that domestic firms are characterized by heterogeneous market strategies and degrees of internationalization and this leads to differentiated incentives to engage with external actors. The intensity of knowledge flows from MNEs into domestic firms depends on both the competitive position of MNEs towards local actors in the same industry, and on the perceived advantage from both sides to commit to innovation-enhancing interactions. If domestic firms engage predominantly with local (regional and national) markets the likelihood and intensity of their links with foreign enterprises may be higher. Conversely firms that are already connected to global markets by means of their commercial strategies or ownership advantages have fewer incentives to take advantage of the presence of foreign firms in their same industry. While absorptive capacities of domestic firms remain crucial for their ability to benefit from foreign MNEs, technology/productivity gap and competition effects play the key role. Internationalized domestic firms – thanks to their higher productivity and better technologies – have a lower potential in terms of imitation and learning from foreign MNEs. At the same time, these firms also benefit from alternative 'global' knowledge channels via their trade relations and/or subsidiaries. These dynamics are reinforced, in the context of intra-industry interactions, by a competition effect. Internationalized firms are more likely to be direct competitors for foreign MNEs active in their same sector, with strong disincentives for cooperation and knowledge-sharing.

The focus on 'innovation active firms' – better accounting for innovation in services than in other existing analyses – has made it possible for these forces to emerge in the empirical analysis. This confirms the increasing importance of more accurate measures of innovation in particular when it comes to assessing the consequences of foreign investments.

The empirical analysis has a number of limitations that should be borne in mind when discussing potential policy implications. First, the knowledge/technology flows identified in the paper are made possible by a combination of demonstration/imitation effects, input-output linkages and labour mobility/circulation. However, under the constraint of UK data availability, it is not possible to disentangle the different mechanisms underlying the observed spillovers. Second, the paper shares many of the limitations of other CIS-based analyses. While our measure of innovation may be relatively broader and more oriented towards the service sector, the CIS might still be under-estimating innovation in services. Both points are very relevant and, with the constantly improving data availability in the UK, they will become a priority in our future research agenda.

The results of the empirical analysis suggest that public policies based on incentives for the attraction of MNEs are risky strategies unless they are based on a careful diagnosis of the sectoral structure and competitive position of domestic firms. In addition, these policies cannot be disjoined from 'horizontal' support for domestic firms' absorptive capacity as well as for their embeddedness into national, regional and sectoral systems of innovation. Policies should also take a broad and holistic approach to innovation so as to incorporate tools targeting the service sector (where large part of the economy-wide beneficial effects may come from), as well as more manufacturing-oriented technological innovation. This has also important implications for the identification of the ex-ante, interim and ex-post indicators to be used to justify, target and evaluate the corresponding policy measures.

If less internationalized firms are more likely to benefit from the operations of MNEs they are also the most difficult actors to be mobilized as part of a broad development strategy. More dynamic internationalized firms are more likely to lobby and voice in order to shape public policies in this area. As a consequence, a relevant policy challenge is linked to the need to involve and mobilize relevant domestic actors with a bottom-up approach to innovation policy design.

Finally, the possibility to benefit less internationalized firms sends an encouraging message for development policies in less dynamic economies: openness to the activities of foreign firms is a potentially suitable tool to promote the dynamism of domestic firms and break the technological lock-in of many countries and regions. Southern European countries (as well as a variety of other backward regions in the European Union) have been often relied on FDI policies targeting high-tech manufacturing investments while, at the same time, restricting in various ways foreign entry in the service sector. Our results would advise policy makers to go in the opposite direction: less internationalized domestic firm might be able to gain from foreign activities and these benefits are more likely to materialize in the service sector in shapes and forms different from 'standard' manufacturing innovation output.

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Tables and Figures

Table 1: Variables Definitions and Descriptive Statistics

Variable	Definition	Obs	Mean	Std. Dev.
Innovation Active	Dummy variable taking value 1 if the firm is defined as innovation active and 0 otherwise	8813	0.6834	0 .4652
MNEs (Number of firms)	Number of firms by 3-digit SIC 2003	8813	599.299	792.293
MNEs (Investment flows)	Investment flows by 3-digit SIC 2003	8813	4828.495	13627.68
Skilled Employment	Share of employment with university degree (S&T or other)	8813	0.5516	1.5020
Firm Size	Dummy variable taking value 1 for large enterprises (250+ employees) and 0 otherwise	8813	0.1922	0.3941
Firm part of an MNE group	Dummy variable taking value 1 if the firm is part of a Multinational Group and 0 otherwise	8813	0.5375	0.4986
Local Market	Dummy variable taking value 1 if firms operate mainly at the local level and 0 otherwise	7769	0.8347	0.3714
National Market	Dummy variable taking value 1 if firms operate mainly at the national level and 0 otherwise	7770	0.6511	0.4766
European Market	Dummy variable taking value 1 if firms operate mainly at the European level and 0 otherwise	7768	0.3093	0.4622
International Market	Dummy variable taking value 1 if firms operate mainly at the International level and 0 otherwise	7768	0.2073	0.4055
TFP Growth	TFP growth rate between 1995 and 2005 (1995=100) by 2-digit sector	8813	14.8258	18.4897

Note: Data for innovative performance, skilled employees, size, turnover and employment, market of reference, firm's ownership and competition are from the UK Community Innovation Survey (CIS5). Variables for the presence of foreign firms and the investments carried out are based on the merged database AFDI-ARD. The UK Office for National Statistics (ONS) provides all raw data under restricted access. Data on productivity growth are from the UK-KLEMS database.

Figure 1: Number of MNEs by sector - 1998-2005

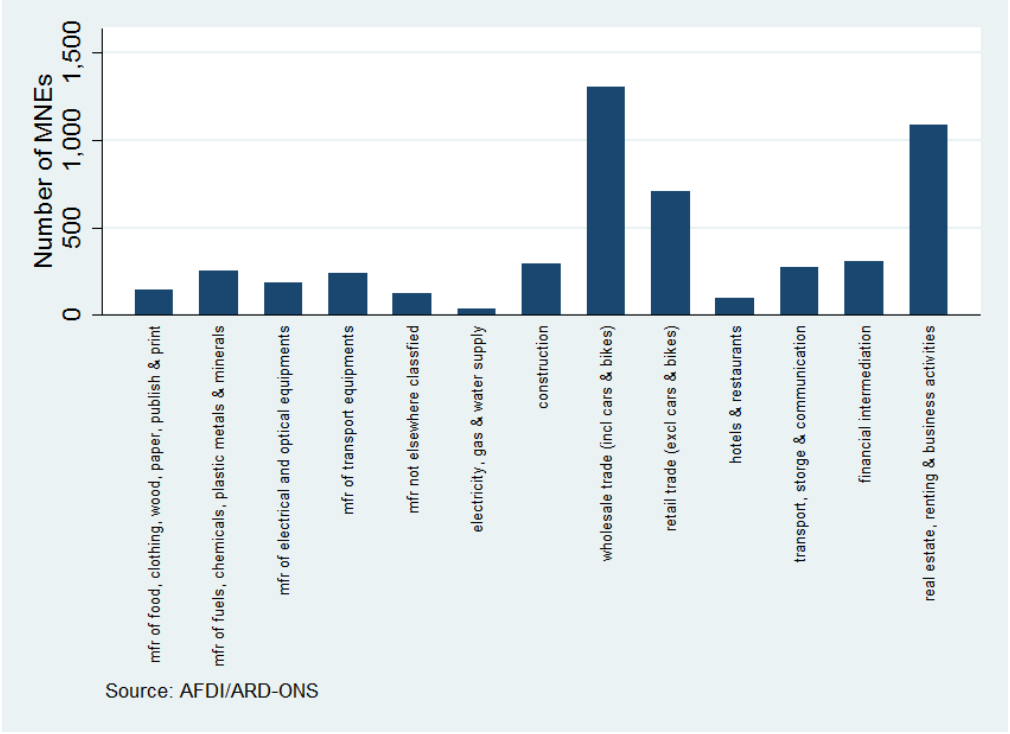
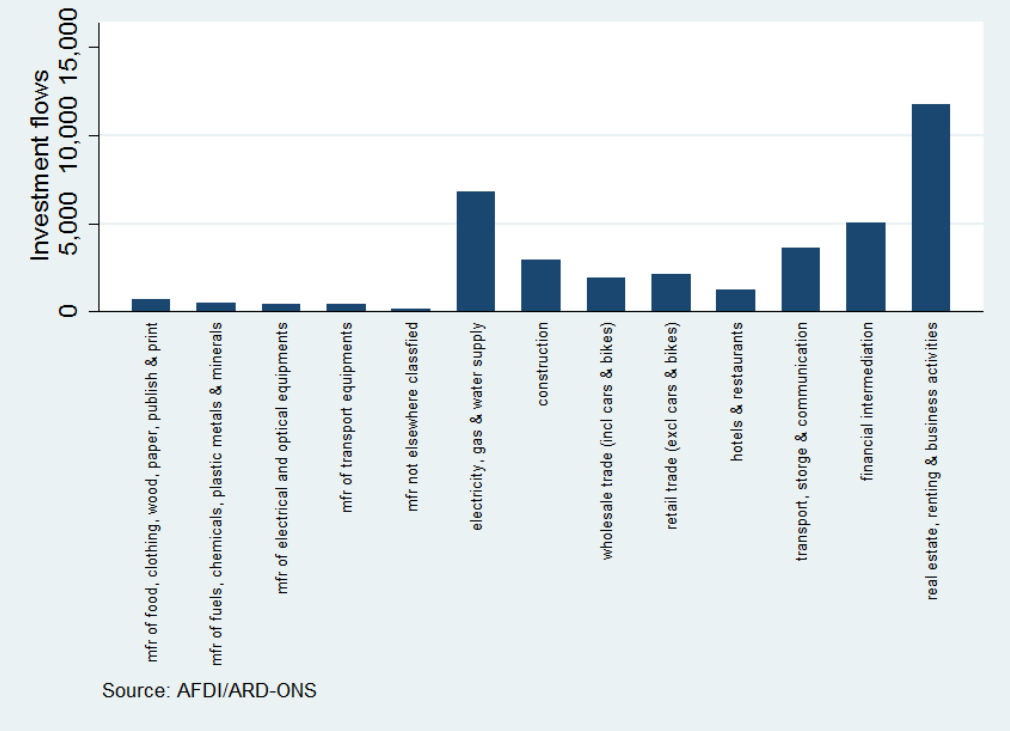
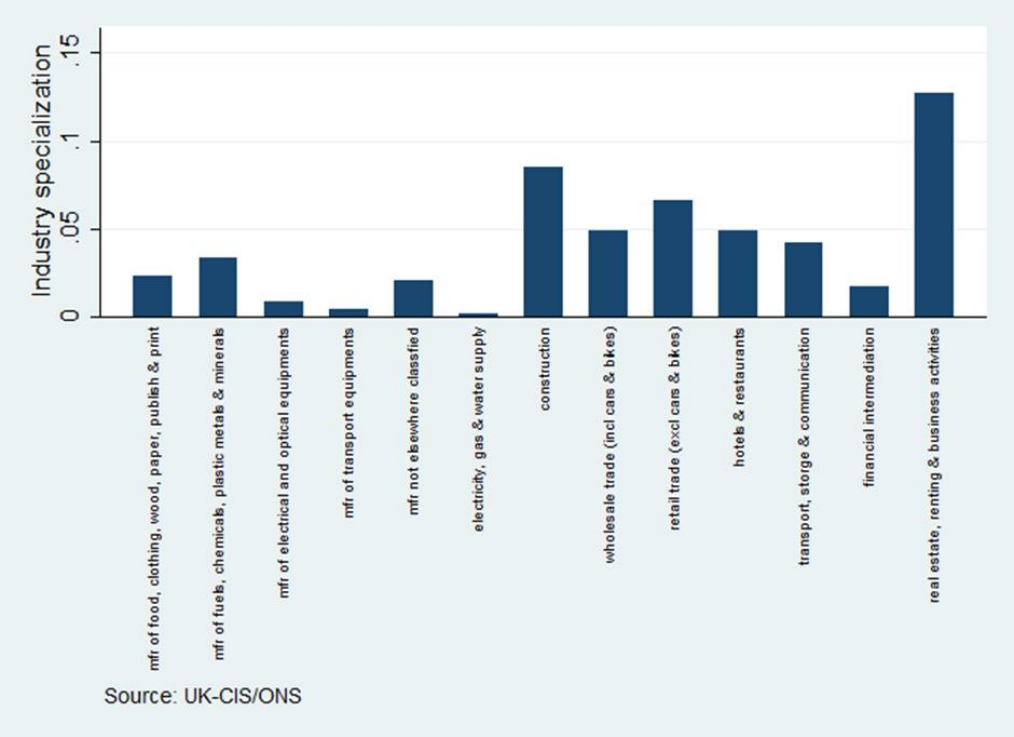


Figure 2: Investment Flows by sector - 1998-2005



Note: Investment flows calculated in £ million

Figure 3: Industry Specialization of UK Firms



Note: Industry specialization is calculated as share of firms by sector from the sample of firms in the UK-CIS5

Table 2: Innovation active and total firms by sector in the UK CIS Sample

Sector	Innovation active firms	Total number of firms	Share of innovative firms
Mfr of food, clothing, wood, paper, publish & print	657	882	0.74
Mfr of fuels, chemicals, plastic metals & minerals	906	1,189	0.76
Mfr of electrical and optical equipment	182	228	0.80
Mfr of transport equipment	56	73	0.77
Mfr not elsewhere classified	165	216	0.76
Electricity, gas & water supply	18	32	0.56
Construction	459	748	0.61
Wholesale trade (incl. cars & bikes)	402	610	0.66
Retail trade (excl. cars & bikes)	369	582	0.63
Hotels & restaurants	224	432	0.52
Transport, storage & communication	537	843	0.64
Financial intermediation	162	233	0.70
Real estate, renting & business activities	1,886	2,745	0.69
Total	**6,023**	**8,813**	**0.68**

Source: ONS - UK CIS5

Table 3: Baseline Results - MNEs Investment flows and Domestic Firms' Innovative Performance

	(1)	(2)	(3)	(4)
Dep.Var. Innovation Active	OLS	OLS	OLS	OLS
MNEs (Investment Flows)	0.0064**	0.0048*	0.0047*	0.0051*
	(0.0028)	(0.0028)	(0.0028)	(0.0028)
Skilled Employment		0.0467***	0.0477***	0.0474***
		(0.0031)	(0.0032)	(0.0032)
Firm size		0.1050***	0.1161***	0.1150***
		(0.0124)	(0.0126)	(0.0126)
TFP				0.0009**
				(0.0004)
Constant	0.7095***	0.6851***	0.7105***	0.7002***
	(0.0216)	(0.0216)	(0.0258)	(0.0262)
Observations	8813	8813	8813	8813
Regional Dummies	NO	NO	YES	YES
Sectoral Dummies	YES	YES	YES	YES

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 4: Instrumental Variable (IV) regression

Dep.Var.	(1) Innovation active firms	(2) MNEs (Investment Flows)
MNEs (Investment Flows)	0.0980**	
	(0.0461)	
Skilled Employment	0.0446***	0.0250*
	(0.0037)	(0.0136)
Firm size	0.0939***	0.2361***
	(0.0169)	(0.0493)
TFP	0.0018***	-0.0094***
	(0.0006)	(0.0016)
Export Orientation		0.5441***
		(0.1064)
Constant	0.1861	5.5422***
	(0.2574)	-0.0811
Observations	8813	8813
Regional Dummies	YES	YES
Sectoral Dummies	YES	YES

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 5: First Stage Statistics

Variable	F(1, 8786)	P-Val	Chi-sq(1)	P-Val	AP F(1,8786)
MNEs (Investment Flows)	26.15	0	26.23	0	26.15

Table 6: Robustness Checks

	(1)	(2)	(3)	(4)	(5)
Dep.Var. Innovation Active	2SLS	2SLS	2SLS	2SLS	IVPROBIT
MNEs (Investment Flows)	0.0980**	0.0929**	0.0925**	0.1264***	0.2773***
	-0.0461	-0.0444	-0.0443	-0.0478	(0.1024)
Skilled Employment	0.0446***	0.0453***	0.0443***		0.1485***
	-0.0037	-0.0036	-0.0035		(0.0259)
Firm size	0.0939***	0.0969***	0.0863***		0.2452***
	-0.0169	-0.0164	-0.0161		(0.0660)
TFP	0.0018***				0.0047***
	-0.0006				(0.0014)
Constant	0.1861	0.2304	0.2061	0.0483	-0.9819
	-0.2574	-0.2436	-0.2436	-0.265	(0.6297)
Observations	8813	8813	8813	8813	8813
Regional Dummies	YES	YES	NO	NO	YES
Sectoral Dummies	YES	YES	YES	NO	YES

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 7: Market of Reference

	Local	National	European	International
	(1)	(2)	(3)	(4)
Dep.Var.				
Innovation Active	2SLS	2SLS	2SLS	2SLS
MNEs (Investment Flows)	0.1057***	0.0781**	0.03	0.0309
	(0.0361)	(0.0335)	(0.0348)	(0.0343)
Skilled Employment	0.0184***	0.0175***	0.0203***	0.0158***
	(0.0037)	(0.0034)	(0.0035)	(0.0058)
Firm size	0.0645***	0.0213	0.0302	0.0208
	(0.0157)	(0.0155)	(0.0239)	(0.0241)
TFP	0.0017***	0.0011*	-0.0004	0.0005
	(0.0006)	(0.0007)	(0.0009)	(0.0009)
Constant	0.2231	0.4298**	0.6778***	0.6928***
	(0.2050)	(0.1852)	(0.1952)	(0.1886)
Observations	6485	5059	2403	1611
Regional Dummies	YES	YES	YES	YES
Sectoral Dummies	YES	YES	YES	YES

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 8: First Stage Statistics (2)

	Variable	F(1, 6458)	P-Val	Chi-sq(1)	P-Val	AP F(1, 6458)
(1)	MNEs (Investment Flows)	30.47	0	30.60	0	30.47
		F(1, 5032)	P-Val	Chi-sq(1)	P-Val	AP F(1, 5032)
(2)	MNEs (Investment Flows)	30.10	0	30.26	0	30.10
		F(1, 2376)	P-Val	Chi-sq(1)	P-Val	AP F(1, 2376)
(3)	MNEs (Investment Flows)	19.24	0.000	19.46	0.000	19.24
		F(1, 1584)	P-Val	Chi-sq(1)	P-Val	AP F(1, 1584)
(4)	MNEs (Investment Flows)	19.4	0.000	19.73	0.000	19.4

Table 9: Whether part of an MNE group

	YES	NO
	(1)	(2)
Dep.Var. Innovation Active	2SLS	2SLS
MNEs (Investment Flows)	0.0138	0.1859**
	(0.0589)	(0.0779)
Skilled Employment	0.0470***	0.0398***
	(0.0054)	(0.0065)
Firm size	0.0703***	0.2064***
	(0.0161)	(0.049)
TFP	0.0007	0.0037***
	(0.0006)	(0.0014)
Constant	0.6956**	-0.3208
	(0.3361)	(0.4279)
Observations	4737	4076
Regional Dummies	YES	YES
Sectoral Dummies	YES	YES

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 10: First Stage Statistics (3)

	Variable	F(1, 4710)	P-Val	Chi-sq(1)	P-Val	AP F(1, 4710)
(1)	MNEs (Investment Flows)	11.76	0.000	11.83	0.000	11.76
		F(1, 5032)	P-Val	Chi-sq(1)	P-Val	AP F(1, 5032)
(2)	MNEs (Investment Flows)	14.37	0.000	14.47	0.000	14.37

Appendix A1

Table A.1: Descriptive Statistics Product or Process Innovation vs Innovation Active

Variable	Obs	Mean	Std. Dev.	Min	Max
TOTAL					
Innovation Active	8813	0.683422	0.465168	0	1
Product or Process Innovation	8813	0.282878	0.450423	0	1
MANUFACTURING					
Innovation Active	3368	0.725356	0.446401	0	1
Product or Process Innovation	3368	0.351841	0.477616	0	1
SERVICES					
Innovation Active	5445	0.657484	0.474595	0	1
Product or Process Innovation	5445	0.24022	0.427257	0	1

Table A.2: Baseline Results - MNEs Investment flows and Domestic Firms' Product and Process Innovation

	(2)
Dep.Var. Product or Process Innovation	2SLS
MNEs (Investment Flows)	0.0567
	(0.0469)
Skilled Employment (with a degree)	0.0388***
	(0.0042)
Firm size	0.0674***
	(0.0164)
TFP	0.0013**
	(0.0006)
Constant	0.0517
	(0.2600)
Observations	8813
Regional Dummies	YES
Sectoral Dummies	YES

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table A.3: Baseline Results – MNEs and Domestic Firms' Product and Process Innovation

	(1)	(2)	(3)	(4)
Dep.Var. Innovation Active	OLS	OLS	OLS	OLS
MNEs (Number of Firms)	0.0178***	0.0131***	0.0127***	0.0142***
	(0.0045)	(0.0045)	(0.0045)	(0.0046)
Skilled Employment		0.0460***	0.0470***	0.0465***
		(0.0031)	(0.0032)	(0.0032)
Firm size		0.1067***	0.1179***	0.1169***
		(0.0124)	(0.0126)	(0.0126)
TFP				0.0010**
				(0.0004)
Constant	0.6659***	0.6536***	0.6792***	0.6635***
	(0.0251)	(0.0252)	(0.0291)	(0.0296)
Observations	8813	8813	8813	8813
Regional Dummies	NO	NO	YES	YES
Sectoral Dummies	YES	YES	YES	YES

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table A.4: Results with alternative time lags of MNEs Investment Flows

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep.Var. Innovation Active	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
MNEs (Investment flows) - 2000/2005	0.0054**	0.0351**						
	(0.0025)	(0.0168)						
MNEs (Investment flows) - 2002/2005			0.0062**	0.0497**				
			(0.0026)	(0.0228)				
MNEs (Investment flows) - 2004/2005					0.0068***	0.0364**		
					(0.0024)	(0.0146)		
MNEs (Investment flows) - 1998/2002							0.0083***	0.0290*
							(0.0023)	(0.0174)
Skilled Employment	0.0476***	0.0446***	0.0475***	0.0450***	0.0467***	0.0436***	0.0466***	0.0436***
	(0.0032)	(0.0036)	(0.0035)	(0.0038)	(0.0034)	(0.0038)	(0.0033)	(0.0042)
Firm size	0.1129***	0.1082***	0.1175***	0.1094***	0.1192***	0.1135***	0.1194***	0.1144***
	(0.0127)	(0.0131)	(0.0132)	(0.0141)	(0.0136)	(0.0141)	(0.0131)	(0.0138)
TFP	0.0007	0.0014**	0.0001	0.0015*	0.0010**	0.0023***	0.0005	0.0006
	(0.0004)	(0.0006)	(0.0005)	(0.0009)	(0.0005)	(0.0008)	(0.0005)	(0.0005)
Constant	0.6724***	0.3745**	0.6717***	0.2561	0.6602***	0.4121***	0.6259***	0.4563***
	(0.0331)	(0.1704)	(0.0338)	(0.2200)	(0.0304)	(0.1249)	(0.0313)	(0.1455)
Observations	8571	8571	7915	7915	7539	7539	8044	8044
Regional dummies	YES	YES	YES	YES	YES	YES	YES	YES
Sectoral dummies	YES	YES	YES	YES	YES	YES	YES	YES

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Changes in the number of observations reflect variations in the time window for the computation of the investment flows variables. Restricting the time window implies a larger number of 3 digits sectors that do not experience any inflow during that period making it impossible to identify the impact of FDI on local firms active in that particular sector.