Intra-industry effects of Foreign Multinationals in the UK: Local Innovation and Firm Heterogeneity

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Abstract

This paper investigates whether the presence of Multinational Enterprises (MNEs) carrying out investment activities in the UK benefits the innovation capacity of domestic firms within the same industry. By employing data on Foreign Direct Investments matched with firm level information we are able to construct a direct measure of capital inflows into the recipient economy at a detailed industry level. We focus on firm innovativeness in a much broader sense than in previous studies, thus obtaining reliable predictions on the impact of MNEs investments on domestic firms in both manufacturing and services. Our results indicate that firms operating in sectors experiencing greater investments by MNEs show a better innovative performance. Importantly however, the heterogeneity across domestic firms in terms of internationalisation of both their market engagement and ownership structure emerges as a main driver of this effect.

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1. Introduction

Over the last few years the number of Multinational Enterprises (MNEs) in the global economy has raised enormously and this exceptional growth has stimulated the attention of scholars and policy makers. MNEs are increasingly seen as 'creator' 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. Scholars have long debated the effectiveness of such attraction by investigating the effects of MNEs investments on the recipient economies. However, the empirical evidence on the impacts of MNEs on local firms in advanced economies is still mixed and inconclusive (see, for example, the reviews in Rodrik, 1999; Smeets, 2008).

The aim of this paper is to provide fresh evidence on the impact of MNEs investment activities in the UK. By building on a novel database that allows us to merge 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. Firstly, we look at the impact 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, thus not fully grasping the whole impact on recipient economies characterised by a strong relevance of service industries, such as that of the UK. Secondly, 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. Thirdly, and more importantly, we shed light on how heterogeneous characteristics of domestic firms may shape the extent to which they are in fact able to benefit from MNE activities. In doing so we aim at contributing to the (still) scant literature modelling spillover mechanisms as a two way relationship rather than a unidirectional exchange (Barnard and Cantwell 2007).

This research interest stems from the large existing literature on the impact of MNEs and on the inconclusiveness of its findings, in particular with respect to intra-industry effects (Harris and Robinson 2003). Our analysis suggests that foreign firms are indeed carrier 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 pronounced for the less internationalized firms, that is those mainly engaged in serving the regional and national demand as opposed to those active also on international markets. Consistently, local firms that are part of a multinational group are less affected by the positive externalities coming from other MNEs: such firms have arguably already access to capabilities and infrastructure channelling the diffusion of global knowledge.

The paper is organized as follow: the next paragraph briefly reviews recent empirical literature on the impact of MNE investments with the aim of identifying some key gaps in the existing studies. Section 2 and 3 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 4 presents the results and robustness checks, while Section 5 concludes with some remarks on implications and further steps for future research.

2. Literature background

There is a wide and well documented 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 multinational enterprises 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 allow local firms access to new technologies and skills from backward and forward linkages, as well as personnel exchanges, R&D collaborations, and a number of other knowledge channels with foreign affiliates. Market access externalities thus come from the experience and knowledge that MNEs have of global and geographically distant local markets, international generation of R&D, commercialisation 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).

Such positive effects have found broadly 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 may possibly be transmitted to or spill over domestic firms.

A number of alternative mechanisms have been argued to mediate the impact of MNEs on domestic firms and the empirical literature has distinguished them in intra-industry and inter-industry channels. The former encompasses demonstration, competition and labour market effects: demonstration effects rely on the benefits arising from the exposure to the superior technology of MNEs subsidiaries (Girma et al. 2001, Gorg and Greenaway 2004, Crespo and Fontoura 2007, Smeets 2008); on the other hand, the competitive pressure caused by the entry of foreign firms may act as an incentive for domestic firms to use available resources and existing technology more efficiently (Blomstrom and Lipsey 1989, Wang and Blomstrom 1992); whilst 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 industrial sectors vertically connected to each other are in fact more likely to experience the benefit of positive externalities (Ernst and Kim 2002, Crespo and Fontoura 2007, Javorcik 2004, Javorcik and Spatareanu 2008, 2009, Blalock and Gertler 2008).

Despite the powerful rationale underlying the likelihood of positive effects of MNEs activities on domestic firms, a number of critical views have emerged in empirical investigations. In the case of intra-industry dynamics perverse effects may derive from

problems in absorbing 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 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 operates (Harris and Robinson 2003).

The lack of conclusive results on the impact of foreign enterprises in particular in the case of intra-industry effects has stimulated a number of further empirical contributions. 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 countries (Chen and Chen 1998, Luo and Tung 2007). 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 toward cooperation and interest to access external knowledge to enrich internal competencies (Cantwell and Iammarino 2000).

In a complementary perspective, as suggested in the recent integration of economic geography and MNE studies, technological learning and innovative capabilities building processes – and therefore the impact of MNEs on host economies, particularly when advanced industrial systems – are strongly dependent on the characteristics of local actors and environments. These in turn are highly diversified within national boundaries: therefore, 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 (Blomstrom and Kokko 2001, Borensztein et al. 1998, Glass and Saggi 2002, Castellani and Zanfei 2002, Durham 2004, Liu and Buck 2007). The greater is the technological gap between foreign and domestic firms, the smaller the probability that the latter are able to adopt new technologies in a

successful way. This may lower the potential beneficial impact of MNEs investments irrespective of the characteristics of foreign firms.

This view, despite highly reasonable, seems to provide only a partial explanation of the recent efforts to modelling 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 the new context (Barnard and Cantwell 2006). This further implies that both characteristics and deliberate market strategies pursued by domestic firms may substantially mediate the degree to which they absorb and exploit external knowledge. Indeed, in his highly cited NBER working paper which reviews the evidence on the distribution between home and host economy of the benefits and costs of FDI, Lipsey (2002, 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 competitive position of MNEs towards local competitors (McCann and Mudambi 2004) and on the perceived advantage from both sides to engage in cooperative relationships.

Hence, it appears striking the limited attention that has been devoted to the relevance of different market choices adopted by domestic firms and the extent of their involvement in internationalization processes. Similarly to foreign enterprises, domestic actors may attach different importance as to whether to rely or not upon external sources of technological advances. Their degree of market internationalization and overall competitive strategies may be a relevant pre-condition to take advantage of MNE knowledge flows and spillovers. Domestic enterprises that have already access to global knowledge through strong

involvement in international markets and linkages or through ownership advantages may have fewer incentives to cooperate with foreign MNEs and be less likely to interact in the localized networks in which foreign firms engage to tap into indigenous expertise and complement their internal capabilities. For such segments of the population of domestic firms - in which internal organizational aspects may be designed to avoid the sharing of knowledge (McCann 1993, 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 sources and variable construction

The database adopted to perform the empirical investigation of the impact of MNEs 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 provided by 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 MNEs in the UK for the period 1996-2005, coming from the balance of payment and available through restricted access 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 investments flows represent a reliable measure of a company's investment in capital (by subtracting non-cash depreciation from capital expenditures) and disinvestments, giving a sense of how much money a company is spending on capital items (such as property, plants and equipment) which are used for operations.

The register from which firms are sampled comes from sources including HM Customs & Revenue, Dunn & Bradstreet's "Worldbase" system, and ONS inquiries on Acquisitions &

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

Mergers. The sampling is based on a stratified design; the largest firms all receive the survey form, while only a proportion of the smaller firms is directly involved. The survey is generally filled in by the head of enterprise groups in the UK providing information for the group as a whole. This further implies that the unit of observation in the AFDI survey is the enterprise group.

Responses to AFDI can be linked to firm level information collected through 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 has to be considered 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 derive a common enterprise group. We also excluded from our sample observations for 1996 and 1997 due to coding change applied to AFDI data for waves before 1998.

Over the period 1998-2005 it is possible to identify 93,438 enterprise groups in AFDI, and among these 64,447 (almost 70% of the total) correspond to a single enterprise in ARD. In this case the attribution of financial flows to each enterprise is automatic. 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 involves 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%) 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-

[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, with smaller reporting units being sampled. Within the ARD there are therefore two types of enterprises. Information collected directly from the survey returns of the ABI are held on the 'selected files' of the ARD. Information on those organisations included within the ABI survey universe but which are not included within the actual survey during a given year are held on the `non-selected' files. By considering information from both the 'selected' and 'non-selected' ARD files, the coverage of the ARD is broadened considerably. The trade-off of that regards the range of data items available for both typologies of data, since the non-selected files provide standard pictures about enterprise sector of activity, turnover and employment rather than the full range of available data. Despite that and given the purpose of the merging procedure that is aimed at identifying MNEs within the sample of UK-based firms, broadening the sample of analysis remains a first order concern for the sake of this investigation.

sample) there is no possibility to attribute automatically the net investment flows, implying the need of defining a weighting scheme. Thus, on the basis of the information available for all enterprises in the ARD, two different criteria have been alternatively applied. Either the share of employment or the share of turnover for each enterprise with respect to that of the whole group are employed to attribute financial flows defined at enterprise group level to each enterprise belonging to the group. In the end, the turnover weight has been used as the preferred option to construct the explanatory variable of interest in the following empirical analysis; however, the employment-based weight has been also adopted as robustness check without any evidence of systematic changes.

The merging procedure performed allows recovering for each enterprise the sector of activity at three digits level (based on the SIC92 classification). Note that 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 unlikely to be a reliable option. 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 coming from the Community Innovation Survey (UK CIS 5) based on the sectoral dimension. This further implies that, as said in the preceding sections, the empirical analysis focuses on the intra-industry dimension.

In addition, it should be noted that the standard measure of foreign investment based on the number of MNEs – typically employed in recent studies - is here integrated 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 adopting the count variable of the numerical presence of MNEs as a proxy for their investments. Despite being reasonable, this measure exacerbates problems associated to measurement biases. Different typologies of investments, both major plans and minor improvements, are likely to be equally weighted. Furthermore, the mere presence of MNEs may reflect investments that were carried out many years before and that may have a less relevant impact as they were subject to depreciation processes that are not accounted for by the proxy measure adopted. Information on financial flows allows controlling for both the actual magnitude and relevance of different typologies of investments and their time frame, accounting for the real value of the activities carried out by the MNEs, depurated by depreciation processes and disinvestments.

Figure 1 reports the number MNEs by main sector of activity (based on one digit SIC92 classification), while Figure 2 provides the same picture, but looking at the amount of financial investments carried out in each sector. Despite emphasizing similar features, the two figures highlight the potential emergence of measurement issues associated with the adoption of the number of firms as proxy for foreign investment activities. MNEs activities in Wholesale Trade and Retails are for example overestimated when the presence of MNEs is used as key variable, while the opposite applies to Real Estate, Renting and Business Activities and Financial Intermediation.

[Insert Figures 1 and 2 here]

Besides that, the most striking feature emerging from both the distribution of firms and investment flows by industrial sector is their concentration in the service industry. This is not surprising given the time frame under analysis and the characteristics of the UK economy that has been subject to deep deindustrialization trends over the 80s and 90s (Turok and Edge 1999). This evidence claims for a greater attention to the way in which the dependent variable is constructed. It is in fact important to rely on a measure of local firms' innovative performance suitable to account also for innovation in services.

The CIS 5, from which our main dependent variable and key controls are derived, 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[3] which have been used to perform the empirical investigation.
On the basis of the descriptive picture provided by the figures above – showing the strong concentration of FDI in the UK in the service industries - traditional proxies, such as patenting activities or total factor productivity (TFP), are likely to provide an unsatisfactory option to construct our dependent variable. Other measures available in the CIS, such as for

[3] The original sample of the CIS5 contains 13,791 observations from which about 1,623 are excluded because present also in the AFDI-ARD dataset (i.e. foreign subsidiaries); additional observations are eliminated 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 for which the amount of net investment flows is either negative or equal to zero (this being mainly the case of investment in the Construction industry and some compartments of Hotels and Restaurants and Manufacturing of Fuel).

example the simple product or process innovation, may also lead to a partial view (see appendix A1 for further details)[4]. To deal with that we adopt as a base for building our dependent variable 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.

The adoption of this wider 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 (Cereda et al. 2005, Johansson and Lööf 2008), to cope with the progressive importance of innovation in services. Data coming from the CIS5 are 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 allowing to account 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]

4. Methodology

The estimation of the relationship between MNEs investments and the innovative performance of local firms is affected by a number of methodological shortfalls ranging from measurement issues to endogeneity concerns.

[4] Table A.1 in Appendix A1 reports information on the comparison between innovative firms defined on the basis of the category of "Product or Process Innovation" and the category of "Innovation Active". As expected the former category is much more restrictive, however 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 found no effect of MNEs' investments: the results are however fully 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.

The investigation proposed looks at the impact of recent investments carried out over the period 1998-2005 on the performance of local firms in 2005-2007[5]. This approach complies with the need of considering a certain time lag between the localization of a new MNE business activity and the emergence of positive spillovers effects to firms operating in the same sector.

The estimated equation is defined as a standard firm Knowledge Production Function (KPF) (Griliches 1979, Jaffe 1986), augmented by the regressor of interest, and it takes the following form:

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

Where $Innovation\ Active_{is}$ is a dummy variable taking value 1 if firm *i* operating in the three digits sector *s* is defined as innovation active at time t, and 0 otherwise; $MNEs_{i,t-T}$ is our regressor of interest, namely investments carried out by MNEs operating in the three digit sector *s* over the period (t, t-T); X 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 by two digits sector. The latter is a key regressor since in absence of a panel structure it can capture general business cycle effects that can drive the emergence in certain industries of specific trends in the innovative performance of domestic firms. Finally sectoral dummies (defined at 1 digit) and area dummies (defined at the level of Governmental Office regions) are also included in the analysis to control for industry and regional fixed effects.

Due to the binary nature of our dependent variable the estimation is performed adopting a standard *Linear Probability Model* (LPM). This methodological choice relates to the relevance of the potential endogeneity as first order concern, and to the possibility to deal with this problem more reliably in a linear context. Robustness checks using alternative estimation methodologies that account for non-linearity in the relation of interest have been also performed without evidence of substantial changes.

[5] Note that the CIS has in theory a panel dimension: however the number of observations drops substantially (by ½) when the previous wave is considered (implying a lag of almost 2 years), and by 2/3 when waves further behind in time are taken into account.

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 to be further investigated.

MNEs may be more willing to invest in sectors characterized by distinctive 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). This latter explanation has 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, they have limited possibilities 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 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). More notably, and in line with the strategy adopted in this paper, two existing contributions adopt an instrumental variable approach to tackle the endogeneity concern. Haskel et al. (2007) instrument investments in the UK with investments in the US. 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. In the authors' words "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 instrumental variable approach adopted uses the initial shares of employment by sector in each province and the average amount of FDI inflows at the national level by sector in the observed period to instrument the amount of FDI that each province receives 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 information regarding international trade flows provided by the COMTRADE Database of the World Bank. Inward investments by 3-digits SIC in the UK are instrumented by a measure of export orientation based on international trade flows in 1989-1990[6]. The rationale behind this instrumental variable approach relies on a well-documented literature on the locational determinant of foreign direct investments. While differences in the labour unit cost is often a major driver of MNEs' investment decisions in developing countries, investment strategies in industrialized economies are based on different criteria. In these contexts foreign MNEs trying to penetrate local markets and satisfy local demand may have an incentive to serve the market through exports only untill the initial proprietary knowledge of the firm is gradually widespread and lower cost competitors arise (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)[7].

The instrument is constructed on the basis of the following index:

$$Export\_Orientation_{st} = \frac{Export_{st} - Import_{st}}{Export_{st} + Import_{st}}$$

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

Import and export measures by sector regard flows from/to the US. This feature reinforces both the exogeneity and significance of our instrument. Firstly, 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. Secondly, tighter cultural links between the United States and the United Kingdom have been traditionally found to be a decisive factor in explaining US activities in the UK. Previous research showed that on average FDI by US firms in Europe and the UK in particular have been stimulated by previous exports, and that large prior export flows did not crowd out FDI but, on the contrary, enhanced them (Culem 1988). Following the above reasoning we expect a positive relation between the variable of interest and the instrument.

5. Results and Robustness Checks

5.1 Baseline Results and Robustness Checks

Results for our main specification are reported in Table 2, where the impact of the variable of interest - investment inflows by foreign firms - is related to the innovative performance of local firms operating in the same three digit sector[8], 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 our regressor becomes substantially lower 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 analysis[9].

[Insert Table 2 here]

[8] As said above, the analysis is restricted to those sector experiencing positive net FDI inflows. This implies the elimination of 859 firms operating in three digit sectors characterized by negative net flows during the period under analysis (see footnote 3). Results on the full sample of firms using the number of foreign enterprise as proxy for MNEs activities show qualitatively similar results.

[9] Note that results are partially different when the presence of MNEs (as customary in the literature) is adopted as proxy for their activities (Table 3 Appendix A1). The impact of MNEs seems to be much larger in terms of both magnitude of the coefficient and significant 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 the existing studies adopting the presence of foreign firms as proxy for their activities that may represent a relevant problem especially when not specifically accounted for in the estimation.

More interestingly, 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 effects specification, shows a positive effect of the presence of foreign enterprises on domestic firms' productivity of about 0.10. 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 significantly associated to domestic firms' total factor productivity in recipient industries with a coefficient slightly higher than 0.05. Despite the use of different measures of innovativeness preventing the possibility to fully compare the magnitude of the coefficients across these studies, our baseline results deserve a deeper investigation: in fact, 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 may expect the degree to which our baseline analysis underestimates its real magnitude to be particularly pronounced.

To account for this limitation the instrumental variable (IV) approach described in the previous section has been adopted to tackle the potential endogeneity concern. Table 3 (column 1) reports the results for our IV estimation. The impact of MNE investments on domestic firms' innovation is now significant at 5% and the coefficient is about 0.09, confirming a magnitude that is generally in line with the range band found by previous studies. As expected, the instrument is positively correlated with our preferred regressor, MNE investment inflows, and the first stage regression (column 2, Table 3) confirms that the correlation is strongly significant ruling out any risk of weak instrument bias. Finally, first stage statistics reported in Table 4 support the reliability of our IV approach through an 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 3 and 4 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 in fact been re-estimated eliminating progressively all the relevant regressors. The results reported in Table 5 (from column 1 to 4) show that the

magnitude and significance level of the coefficient of MNEs investment flows is generally consistent. Secondly, 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 that alternative estimation models may be more appropriate in the case of binary dependent variables in the context of nonlinear specifications. To test whether this dimension affects our results the main estimates has been re-run using a probit estimation approach[10] (Table 5, column 5). The results confirm our main findings regarding the positive impact of MNE investments on local firms' innovative performance.

[Insert Table 5 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 alternative studies have disputed 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). No attention has been placed on the market engagement of local firms and the extent to which their strategies are mainly focused on internal demand or instead internationalized. Domestic firms already characterized by an intense engagement with global markets may have smaller incentives to interact with locally-based foreign affiliates and their innovation networks, therefore resulting less sensitive to the process of knowledge diffusion in the host region by MNEs.

To test for this source of potential heterogeneity the main estimation equation has been run over different subsamples of firms classified on the basis of their geographical market of reference. From the CIS questionnaire it is possible to distinguish between firms operating

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

mainly on the regional, national, European or international market[11]. The results reported in Table 6 show that the impact of MNE investments remains significantly and positively correlated to the innovative performance of domestic firms only for those enterprises that are mainly oriented towards serving the regional and national markets (column 1 and 2 respectively) and this finding is robust to the inclusion of our main controls for firms' absorptive capacity. Interestingly, the magnitude of the impact is lower the greater is the geographical scope of the commercialization strategies and the "distance" from the market of origin, 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 7 reports the first stage statistics for each subsample confirming the reliability of our instrumental variable approach.

[Insert Tables 6 and 7 here]

The emergence of heterogeneous effects associated to domestic firms' market engagement and internationalization is also supported by an additional test performed on the subsamples of firms belonging to a multinational enterprise group[12]. Affiliates of multinational groups may have little incentives 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 true when considering the intra-industry dimension – as it is the case here – as the effect of competition is likely to prevail over collaboration with MNEs in the same industry. Table 8 shows that the impact of MNEs activities is much smaller (and indeed not significant) for firms that are part of an MNE group (column 1) ceteris paribus their level of absorptive capacity. Also in this case first stage statistics reported in Table 9 confirm the reliability of our results.

[Insert Tables 8 and 9 here]

[11] Note that the four categories are not mutually exclusive because the same firm may indicate different market as relevant for its business activities. Therefore, firms operating mainly on European and world markets may also be active on national and regional ones.

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

Over and above the capability to absorb positive externalities coming from the presence and investment activities of MNEs, market strategies and degree of internationalization of domestic firms seems 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 showing a greater engagement with the regional and national markets of origin 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 strengthen the scope and interpretation of previous analyses on the positive effects of foreign MNEs on local firms' innovativeness in advanced recipient economies.

6. Conclusions

The attraction of Multinational Enterprises is at the centre of the policy agenda in both advanced and emerging economies. Foreign firms are seen as a way to revitalizing declining economies or fostering 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 flows into recipient industrial sectors benefitting domestic firms. Recently, a growing literature has suggested the need of a more comprehensive view in modeling the emergence of positive externalities as a two way relationship rather than a unilateral pipeline. In this vein, a rediscovery of the role of domestic firms as more than passive recipient of foreign capabilities and technologies has gained increasing attention.

The empirical literature has pointed out that, conflicting results on MNE impact may actually stem from unobserved firm heterogeneity: however, in the large majority of studies this dimension has been qualified only with respect to MNEs characteristics driving the nature of their internationalization strategies. Although this kind of studies has helped overcome the traditional scholarly focus on the impact of FDI mainly intended as aggregate financial flows, and the consequent neglecting of the firm level dimension, scant attention has so far been devoted to domestic firms' features and other sources of firm heterogeneity.

This paper has provided preliminary evidence on the fact that domestic firms may indeed be characterized by heterogeneous market strategies and degree of internationalization, and therefore by different incentives to engage with external actors. In this context, the intensity of knowledge flows and spillovers from MNEs to domestic firms depends both on the

competitive position of MNEs towards the local actors in the same industry, and on the perceived advantage from both sides to commit to innovation-enhancing interactions. Different extents of engagement with the local (regional and national) markets may drive the likelihood and intensity of the potential links with foreign enterprises. On the other hand, firms that are already connected to global markets by commercialization strategies or ownership advantages may have fewer incentives to exploit the presence of locally-based foreign firms.

Relevant policy implications are related to these findings. Traditional initiatives exploiting incentives for the attraction of MNEs without attempting at maximizing the linkages within the domestic economy are likely to result in a net negative sum game. Heterogeneity across local firms in terms of market strategies may hamper the potential to interact with foreign actors. The correct mapping of the structure and characteristics of domestic firms by industrial sector is at the roots of effective policies aimed at a beneficial attraction of foreign enterprises. In this view it is also important to put in place the adequate scheme of incentives to favor the establishment of localized cooperative relationships and the consolidation of actual local innovation systems.

Our results overall show that a greater attention to the heterogeneity of domestic firms is needed as it turns out as a crucial dimension in driving the emergence of the positive impact traditionally associated by the economic and international business theory to MNEs. Further analyses in this direction may complement the more established literature on the heterogeneity of foreign firms accounting for a further element of complexity and providing a better understanding of the dynamics at play. Future research will also consider domestic firms' heterogeneity with respect to the complementary dimension of internationalization represented by outward FDI and their local impact.

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Tables and Figures

Table 1: Descriptive Statistics

Variable	Description	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 per SIC 2003 - 3 digits	8813	599.299	792.293
MNEs (Investment flows)	Investment flows per SIC 2003 - 3 digits	8813	4828.495	13627.68
Skilled Employment	Share of employment with a university degree (S&T or other)	8813	0.5516	1.5020
Firm Size	Dummy variable taking value 1 if the firm is defined as large enterprise (250+ employees) and 0 otherwise	8813	0.1922	0.3941
Firms part of an MNE group	Dummy variable taking value 1 if the firms is part of a Multinational Group and 0 otherwise	8813	0.5375	0.4986
Local Market	Dummy variable taking value 1 if the firms operate mainly at the local level and 0 otherwise	7769	0.8347	0.3714
National Market	Dummy variable taking value 1 if the firms operate mainly at the national level and 0 otherwise	7770	0.6511	0.4766
European Market	Dummy variable taking value 1 if the firms operate mainly at the European level and 0 otherwise	7768	0.3093	0.4622
International Market	Dummy variable taking value 1 if the 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 digits 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 come from the Community Innovation Survey (CIS5). Variables for the presence of foreign firms and the investments carried out are constructed on the merged database AFDI-ARD. The UK Office for National Statistics (ONS) provides all raw data under restricted access. Data on productivity growth come from the UK-KLEMS database.

Figure 1: Number of MNEs per sector - 1998/2005

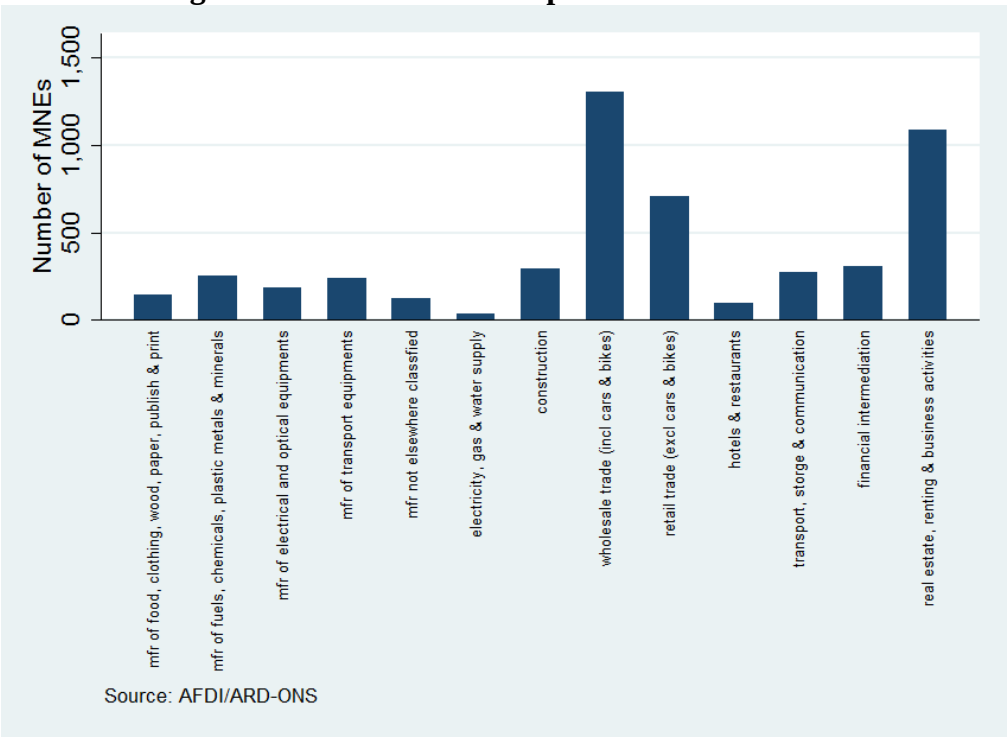

Figure 2: Investment Flows per sector - 1998/2005

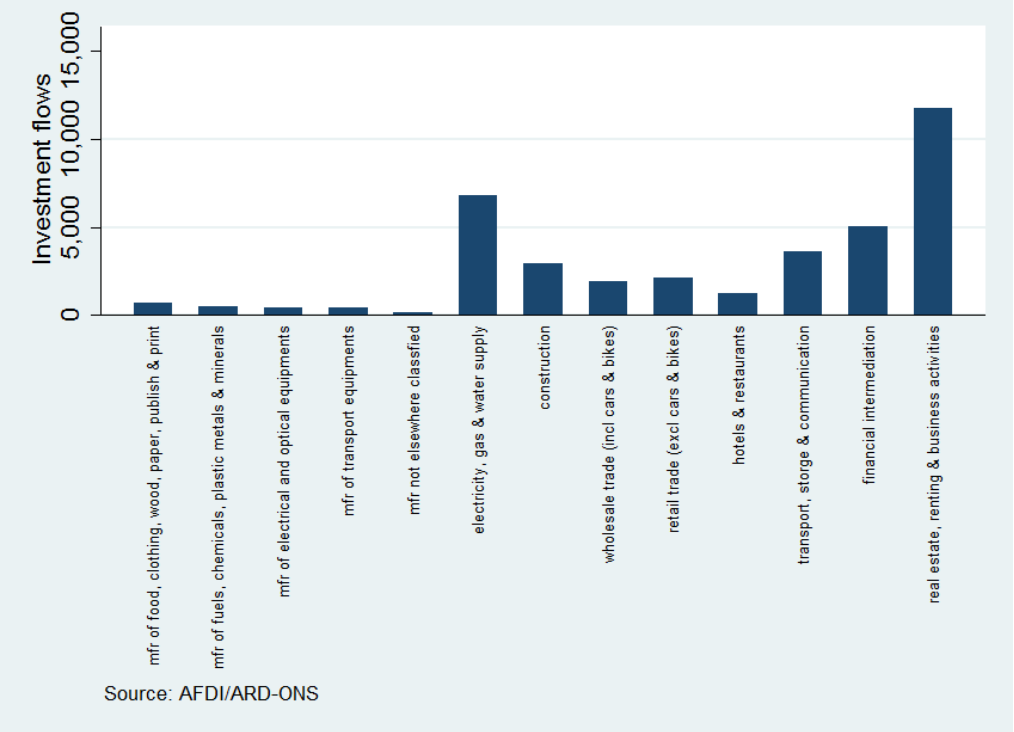

Table 2: Baseline Results - MNEs Investment flows and Domestic Firms' Innovative Performance

	(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 (with a degree)		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 parenthesis; *** p<0.01, ** p<0.05, * p<0.1

Table 3: Instrumental Variable (IV) regression

Dep.Var.	(1) Innovation active firms	(2) MNEs (Investment Flows)
MNEs (Investment Flows)	0.0980**	
	(0.0461)	
Skilled Employment (with a degree)	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 parenthesis; *** p<0.01, ** p<0.05, * p<0.1

Table 4: 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 5: 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 (with a degree)	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 parenthesis; *** p<0.01, ** p<0.05, * p<0.1

Table 6: 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 (with a degree)	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 parenthesis; *** p<0.01, ** p<0.05, * p<0.1

Table 7: 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 8: 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 (with a degree)	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 parenthesis; *** p<0.01, ** p<0.05, * p<0.1

Table 9: 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 parenthesis; *** p<0.01, ** p<0.05, * p<0.1

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

Dep.Var. Innovation Active	(1) OLS	(2) OLS	(3) OLS	(4) OLS
MNEs (Number of Firms)	0.0178***	0.0131***	0.0127***	0.0142***
	(0.0045)	(0.0045)	(0.0045)	(0.0046)
Skilled Employment (with a degree)		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 parenthesis; *** p<0.01, ** p<0.05, * p<0.1