Working Paper 265

JUNE 2025

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Research for this paper was financed by the Anniversary Fund of the Oesterreichische Nationalbank (Project No. 18800). Support provided by the Oesterreichische Nationalbank for this research is gratefully acknowledged.

Abstract

The hope that multinational firms will improve local employment and productivity is a driving force behind policy efforts to attract investment. Such spillovers are often motivated by technological spillovers from foreign to domestic firms. We address this possibility by using the patenting activity of foreign multinationals in Europe as a measure of affiliate activity alongside more traditional proxies. We find that local firms' employment and labour productivity is higher when FDI activity increases, particularly when those multinationals are upstream of locals. Furthermore, this effect is particularly significant among domestic patenting firms. Thus, it seems that the benefits of inbound investment are greatest for local innovators who are exposed to inbound innovating foreigners.

Keywords: spillovers; Foreign Direct Investment; Patents

JEL classification: F23; O24; O33; O34; Q55

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1 Introduction

Multinational enterprises (MNEs) have been shown to be among the most profitable, innovative, and productive firms.[1] It is therefore unsurprising that many governments actively seek to attract such firms in the hope that their advantages will spill over to indigenous firms and increase their own performance (measured as employment, productivity, or some other indicator). Evidence supporting this notion can be found, although it is rather mixed.[2] In part, the variable findings can be linked to heterogeneity in domestic firms. One source of heterogeneity is how local firms link to inbound foreign direct investment (FDI) along the global supply chain, with the strongest evidence for local performance improvement found when inbound MNEs are upstream suppliers to local industry (see, e.g., Javorcik (2004)). Even within an industry, heterogeneity across local firms can play a significant role in the emergence of potential spillovers. In particular, attention has been given to the idea of absorptive capacity, meaning the ability of a domestic firm to take on board the technology of MNEs. Although theoretically ambiguous, the empirical literature here tends to find that locals who have more absorptive capacity benefit the most from foreigners.

To this literature, we add a further twist by suggesting that the impact of foreign investment can depend on the characteristics of the MNE, as well. Specifically, we consider the amount of innovative activity undertaken by foreign firms as measured by patents. We focus on this for two reasons. First, spillovers from MNEs to domestic firms are often framed as 'technological spillovers' (Branstetter 2006). Given that MNEs are among the most important innovators globally, this line of thought suggests that the gains they provide to local firms may be because their presence brings cutting-edge technology into a nation, some of which then trickles down to domestic companies. Second, the literature's focus on absorptive capacity takes that concept one step further by giving credence to the idea that simply having the latest technology nearby is not enough and that a local firm must instead be able to actually make use of it for spillovers to occur.

With this in mind, we do two things using firm-level data from Orbis for the European Union

[1] See, e.g., Bloom et al. (2012), Helpman et al. (2004), Tintelnot (2017), Alfaro & Chen (2018) and Gumpert et al. (2025).

[2] Examples of literature surveys and meta-analyses include Rojec & Knell (2018), Bruno & Cipollina (2018), Demena & Van Bergeijk (2017), Wooster & Diebel (2010), Meyer & Sinani (2009), Crespo & Fontoura (2007), and Blomström & Kokko (1998).

(EU) for the 2013-2020 period. First, in addition to the traditional measures of MNE activity (e.g. the value of investments or the number of FDI projects), we also use the patents held by those affiliates as a further proxy for local FDI activity. We do so because this then speaks directly to the technology-driven potential for spillovers. While these measure are correlated, they are not perfectly so given that small MNE affiliates can be major innovators.
Furthermore, since Orbis provides information on the parent company of a foreign affiliate, we can examine patents held by the parent, not just those of the affiliate. This provides a sense of how inbound FDI provides a conduit to global innovation. Second, we use data on the domestic firm's innovation activities to proxy for local firms' absorptive capacities (see the discussion of Fabrizio (2009) on various measures of absorptive capacity). Thus, by using patent information to measure both of these, we directly approach the idea of technological spillovers using a measure of innovation that is fairly easy to access.

When following the bulk of the literature and measuring FDI activity by value or counts, we find relatively robust positive relationships between the amount of upstream FDI and a local firm's employment and (labour) productivity. More FDI downstream, however, tends to be negatively correlated with a domestic firm's performance. More FDI in the same industry (a horizontal spill-over) has rather ambiguous effects. When measuring FDI by patents, however, we tend to find stronger evidence that upstream FDI increases both employment and productivity. This is true whether patents are held by the affiliates or their parents. When there are more affiliate patents among downstream MNEs, this increases employment but lowers productivity, suggesting that any sales boost fails to keep up with employment gains. Horizontal spillovers, however, tend to be positive for both employment and productivity. While upstream parental patents also tend to boost employment and productivity, the estimates on horizontal and downstream spillovers tend to reverse the above-mentioned patterns, suggesting that what is important is in-country innovation rather than simply linking to innovation in the MNE's home country. These patterns are also true when using only green patents, which (as per Haščič & Migotto (2015)) are those identified by the European Patent Office as having implications for environmental protection, energy efficiency, or sustainable practices. We find very similar results for this sub-set of patent activity, which is something worth knowing given the overall policy drive to encourage innovation in this area

(International Energy Agency 2021). Finally, by and large, we find that the local firms that themselves innovate tend to see the more positive employment and productivity changes taking place following incoming MNE investments, particularly when those MNEs are innovative.

While the estimates are in line with the bulk of the literature's findings, our contribution shows that the accepted wisdom regarding FDI spillovers holds even when giving full force to the technological spill-over framing of their nature. Furthermore, we find that the relation between foreign-owned innovation and local outcomes can vary widely depending on whether MNE innovation is held locally or elsewhere. Thus, our contribution is both to show the reliance of the existing literature and to provide some indications of where future work may be needed.

In Section 2, we provide a brief overview of the literature to frame our contribution, particularly with regards to the measurement of FDI activity and heterogenous effects. Section 3 introduces our data and empirical methodology. Section 4 provides our results. Finally, Section 5 provides a summary and concluding remarks.

2 Literature Review

Our analysis contributes to two main threads of the FDI literature. The first concerns itself with measuring the activity of MNEs. Here, several methods have been used even in just the literature focusing on FDI spillovers. These measures include capital flows (Zhang & Felmingham (2002), Demir (2016), Aleksynska & Havrylchyk (2013)), capital stocks (Wen 2014), counts of MNEs (Alfaro & Chen 2018), employment (Keller & Yeaple (2009); Girma (2005); Aitken & Harrison (1999)), and output (Javorcik (2004); Chen et al. (2022); Vujanović et al. (2021)). Furthermore, one can separate out mode of investment, meaning whether it is greenfield FDI or a MNE affiliate arising from a merger or acquisition (M&A). This was done by Ashraf et al. (2016) and Liu & Zou (2008). Each of these has both advantages and disadvantages, with data availability often playing a decisive role. By and large, each of these approaches tends to yield similar results: that local firms benefit from MNE affiliates in the same location, particularly when they purchase from those foreign firms. Nevertheless, as argued by Görg & Strobl (2001) in their meta-analysis, it is paramount to measure FDI activity as precisely as possible in order to estimate potential spillovers. With that in mind, we add patents by MNEs to this list of possibilities, a measure intended to get closer to the heart of technological spillovers.

The second literature examines the potential impact of inbound foreign investment on domestic firms. Although FDI is generally assumed to bring productivity-enhancing benefits to host countries, empirical evidence is noticeably mixed, with various studies finding positive, negative, or non-existent spillovers (Bruno & Cipollina (2018); Crespo & Fontoura (2007); Demena & Van Bergeijk (2017); Fons-Rosen et al. (2021); Görg & Strobl (2001); Mercer-Blackman et al. (2021); Rojec & Knell (2018); Smeets (2008)). Some authors have concluded that 'much ado about nothing' is the best way to summarise the evidence on FDI spillovers (Görg & Greenaway 2004). Others, meanwhile, have sought to explain the varied findings as a function of a range of factors, such as the scope of analysis, the connections between foreign and local firms, and heterogeneity across host countries, home countries, or even firms themselves.

One potential reason for the differences across studies is the level of aggregation used. Early work focused on the impact of inbound FDI on the host country, with examples including Alfaro et al. (2009) and Li & Tanna (2019)). This was followed by attempts to better pinpoint potential effects by disaggregating the data to the industry level (e.g. Bijsterbosch & Kolasa (2010); Bournakis & Mei (2023); Desbordes & Franssen (2019)) or even further to the level of individual firms (e.g.Alfaro-Ureña et al. (2022); Bournakis (2021); Bournakis & Tsionas (2022); Fons-Rosen et al. (2017); Gong (2023); Haskel et al. (2007); Javorcik (2004); Lu et al. (2017); Mercer-Blackman et al. (2021); Monastiriotis (2016)). While disaggregation does tend to provide greater support for positive spillovers, this is not universal. For example, Aitken & Harrison (1999) and Girma et al. (2006) find a negative relationship between FDI and productivity growth, whereas Ruane & Uğur (2005) find no significant relationship. In our analysis, we follow the most recent work and use firm-level data.

A second approach to reaching more consistent results has been to focus on the types of connections between domestic and foreign firms, particularly along the supply chain. In particular, it may be important to distinguish between horizontal (within-sector) relationships and vertical (between-sector) ones. Most of the early literature on FDI spillovers focused on horizontal spillovers (i.e. on the impacts of FDI on domestic firms in the same industries). This often finds negative effects (e.g.Aitken & Harrison (1999); Djankov & Hoekman (2000); Konings (2001)).[3] Such results were generally justified in light of the competition effects that MNEs create in both input and output markets, thereby crowding out investment opportunities. Furthermore, it may well be the case that MNEs seek to limit horizontal technology spillovers so as to inhibit their competitors, further explaining the lack of positive spillovers.

That, however, may not be the case for vertical relationships in which the MNE has an incentive to share technology to increase demand for the intermediates it produces and/or reduce the cost and improve the quality of its inputs. Furthermore, the potential for these spillovers may hinge on whether the domestic firm buys from the MNE (sometimes referred to as backward or upstream spillovers) or sells to the MNE (also known as forward or downstream spillovers). The evidence for these vertical spillovers – especially when the local firm buys from the MNE – is far more robust. Indeed, numerous studies across a variety of countries finds strong support for positive upstream spillovers. Examples here include Javorcik (2004) (Lithuania), Javorcik & Spatareanu (2008) (Romania), Belderbos & Van Roy (2010) (Belgium), Barrios et al. (2009) (Ireland), Reganati & Sica (2007) (Italy), Schoors & van der Tol (2002) and Halpern & Muraközy (2006) (both on Hungary). This result also holds up on cross-country analyses, such as Stojčić & Orlić (2019)'s analysis within the EU. With this in mind, we allow for differing effects from horizontal, upstream, and downstream linkages in our cross-EU study.

Although the support for downstream linkages are harder to come by, recent papers that consider these relationships in greater detail are finding positive effects for local firms that supply to MNEs (e.g. Alfaro-Ureña et al. (2022); Amiti et al. (2024); Li et al. (2024)). In particular, Alfaro-Ureña et al. (2022) and Amiti et al. (2024) show that starting to supply a 'superstar' firm (including but not limited to multinationals) boosts productivity by 8% after three years. Thus, it may be the case that positive downstream effects hinge on what type of MNE is a customer of the local firm. Unfortunately, we do not have data on which particular MNEs are purchasing from which specific domestic ones.

[3]That said, some studies do find positive horizontal spillovers, with examples including Keller & Yeaple (2009), Alvarez & López (2008), Bournakis (2021), and Barge-Gil et al. (2018)). For a review of this literature, see Irsova & Havranek (2013).

A third approach to explaining the conflicting results in the literature has been to consider firm-level differences. In particular, the literature provides strong evidence on the role of the absorptive capacity of host countries and domestic firms in realising potential spillovers (Cohen & Levinthal 1990). Absorptive capacities help domestic firms understand and use the knowledge transferred by the MNE, supporting integration of new abilities and thereby raising productivity (e.g. Crespo & Fontoura (2007); Gong (2023)).[4] Looking particularly at the firm-level evidence for Europe, the consensus is that domestic firms with greater absorptive capacity benefit more from inbound FDI.[5] It is worth noting, however, that this relationship is not universal, with some studies finding that the larger the gap between the domestic firm's capability and the technological frontier embodied by FDI, the larger the beneficial spillovers since there may be 'low-hanging fruit' for the domestic firm to exploit.[6] Even in that case, however, the impact may be non-monotonic, with the result that the impact is greater for domestic firms that are moderately behind foreigners (Sears & Muhammad 2024).

With that in mind, an empirical question is how to estimate absorptive capacity. It seems intuitive that firms can increase their capacity through in-house R&D, engaging in R&D collaborations, and hiring and training skilled workers. One implication of these would be a (potential) increase in productivity. As such, several studies proxy absorptive capacity with measures of productivity.[7] Alternatively, Barrios & Strobl (2002), Barrios et al. (2004), and Castellani & Zanfei (2005) use R&D expenditures. In our analysis, we use patent activity to proxy absorptive capacity. To the best of our knowledge, no study to date has measured the degree of absorptive capacity of domestic firms via patent counts when studying the spill-over effects of FDI.[8] Similarly, we differentiate across MNEs by using the patenting activity of the local affiliate or its parent. Intuitively, one might well expect that more innovative MNEs have the potential to generate greater spillovers (Gong 2023). This then reflects the superstar

[4]For an extensive review of this literature, see Keller (2021), Rojec & Knell (2018), and Smeets (2008).

[5]This has been shown, for example, in Spain (Barrios & Strobl 2002), Italy (Castellani & Zanfei 2005), the EU periphery – Spain, Greece, and Ireland (Barrios et al. 2004), Central and Eastern Europe (Nicolini & Resmini 2010), transition countries (Damijan et al. (2013); Gorodnichenko et al. (2013)), and the UK (Girma 2005), among others.

[6]Examples include Findlay (1978), Wang & Blomström (1992), Castellani & Zanfei (2003), Griffith et al. (2002), Peri & Urban (2006),

[7]Examples include Castellani & Zanfei (2003), Damijan et al. (2013), Girma (2005), Griffith et al. (2002), Haskel et al. (2007), Nicolini & Resmini (2010), and Peri & Urban (2006).

[8]Some literature uses patent citations to trail knowledge spillovers in the context of FDI (e.g. Branstetter (2006)). Others have used patent counts at the local level to study the impact of FDI on patenting (e.g. Antonietti et al. (2015).

results of Amiti et al. (2024) and Alfaro-Ureña et al. (2022) noted above.

3 Methodology and Data

The goal of our analysis is to examine the impact of inbound FDI on the performance of domestic firms. To do so, we draw on the firm-level data from Orbis provided by Moody's Analytics.[9] This is supplemented by the Orbis Crossborder and Orbis Intellectual Property databases for FDI and patent information, respectively. To be precise, we use data on all firms active in the EU over the 2013-2020 period.[10] We include firms in both manufacturing and services, and sectors are defined using the two-digit NACE classification. This provides us with information on both European-owned non-MNEs (which comprise our estimating sample) and MNEs in Europe (which includes both European and non-European MNEs). This dataset provides us with a number of firm-year characteristics, including employment, turnover, and patenting information.

We use these data in our estimating equation:

$$Y_{icst} = \alpha FDI_{cst-1} + \beta X_{icst-1} + \gamma_i + \delta_{ct} + \zeta_{st} + \varepsilon_{icst}. \quad (1)$$

For firm i, which is located in country c and active in sector s during year t, Y_{icst} is one of two performance measures: either the number of employees or labour productivity (i.e. turnover relative to employment). This performance depends on a vector FDI_{cst-1} capturing FDI activity, which is described in detail below. Note that although we doubt that the activity of a given domestic firm should influence the amount of FDI in its country-sector, we nonetheless lag it by one year in order to reduce potential endogeneity. In addition, we control for lagged values of various time-varying, firm-level characteristics in X_{icst-1}. Time-invariant attributes are captured by a set of fixed effects at the firm (γ_i), country-year (δ_{ct}), and sector-year (ζ_{st}) levels. Finally, ε_{icst} is the robust error term. All non-binary variables are transformed using the inverse hyperbolic sine (IHS).[11] This transformation is akin to logs but permits zero values. It nonetheless retains the advantages of a log-linear

[9]These can be found at `http:\orbis.bvdinfo.com`.
[10]Note that the UK is excluded from the dataset post-Brexit (i.e. starting in 2020).
[11]For a given value x, this is $ln\left(x + \left(x^2+1\right)^{0.5}\right)$.

transformation, meaning that it reduces the impact of outliers and allows for an elasticity interpretation (Bellemare & Wichman 2020). All monetary variables are in US dollars, which are in real values by virtue of the IHS transformation and year dummies.

3.1 Measuring FDI

Measuring FDI is notoriously difficult because it covers a wide range of activities. For example, FDI can include both 'greenfield' investment, where a new MNE represents a completely new establishment, or 'brownfield' M&As, where the new MNE results from the purchase of a pre-existing entity. Such a distinction may matter when searching for performance-enhancing technological spillovers, as the technology in an M&A may have already been present in the host. Furthermore, when aggregating across investments, this can be done using their monetary value (in which small, innovative projects receive little weight) or their count (where every investment is equally weighted). Alternatively, if the true aim is to consider technological spillovers, both of these may understate the importance of highly innovative investments by giving them the same weight as non-innovative ones. Finally, given the likelihood that technology flows within the firm, there are reasons to consider not only the affiliate R&D, but also that held centrally by the parent.[12] Each of these alternatives has some merit and the potential to provide an alternative perspective on the same overarching problem.

With these considerations in mind, we use four approaches to measuring FDI. The first approach is the value of total assets held by a MNE in millions of US dollars. Note that this is the total investment stock.[13] Given the distinction between greenfield and M&A investment, in some specifications, we separately use the flow value of FDI for each of these modes. Second, following Davies et al. (2018), we use the count of new greenfield or M&A investments (i.e. a flow mirroring the greenfield and M&A value measure). Note that since we do not have the historical data to judge whether the MNEs at the start of the sample were created via a new investment or a change in ownership, we are forced to use the flows of FDI when decomposing along these lines.

[12] Bilir & Morales (2020), for example, estimate that one fifth of the return to US-based R&D is earned by American affiliates abroad.

[13] Comparable results are found when using the flow.

Third, in deference to the focus on technological spillovers, we use the number of new patents families held by a given affiliate.[14] When placing a patent in time, three options are available. First, there is the issue of when the timing of a patent should be measured. This can be the priority date (i.e. the date of the patent application), the publication date (i.e. when it was made public by the patent office), or the grant date (if the application was granted). Since the publication date is perhaps the most closely related to technological spillovers, this is what we present in our main results. As shown in the Appendix, however, we find similar results regardless of which date is used.

Finally, recognising that the parent firm (identified as the 'global ultimate owner', or GUO, in Orbis) may own technology that is used by the affiliate, we replace the affiliate patent measure with the number of new patents in the parent. Please note that since we allocate a full patent to any of the owners of a patent – be they affiliate or parent – this measure includes any such jointly held intellectual property (including that held by affiliates outside of a firm's sector-country).

Following Javorcik (2004), for example, we construct three exposures to the activity of MNEs for each sector-country-year: horizontal, backward, and forward linkages. Indexing MNEs by j, horizontal exposure is given by:

$$HOR_{sct} = \sum_{j \in \{s,c\}} FDI_{j,t-1} \tag{2}$$

that is, the sum of the lagged relevant FDI activity by all multinationals present in country c's sector s.[15]

Backward linkages, meanwhile, consider the role of suppliers to and purchasers from domestic firms. Using the technical coefficients derived from the OECD Trade in Value Added (TiVA) database (which was recently renamed the Inter-Country Input-Output Tables), we construct the Leontief (1936) matrix, in which cells represent the share of inputs deriving from the differing sectors.[16] This is then used to construct an upstreamness measure $Down_{csi}$, as per Antràs & Chor (2018). Backward exposure is then:

[14]Note that since as our aim is to consider technological presence, if a given patent is held by many affiliates, it counts as a full patent for each of them. Note also that by using patent families, we do not double-count innovations, as can occur if a single invention leads to multiple patent actions.

[15]To be clear, in this we first sum the FDI value across MNEs in cst and then take the IHS transformation.

[16]Note that although we exclude firms in the primary sectors in our estimation, they are used in constructing the backward and forward linkages.

$$Back_{sct} = \sum_{i \neq s} Down_{csi} \sum_{j \in \{i,c\}} FDI_{j,t-1} \tag{3}$$

that is, the sum of the relevant FDI activity in each sector of the country, weighted by importance to s and aggregated to a single value. Note that, in doing so, we exclude own-sector inputs (which are somewhat captured by the horizontal measure).
For forward linkages, we use the Ghosh (1958) approach, which is similar to measuring downstreamness but instead uses the sales by (rather than to) a given sector. This is then used to make a value Up_{csi}, so that forward exposure to MNEs is then:

$$For_{sct} = \sum_{i \neq s} Up_{csi} \sum_{j \in \{i,c\}} FDI_{j,t-1}. \tag{4}$$

3.2 Additional Controls

In addition to the firm-specific fixed effects, we include a set of additional time-varying controls, all lagged one period. To control for size, when the performance measure is employment in t, we include turnover in $t-1$. When performance is productivity, this is replaced by employment in $t-1$. To control for vintage effects, we control for firm age. A common result is that as firms age, they become larger (i.e. they have more employees) but less productive (reflecting slower growth as they mature). To control for within country-sector production method differences, we control for the K/L_{it}, which is the firm's capital-to-labour ratio. To control for potential agglomeration effects, we also include Agg, which is the share of employment in the firm's region-sector-year.[17] The data for this variable are sourced from the Structural Business Statistics (SBS) of Eurostat. For sectors and regions where employment data were missing, interpolation from the closest available years was used.
Finally, as our focus is on technological spillovers, we also include the stock of patents (i.e. the number of patents applied for) held by the firm in year t. Note that here we use the priority date of patents, as that best represents whether the firm is currently innovating. In unreported results, we use alternative dating approaches and find essentially the same results.
Our last control variable is a composite that captures trade barriers, which is constructed via principal component analysis on six individual trade policy measures for each

[17] Note that this is done by sub-national region given the size of some countries.

country-sector-year triad. The first of these is the simple average tariff on the products produced by sector s, a number that is uniform across EU members.[18] Tariff data comes from the World Integrated Trade Solution (WITS), a database that combines data provided by the World Trade Organization's Integrated Database (WTO-IDB) and the Trade Analysis Information System (TRAINS) of the United Nations Conference on Trade and Development (UNCTAD). We use the minimum of the effectively applied tariff rate, the preferential rate, and the most-favoured-nation (MFN) rate.

Recognising the increasing importance of non-tariff measures (NTMs), we control for several such regulations using the data provided by Cieślik & Ghodsi (2024). To start, we control for the average number of technical barriers to trade (TBTs) imposed on s's products. Note that since these are imposed by both the EU and individual countries, this varies across EU member states. Similarly, we use the average number of sanitary-and-phytosanitary (SPS) regulations for s by country-year. Recognising that TBTs and SPS regulations can also be imposed by exporters, we control for the average regulatory divergence between the single member (or the EU) and all trading partners. Finally, if s is in services, we also include the Services Trade Restrictiveness Index (STRI). In unreported results, we instead used these separately rather than as a composite measure, obtaining similar results.

4 Results

In this section, we present our results, beginning with Tables 2 and 3, where we regress employment and productivity on the value or count of FDI projects. Since these are the most frequent measures of FDI activity, this seems to be the natural starting point.

Before turning to the spill-over variables, we first discuss our additional controls. First, domestic firms that patent, are larger, and enjoy more local agglomeration have both higher employment and greater productivity. Older firms tend to have more workers but lower productivity. The latter result may be the outcome of a mechanical result driven by our productivity measure (i.e. turnover divided by employment). Since employment rises with age, even if sales also rise, they may not move as quickly as employment does. Thus, rather than a true decline in productivity, this may signal a delayed reaction in sales as compared to

[18] Note that in some sectors where there is no goods trade, this is by definition zero.

employment. The coefficient pattern for trade protection looks quite similar and suggests that protected firms have more workers but that sales do not keep up with that rise. Working in the opposite direction but with a similar prediction, we see that more capital-intensive firms have higher productivity but lower employment. Finally, note that these results are quite significant and vary little regardless of how FDI is measured.

In column 1 of Table 2, we use the total value of MNE activity in the same industry (horizontal), upstream industries, and downstream industries.[19] This reveals no significant relationship between a domestic firm's employment and horizontal MNE activity in the same industry. However, when the domestic firm is connected to its upstream suppliers, employment is significantly higher, with a 10% increase in the FDI presence linked to a 0.9% increase in employment. In contrast, when the domestic firm sells to more MNEs, its employment is lower. This result for upstream linkages is common in the literature and is found by Javorcik (2004), among others. The signs of the horizontal and downstream effects likewise mirror her results. However, while she finds significant horizontal effects and insignificant downstream impacts, we find the opposite.

Given the differences in greenfield and M&A FDI, as discussed by Davies et al. (2018), we next decompose our MNEs into those created by a new investment (columns 2 and 3) and those resulting from a change in ownership (columns 4 and 5). Also, please recall that the value is now measured as a flow due to lack of historical data; likewise the count is the number of new investments. Horizontal MNE activity is generally positively correlated with the domestic firm's employment. Furthermore, the coefficient is now significant, albeit small, when measured as the count of investments. When using the value of FDI (columns 2 and 4), we again find a positive and significant coefficient, which is about one third as large as for total FDI. This smaller value may reflect the use of a flow rather than stock of investment. Curiously, we find the opposite result when using the count of projects (columns 3 and 5), although this is only significant once. Downstream FDI, meanwhile, follows the negative correlation in column 1, with the exception of the count of M&A projects.

Thus, we tend to find positive employment effects when the domestic firm is downstream from MNEs, some partial evidence for this when MNEs are in the same industry, and a largely

[19] Again, in comparison to the terminology of e.g. Javorcik (2004), upstream firms are 'backward' linkages and downstream firms are 'forward' linkages.

negative effect when the domestic firm is a supplier to MNEs. In Table 3, rather than employment, we use labour productivity.[20] By and large, the results match those gleaned from Table 2 in terms of signs, magnitudes, and significance.

4.1 Foreign-Owned Patents

Our prime motivation, however, is not to repeat the approach used elsewhere, but to give full force to the idea of spillovers aredriven by technology. Thus, in Table 4, we instead use the number of patents held by affiliates (columns 1 and 3) and the parent (columns 2 and 4). Note that this table includes both the employment (columns 1 and 2) and productivity (columns 3 and 4) measures of domestic firm performance.

In column 1, the relationship between domestic firm employment and horizontal and upstream linkages, as measured by affiliate patents, are positive with a significant estimate for upstream links. This then mirrors Table 2's first column, which is the best comparison given that we cannot decompose by mode of investment when using the patent measure. Unlike those results, however, using the patents of downstream MNEs provides a significantly positive correlation with domestic employment.

Comparing column 3's productivity outcome to Table 3's column one, however, yields very different results. Although both of these suggest that more downstream FDI lowers domestic productivity, using patents suggests a positive effect from horizontal FDI and an insignificant one from upstream links, which is the opposite of what is found when using the value. Thus, while there are parallels between the value and patent results, significance and occasionally also the sign of the estimated coefficient varies.

In the even-numbered columns, we use the patents held directly by the parent, including those that might be directly co-owned with the affiliate. In comparison to the odd columns, we see that the horizontal and downstream coefficients reverse sign and are highly significant. This suggests that more patents owned by the parent reduces employment when the affiliate is in the same or a downstream industry, which is something that may occur if having more parental patents leads the affiliate to rely more on the parent. Having more parental patents also appears to lower domestic productivity. Upstream linkages, however, again show a

[20]Note that due to missing data, this results in 1.8% fewer observations than when using employment.

positive effect on both employment and productivity. Thus, while horizontal and downstream effects continue to be somewhat muddled and dependent on FDI measurement and outcome, when a local firm's input provision comes from MNEs, we find a reasonably robust positive coefficient. This would suggest that attracting more FDI in terms of value, affiliate patents, or parental patents into local firms' upstream industries is associated with improved outcomes for domestic firms.

4.2 Heterogeneous Effects: Absorptive Capacity

The above results suggest that just because MNEs bring new technology to a country does not necessarily result in size or productivity gains for local firms, but rather that this can depend on how the MNEs relate to a given local firm in the supply chain. Equally, it seems plausible that the extent of these spillovers may depend on the local firm's ability to learn from the MNE and implement those changes. Various studies, such as Kirschning & Mrożewski (2023), Yu et al. (2022), and Aldieri et al. (2018), find evidence consistent with the idea that exposure to knowledge only improves growth when there is sufficient absorptive capacity. It seems reasonable to then suppose that the same is true for FDI spillovers. Indeed, the literature surveyed by Rojec & Knell (2018) finds that variation in absorptive capacity can help to explain the mixed results on FDI spillovers. As they discuss, a firm that itself innovates may be in a better position to take on board the lessons it learns from MNEs in its country. As such, the spill-over effects may be more positive for innovating firms. That said, there is also the possibility that it is the technological laggards who can gain the most ground by being exposed to the technological frontier presented by MNEs. While these conflicting possibilities suggest ambiguity, Rojec & Knell (2018) indicates that the bulk of the literature points to higher gains for innovative locals.

In Table 5, we therefore estimate whether the relationship between MNEs and a firm's employment is conditional on two measures of the domestic firm's innovation activity: the number of patents (columns 1 to 3) or whether they patent at all in our data (columns 4 to 6). We do so using our three main measures of FDI activity: the value of investments (columns 1 and 4), the patents by affiliates (columns 2 and 5), and the patents by the parent (columns 3 and 6). Table 6 does the same but using labour productivity.

We do so by including the three MNE connection variables on their own as well as interacted with the domestic firm's innovation measure (note that, as always, we also include the domestic firm's patents as a control). Starting with the employment results and looking at the horizontal spillovers, we see that, similar to Table 4, more FDI in the same industry has little effect on domestic employment. However, the second row of coefficients suggests that there is a significantly positive effect so long as the domestic firm itself innovates. Notably, this only holds true when measuring FDI by patents rather than by value. Thus, this suggests that highly innovative MNEs boost employment of other firms in the same industry when those local firms themselves innovate.

Upstream FDI continues to produce a strongly significant positive coefficient regardless of how FDI is measured. Unlike the horizontal spill-over, however, there is little evidence that this impact is conditional on the domestic firm's innovative activity. Finally, downstream FDI presence again tends to lower domestic employment and, similar to the upstream results, does not vary with domestic firm innovation. A very notable exception to this can be found when using affiliate patents as the measure of FDI presence. In that case, we find a positive employment result for domestic non-innovators and an even larger one for those that do create their own patents.

Taken as a whole, these estimates suggest two things. First, domestic absorptive capacity may well be key to higher domestic employment resulting from attracting inbound FDI, especially when those MNEs are in the same or downstream industries. Second, this impact may additionally hinge on the innovation done by those inbound affiliates.

In Table 6, we repeat this for productivity. Here, the non-interacted horizontal spillovers are largely negative, which, when taken with the generally insignificant employment effects in Table 5, suggests that foreign firms may eat into the sales, if not the employment, of their local competitors. Again, this may be tempered when the local firm itself innovates (at least when using FDI values).

More FDI in upstream industries again tends to benefit local firms regardless of whether they innovate or not. When using the number of the local firm's patents, this relationship is stronger (columns 1 to 3); when using the innovation dummy, the reverse may be true (columns 4 to 6). This may indicate that productivity gains require not just a minimal level of innovation, but a relatively large one to enjoy the greatest productivity effects. When there is more FDI downstream, however, this again tends to lower productivity, with that loss often being more fierce when the domestic firm innovates. This may again be due to the fact that innovative MNEs do more within the firm's global value chain structure instead of sourcing inputs from locals.

4.3 Heterogeneous Effects: Trade Policy

When a local industry is more protected, one might think that this has led to complacency, leaving them farther behind the technological frontier. If that means lower absorptive capacity, that can mean smaller spillovers. However, that can instead mean that there is more to learn from inbound FDI. In an additional wrinkle, protection in one's own industry can imply that FDI is driven by a tariff-jumping motive, resulting in a greater increase in competition than in a less protected setting (see Blonigen et al. (2004) for a discussion of and evidence on tariff-jumping FDI). Thus, since it is unclear precisely what the net effect will be, we let the data provide guidance.

To this end, in Table 7, we follow Tables 5 and 6 and interact the firm's sector trade policy measure with the three MNE connection variables. Starting with the horizontal spillovers, on the whole we again find a negative impact on local employment and labour productivity. This effect, however, does not have a clear variation with trade policy, with the exception being when measuring FDI activity by parental patents. In that case, more protected industries have higher employment and productivity when they are exposed to more parental patents. This may point towards the added 'catch-up' a protected industry can make.

The uninteracted coefficients of upstream investments again point to higher employment but lower productivity (i.e. sales do not rise as fast as employment). Employment changes are even larger in protected industries, suggesting greater catch-up. The insignificant results for productivity here would suggest that the protection-FDI interaction increases turnover in line with the additional employment. Finally, while the coefficients for downstream FDI tend to vary in sign and significance, the overall net effect once again slightly points towards less employment and productivity when there is more downstream MNE activity.

4.4 Green Foreign-Owned Patents

Many nations have prioritised green innovation above other types of innovation (see International Energy Agency (2021)). While evidence suggests that these do indeed increase green patents (Johnstone et al. 2010), there is a worry that those patents are simply 'greenwashing', meaning that their technological innovations are less important than others. As such, the FDI spillovers may be smaller for green patents as compared to patents overall. To this end, we identify patents on environmental and green technologies by affiliates and parents using the classification provided by Haščič & Migotto (2015) and repeat our estimates using just those patents.

The results from this are in Table 8. When comparing this to Table 4, we find very similar results in terms of the sign and significance of the estimates. Furthermore, there is no clear-cut magnitude difference. Similar results are found when interacting the MNE connections with domestic innovation (Table 9) or trade policy (Table 10). Thus, the fiscal push towards promoting specifically green innovation does not seem to have limited the potential for spillovers from FDI.

5 Conclusion

This paper examines the impact of inbound foreign direct investment (FDI) on domestic firm performance in the European Union, with a particular emphasis on the role of technological spillovers. Using firm-level data from Orbis covering the 2013-2020 period, we enhance existing methodologies by incorporating patent data as a proxy for the innovative activity of both foreign affiliates and their parent companies. This allows us to better capture the technological dimensions of FDI and its potential for spill-over effects.

Our results confirm the well-documented heterogeneity of FDI spillovers. We find robust evidence that upstream FDI, where foreign firms act as suppliers to domestic firms, is positively associated with both employment and labour productivity. This effect is particularly pronounced when the foreign firms are also actively innovating, as indicated by their patenting activity. Conversely, downstream FDI generally exerts a negative effect on domestic firm outcomes, although innovative domestic firms may still experience gains when linked to downstream MNE subsidiaries with high levels of innovation.

Horizontal spillovers (i.e. those within the same sector) exhibit mixed effects, largely depending on the innovative capabilities of both foreign and domestic firms. Notably, our results show that the positive effects of FDI on domestic firms are significantly stronger when domestic firms themselves are innovative, supporting the role of absorptive capacity as a key determinant of spill-over realisation.

Furthermore, we explore how the nature of FDI (i.e. greenfield investments versus mergers and acquisitions) matters for spillovers and how trade policy can moderate these effects. We also show that green innovation, measured using patents classified as environmentally beneficial, generates similar spill-over patterns to general innovation, suggesting that policies promoting green FDI need not compromise on broader productivity-enhancing goals.

Overall, our findings underscore the importance of considering both the type of FDI and the innovation characteristics of firms on both sides of the investment relationship. Policy efforts to attract FDI should therefore be complemented by strategies to build domestic absorptive capacities and ensure that the local environment is conducive to technological diffusion.

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Appendix

Table 1: Summary Statistics

Variable	Unit of Obs. & Notes	Obs.	Mean	Std. Dev.	Min	Max
Labour Productivity (log)	*it*	15,921,714	11.751	1.876	-19.756	23.682
Employment (log)	*it*	16,260,961	2.22	1.287	0	14.166
Age	*it*	16,260,961	3.034	0.926	-2.893	7.398
K/L	*it*	16,049,500	11.714	1.831	-15.28	29.712
Operating Revenue	*it*	16,105,508	13.179	2.624	-22.528	27.286
Patent Stock	*it*	16,260,961	0.039	0.379	0	13.631
Trade Policy Index	*cst*	16,260,961	0.074	1.954	-1.487	31.363
Agglomeration	*rst*	15,881,344	0.026	0.029	0	0.746
MNE connection: Total Value						
Horizontal	*cst*	16,260,961	23.952	1.92	0	31.493
Upstream	*cst*	16,260,961	23.997	1.584	0	29.463
Downstream	*cst*	16,260,961	23.556	1.593	0	30.484
MNE connection: Greenfield Value						
Horizontal	*cst*	16,260,961	4.35	2.901	0	10.716
Upstream	*cst*	16,260,961	5.023	1.36	0	9.226
Downstream	*cst*	16,260,961	4.852	1.458	0	9.679
MNE connection: Greenfield Count						
Horizontal	*cst*	16,260,961	2.773	2.192	0	7.307
Upstream	*cst*	16,260,961	2.735	1.267	0	5.967
Downstream	*cst*	16,260,961	2.511	1.366	0	6.681
MNE connection: M&A Value						
Horizontal	*cst*	16,260,961	3.177	3.146	0	11.819
Upstream	*cst*	16,260,961	4.86	1.867	0	8.875
Downstream	*cst*	16,260,961	4.625	1.953	0	9.837
MNE connection: M&A Count						
Horizontal	*cst*	16,260,961	2.003	1.286	0	5.762
Upstream	*cst*	16,260,961	1.595	0.867	0	4.353
Downstream	*cst*	16,260,961	1.45	0.922	0	4.794
MNE connection: Affiliate Patents						
Horizontal	*cst*	16,260,961	3.479	2.608	0	9.58
Upstream	*cst*	16,260,961	2.289	1.556	0	6.816
Downstream	*cst*	16,260,961	2.151	1.573	0	7.037
MNE connection: Affiliate Green Patents						
Horizontal	*cst*	16,260,961	1.444	1.798	0	7.715
Upstream	*cst*	16,260,961	1.892	1.519	0	5.645
Downstream	*cst*	16,260,961	1.815	1.608	0	6.296
MNE connection: Parent Patents						
Horizontal	*cst*	16,260,961	4.427	3.479	0	10.852
Upstream	*cst*	16,260,961	5.312	2.111	0	9.38
Downstream	*cst*	16,260,961	5.225	2.074	0	10.242
MNE connection: Parent Green Patents						
Horizontal	*cst*	16,260,961	2.06	2.331	0	8.443
Upstream	*cst*	16,260,961	2.727	1.691	0	6.641
Downstream	*cst*	16,260,961	2.638	1.715	0	7.357

Excepting labour productivity, the sample corresponds to the first column in Table 2. Unit of observation: firm (i), country (c), sector (s), year (t), region (r).

Table 2: Employment: Values and Counts

	All	Greenfield		M&A	
FDI Measure:	Value	Value	Count	Value	Count
	(1)	(2)	(3)	(4)	(5)
MNE connections					
Horizontal	0.0011	0.000095	0.0013***	-0.000041	0.00072***
	(0.0012)	(0.000083)	(0.00024)	(0.000059)	(0.00023)
Upstream	0.0092***	0.0032***	-0.0019**	0.0028***	-0.00025
	(0.00095)	(0.00051)	(0.00082)	(0.00033)	(0.001)
Downstream	-0.014***	-0.0038***	-0.0059***	-0.0017***	0.0044***
	(0.0019)	(0.0006)	(0.001)	(0.00036)	(0.0015)
Firm variables					
Patents	0.078***	0.078***	0.078***	0.078***	0.078***
	(0.0022)	(0.0022)	(0.0022)	(0.0022)	(0.0022)
Age	0.066***	0.066***	0.066***	0.066***	0.066***
	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
K/L	-0.058***	-0.058***	-0.058***	-0.058***	-0.058***
	(0.00033)	(0.00033)	(0.00033)	(0.00033)	(0.00033)
Size	0.057***	0.057***	0.057***	0.057***	0.057***
	(0.00019)	(0.00019)	(0.00019)	(0.00019)	(0.00019)
Trade Policy	0.0020***	0.0020***	0.0020***	0.0020***	0.0020***
	(0.00033)	(0.00033)	(0.00033)	(0.00033)	(0.00033)
Agglomeration	0.20***	0.22***	0.23***	0.21***	0.21***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Constant	2.04***	1.95***	1.96***	1.94***	1.94***
	(0.062)	(0.0053)	(0.0047)	(0.0045)	(0.005)
Observations	16260961	16260961	16260961	16260961	16260961
R-squared	0.942	0.942	0.942	0.942	0.942
AIC	8065640.5	8065820.3	8065708.9	8065799.6	8065898

Notes: Robust standard errors in parentheses. All explanatory variables are lagged by one year. All specifications include firm, country-year, and sector-year fixed effects. */**/*** indicates significance at the 10/5/1% levels.

Table 3: Productivity: Values and Counts

	All	Greenfield		M&A	
FDI Measure:	Value	Value	Count	Value	Count
	(1)	(2)	(3)	(4)	(5)
MNE connections					
Horizontal	-0.019***	0.00058**	-0.00058	0.00077***	0.0057***
	(0.0025)	(0.00023)	(0.00067)	(0.00017)	(0.00064)
Upstream	0.025***	0.0093***	0.010***	0.0022**	0.032***
	(0.0022)	(0.0013)	(0.0021)	(0.00098)	(0.0031)
Downstream	-0.023***	-0.0038**	-0.0080***	-0.0025**	0.0080*
	(0.0054)	(0.0017)	(0.0027)	(0.001)	(0.0044)
Firm variables					
Patents	0.029***	0.029***	0.029***	0.029***	0.029***
	(0.0051)	(0.0051)	(0.0051)	(0.0051)	(0.0051)
Age	-0.069***	-0.069***	-0.069***	-0.069***	-0.069***
	(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0014)
K/L	0.16***	0.16***	0.16***	0.16***	0.16***
	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.0011)
Size	0.17***	0.17***	0.17***	0.17***	0.17***
	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0015)
Trade Policy	-0.0033***	-0.0032***	-0.0032***	-0.0032***	-0.0031***
	(0.00096)	(0.00096)	(0.00096)	(0.00096)	(0.00096)
Agglomeration	0.27***	0.27***	0.27***	0.27***	0.25***
	(0.076)	(0.076)	(0.076)	(0.076)	(0.076)
Constant	10.2***	9.71***	9.74***	9.74***	9.67***
	(0.16)	(0.017)	(0.015)	(0.015)	(0.016)
Observations	15961053	15961053	15961053	15961053	15961053
R-squared	0.787	0.787	0.787	0.787	0.787
AIC	40697072.1	40697250.3	40697281.9	40697272.5	40697039.5

Notes: Robust standard errors in parentheses. All explanatory variables are lagged by one year. All specifications include firm, country-year, and sector-year fixed effects. */**/*** indicates significance at the 10/5/1% levels.

Table 4: Employment and Productivity: MNE Patents

	Employment		Productivity	
Patents by:	Affiliate	Parent	Affiliate	Parent
	(1)	(2)	(3)	(4)
MNE connections				
Horizontal	0.000036	-0.0031***	0.0024***	-0.0078***
	(0.00024)	(0.00062)	(0.00074)	(0.0019)
Upstream	0.0096***	0.0053***	-0.0028	0.013***
	(0.0012)	(0.00097)	(0.0032)	(0.0023)
Downstream	0.012***	-0.0043***	-0.012***	0.070***
	(0.0014)	(0.0016)	(0.004)	(0.0044)
Firm variables				
Patents	0.078***	0.078***	0.029***	0.029***
	(0.0022)	(0.0022)	(0.0051)	(0.0051)
Age	0.066***	0.066***	-0.069***	-0.069***
	(0.0005)	(0.0005)	(0.0014)	(0.0014)
K/L	-0.058***	-0.058***	0.16***	0.16***
	(0.00033)	(0.00033)	(0.0011)	(0.0011)
Size	0.057***	0.057***	0.17***	0.17***
	(0.00019)	(0.00019)	(0.0015)	(0.0015)
Trade Policy	0.0020***	0.0020***	-0.0033***	-0.0034***
	(0.00033)	(0.00033)	(0.00096)	(0.00096)
Agglomeration	0.21***	0.20***	0.28***	0.21***
	(0.03)	(0.03)	(0.076)	(0.076)
Constant	1.90***	1.96***	9.76***	9.33***
	(0.0054)	(0.011)	(0.017)	(0.031)
Observations	16260961	16260961	15961053	15961053
R-squared	0.942	0.942	0.787	0.787
AIC	8065619.4	8065820.2	40697269.2	40696813.7

Notes: Robust standard errors in parentheses. All explanatory variables are lagged by one year. All specifications include firm, country-year, and sector-year fixed effects. */**/*** indicates significance at the 10/5/1% levels.

Table 5: Employment by Domestic Innovation Status

Innovation Measure:	Number of Patents			Ever Patent		
FDI Measure:	Value	Affiliate Patents	Parent Patents	Value	Affiliate Patents	Parent Patents
	(1)	(2)	(3)	(4)	(5)	(6)
MNE connections						
Horizontal	0.0013	0.0000077	-0.0032***	0.001	-0.00002	-0.0032***
	(0.0012)	(0.00024)	(0.00062)	(0.0011)	(0.00025)	(0.00062)
Hor*Innovation	-0.0013	0.0019**	0.0037***	0.0015	0.0075**	0.013**
	(0.0016)	(0.00087)	(0.00093)	(0.012)	(0.0031)	(0.0061)
Upstream	0.0091***	0.0099***	0.0053***	0.0090***	0.0097***	0.0052***
	(0.00095)	(0.0012)	(0.00097)	(0.00096)	(0.0012)	(0.00097)
Up*Innovation	0.0031	-0.0049**	-0.0035*	0.017*	0.0077	0.0014
	(0.0021)	(0.002)	(0.002)	(0.0089)	(0.0076)	(0.009)
Downstream	-0.014***	0.012***	-0.0043***	-0.014***	0.011***	-0.0044***
	(0.0019)	(0.0014)	(0.0016)	(0.0019)	(0.0014)	(0.0016)
Down*Innovation	-0.004	0.0091***	-0.0024	-0.014	0.043***	0.003
	(0.0026)	(0.0021)	(0.0022)	(0.012)	(0.0074)	(0.011)
Firm variables						
Patents	0.14***	0.051***	0.092***	0.078***	0.070***	0.078***
	(0.051)	(0.0061)	(0.012)	(0.0023)	(0.0023)	(0.0022)
Age	0.066***	0.066***	0.066***	0.066***	0.066***	0.066***
	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
K/L	-0.058***	-0.058***	-0.058***	-0.058***	-0.058***	-0.058***
	(0.00033)	(0.00033)	(0.00033)	(0.00033)	(0.00033)	(0.00033)
Size	0.057***	0.057***	0.057***	0.057***	0.057***	0.057***
	(0.00019)	(0.00019)	(0.00019)	(0.00019)	(0.00019)	(0.00019)
Trade Policy	0.0020***	0.0020***	0.0020***	0.0020***	0.0020***	0.0020***
	(0.00033)	(0.00033)	(0.00033)	(0.00033)	(0.00033)	(0.00033)
Agglomeration	0.20***	0.21***	0.20***	0.20***	0.21***	0.20***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Constant	2.04***	1.90***	1.96***	2.04***	1.90***	1.96***
	(0.061)	(0.0054)	(0.011)	(0.061)	(0.0054)	(0.011)
Observations	16260961	16260961	16260961	16260961	16260961	16260961
R-squared	0.942	0.942	0.942	0.942	0.942	0.942
AIC	8065635.1	8065561.4	8065790.6	8065638.1	8065337	8065816.7

Notes: Robust standard errors in parentheses. All explanatory variables are lagged by one year. All specifications include firm, country-year, and sector-year fixed effects. */**/*** indicates significance at the 10/5/1% levels.

Table 6: Productivity by Domestic Innovation Status

Innovation Measure:	Number of Patents			Ever Patent		
FDI Measure:	Value	Affiliate Patents	Parent Patents	Value	Affiliate Patents	Parent Patents
	(1)	(2)	(3)	(4)	(5)	(6)
MNE Connections						
Horizontal	-0.020***	-0.00077	-0.0078***	-0.020***	-0.00081	-0.0080***
	(0.0025)	(0.00073)	(0.0019)	(0.0026)	(0.00073)	(0.0019)
Hor*Innovation	0.0053***	0.0016	-0.00074	0.027***	0.0094	0.018
	(0.0018)	(0.0022)	(0.0023)	(0.0093)	(0.0079)	(0.015)
Upstream	0.024***	0.016***	0.013***	0.025***	0.016***	0.014***
	(0.0022)	(0.0033)	(0.0023)	(0.0022)	(0.0033)	(0.0023)
Up*Innovation	0.0073*	0.015***	0.014***	-0.052***	0.024	-0.037**
	(0.0044)	(0.004)	(0.0046)	(0.016)	(0.017)	(0.018)
Downstream	-0.023***	-0.090***	0.070***	-0.024***	-0.090***	0.070***
	(0.0054)	(0.0042)	(0.0044)	(0.0054)	(0.0042)	(0.0044)
Down*Innovation	-0.007	-0.019***	-0.012**	0.10***	-0.060***	0.034
	(0.0062)	(0.0045)	(0.0057)	(0.021)	(0.017)	(0.028)
Firm variables						
Patents	-0.1	0.036**	0.023	0.027***	0.034***	0.028***
	(0.098)	(0.016)	(0.032)	(0.0052)	(0.0054)	(0.0052)
Age	-0.069***	-0.069***	-0.069***	-0.069***	-0.069***	-0.069***
	(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0014)
K/L	0.16***	0.16***	0.16***	0.16***	0.16***	0.16***
	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.0011)
Size	0.17***	0.17***	0.17***	0.17***	0.17***	0.17***
	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0015)
Trade Policy	-0.0033***	-0.0030***	-0.0034***	-0.0033***	-0.0030***	-0.0034***
	(0.00096)	(0.00096)	(0.00096)	(0.00096)	(0.00096)	(0.00096)
Agglomeration	0.27***	0.29***	0.22***	0.26***	0.29***	0.21***
	(0.076)	(0.076)	(0.076)	(0.076)	(0.076)	(0.076)
Constant	10.2***	9.91***	9.33***	10.2***	9.91***	9.33***
	(0.16)	(0.018)	(0.031)	(0.16)	(0.018)	(0.031)
Observations	15961053	15961053	15961053	15961053	15961053	15961053
R-squared	0.787	0.787	0.787	0.787	0.787	0.787
AIC	40697065.2	40696402.4	40696806.8	40697042	40696400.2	40696812.9

Notes: Robust standard errors in parentheses. All explanatory variables are lagged by one year. All specifications include firm, country-year, and sector-year fixed effects. */**/*** indicates significance at the 10/5/1% levels.

Table 7: Employment and Productivity: Trade Policy Heterogeneity

Outcome:		Employment			Productivity	
FDI Measure:	Value	Affiliate Patents	Parent Patents	Value	Affiliate Patents	Parent Patents
	(1)	(2)	(3)	(4)	(5)	(6)
MNE connections						
Horizontal	0.0022*	0.000097	-0.0039***	-0.018***	-0.00034	-0.012***
	(0.0012)	(0.00024)	(0.00062)	(0.0026)	(0.00048)	(0.0013)
Hor*Trade Policy	-0.0015***	-0.000035	0.0028***	-0.0012	0.00017	0.0046***
	(0.00047)	(0.00011)	(0.00022)	(0.00079)	(0.00015)	(0.0004)
Upstream	0.0090***	0.0096***	0.0047***	-0.0095***	-0.0015*	-0.0043***
	(0.00095)	(0.0012)	(0.00097)	(0.00087)	(0.00082)	(0.00081)
Up*Trade Policy	0.0023***	0.0046***	0.0041***	0.014	-0.0026*	0.0029
	(0.00037)	(0.0004)	(0.00038)	(0.015)	(0.0016)	(0.0025)
Downstream	-0.014***	0.012***	-0.0051***	-0.020***	-0.0033	0.043***
	(0.0019)	(0.0014)	(0.0016)	(0.0054)	(0.0026)	(0.0042)
Down*Trade Policy	0.00038	-0.0020***	-0.0050***	0.0094***	0.00028	-0.00049
	(0.00053)	(0.00033)	(0.00036)	(0.0012)	(0.00069)	(0.00076)
Firm Variables						
Patents	0.078***	0.078***	0.078***	0.029***	0.029***	0.029***
	(0.0022)	(0.0022)	(0.0022)	(0.0051)	(0.0051)	(0.0051)
Age	0.066***	0.066***	0.066***	-0.069***	-0.069***	-0.069***
	(0.0005)	(0.0005)	(0.0005)	(0.0014)	(0.0014)	(0.0014)
K/L	-0.058***	-0.058***	-0.058***	0.16***	0.16***	0.16***
	(0.00033)	(0.00033)	(0.00033)	(0.0011)	(0.0011)	(0.0011)
Size	0.057***	0.057***	0.057***	0.17***	0.17***	0.17***
	(0.00019)	(0.00019)	(0.00019)	(0.0015)	(0.0015)	(0.0015)
Trade Policy	-0.024***	-0.0000077	0.0033***	0.026***	0.013***	0.012***
	(0.0051)	(0.00059)	(0.00084)	(0.0022)	(0.0023)	(0.0024)
Agglomeration	0.19***	0.21***	0.18***	0.27***	0.25***	0.24***
	(0.03)	(0.03)	(0.03)	(0.076)	(0.076)	(0.076)
Constant	2.02***	1.90***	1.97***	10.0***	9.72***	9.52***
	(0.062)	(0.0054)	(0.011)	(0.16)	(0.015)	(0.027)
Observations	16260961	16260961	16260961	15961053	15961053	15961053
R-squared	0.942	0.942	0.942	0.787	0.787	0.787
AIC	8065496.5	8065284.4	8065265	40696923.6	40697274.8	40696761.3

Notes: Robust standard errors in parentheses. All explanatory variables are lagged by one year. All specifications include firm, country-year, and sector-year fixed effects. */**/*** indicates significance at the 10/5/1% levels.

Table 8: MNE Green Patents

	Employment		Productivity	
Patents By:	Affiliate	Parent	Affiliate	Parent
	(1)	(2)	(3)	(4)
MNE connections				
Horizontal	-0.00022	-0.00012	0.0017***	-0.023***
	(0.00026)	(0.00058)	(0.00049)	(0.0017)
Upstream	0.0058***	0.011***	-0.0032	0.029***
	(0.0012)	(0.0011)	(0.0025)	(0.0029)
Downstream	-0.0053***	-0.029***	-0.010***	0.090***
	(0.0015)	(0.0019)	(0.003)	(0.0053)
Firm variables				
Patents	0.078***	0.078***	0.029***	0.029***
	(0.0022)	(0.0022)	(0.0051)	(0.0051)
Age	0.066***	0.066***	-0.069***	-0.069***
	(0.0005)	(0.0005)	(0.0014)	(0.0014)
K/L	-0.058***	-0.058***	0.16***	0.16***
	(0.00033)	(0.00033)	(0.0011)	(0.0011)
Size	0.057***	0.057***	0.17***	0.17***
	(0.00019)	(0.00019)	(0.0015)	(0.0015)
Trade Policy	0.0020***	0.0020***	-0.0033***	-0.0031***
	(0.00033)	(0.00033)	(0.00096)	(0.00096)
Agglomeration	0.21***	0.21***	0.27***	0.27***
	(0.03)	(0.03)	(0.076)	(0.076)
Constant	1.95***	2.00***	9.76***	9.46***
	(0.0053)	(0.0074)	(0.015)	(0.022)
Observations	16260961	16260961	15961053	15961053
R-squared	0.942	0.942	0.787	0.787
AIC	8065867.7	8065399.6	40697260	40696158.4

Notes: Robust standard errors in parentheses. All explanatory variables are lagged by one year. All specifications include firm, country-year, and sector-year fixed effects. */**/*** indicates significance at the 10/5/1% levels.

Table 9: MNE Green Patents and Domestic Innovation

Innovation Measure:	Number of Patents				Ever Patent			
	Employment		Productivity		Employment		Productivity	
Green patents by:	Affiliate	Parent	Affiliate	Parent	Affiliate	Parent	Affiliate	Parent
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
MNE connections								
Horizontal	-0.0010***	-0.00017	0.0016***	-0.023***	-0.0011***	-0.00019	0.0016***	-0.023***
	(-0.00016)	(-0.00059)	(-0.0005)	(-0.0017)	(-0.00016)	(-0.00059)	(-0.0005)	(-0.0017)
Hor*Innovate	0.00047	0.00075	0.001	0.0043**	0.0029***	0.0037	0.0042*	0.021**
	(-0.00032)	(-0.00078)	(-0.00084)	(-0.0018)	(-0.00086)	(-0.0034)	(-0.0023)	(-0.0089)
Upstream	0.0064***	0.011***	-0.0034	0.029***	0.0066***	0.011***	-0.0025	0.030***
	(-0.0009)	(-0.0011)	(-0.0025)	(-0.0029)	(-0.0009)	(-0.0011)	(-0.0025)	(-0.0029)
Up*Innovate	-0.0041***	-0.0014	0.0029	-0.0025	-0.021***	0.017**	-0.031***	-0.099***
	(-0.0015)	(-0.0019)	(-0.0034)	(-0.0042)	(-0.0046)	(-0.0078)	(-0.011)	(-0.017)
Downstream	-0.014***	-0.029***	-0.0097***	0.090***	-0.014***	-0.030***	-0.0098***	0.089***
	(-0.001)	(-0.0019)	(-0.003)	(-0.0053)	(-0.001)	(-0.0019)	(-0.003)	(-0.0053)
Down*Innovate	0.000027	-0.0024	-0.014***	-0.00089	0.0061	0.020**	-0.024**	0.033*
	(-0.0015)	(-0.0021)	(-0.0037)	(-0.0047)	(-0.0042)	(-0.0081)	(-0.01)	(-0.018)
Firm variables:								
Patents	0.088***	0.090***	0.054***	0.026	0.077***	0.077***	0.026***	0.032***
	(-0.0041)	(-0.0065)	(-0.011)	(-0.018)	(-0.0022)	(-0.0022)	(-0.0051)	(-0.0052)
Age	0.066***	0.066***	-0.069***	-0.069***	0.066***	0.066***	-0.069***	-0.069***
	(-0.0005)	(-0.0005)	(-0.0014)	(-0.0014)	(-0.0005)	(-0.0005)	(-0.0014)	(-0.0014)
K/L	-0.058***	-0.058***	0.16***	0.16***	-0.058***	-0.058***	0.16***	0.16***
	(-0.00033)	(-0.00033)	(-0.0011)	(-0.0011)	(-0.00033)	(-0.00033)	(-0.0011)	(-0.0011)
Size	0.057***	0.057***	0.17***	0.17***	0.057***	0.057***	0.17***	0.17***
	(-0.00019)	(-0.00019)	(-0.0015)	(-0.0015)	(-0.00019)	(-0.00019)	(-0.0015)	(-0.0015)
Trade Policy	0.0019***	0.0020***	-0.0033***	-0.0031***	0.0019***	0.0020***	-0.0033***	-0.0031***
	(-0.00033)	(-0.00033)	(-0.00096)	(-0.00096)	(-0.00033)	(-0.00033)	(-0.00096)	(-0.00096)
Agglomeration	0.22***	0.21***	0.27***	0.27***	0.22***	0.21***	0.27***	0.27***
	(-0.03)	(-0.03)	(-0.076)	(-0.076)	(-0.03)	(-0.03)	(-0.076)	(-0.076)
Constant	1.96***	2.00***	9.76***	9.46***	1.96***	2.00***	9.76***	9.47***
	(-0.0044)	(-0.0074)	(-0.015)	(-0.022)	(-0.0044)	(-0.0074)	(-0.015)	(-0.022)
Observations	16260961	16260961	15961053	15961053	16260961	16260961	15961053	15961053
R-squared	0.942	0.942	0.787	0.787	0.942	0.942	0.787	0.787
AIC	8065651	8065395.4	40697241.3	40696157.8	8065632.6	8065361.8	40697227.3	40696122.3

Notes: Robust standard errors in parentheses. All explanatory variables are lagged by one year. All specifications include firm, country-year, and sector-year fixed effects. */**/*** indicates significance at the 10/5/1% levels.

Table 10: MNE Green Patents and Trade Policy

Green	Employment		Productivity	
Patents By:	Affiliate	Parent	Affiliate	Parent
Horizontal	-0.0010***	-0.000078	0.0020***	0.015***
	(0.00016)	(0.00059)	(0.00075)	(0.0014)
Hor. *Trade Policy	0.00029***	-0.00049**	0.0011***	0.00041
	(0.000074)	(0.00019)	(0.00022)	(0.00041)
Forward	-0.015***	-0.029***	-0.015***	0.074***
	(0.001)	(0.0019)	(0.0042)	(0.0054)
For .*Trade Policy	0.0014***	-0.0047***	-0.0015*	0.0036***
	(0.00021)	(0.00036)	(0.00084)	(0.00087)
Backward	0.0062***	0.011***	-0.0034	0.028***
	(0.0009)	(0.0011)	(0.0032)	(0.0033)
Back.* Trade Policy	-0.00080**	0.0072***	0.0033***	-0.0046***
	(0.00033)	(0.00049)	(0.001)	(0.0011)
Patents	0.078***	0.078***	0.029***	0.029***
	(0.0022)	(0.0022)	(0.0051)	(0.0051)
Age	0.066***	0.066***	-0.069***	-0.069***
	(0.0005)	(0.0005)	(0.0014)	(0.0014)
K/L	-0.058***	-0.058***	0.16***	0.16***
	(0.00033)	(0.00033)	(0.0011)	(0.0011)
Size	0.057***	0.057***	0.17***	0.17***
	(0.00019)	(0.00019)	(0.0015)	(0.0015)
Trade Policy	-0.0000083	0.0032***	-0.0044***	-0.0057***
	(0.00043)	(0.00057)	(0.0016)	(0.0017)
Agglomeration	0.22***	0.19***	0.28***	0.30***
	(0.03)	(0.03)	(0.076)	(0.076)
Constant	1.96***	2.00***	9.77***	9.50***
	(0.0044)	(0.0074)	(0.017)	(0.02)
Observations	16260961	16260961	15961053	15961053
R-squared	0.942	0.942	0.787	0.787
AIC	8065584.3	8064973.6	40697238.1	40696891.8

Notes: Robust standard errors in parentheses. All explanatory variables are lagged by one year. All specifications include firm, country-year, and sector-year fixed effects. */**/*** indicates significance at the 10/5/1% levels.

IMPRESSUM

Herausgeber, Verleger, Eigentümer und Hersteller:
Verein „Wiener Institut für Internationale Wirtschaftsvergleiche“ (wiiw),
Wien 6, Rahlgasse 3

ZVR-Zahl: 329995655

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Offenlegung nach § 25 Mediengesetz: Medieninhaber (Verleger): Verein "Wiener Institut für Internationale Wirtschaftsvergleiche", A 1060 Wien, Rahlgasse 3. Vereinszweck: Analyse der wirtschaftlichen Entwicklung der zentral- und osteuropäischen Länder sowie anderer Transformationswirtschaften sowohl mittels empirischer als auch theoretischer Studien und ihre Veröffentlichung; Erbringung von Beratungsleistungen für Regierungs- und Verwaltungsstellen, Firmen und Institutionen.