Does FDI promote regional development? Evidence from local and regional productivity spillovers in Greece

Vassilis MONASTIRIOTIS[*] and Jacob A. JORDAAN[**]

Abstract

Studies on the productivity spillovers of FDI have concentrated on the national-sectoral level. As a result, little is known about the impact of FDI on absolute and relative regional economic performance. In this paper we examine this issue by relying on a unique dataset of over 20,000 Greek firms for the period 2002-2006 covering all sectors of economic activity. We examine the spatial distribution of foreign-owned firms in the country and analyse the effect that their presence – at the local, regional and national levels – has on the productivity of domestic firms. We find strong evidence suggesting that foreign-owned firms self-select into regions and sectors of high productivity. Net of this selection effect, the impact of foreign presence on domestic productivity is negative – although at the very local level some positive spillover effects are identifiable. The bulk of the effects concentrate in non-manufacturing activities, high-tech sectors, and medium-sized high-productivity firms. Importantly, this effect is not constant across space however. Productivity spillovers tend to be negative in the regions hosting the main urban areas in the country but positive in smaller and more peripheral regions. In this way, despite the tendency of FDI to concentrate in a limited number of areas within the country – those of the highest level of development – the externalities that FDI activity generates to the local economies appear to be of a rather equilibrating character.

Key words: regional development, FDI, productivity spillovers, Greece, spatial heterogeneity

JEL classification: F23, R11, C23, O12

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1. Introduction

Foreign direct investment can be an important source of economic development for recipient economies. FDI inflows strengthen capital accumulation and job creation domestically, while they improve the fiscal and external position of the recipient countries, thus helping finance government expenditures that can further stimulate economic development (Caves, 2007; Dunning and Lundan, 2008). Besides these macroeconomic effects, foreign investments may have more direct effects on industrial activity and performance, through their impact on the technology and productivity of domestic firms. Owing to their technological and other advantages, foreign-owned firms can generate significant externalities for the domestic economy. These can operate mainly through three channels: pecuniary/demand spillovers, technological/ learning spillovers, and competition effects[1].

There is now a large literature examining the magnitude and direction of these effects. Reflecting its industrial and business economics origins, the literature has typically focused at the national-sectoral level, as these spillovers are assumed to operate along sectoral lines. As a consequence, only limited attention has been paid to the spatial distribution of FDI spillovers and the identification of region-specific effects accruing from FDI. Of the few cases that have studied regional-level FDI spillovers, most have either treated the geographical information as an additional dimension in their sample (Aitken and Harrison, 1999; Blalock and Gertler, 2008) or have limited their focus to the role that industrial clusters and agglomeration play for the realisation of FDI spillovers (Driffield and Munday, 2001; Jordaan, 2005; De Propris and Driffield, 2006) – both without explicitly examining the geography of such spillovers. Only very few studies have instead examined the process of diffusion of FDI spillovers across space (Halpern and Muraközy, 2007; Haskel et al, 2007; Jordaan, 2008) and, to our knowledge, only one has examined specifically the issue of differentiation in the direction and magnitude of FDI spillovers across space (Mullen and Williams, 2007). By implication therefore, there is a notable gap in our knowledge and understanding of the overall impact of foreign investment on the host country's regional economic structure and performance.

This paper makes an important contribution in this regard, by providing an analysis of the location and productivity spillovers of FDI at the regional and sub-regional (local) level and examining both the process of spatial diffusion of

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[1] See Blomstrom and Kokko (1998) and Aitken and Harrison (1999) for an early literature on these issues and Smeets (2008) for an excellent review of these theoretical channels. It should be noted that spillovers can also be negative (and empirically they appear to be so more often than not), especially in cases where market-capturing by the foreign affiliates creates a 'demand-siphoning' effect for the domestic firms which raises average production costs and lowers productivity. Moran et al (2005) offer an extensive discussion of positive and negative productivity effects that arise from FDI.

FDI spillovers and the extent of differentiation of these spillovers across space. We focus on the case of Greece, a country with a significantly skewed geographical production structure (over-concentration of economic activity in a few centres) and a low degree of FDI attraction. Owing to these features, Greece appears as a particularly appealing empirical case – where the geographical concentration of FDI is expected to be more intense and spatial differences in the extent of spillovers more heightened. Our analysis sets to explore three main questions. First, what has been the incidence and sectoral distribution of foreign activity across the regional economies of Greece. Second, what is the effect of foreign activity on the productivity of domestic firms in the country and how localised is this effect. Third, whether and to what extent are FDI spillovers regionally differentiated and conditioned upon specific firm-level, sectoral and regional characteristics.

Our data refer to a firm-level panel of annual observations covering the period 2002-2006, a period of relative stability and fast growth, starting after the country's successful adoption of the EURO and ending before the first signs of the global financial crisis. All data are derived from the Amadeus database produced by Bureau van Dijk (BvD), which contains firm-level information on turnover, fixed assets, employment, ownership and other variables of interest for the majority of European countries, covering all sectors of economic activity. For Greece, the Amadeus database contains some 27,000 firms per year, of which just over 2,000 are foreign owned, representing an employment share of 7.78%.[2] This dataset is unique in its detail and coverage and, to our knowledge, it has not been used before for the case of Greece.

Our starting premise is that FDI spillovers are essentially and fundamentally heterogeneous across space – not least because FDI itself tends to be particularly concentrated, especially in locations of high productivity, accessibility and industrial agglomeration. The scant existing empirical evidence seems to support this claim, showing that industrial clustering (agglomeration) is significant not only for attracting foreign firms (Guimaraes et al, 2000; Hilber and Voicu, 2010) but also for determining the size of the realised productivity spillovers (Driffield and Munday, 2001; Jordaan, 2005; De Propris and Driffield, 2006). There are also good theoretical reasons to expect FDI-induced productivity spillovers to take a heterogeneous geographical manifestation – although the effects can go either way. On the one hand, foreign investments may be less able to generate positive spillovers in less developed regions

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[2] As is standard in the literature, we define a firm as foreign owned if at least 10% of its value is owned by an ultimate owner who is resident or established outside the country. After excluding thus defined foreign affiliates and observations with incomplete or erroneous information, our estimating sample reduces to just over 20,000 firms (98,408 firms-specific observations in the pooled sample) – bringing the average employment share of foreign-owned firms to just below 13%.

because their technological distance to local firms does not allow for potential spillovers to be absorbed (the 'absorptive capacity' argument – see Kokko, 1994; Damijan et al, 2001; Girma, 2005; Jordaan, 2009). On the other hand, foreign investments may produce larger spillovers in less developed regions, as firms there are typically less exposed to international competition and have thus more to 'learn' from the foreign-owned firms (the 'scope for spillovers' argument – see Kinoshita, 2000; Merlevede and Schoors, 2005; Gersl et al, 2007; Monastiriotis and Alegria, 2011).[3]

In the remainder of this paper we set to explore the empirical validity of these expectations by providing a holistic analysis of the incidence, geographical scale and spatial differentiation of FDI-induced productivity spillovers across the Greek regions. We examine the incidence and sectoral distribution of foreign activity in section 2. Section 3 presents our econometric analysis, which explores in detail the FDI productivity spillovers and the extent to which they diffuse across space (how localised they are and how neighbouring FDI affects local productivity). In section 4 we analyse the issue of spatial and functional differentiation of these spillovers. We conclude with a short discussion of the implications of our findings for both policy and the empirical literature on FDI spillovers.

2. FDI in Greece and its regions

Historically, Greece has not been an important recipient of FDI. The country embarked on a policy to encourage inward investments since the 1950s and while FDI flows recorded an almost continuous growth (in absolute terms) for decades (Louri et al, 2000), its total inward FDI stock was below 10% of GDP in the 1990s and 2000s with annual FDI flows representing less than 10% of total gross fixed capital formation in the country (UNCTAD, 2009). As a result, Greece ranks persistently at the bottom of the international rankings of FDI recipients and its FDI stock represents less than 1% of the total inward FDI stock of the EU27. Moreover, it appears that the technology content of inward FDI in Greece is also particularly low: according to data by the Bank of Greece, in 2008 manufacturing accounted for some 33% of the total stock of inward FDI,

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[3] Ambiguity also exists with regard to the location of FDI across regions. Theory and empirical evidence suggest that FDI tends to locate in national capitals and some highly accessible and relatively developed regions, which "cream-off" the most productive foreign investors, thus reinforcing existing spatial asymmetries in production structures and capabilities (Guimaraes et al, 2000; Cantwell and Iammarino, 2001; Resmini, 2008 – see Pantelidis and Nikolopoulos, 2008 for the case of Greece). In theory, however, high-productivity foreign-owned firms may also choose to locate in less developed regions, as part of a strategy to protect their technological advantages from diffusing to their domestic competitors who are typically located in the more developed regions of the host country.

almost two-thirds of which was in sectors producing consumer goods, with FDI in the manufacture of capital goods representing a mere 0.8% of the total FDI stock in the country.

This is consistent with findings of previous research, which has shown that FDI is below the country's potential (Papazoglou, 2001; UNCTAD, 2004; Kokkinou and Psycharis, 2004), predominantly of a market-seeking type (Georganta et al, 1986; Georgopoulos and Preusse, 2006) and concentrating in traditional sectors that are characterised by low technology and labour-intensive production (Barrios et al, 2004). The low degree and quality of FDI in the country has often been attributed to factors such as the extent of red-tape and bureaucracy, high tax rates, poor infrastructure and a weak business and macroeconomic environment (Apergis and Katrakylidis, 1998; Barbosa and Louri, 2002; Filippaios and Kottaridi, 2004; Pantelidis and Nikolopoulos, 2008).

Previous research has also shown that FDI in Greece is highly concentrated, along both sectoral and spatial lines (Dimelis et al, 2004; Bitzenis et al, 2007). Indeed, together with manufacturing, three other sectors account jointly for over 90% of the FDI stock in the country (financial services 30%, transport and communications 15%, wholesale/retail trade 13%).[4] Interestingly, the Hotel and Restaurants sector, which includes the tourism industry, one of the country's main comparative advantages, only accounts for 2% of total FDI stock. FDI appears also particularly concentrated across space. Bank of Greece data show that in the period 2000-2008 only 25 out of the 51 NUTS3 regions of the country received any form of FDI, with 87% of FDI inflows going to the prefecture of Attiki, where the national capital is situated, and the fifth highest FDI recipient accounting for a mere 0.5% of total FDI inflows into the country (€100m compared to a national figure of €18.8bn).

Thus, both along sectoral and geographical lines, the distribution of foreign-owned activity in Greece is particularly skewed, with FDI being of an important relative size in only a few sectors and regions. This is also revealed in the data derived from the Amadeus database. Using this data, Figure 1 presents the geography of FDI concentration (employment in foreign-owned firms as a share of total employment in each region) at the NUTS3 level, averaged over the 2002-2006 period.

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[4] Data refer to the on the book value of investments derived from the Bank of Greece. In our data we get a similar picture of concentration in these main sectors, although given that we use employment than investment shares the ranking of the sectors is different, reflecting sectoral differences in capital-labour ratios. The four main sectors account in our data for 85% of total employment in foreign-owned firms (wholesale and retail trade: 37%; manufacturing: 26%; transport and telecommunications: 14%; financial and business services: 8%).

Figure 1. Presence of foreign-owned activity in the Greek regions (employment shares, period average, 2002-2006)
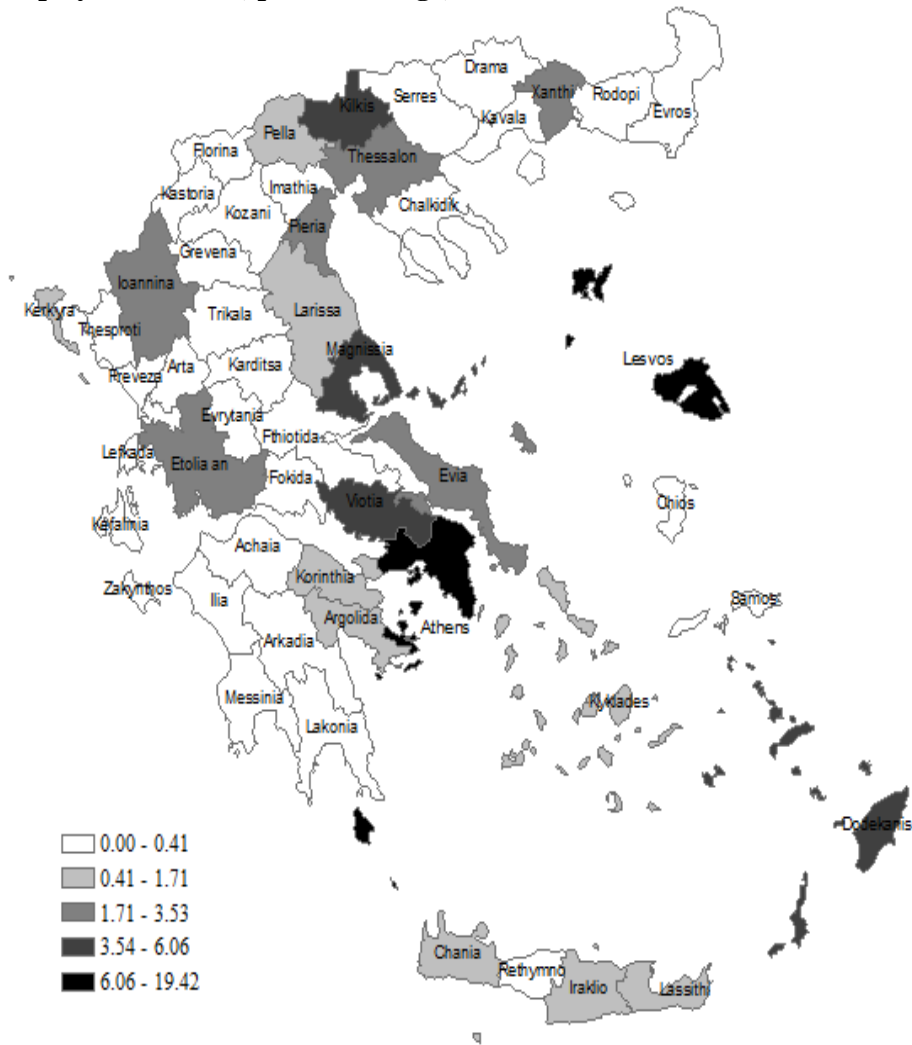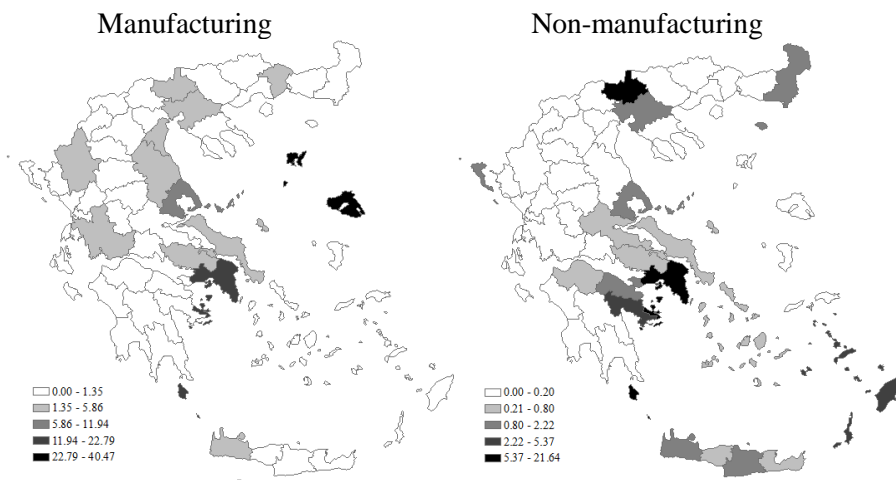

Source: Authors' calculations from the Amadeus database (BvD).
Note: Regions have been classified into five groups using a 'natural breaks' criterion

Figure 2 presents the same information this time split by sector (manufacturing – non-manufacturing). As can be seen, high-concentrations of foreign-owned activity are mainly in the regions of Attiki and Thessaloniki, which host the two main urban centres in the country, and secondarily in the island regions of Lesvos (for manufacturing) and the Dodecanese (for non-manufacturing). Foreign-owned activity in the rest of the country is very sparse.

Overall, out of the 51 NUTS3 regions, in only two regions in the country does employment in foreign-owned firms represent more than 6% of total regional employment –while in only another 10 regions does it represent a share above 2%.

Figure 2. Foreign-owned activity by broad sector and region (employment shares, period average, 2002-2006)

Manufacturing   Non-manufacturing

| 0.00 - 1.35 |
| 1.35 - 5.86 |
| 5.86 - 11.94 |
| 11.94 - 22.79 |
| 22.79 - 40.47 |

| 0.00 - 0.20 |
| 0.21 - 0.80 |
| 0.80 - 2.22 |
| 2.22 - 5.37 |
| 5.37 - 21.64 |

Note: See note in Figure 1.

Figures 1 and 2 suggest a rather high degree of geographical concentration of FDI around two main clusters (centred in the main cities of Athens – Attiki, Voiotia, Evoia – and Thessaloniki – Thessaloniki, Kilkis, Pieria), with a few 'hotspots' of FDI activity in the remaining periphery. To examine to what extent this visual pattern is supported by statistical evidence of spatial association across or within regions, we performed an exploratory spatial data analysis (see Anselin, 1995) using various definitions of neighbourliness based on distance thresholds or on a pre-defined maximum number of neighbours.[5] Figure 3 reports the results obtained from the analysis based on the 4-nearest neighbours criterion. The maps depict the membership of regions into different types of spatial association. The high-high cluster (black shade) includes regions that have high shares of FDI employment and are also surrounded by regions of high FDI shares. The high-low cluster (dark grey) includes high-FDI regions which

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[5] We used a range of alternative distance cut-off points as well as the k-nearest neighbour criterion for values of k in the range {2, 8}. Using contiguity-based neighbourliness is not appropriate in the case of Greece due to its peculiar physical geography (many island regions). In no case was the level of global spatial association greater than 0.03 and in no case was it statistically significant (the expected value of the Moran's I is around 0.16).

are surrounded by regions with low FDI shares. Similarly, the low-low and low-high clusters include regions that have low FDI employment shares and are surrounded by regions that also have low FDI shares (plain grey shade) or by regions with high FDI shares (light grey stripes). Regions for which no statistical association exists between local and neighbouring values are coloured white.

As can be seen, there is very little evidence of clustering across space. The Moran's I, which measures the extent to which local outcomes correlate with outcomes in neighbouring regions, is effectively zero; while although a few 'hotspots' can be identified, these are not necessarily in the places one would expect them to appear. Specifically, for total FDI there are two main hotspots, both located in the west (Ioannina and Etoloakarnania). These two regions are effectively 'spatial outliers', having relatively high shares of FDI but being surrounded by regions with low FDI shares. Three other regions constitute negative outliers, in the sense that they have neighbouring regions with high values but they themselves have low shares of employment in foreign-owned firms. Finally, two main clusters are also observable: Kozani in the north is the centre of a low-low cluster, while Evoia in Central Greece signifies the high-high cluster which extends southwards to Attiki and northwards to Magnisia (see Figure 1 for the location of specific regions). Interestingly, this picture is not replicated in either of the maps that depict the geography of spatial association of FDI employment in the manufacturing and non-manufacturing sectors. The Etoloakarnania outlier survives in the case of manufacturing and some new outliers emerge in the case of non-manufacturing, but overall there is very little consistency between the different maps, suggesting that even in cases where local spatial association is statistically significant, the extent of clustering across regions is rather weak.

Figure 3. Local clusters of FDI (LISA maps)

FDI:	Total	Manufacturing	Non-manufacturing
Moran's I:	0.0016	0.0283	-0.0200

Note: See text and footnote 7.
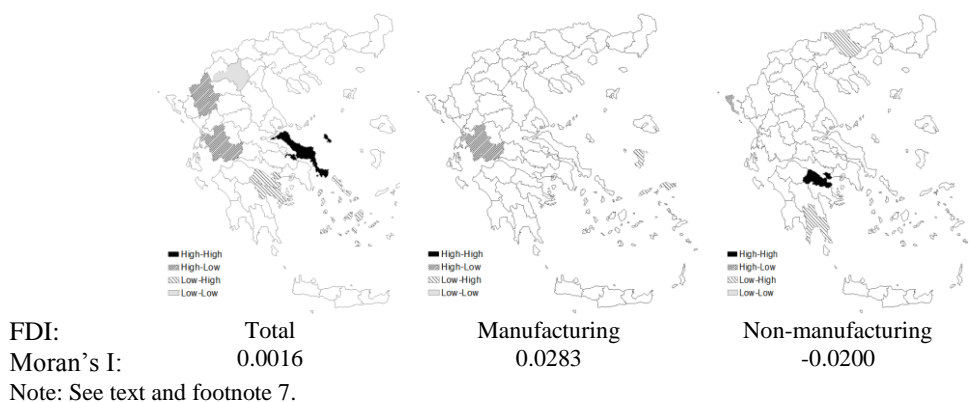
The high degree of geographical concentration of FDI within Greece and its low technological content makes it plausible that, despite being a relatively small proportion of the domestic economy, it can generate significant spillovers. This is because spillovers often occur inside agglomerations and in a rather localised manner (Driffield and Munday, 2001; Jordaan, 2009)[6] and because the low technological content means that problems of absorptive capacity for the domestic firms are less likely to arise. Indeed, this is not refuted in the scant literature that exists on the topic in Greece. The study by Dimelis and Louri (2002) for a sample of manufacturing firms found some evidence of positive productivity spillovers to domestic firms – but only from firms with a minority foreign ownership. A similar effect was found by Barrios et al (2004), although in that study the effect vanished when controls were introduced for sectoral heterogeneity. Finally, Fotopoulos and Louri (2004) also provide indirect evidence of positive spillovers in their analysis of foreign presence and domestic firm growth, finding that foreign participation accelerates firm growth especially for medium-sized firms. To our knowledge, no other study has examined the extent and nature of FDI spillovers in Greece and no study has done so with any attention to the geography of these spillovers. Our analysis in the remainder of this paper seeks to fill this gap by providing unique evidence on the direction and intensity of FDI spillovers across the Greek regions.

3. FDI spillovers across the Greek regions

As mentioned earlier, our dataset consists of firm-level data on turnover, fixed assets and employment, organised across sectors (NACE2 and NACE4), regions (NUTS2 and NUTS3) and years (2002-2006). Additionally, we have aggregated the foreign ownership information at the sectoral (NACE2) and regional (NUTS3) level to construct a variable measuring the intra-sector share of foreign ownership in each of the 51 prefectures of Greece. As is standard in the literature, we follow a production-function approach, where firm-level output is made a function of each firm's value of fixed assets and level of employment, adding the FDI variable as an additional regressor. Our approach implies that investment and manning decisions are not influenced by a firms' own productivity and that FDI affects a firm's total factor productivity but not its level of investment or employment. Although the literature has occasionally questioned the full validity of such assumptions (see Olley and Pakes, 1996; Jarvocik, 2004), others have shown that the bias introduced by these assumptions is minimal, especially in empirical studies with limited time-horizons (Monastiriotis and Alegria, 2011).

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[6] See however Haskel et al (2007) for evidence against this.

Empirically, our estimating model takes the following form:

$$y_{irst} = a + b_1 k_{irst} + b_2 l_{irst} + e_{irst} \qquad (1)$$

which we later amend with the inclusion of the FDI variable and occasionally by adding various fixed effects. Thus, our full estimating model is

$$y_{irst} = a + b_1 k_{irst} + b_2 l_{irst} + c H_{rst} + R_r d_1 + S_s d_2 + T_t d_3 + F_i d_4 + e_{irst} \quad (2)$$

where small letters stand for logarithms, y is turnover; k is capital (measured by fixed assets); l is employment; H is the employment share of foreign-owned firms; R, S, T, and F are vectors containing binary dummies for regions, sectors, time and firms, respectively; $a, b1, b2, c, d1, d2, d3$ and $d4$ are coefficients to be estimated; $i, r, s,$ and t index firms, regions, sectors and time, respectively; and e is an error term. We do not restrict the coefficients $b1$ and $b2$ to add up to one, thus allowing for increasing or decreasing returns to scale. We experiment with different definitions of the H variable (at the NUTS2 level, the NUTS3 level, or both) and we introduce the various sets of dummy variables selectively in alternative specifications.

Given the fact that our sample contains many dimensions (sectors, regions, years), we start our analysis by examining the performance of our production-function model across alternative fixed-effects specifications, introducing gradually additional regressors to control for these dimensions. Table 1 presents the results from this analysis. As can be seen, our base model performs very well and the obtained factor elasticities are very robust to the inclusion of controls for the different dimensions of our dataset.

Table 1. Production function analysis

Model: ln(output)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln(capital)	0.133*** (0.0019)	0.131*** (0.0019)	0.192*** (0.0019)	0.200*** (0.0019)	0.158*** (0.0020)	0.160*** (0.0020)	0.206*** (0.0019)	0.112*** (0.0026)
ln(employ-ment)	0.606*** (0.0039)	0.608*** (0.0039)	0.638*** (0.0036)	0.628*** (0.0036)	0.574*** (0.0039)	0.573*** (0.0039)	0.612*** (0.0036)	0.397*** (0.016)
Constant	5.002*** (0.011)	4.901*** (0.013)	4.525*** (0.038)	4.440*** (0.099)	4.686*** (0.025)	4.715*** (0.044)	4.129*** (0.10)	5.564*** (0.041)
Fixed effects	No	Time	Nace2	Nace4	NUTS2	NUTS3	All	Firms & Time
Obs	98407	98407	98407	98407	98407	98407	98407	98407
R-sq	0.35	0.35	0.49	0.53	0.36	0.37	0.54	0.05

Notes: Model (8) is estimated using the Fixed Effects Within estimator. All other regressions are estimated with OLS. NACE2 (NACE4) contains 54 (429) sectoral dummies while NUTS2 (NUTS3) contains 13 (51) regional dummies. The model of column 7 includes dummies for NACE4, NUTS3 and time.

The coefficient on capital is rather low, but within acceptable limits, and it increases somewhat when we add sectoral controls, which appear to control partly for differences in capacity utilisation. The coefficient on labour is much

more stable suggesting little variation across sectors or regions in the extent of labour hoarding. Together, the two coefficients are consistently below 1, suggesting the presence of decreasing returns to scale in the Greek economy – a finding consistent with the widely acknowledged inefficiency of its production system (Bryant et al, 2001; Pagoulatos, 2003).

Importantly, adding temporal fixed effects does not affect the regression estimates, consistent with the observation that the 2002-2006 period was a period of relative stability for Greece. As mentioned above, sectoral controls (either at the 2- or 4-digit of the NACE classification) raise the estimated productivity of capital (columns 3 and 4). The influence of the regional fixed effects (columns 5 and 6) is smaller and is again very similar for fixed effects of different spatial scales (NUTS2 or NUTS3), suggesting that regional differences in production technologies are minimal and smaller than differences across sectors. Finally, introducing firm-specific fixed effects (which subsume the regional and sectoral controls) leads to a drop in the estimated coefficients for capital and labour, as these effects capture unobserved firm-specific characteristics which contribute to firm output (managerial capacities, distribution/client networks, etc).

To this basic but well performing specification we add next our FDI variable. We experiment with different specifications of this variable for reasons that will become clear in the discussion that follows. Table 2 presents a set of key findings. We start by introducing a sector-specific FDI measure calculated at the NUTS2 level (columns 1-5). When not controlling for fixed effects, of any type, the impact of foreign firms on domestic productivity appears positive and very significant. An increase in the employment share of foreign-owned firms by one percentage point (e.g., from the sample average of 13% to 14%) raises domestic productivity by 1.7%, with the effect being significant well beyond the 1% level.

Controlling for firm heterogeneity (column 2) maintains this significance but reduces the magnitude of the estimated spillover by more than 10 times. This clearly suggests that foreign investments concentrate in regions and sectors with high concentrations of firms that possess productivity-enhancing unobservable characteristics, such as good managerial practices and inter-firm networks. This is consistent with findings elsewhere in the literature (Head et al, 1995; Hilber and Voicu, 2010). The observed productivity spillovers increase somewhat when we replace the firm-specific fixed effects with sector-specific ones (column 3), but remain many times lower than those obtained through a simple OLS estimation (column 1). Moreover, when we additionally cluster the standard errors within sectors (column 4) the estimated spillover effect becomes

statistically not different from zero.[7,8] This suggests that a large part of the self-selection of foreign investments takes place across sectoral lines: high productivity sectors typically attract above-average amounts of FDI.

The influence of self-selection, however, appears even stronger in its spatial dimension. When NUTS3 fixed effects are added (col.5), the estimated spillover effect becomes significantly negative and rather large (a rise in foreign presence by 1 percentage point reduces domestic productivity by 0.55%). In other words, when we control for geographical differences in productivity, the effect of FDI turns out negative. This result, which is very consistent across different specifications as we shall see later, has a very important implication for the study of the spatial effects of FDI: productivity spillovers appear misleadingly positive, largely due to the fact that foreign investments concentrate –in the case of Greece very heavily– in regions of above-average productivity. Net of this self-selection effect, the impact of FDI is to reduce domestic productivity, reflecting a negative competition effect, which presumably operates via one of the following channels: by lowering pre-existing monopolistic rents, by creaming off skilled labour in the sector/region, or by lowering the market share of domestic firms. All these channels are consistent with features that are known to characterise the Greek economy, such as low labour mobility, low effective competition within sectors and attraction of foreign investments which are predominantly of a market-seeking type.

These results are fully replicated when using an FDI measure defined at a much narrower geographical scale, namely the NUTS3 level (see col.6-10). The results there are qualitatively identical to those obtained from the NUTS2-level analysis, although in general the estimated elasticities are somewhat higher, implying that the positive impact of foreign presence on domestic productivity is stronger at a more localised level.

The negative spillover effect that we identify when controlling for regional fixed effects –and thus for self-selection of foreign affiliates into high-productivity regions– casts doubt on the conventional wisdom about the beneficial effects of FDI but is not at odds with empirical estimates in the international literature (Haddad and Harrison, 1993; Aitken and Harrison, 1999; Blomström and Sjoholm, 1999; Damijan et al, 2001; Kugler, 2006; Gorodnichenko et al, 2007). A possible factor that could account for this negative effect, if one maintains that the overall impact of FDI should be

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[7] This is necessary to account for the fact that our FDI variable is measured at the sectoral level. Clustered standard errors relax the assumption of within-cluster independence, thus allowing for firm-specific productivities within sectors to be correlated and, by implication, for the errors to be heteroskedastic.

[8] The same result is obtained when we cluster the standard errors within regions, as well as when we cluster within region-sector clusters (results available upon request).

Table 2. The impact of FDI on domestic productivity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Capital	0.156***	0.112***	0.192***	0.192***	0.199***	0.157***	0.112***	0.193***	0.193***	0.200***	0.201***	0.202***	0.193***	0.200***
	(0.0019)	(0.0026)	(0.0019)	(0.016)	(0.015)	(0.0019)	(0.0026)	(0.0019)	(0.016)	(0.015)	(0.015)	(0.015)	(0.016)	(0.015)
Employment	0.589***	0.396***	0.636***	0.636***	0.624***	0.588***	0.396***	0.635***	0.635***	0.624***	0.615***	0.606***	0.635***	0.624***
	(0.0038)	(0.016)	(0.0036)	(0.032)	(0.028)	(0.0038)	(0.016)	(0.0036)	(0.032)	(0.028)	(0.028)	(0.029)	(0.031)	(0.028)
FDI (nuts2)	1.701***	0.148***	0.237***	0.237	-0.549***									
	(0.028)	(0.041)	(0.03)	(0.15)	(0.19)									
FDI (nuts3)						1.730***	0.138***	0.284***	0.284*	-0.428**			-0.407	-0.827**
						(0.027)	(0.04)	(0.029)	(0.17)	(0.19)			(0.32)	(0.33)
FDI(t-1) nuts3											-0.455**		0.667**	0.310
											(0.19)		(0.33)	(0.28)
FDI(t-2) nuts3												-0.500**		
												(0.21)		
Fixed effects	No	Firm Year	NACE2 Year	NACE2 Year	NACE2 NUTS3 Year	No	Firm Year	NACE2 Year	NACE2 Year	NACE2 NUTS3 Year	NACE2 NUTS3 Year	NACE2 NUTS3 Year	NACE2 Year	NACE2 NUTS3 Year
Estimation method	OLS	Within	OLS	OLS + cl(nace2)	OLS + cl(nace2)	OLS	Within	OLS	OLS + cl(nace2)	OLS + cl(nace2)	OLS + cl(nace2)	OLS + cl(nace2)	OLS + cl(nace2)	OLS + cl(nace2)
Constant	4.703***	5.546***	4.430***	4.430***	4.240***	4.702***	5.548***	4.428***	4.428***	4.245***	4.306***	4.444***	4.430***	4.239***
	-0.012	-0.042	-0.039	-0.075	-0.12	-0.012	-0.042	-0.039	-0.074	-0.12	-0.11	-0.11	-0.075	-0.12
Observations	98407	98407	98407	98407	98407	98407	98407	98407	98407	98407	79801	60045	98407	98407
R-squared	0.37	0.05	0.49	0.49	0.5	0.37	0.05	0.49	0.49	0.50	0.49	0.49	0.49	0.50

Notes: Estimated standard errors in parentheses. ***, ** and * indicate significance at the 1, 5 and 10% levels. Estimations where standard errors are clustered within NACE2 sectors are indicated with 'cl(nace2)'. 'Within' is the fixed effects panel data estimator.

positive, is the possibility that the beneficial effects of FDI take time to materialise, i.e. occur with some hysterisis (Monastiriotis and Alegria, 2011). If this hypothesis is valid, then we should observe a contemporaneous negative association between foreign presence and domestic productivity but a more positive relation between current domestic productivity and past values of FDI. Although year-to-year variation in the share of foreign presence in the Greek economy is limited, which somewhat problematises the identification of this mechanism in our data, our estimations that test the hysterisis hypothesis (columns 11 and 12) do not seem to support this assumption: the estimated spillovers remain negative when we replace the contemporaneous FDI variable with its one- and two-year lags. In fact, the magnitude of the negative FDI effect is actually increasing, suggesting if anything a deterioration of domestic productivity as a response to foreign presence over time. It thus appears that domestic firms do not adapt (at least not in a two-year horizon) to the negative shock of foreign presence and continue to suffer from the increased competition generated by the foreign affiliates. Again, this is consistent with the view of Greece as an economy that lacks dynamism and where competition is largely a zero-sum game which does not lead to market expansion.

Returning to the point that we raised earlier about the geographical scale at which the positive and negative spillovers of FDI occur, in the last two columns of Table 2 we include simultaneously two FDI variables, measured at two different geographical scales (NUTS2 and NUTS3), alternatively excluding and then including our controls for regional fixed effects. In both cases, an interesting pattern emerges: FDI spillovers appear negative at the wider geographical scale but are consistently positive at the more localised level.[9] This suggests that locally concentrated FDI helps the performance of domestic firms, especially in comparison to the performance of similar firms in other NUTS3 regions (since the estimated NUTS3 spillover is stronger and larger when not including regional fixed effects). At the same time, concentration of FDI in neighbouring areas, within a local economy's administrative region, has an absolute negative effect on the performance of domestic firms. This offers an important insight into the workings of FDI spillovers in Greece. Positive FDI spillovers, presumably due to both pecuniary (demand) and technology effects (demonstration, imitation), do exist, but they are very localised. Indeed, these benefits do not diffuse to wider geographical scales and thus at the regional (and national) level the competition and market capture effect of FDI dominates. Therefore, despite the localised benefits, the overall effect of FDI on domestic

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[9] The NUTS2 and NUTS3 spillover coefficients reported in columns 13 and 14 are not simultaneously significant statistically. They are however jointly significant in each of the regressions and also significantly different from each other. When replicating these regressions without clustering the standard errors all coefficients are highly significant even at the 0.1% level.

productivity, when taking into account the tendency of foreign investments to self-select into high-productivity regions and sectors, is negative.

4. Spatial and functional heterogeneity of FDI spillovers

The literature on FDI productivity spillovers has often found that spillovers do not accrue homogeneously across different types of firms and sectors but are rather dependent on specific firm characteristics such as size, technology content and sector of economic activity. A similar argument can be made about the heterogeneity of FDI effects across space, especially under the light of our preceding discussion and findings. In this section we explore these two issues, starting with the functional dimension. Table 3 reports the results from a set of regressions where we split the sample across sectoral characteristics (manufacturing versus non-manufacturing, high-tech sectors versus low-tech sectors), firm sizes (large, medium, small), and firm-specific technological content (high/low technology gap[10]). We perform this analysis for two alternative specifications, first excluding (top panel) and then including regional fixed effects (bottom panel).

The results are particularly revealing. Although in virtually all cases the pattern of positive localised spillovers and negative overall spillovers is maintained (with the exception of the results obtained for large firms, as discussed below), there are important variations in the effects observed for different firm types. The impact of FDI is much more heightened outside the manufacturing sector: the positive localised (NUTS3) effect is stronger, while the negative diffused (NUTS2) effect is also more pronounced. In contrast, the impact of FDI in the manufacturing sector is statistically weak (although the introduction of only one FDI variable at a time makes the results consistent with our earlier analysis). This is true both for including or excluding regional fixed effects. In the latter case, the negative diffused effect becomes larger, while the positive localised effect is smaller. This suggests that in non-manufacturing sectors foreign firms self-select into high-productivity localities but, interestingly, away from localities that are neighbouring to high productivity ones.[11]

In a somewhat similar fashion, localised FDI spillovers appear stronger (more positive) in high-tech sectors, especially when we do not control for self-selection, and the diffused spillover effect appears more negative, especially

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[10] This is measured as the distance of each domestic firm from the productivity frontier of its sector, proxied by the level of productivity achieved by the most productive foreign-owned firm in the sector nationally.

[11] For the manufacturing sector the opposite pattern is observed, with foreign firms self-selecting into broader regions of high productivity but not necessarily into the localities with the highest productivity within these broad regions. The results here, however, lack statistical significance and thus this interpretation is tentative.

when we do control for self-selection. Although the results for the low-tech sectors are of a similar nature, they are more modest and at the margin of statistical significance. Our findings, however, differ markedly when we split our sample by firm size. For large firms, the presence of foreign-owned affiliates within the same locality appears to produce negative, not positive, productivity effects, especially when we control for self-selection. In contrast, it is the diffused spillovers that turn out positive. This suggests an interesting property for large firms in Greece: co-location with foreign affiliates seems to hamper their performance, presumably as large firms have less to gain from demonstration effects and pecuniary spillovers accruing from their foreign-owned competitors; but the agglomeration of foreign firms in the wider region outside the domestic large firms' own locality has a positive effect on their performance. The absence of localised benefits in the presence of wider-scale ones seems to suggest that foreign-firm concentration tends to generate a market-creation effect for large firms, which is not operational in the case of medium and small firms within the same sector. For the latter, and especially for medium-sized firms, the main (and only) benefit is from the presence of foreign affiliates within the local economy, while the wider-scale effect is consistently and very strongly negative. An obvious interpretation of this finding is that smaller firms do not have the reach to capture the benefits from the market-creation effect at wider geographical scales. Medium-sized firms appear able to internalise successfully some of the positive spillovers of foreign participation in the local economy, while very small firms lack the absorptive capacity to do so, which would explain why the estimated localised spillover effect fails to reach acceptable levels of statistical significance for these firms.

The level of productivity (technology gap) of domestic firms does not seem to be a crucial factor for the realisation of FDI spillovers. Firms with a lower technological gap appear to benefit more from the presence of foreign firms in the local economy and to suffer less from the agglomeration of foreign affiliates at the wider geographical scale outside the local economy – although self-selection appears to be more important here than in the case of firms with a lower technology content (higher technology gap).[12] When controlling for selection, the latter appear to be better placed to reap the benefits of co-location (technology transfers and pecuniary effects), although they remain more susceptible to suffering from competition with foreign-owned firms at a wider geographical scale (market capture effect).

What do these patterns imply for the geography of productivity spillovers accruing from the geographical concentration of foreign-owned firms across the Greek economy?

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[12] This implies that foreign firms tend to locate in areas with higher concentrations of high technology firms within any given sector – a finding which is consistent with widespread evidence in the literature concerning the location of FDI.

Table 3. Functional heterogeneity of FDI spillovers

	Manu-facturing	Non-manuf.	High-tech	Low-tech	Large	SMEs	Medium	Small	Low techn. gap	High techn. gap
WITHOUT REGIONAL DUMMIES										
Capital	0.224***	0.186***	0.192***	0.193***	0.252***	0.175***	0.186***	0.148***	0.133***	0.134***
	(0.021)	(0.019)	(0.025)	(0.019)	(0.025)	(0.015)	(0.017)	(0.019)	(0.016)	(0.019)
Employment	0.633***	0.632***	0.644***	0.633***	0.690***	0.532***	0.729***	0.307***	0.716***	0.792***
	(0.027)	(0.040)	(0.052)	(0.038)	(0.038)	(0.028)	(0.042)	(0.026)	(0.029)	(0.041)
FDI (nuts2)	-0.0323	-0.915*	-0.514	-0.350	0.562***	-0.705**	-0.618*	-0.813*	0.0527	-0.505
	(0.27)	(0.46)	(0.60)	(0.37)	(0.18)	(0.32)	(0.33)	(0.43)	(0.16)	(0.36)
FDI (nuts3)	0.398	1.13**	1.35**	0.491	-0.111	0.853**	0.810**	0.810*	0.549***	0.507
	(0.28)	(0.50)	(0.58)	(0.38)	(0.15)	(0.34)	(0.33)	(0.47)	(0.16)	(0.35)
Constant	5.106***	4.487***	3.075***	4.452***	3.934***	4.643***	4.028***	5.084***	4.797***	1.696***
	(0.049)	(0.088)	(0.19)	(0.082)	(0.14)	(0.070)	(0.11)	(0.073)	(0.080)	(0.061)
Observations	26224	72183	18563	79844	20520	77887	53742	24145	48366	50041
R-squared	0.55	0.47	0.47	0.49	0.52	0.34	0.34	0.22	0.73	0.58
INCLUDING REGIONAL DUMMIES										
Capital	0.236***	0.191***	0.195***	0.199***	0.260***	0.181***	0.195***	0.151***	0.141***	0.135***
	(0.019)	(0.017)	(0.023)	(0.018)	(0.023)	(0.014)	(0.015)	(0.018)	(0.017)	(0.018)
Employment	0.620***	0.620***	0.634***	0.621***	0.676***	0.523***	0.712***	0.307***	0.701***	0.793***
	(0.025)	(0.035)	(0.048)	(0.034)	(0.035)	(0.025)	(0.041)	(0.027)	(0.026)	(0.040)
FDI (nuts2)	-0.191	-1.52***	-0.819***	-0.765*	0.295	-1.16***	-1.16***	-1.04***	-0.207	-0.642*
	(0.27)	(0.33)	(0.25)	(0.39)	(0.21)	(0.31)	(0.33)	(0.38)	(0.16)	(0.38)
FDI (nuts3)	0.0598	0.661**	0.536**	0.254	-0.480**	0.499*	0.506*	0.446	0.275*	0.598*
	(0.29)	(0.30)	(0.23)	(0.33)	(0.19)	(0.26)	(0.29)	(0.36)	(0.15)	(0.34)
Constant	4.589***	4.461***	2.366***	4.265***	4.052***	4.419***	3.673***	5.064***	4.671***	1.566***
	(0.093)	(0.12)	(0.34)	(0.13)	(0.18)	(0.11)	(0.12)	(0.16)	(0.10)	(0.12)
Observations	26224	72183	18563	79844	20520	77887	53742	24145	48366	50041
R-squared	0.56	0.48	0.49	0.49	0.52	0.35	0.34	0.23	0.73	0.58

Notes: Estimated standard errors in parentheses. ***, ** and * indicate significance levels at the 1, 5 and 10%. All regressions include time and sector dummies, with standard errors clustered at the NACE2 level.

We examine this by replicating the regressions presented in columns 5 and 10 of Table 2, this time interacting the FDI variable with a set of regional (alternatively, NUTS2 and NUTS3) dummies.[13] This provides us with a full set of region-specific estimates of the productivity effects of FDI on domestic firms. It is of course difficult to report the full set of obtained coefficients in tabular form (in the NUTS3 analysis, this set contains 51 region-specific spillover coefficients). Instead, in Figure 4 we offer a visualisation of the magnitude and geography of these effects.

Figure 4. Region-specific estimates of local FDI spillovers

Without local/regional fixed-effects   Including local/regional fixed effects
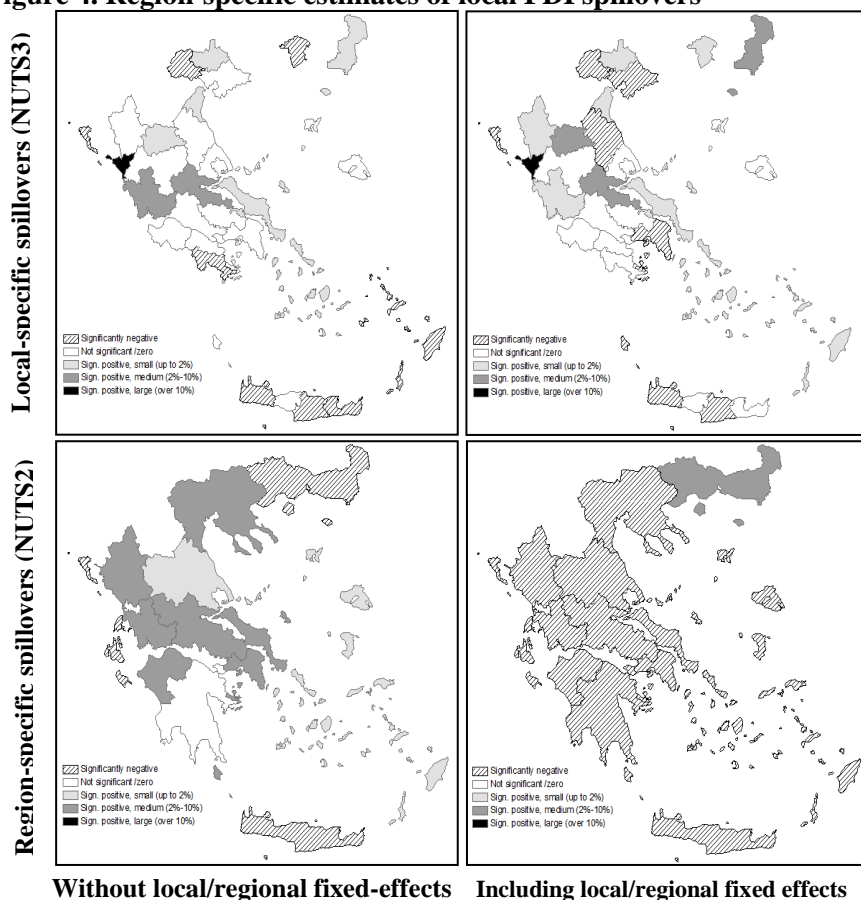
Notes: Estimated coefficients derived from an extension of models 5 and 10 of Table 2, which includes interaction terms between the FDI variable and the regional dummies. See the text for more details.

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[13] We can not replicate this analysis for the models presented in columns 13 and 14 of Table 2, as the NUTS2-level effects are absorbed completely by the NUTS3-level effects when both are included in the same model.

The top panel depicts the results obtained from the NUTS3-level analysis (corresponding to the regression of column 10 in Table 2), while the bottom panel presents the results of the NUTS2-level analysis. The right-hand side maps correspond to regressions that include locational fixed effects (regional or local), which take into account the self-selection of foreign firms into high-productivity regions.

As can be seen, there is significant variation both in the size and, more importantly, in the direction of the estimated effects. At the NUTS2 level, when not controlling for self-selection (bottom-left map), this variation is less heightened and the overall picture appears to be one of a core-periphery pattern. Peripheral regions in the north-east, west and south appear unable to internalise positive productivity spillovers, thus ending up with a net loss in their performance. In contrast, more central regions, especially in central and western mainland Greece, experience net gains from the presence of foreign-owned firms.

Controlling for self-selection, however, completely overturns this picture: in this case, the direct productivity effect of FDI is negative in all regions (consistent with the findings reported in column 5 of Table 2), but with one important exception. The region of Eastern Macedonia and Thrace (EMT: located in north-east mainland Greece) appears now to benefit from positive spillovers, suggesting that self-selection in this region operates in the opposite direction. The structure of incentives operating in this region through the country's Incentives Laws (Filippaios and Kottaridi, 2004) may have a big role to play here, as foreign firms may locate there not because the region offers a high concentration of more productive firms but rather because the structure of incentives provided by the government attracts high-productivity foreign affiliates to this low-productivity region. In any case, the issue of regional incentives aside, our results suggest that had average productivity in this region been the same as the average productivity nationally, the effect of foreign presence in the region would have been to raise the overall productivity of the domestic firms located there.

The NUTS3-level analysis (top panel) suggests that this is essentially due to two more localised effects: a negative effect in Xanthi (located in the middle of the EMT region), which after controlling for selection turns mildly positive, and a mildly positive effect in Evros (the eastern-most prefecture of the EMT region), which after controlling for selection becomes even stronger. Besides this, self-selection seems to operate more strongly (and to result to a negative overall effect of FDI) in the prefectures of Attiki, Thessaloniki and Larissa –the regions hosting three of the five largest cities in Greece– and less strongly in the case of Etoloakarnania (the western-most region of central Greece). FDI spillovers are invariably negative (irrespective of controls for region-specific fixed effects) in Pella (in the north), Kerkyra (the western-most island) and

Chania and Irakleio (both in the southern-most island of Crete); while inverse self-selection (into low productivity regions) appears, besides Xanthi and Evros, in the cases of Argolida (south-west of Athens), Lasithi (in eastern Crete), Trikala (located north of central Greece), Ipeiros (west of Trikala) and the Dodecanese (the south-eastern island complex). Interestingly, the estimated spillovers of FDI are persistently negligible in the prefectures of Lesvos (north-east islands), Rethymno (in Crete), Voiotia (north of Athens), Magnisia (in central-east mainland Greece) and Achaia and Korinthos (both in northern Peloponese)[14], while the most positive FDI effect at the NUTS3 level, which appears also independent of self-selection, is observed in the case of Preveza – whose predominantly agricultural economy (representing some 30% of total employment) has attracted in the past some modest, but highly concentrated, foreign investment in the manufacture of wood and wood products.

5. Discussion

This paper has sought to contribute to filling an important gap in the literature of FDI-induced spillovers, by providing a detailed and novel analysis of the spatial heterogeneity of the productivity effects of foreign-owned firms at the local and regional level. Our results confirm that FDI tends to concentrate in a limited number of locations, self-selecting into regions and sectors of high productivity. It thus acts to heighten existing spatial imbalances, as the productive capacity of the most developed regions is strengthened and the relative performance of regions located in the economic periphery deteriorates. Nevertheless, although this effect on the spatial structure is important, our analysis has found that FDI does not raise the productivity of domestic firms, neither contemporaneously nor in a longer time-horizon. In this sense, the concentration of FDI in the most developed regions in the country is not a hindrance to regional growth and convergence for the less well-off regions. This is consistent with the scant evidence in the literature about the localised effects of FDI.

Besides this, our analysis has shown further that the productivity spillovers of FDI exhibit substantial heterogeneity across space, even after controlling for regional differences in the volume and sectoral composition of FDI. To our knowledge, this is a unique finding in the literature. Moreover, it has very important policy implications, pointing to a strong need for FDI-attracting policies to incorporate a clear regional dimension. This is because if, as it seems, FDI is not equally beneficial (or harmful) across the national economic space, maximising the benefits of FDI at the aggregate/national level necessitates paying specific attention to the set of endogenous (e.g., average firm sizes) and exogenous (e.g., proximity to main agglomerations) locational

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[14] This is despite the fact that the latter four are rather highly industrialised regions.

characteristics that influence local abilities to benefit from FDI spillovers. In other words, it requires policies that are spatially targeted and selective.

Our analysis has identified a number of factors that condition the externalities generated by the presence of foreign-owned activity. Some of these, concerning firm- and sector-specific characteristics, have already been identified in the literature and the evidence presented here has lent further support to them. Two other factors identified in our analysis, however, are novel in character and perhaps also more important for understanding the spatial processes that underlie FDI spillovers. The first has to do with the extent of urbanisation and the size of the recipient economy. Our results indicate that FDI spillovers are negative mainly in regions that host the largest urban areas (Athens, Thessaloniki, Irakleio, Larissa). In contrast, they are positive, even after controlling for selection, in smaller and more peripheral regions. Whether this signifies an adverse agglomeration effect or something qualitatively different[15], its policy implications are clear. At least in the case of Greece, the spatial selectivity of policies seeking to maximise the productivity effects of FDI should be such so as to direct foreign investments towards less dynamic, less urbanised and less competitive regions in the country. This is particularly relevant for Greece today, as the country is ready to embark on a new phase of FDI promotion to deal with the acute investment problems that it faces following the fiscal crisis and the austerity measures that were implemented to address it.

The second factor concerns geographical proximity and the scale of the spillovers. Domestic firms tend to enjoy positive FDI spillovers at the very localised level (with the exception of large domestic firms, which operate at a different scale), even after controlling for self-selection of FDI firms into high-productivity areas. The overall effect remains negative, but this is due to a very strong negative effect on local productivity coming from the location of foreign investments in neighbouring regions. The implication of this finding is of paramount importance and has foregone the attention in most of the FDI literature so far: not only is the effect of FDI spatially heterogeneous or conditioned on specific firm, sectoral, and regional characteristics, it is moreover dependent on geographical proximity.

To us, this seems to suggest that different mechanisms are in operation at different geographical scales – at least in the case of Greece. Although we cannot provide conclusive evidence to support this interpretation, it appears that processes of technology diffusion and learning are very localised, taking place at the prefectural level within NUTS3 areas. In contrast, at wider geographical scales the effect that dominates is a negative competition effect of market capture and demand siphoning, where foreign-owned firms limit the market size

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[15] For example, it is consistent with the observation that FDI spillovers tend to be weaker in areas exposed to high domestic and international competition, because firms in such areas have already acquired the technological features that foreign-owned firms are believed to incorporate.

of the domestic firms and thus push upwards their average production costs and reduce their productivity – as domestic firms find it difficult to adjust either positively (for example, through product differentiation and expansion to new markets) or negatively (through disinvestment and downsizing) to the foreign presence. This may be a feature unique to Greece, as the country is known to have rather inflexible industrial relations and inefficient managerial practices, but our sense is that it may be true, perhaps to different extents, also in other countries, at least in cases where significant spatial differences exist in the competitiveness and extroversion of local firms.

The extent to which this is true, and the particular mechanics under which this process takes effect (e.g., the role of agglomeration, openness, industrial diversity, etc), is something that we could not address in this paper and that future research needs to address. For what concerns the present analysis, the main conclusions that we can draw are the following. Foreign investments have inequitable location patterns that can intensify existing spatial and sectoral asymmetries. In economies such as that of Greece, however, such investments do not generate positive productivity spillovers, especially in more developed regions. Therefore, their overall impact on relative regional performance and cross-regional convergence is not detrimental. Positive spillovers, when they exist, are very localised and dominated by wider-area negative market-capture effects. It follows that a successful FDI promotion and regional development policy is not a policy that maximises the FDI flows accruing to the country but one that addresses effectively two key issues: the location of FDI within the national economic space and the conversion of negative competition into economic extroversion and market expansion.

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