Outward Investments and Productivity
Evidence from European Regions *

Davide Castellani[†] Fabio Pieri[‡]

November 2014

Draft version - **forthcoming in *Regional Studies***

Abstract

Using a novel dataset on international investment projects, we build measures of outward foreign direct investments (FDIs) for 262 regions of the European Union. This allows us to estimate regressions of productivity growth over the 2007-2011 period as a function of the number of FDIs. The number of outward FDIs in manufacturing activities is negatively associated with productivity growth in the home region, but investments in sales, distribution and marketing are associated with a boost in local productivity. This is driven especially by investments towards non-EU locations. This evidence qualifies the fear of hollowing-out as a consequence of outward investments.

JEL classification: C23, F23, O47, R11
Keywords: Regional productivity growth, foreign investments, Europe

*This is a substantially revised version of a paper previously appeared as "Foreign Investments and Productivity. Evidence from European Regions", *Quaderni del Dipartimento di Economia, Finanza e Statistica*, n.83, 2011.

[†]Department of Economics, University of Perugia, Via A. Pascoli 20, 06123, Perugia (Italy); Centro Studi Luca d'Agliano, Milan (Italy); Centre for Innovation, Research and Competence in the Learning Economy (CIRCLE), Lund (Sweden); davide.castellani@unipg.it

[‡]*Corresponding author*: Departamento de Economia Aplicada, Universitat de Valencia, Avinguda dels Tarongers s/n, 46022, Valencia (Spain); fabio.pieri@uv.es

1 Introduction

Regional competitiveness and social and economic cohesion have been crucial concerns for policy makers —especially in the European Union (EU)[1]— and have attracted a considerable amount of economic research. In particular, empirical works have focused on explaining differences in productivity among EU regions. Agglomeration economies, technology and human capital have been most often considered as the key dimensions to explain such differences[2]. While the direct and indirect effects of inward FDI at the regional level have attracted subtantial research[3], with the notable exceptions of Gambardella *et al.* (2008) and Boschma and Iammarino (2009), outward internationalization has been rarely considered as a factor affecting regional productivity.

This is probably due to the lack of accurate measures of regional openness[4]. This lack of evidence is at odds with the increasing relevance of regions in the global economy, and in Europe in particular. With the free movement of goods, capital and labor, it makes less and less sense to think about economic relations within Europe in terms of the standard paradigm of international trade. One should rather take a regional perspective and emphasize relations of sub-national units within the EU and with the rest of the world (Krugman, 1993).

In this work, using a novel dataset on international investment projects, we are able to build unique measures of outward foreign direct investments (FDIs) at the regional level (NUTS 2)[5] for the European Union (EU)[6] countries. This allows us to assess the extent to which regional productivity dynamics is associated with internationalization, and in particular with foreign investments by multinational enterprises (MNEs). This issue is particularly relevant in the EU, which is a major home area for FDIs: outward FDIs account for almost 4% of the EU GDP, but with very differentiated patterns across countries[7].

Exploiting data over the 2003-2011 period, we estimate regressions of (average) productivity growth over the four-year period from 2007 to 2011 as a function of the (average) number of foreign investments in the previous 4 years (2003-2007). We find that outward

[1]As a matter of fact, 45% of the EU budget for the period 2007-2013 has been allocated to foster competitiveness and promote social and economic cohesion among the regions of its member states.

[2]See, for example, the empirical evidence provided by Paci and Usai (2000), Ciccone (2002), Bronzini and Piselli (2009).

[3]As for the effect of FDI spillovers, see Driffield (2004), Girma and Wakelin (2007), Driffield *et al.* (2010) for some evidence on UK regions; Mullen and Williams (2007) on US states; Altomonte and Colantone (2009) on Romania; Halpern and Murakozy (2007) on Hungary, Crespo *et al.* (2009) on Portugal; Hamida (2013) on Switzerland.

[4]In fact, Gambardella *et al.* (2008) introduce a generic measure of openness using the share of hotels in the population and the share of the population which speaks a second language. Instead, Boschma and Iammarino (2009) exploit the rare availability of import and export data at the NUTS 3 level, made available by the Italian National Statistical Office.

[5]NUTS is an acronym for Nomenclature of Units for Territorial Statistics which indicates a hierarchical classification of administrative areas used by the European statistical office (Eurostat). NUTS levels (1-3) indicate different degrees of aggregation.

[6]Our database does not include information on Croatia, which has joined the EU on 1 July 2013.

[7]For example, outward FDIs as a share of GDP go from values close to zero in most New Member States, to around 1% in countries such as Italy and Greece and more than 5% in the UK, France and Spain.

FDI projects are negatively correlated with regional productivity growth. However, to a closer look, the impact of outward FDI is not homogeneous across types of investment. In particular, while a higher number of outward investment projects in manufacturing activities is negatively associated with productivity growth in the home region, investments in marketing, distribution and sales activities are positively associated with local productivity growth. This seems to be driven especially by investments towards non-EU locations.

This evidence bears implications for policy. In particular, it allows qualify the fears of hollowing-out as a consequence of outward investments. On the one hand, we support the idea that moving manufacturing activities outside the EU may not necessarily strengthen the EU economy. This provides some support to the theses warning against the risks of de-industrialization of the EU, which are strongly advocated, among others, by the European Commission in some recent communications (European Commission, 2012, 2014). On the other hand, our evidence also points to the importance of a structured outward orientation of EU firms. To the extent that opening up marketing, distribution and sales posts abroad is an important tool to boost home region productivity, it becomes crucial for EU firms to be able to overcome the costs of such internationalization strategy.

More generally, this finding suggests that investing abroad may affect productivity at home through some reallocation effect, more than through a within firm productivity increase or decrease. In fact, it is most likely that outward investments in marketing, distribution and sales activities contribute to increasing the overall sales of the internationalizing firms and (possibly) of their suppliers. This type of investments usually does not substitute for production at home, instead they increase firm's market penetration. To the extent that such firms (and their suppliers) are relatively more productive than the average firm in the region, this increase in overall sales contributes to increasing aggregate productivity in their home regions.

The rest of the paper is organized as follows: Section 2 presents the relevant literature on the links between outward FDIs and home productivity; Section 3 describes our empirical strategy; Section 4 provides details on the characteristics of the data and focuses on how the main variables of interest have been built; Section 5 provides some descriptive evidence, while Section 6 illustrates the econometric results and some robustness checks. Section 7 concludes the paper.

2 Foreign investments and productivity: theory and evidence

2.1 Theory

Outward investments can have both direct and indirect effects on the productivity of the home economy. As for the direct effects, firms engaging in foreign activities (either through export or foreign investments) are more productive than purely domestic ones, since they need to overcome the cost of doing business abroad. By going abroad, firms can reach larger markets, thus they grow larger and this positively affects aggregate productivity growth (Helpman *et al.*, 2004). At the same time, this allows firms to reap the benefit of higher economies of scale and provides further incentives to invest in R&D (Petit and Sanna-Randaccio, 2000). Furthermore, foreign investors may be able to source foreign knowledge (Cantwell, 1995; Fosfuri and Motta, 1999), which will increase their productivity, boost their growth, and contribute to raising aggregate productivity. Admittedly, outward investments may also be associated with a decrease in the size and productivity of home activities. This would occur when domestic firms relocate a substantial share of their activities abroad. In this case, even if an investing firm would gain from a competitiveness boost, this may not be able to compensate the aggregate loss in terms of value-added resulting from moving a substantial part of production abroad.

Outward investments may also contribute to increasing the aggregate productivity through indirect effects on the performance of local firms. On the one hand, an increase in size, productivity and/or knowledge of home multinationals may spill-over on other domestic firms through input-output relations and imitation. On the other hand, to the extent that investing firms move value-added creating activities abroad, domestic suppliers along the value chain may be forced to shrink or to exit. At the same time, opportunities may arise in upstream or downstream sectors, for example in activities like logistics, R&D, design, and other business services. The overall effect of this process on aggregate productivity may be positive or negative (Castellani and Zanfei, 2006), according to the balance between the productivity of firm entering (or increasing their market share) and exiting the market (or shrinking).

Various theoretical arguments can be used to support that the effects of outward FDIs are relatively confined in space and, thus, the regional level would be more appropriate than the country level to capture them. First, the smaller the units of observation, the easier would be to appreciate the direct effects of outward FDI, which may be more diluted in more aggregate data. Second, indirect effects may be enhanced by the geographic proximity, which can be important for transmitting knowledge as face-to-face communication (Audretsch and Feldman, 2004). Third, in the presence of transport costs, vertical linkages (which foster pecuniary and knowledge externalities) occur between closely-located suppliers and customers (Venables, 1996). Finally, to the extent that multinationals serve the local markets, crowding out and business stealing effects are spatially confined. Admittedly, since firms competing with multinationals may not be local companies, these effects are likely to span across regional borders.

Since theoretical results do not predict clear-cut effects, the issue of whether outward foreign investments have positive or negative effects on regional productivity becomes mainly an empirical question.

2.2 Evidence

The literature on outward investments and productivity is relatively scattered, but has gained *momentum* in the last decade. Many studies in this field have provided evidence that firms investing abroad tend to be more productive than their home country counterparts (Greenaway and Kneller, 2007): these results would predict that in regions with a larger share of highly productive firms (thus a higher average productivity) one would observe a higher number of firms investing abroad. Other studies have found that investing abroad may further reinforce productivity of investing firms (Branstetter, 2006; Griffith *et al.*, 2006; Barba Navaretti *et al.*, 2010; Debaere *et al.*, 2010), while only a few works in this literature have addressed the indirect effects of FDIs, finding that the growth of domestic multinationals in the home country can be a source of spillovers for local firms (see, for example, Castellani and Zanfei, 2006; Vahter and Masso, 2007).

At the aggregate level, few studies have been conducted on the relation between outward FDIs and productivity, and they also show mixed results. van Pottelsberghe de la Potterie and Lichtenberg (2001), in a panel of 13 developed countries, find that outward investments are a more effective channels for international technology transfer than inward FDIs. Driffield *et al.* (2009) find that outward FDIs are positively related to productivity growth in UK, while Bitzer and Görg (2009), who examine the effect of outward and inward FDIs on domestic total factor productivity for 17 OECD countries, report that only the latter are positively related to a country productivity.

To the best of our knowledge, the only study at the sub-national level on the effects of outward FDIs on the productivity of local economies is the one by Castellani and Pieri (2013), who analyze the effect of R&D offshoring on the productivity growth of European regions. Somewhat related is the work by D'Agostino *et al.* (2013), who investigate the relationship between home and offshore R&D activities on the knowledge production of the investing home region.

3 The empirical specification

In order to assess the effect of outward FDIs on regional labor productivity growth we estimate the following equation:

$$\Delta\overline{y}_{ij,2007-11} = \alpha+\beta\Delta\overline{k}_{ij,2007-11}+\gamma\overline{OUT}_{ij,2003-07}+\lambda\overline{INW}_{ij,2003-07}+\delta\mathbf{z}_{ij,2007}+\eta_j+\epsilon_{ij,2007-11}, \tag{1}$$

where: $\Delta\overline{y}_{ij,2007-11}$ is the average labor productivity growth of the ith region, located in the jth country and calculated over the period 2007-2011; $\Delta\overline{k}_{ij,2007-11}$ is the regional (average) physical capital deepening calculated over the same period of time; $\overline{OUT}_{ij,2003-07}$ is the average number of outward investments from the region in the period before the considered growth rate. The choice of time periods and lags is dictated by the structure of our data: as we will explain in Section 4, we have data on productivity until 2011 and on foreign investments from 2003 onwards. Choosing the period 2007-2011 for the dependent variable and 2003-2007 for foreign investments allows us to avoid overlaps between the period in which we observe the dependent variable and the period in which we observe the regressor. At the same time, computing productivity growth over a four-year period allows us to reduce noise and measurement errors that usually characterize growth rates over shorter time periods. This also helps mitigate possible reverse causality from productivity growth to outward FDI. As a robustness check, we will also run regressions with growth rates over shorter periods, and this will allow us to have up to eight non-overlapping cross-sections.

We also include the average number of inward investments received by the region during the same period of time considered for outward investments, $\overline{INW}_{ij,2003-07}$, to take into account the extent to which each region is also attracting multinational activities.

We believe that it is key for our analysis to be able to control for $\overline{INW}_{ij,2003-07}$, since inward and outward FDI can be highly correlated and, as a matter of fact, in our data the Person correlation coefficient is 0.7594 (as reported in the correlation matrix contained in the Appendix). Failing to control for $\overline{INW}_{ij,2003-07}$ could lead us to capture a spurious correlation between $\overline{OUT}_{ij,2003-07}$ and $\Delta\overline{y}_{ij,2007-11}$.

The correlation between inward and outward FDIs is at the heart of a macroeconomic theory of FDIs, known as the Investment Development Path (IDP) (Dunning and Narula, 1996; Narula and Dunning, 2010), which suggests that economies at medium-high stages of development should exhibit net outward investments flows close to zero. At the micro-economic level, this correlation can be explained by the fact that some regional characteristics, such as human capital, agglomeration economies or the sectoral structure of the economy, may both attract foreign MNEs and foster the growth of outward oriented local firms[8]. Furthermore, controlling for inward FDIs is necessary, since it is well known that foreign MNEs may have significant direct and indirect effects on the productivity of the host economy.[9]

As we illustrate in details in the Appendix, this specification can be thought as the long difference of a specification of the level of labour productivity as a function of the capital intensity and the stock of inward and outward FDIs. Therefore, we submit that this specification is able to account for the unobserved regional heterogeneity that causes correlation between productivity shocks and FDI stocks. However, it may well be that some residual correlation exists between FDI flows and shocks to productivity growth. We account for this event by introducing: (i) a vector of country effects η_j to capture the country-specific trends in labor productivity due, for example, to institutional characteristics affecting productivity growth rates, which may well be also correlated with FDI flows (Nicoletti and Scarpetta, 2003); (ii) a vector of regional characteristics at the beginning of the period, $\mathbf{z}_{ij,2007}$, which may be correlated with both FDIs and future productivity growth.

The vector $\mathbf{z}_{ij,2007}$ gathers a set of drivers of regional productivity, as suggested by the previous theoretical and empirical works[10]. In particular, the vector includes:

- the level of human capital, whose positive role on productivity has been underlined by several scholars (see Mankiw *et al.*, 1992; Benhabib and Spiegel, 1994, among others);
- the stock of technological capital, which may be certainly related to regional productivity growth: technology is partly a public good and firms localized in a certain area may benefit (in terms of higher productivity) from the level of knowledge available there, as observed by Dettori *et al.* (2012) in a recent work;
- the degree of concentration/diversification of the regional industrial mix in order to capture possible externalities *à la Jacobs* (Cingano and Schivardi, 2004);

[8]As a matter of fact, as revealed in the correlation matrix contained in the Appendix, these variables show similar correlation coefficients with $\overline{OUT}_{ij,2003-07}$ and $\overline{INW}_{ij,2003-07}$.

[9]See, among others, the review of the literature in Barba Navaretti and Venables (2004) and Castellani and Zanfei (2006) and footnote 2 for empirical studies at the regional level.

[10]We cross-refer the reader to the Appendix for further information on how control variables included in the analysis have been built.

- a measure of employment density as a proxy of agglomeration economies (Ciccone and Hall, 1996);

- a measure of total population in order to 'standardize' variables of (outward and inward) FDIs and account for the size heterogeneity among regional economies at NUTS 2 level;

- two dummy variables for coastal and capital regions: the coastal dummy should account for the general accessibility of a region, which may be correlated with its productivity and the degree of internationalization, while the capital dummy is intended to capture the economic activity and related services taking place in a country's capital;

- a dummy for regions indicated by the European Commission as eligible for structural ('Objective 1') funds, since it has been documented that these regions achieved higher productivity growth (Fiaschi *et al.*, 2009);

- the sectoral structure of the region, by introducing the share of employment in three broad sectors, i.e. Agriculture, Industry and Services. Taking the 'quality' of the industrial structure into account has been underlined as an important determinant of growth differences among regions (see Paci and Pigliaru, 1999, among others).

4 Data and variables

4.1 Data sources

We exploit an original database, which has been compiled recovering data from different sources. Data refer to European regions, at the NUTS 2 level. This level of analysis has been chosen for three main reasons. First of all, it is suitable for taking into account the within-country heterogeneity (in terms of labor productivity, foreign direct investments and the other observed and unobserved characteristics); second, it ensures comparable units across different countries; finally, more information on other regional characteristics is available at this level of disaggregation.

Data on gross value added, employment, population and gross fixed capital formation (GFCF) at the regional level come from the *European Regional Database* (ERD), maintained by Cambridge Econometrics (last release, 2013). We have used this information to build a measure of labor productivity and a measure of physical capital-labor ratio at the regional level.

Data on outward and inward FDIs, come from *fDi Markets*, an online database maintained by fDi Intelligence —a specialist division of the Financial Times Ltd—, which monitors cross-border investments covering all sectors and countries worldwide. Relying on media sources and company data, fDi Markets collects detailed information on cross-border greenfield investments (available since 2003). fDi Markets data are based on the announcement of the investment and provide daily updated data. For each FDI project, fDi Markets reports information on the investment (e.g., the type of business activity in which the investment has been made), the home and host countries, and regions and cities involved, and the investing company (e.g., location, parent company). The database has been used as the data source for FDI project information in UNCTAD's World Investment Reports, in publications by the Economist Intelligence Unit and in a number of scientific papers[11].

Moreover, information on the percentage of population with tertiary education degree, the number of patent applications to the European Patent Office (EPO) and the regional area comes from the *EU Regional Database* (EURD) developed and maintained by Eurostat[12]. Finally, information about those regions indicated by the European Commission as eligible for 'Objective 1' funds has been recovered from the European Commission web-site[13].

4.2 Labor productivity

Labor productivity growth (the dependent variable) has been computed using the information on the regional gross valued added (at constant 2005 prices in millions of euro) and regional employment (in thousands of employees) contained in the ERD database. The last year for which information on value added and employment is available is 2011.

4.3 Foreign investments

Data on outward and inward foreign investments flows have been recovered from the fDi Markets database. This source tracked 57,132 outward and 37,032 inward investments projects (either outgoing from or incoming to European regions) appeared on publicly available information sources in the period 2003-2013[14]. One of the limitations of the fDi Market database is that it collects planned future investments. Some of these projects may not actually be realized or may be realized in a different form than the one originally announced. However, the database is regularly updated and projects which have not been completed are deleted from the database. In this regards, data on the projects related to the early years of the series should be more reliable than data regarding the last years of the series. In order to (i) be able to tackle the lower reliability of the last years of FDI data and (ii) ensure some time lag between the outflow/inflow of new investment projects and productivity growth, we use information on FDIs between 2003 and 2007. Our measures of FDI flows are then built from the number of outward/inward investment projects from/to each European region in each year of the period 2003-2007.

Admittedly, the count of FDI projects may not be an accurate proxy of yearly FDI flows for various reasons, possibly undermining the reliability of our measures. First, it

[11] See, for example, Basile *et al.* (2013); Castellani *et al.* (2014, 2013); Castellani and Pieri (2013); Crescenzi *et al.* (2013); D'Agostino *et al.* (2013).

[12] See the Eurostat web page http://epp.eurostat.ec.europa.eu/portal/page/portal/region_cities/.

[13] See the web page http://europa.eu/legislation_summaries/regional_policy/.

[14] A team of in-house analysts searches daily for investment projects from various publicly available information sources, including, Financial Times newswires, nearly 9,000 media, over 1,000 industry organizations and investment agencies, data purchased from market research and publication companies. Each project identified is cross-referenced against multiple sources, and over 90% of projects are validated with company sources. More information at http://fdimarkets.com/.

neglects depreciation of the existing capital stock and, second, it neglects both disinvestments as well as the difference between absolute and relative changes in the capital stock. Finally, the count of FDI projects does not weight investments for the value of the capital involved. As a consequence of this approximation, results in this paper mainly relate to the productivity effects of newly established FDI projects. Nonetheless, the correlation coefficients (0.88 and 0.85), reported in Table 1, between the distribution of FDI projects by country and the actual distribution of FDI flows, as reported by UNCTAD, reassures us that data on investment projects are a good proxy for FDI flows.

As expected, about 95% of EU outward investments are made from EU-15 countries[15], while inward investments are split more evenly among EU-15 and 'New Member States' (NMS)[16]: United Kingdom, Germany and France result to be the leading countries both in terms of outward and inward FDIs in the period which goes from 2003 to 2007. As for inward investments Poland, Romania, Hungary, Czech Republic and Bulgaria show a good performance[17].

Unfortunately, official statistics on outward and inward investments at the regional level are not available, so we cannot benchmark fDi Markets data at this finer geographical level. However, we can check the data against previous results and some theoretical expectations. To this end, we will exploit the visual representation of the geographical distribution of the number of investment projects at the NUTS 2 level, provided in Figure 1. An inspection of the maps reveals that from 2003 to 2007 outward investments have been concentrated in some of the core regions of EU-15 countries (Southern Germany, Southern France, Northern Italy, London, Dublin, Denmark and few Scandinavian regions), while inward investments have also been frequent in a number of peripheral areas, such as in Ireland, Scotland, Spain and in regions belonging to accession countries in Central and Eastern Europe. The latter result is consistent with previous evidence on the positive role of EU Structural and Cohesion Policies in attracting FDI in peripheral regions (Basile *et al.*, 2008). In line with previous evidence on the role of agglomeration economies for the location of multinational firms (e.g., Crozet *et al.*, 2004; Bobonis and Shatz, 2007), inward and outward investments appear highly concentrated in a limited number of clustered regions within each country, including the regions around the major cities. This may be related to the fact that outward investments are accounted as originating from the region where the legal unit of the parent company is located. In the subsequent econometric analysis, we try and control for this bias, by introducing a dummy for regions where the country capital is located. It should be noted that this suggests some caution in interpreting our results. In fact, the effects of an outward investment need not be confined to the region of the parent company, especially in the case of large multi-plant MNEs. In these cases, one would probably need to weight the impact of an

[15] Member countries in the European Union prior to 1 May 2004: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom.

[16] Bulgaria, Czech Republic, Cyprus, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia.

[17] A careful inspection of the values in Table 1 reveals that the number of projects is a better proxy the number of outward than of inward flows, given the higher correlation coefficient: inward investment flows are overestimated in some NMS, such as Poland, Romania, Hungary, Bulgaria and Czech Republic, probably due to the fact that these countries received a large number of projects of relatively small-scale.

Table 1: fDi Markets projects vs. UNCTAD flows, 2003-2007

	Outward			Inward	
Country	# proj.	flows	Country	# proj.	flows
Germany	22.3	12.2	United Kingdom	16.0	25.2
United Kingdom	18.4	20.2	France	11.2	13.3
France	14.0	15.5	Germany	8.5	8.4
Italy	6.3	6.1	Spain	7.5	6.9
Netherlands	6.2	10.6	Poland	6.3	2.9
Spain	5.9	11.6	Romania	5.9	1.5
Sweden	5.4	4.2	Hungary	5.4	1.0
Austria	4.4	2.4	Czech Republic	3.8	1.4
Finland	3.1	0.4	Italy	3.8	6.1
Belgium	2.7	7.3	Ireland	3.7	0.0
Denmark	2.6	1.1	Belgium	3.6	10.7
Ireland	1.8	2.3	Bulgaria	3.6	1.2
Greece	1.0	0.4	Netherlands	3.0	8.9
Luxembourg	0.9	3.0	Sweden	2.5	3.5
Portugal	0.8	0.9	Austria	2.4	2.4
Slovenia	0.8	0.1	Slovakia	2.3	0.8
Lithuania	0.7	0.0	Latvia	1.7	0.2
Poland	0.6	0.6	Denmark	1.7	0.8
Estonia	0.6	0.1	Lithuania	1.4	0.2
Czech Republic	0.5	0.1	Portugal	1.3	1.1
Hungary	0.4	0.4	Estonia	1.2	0.4
Latvia	0.3	0.0	Greece	0.9	0.5
Cyprus	0.2	0.1	Finland	0.8	1.3
Romania	0.2	0.0	Slovenia	0.5	0.2
Bulgaria	0.1	0.0	Luxembourg	0.4	0.7
Malta	0.1	0.0	Cyprus	0.3	0.3
Slovakia	0.1	0.1	Malta	0.2	0.2
Total	100	100		100	100
Pearson corr. coefficient	0.88			0.85	

investment over all the locations where the parent company is active. Unfortunately, this is not feasible with the data at our disposal.

5 Descriptive analysis

Table 2 provides some basic statistics for the variables used in the econometric analysis. As concerns foreign investments, Table 2 shows that, on average, from each region about 19.3 outgoing investments and 14.3 incoming investments per year have been recorded. Exploiting the information on the main business activity involved in each of the international projects, and grouping them into three categories, namely manufacturing, sales[18], and a residual category including other activities[19], we appreciate that investments in sales activities are relatively more frequent than investments in manufacturing activities. Indeed, the average region shows almost 7 outward investments in sales and almost 5 in manufacturing, and, at the same time, attracts 5.1 investments in sales and 3.39 investments in manufacturing activities. Overall, the distribution of the number of investments is highly skewed: from more than 10% of regions no outward investments in one year take place, while the 'best' regions (top 10% of the distribution of outward investments) make, on average, 41 outward investments. As for inward investments, the picture is not very different: almost 10% of the regions attract barely more than 1 foreign investment, while the most 'appealing' regions are able to attract more than 30 investments per year.

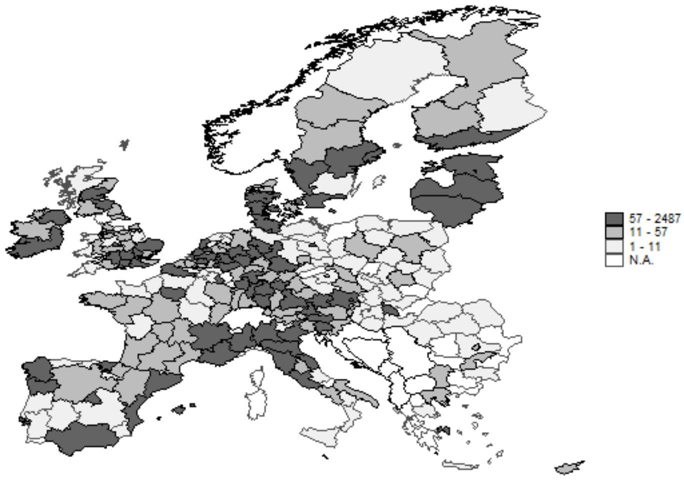
Figure 2 provides a graphical representations of the variables measuring labor productivity levels and growth rates at the NUTS 2 level. Productivity is clearly higher in the regions belonging to the 'core' countries (France, Germany and Austria), Northern countries (Belgium, Netherlands, Denmark, Finland and Sweden), the North of Italy, Dublin and London. Conversely, it declines in regions located in Southern and 'peripheral' Europe (Portugal, Greece, Spain and the South of Italy) and reaches the minimum values in the regions belonging to NMS. As for productivity growth, regions belonging to NMS show the highest productivity dynamics (together with Spain[20]), while the lowest values are measured in Italy and the 'core' countries; UK and Germany productivity growth displays a remarkable within-country variability. In order to account for possible biases stemming from these country patterns in productivity growth, a vector of country dummies has been included in Equation 1.

[18]Sales includes three closely related types of activities, namely: sales, retail, marketing and support activities.

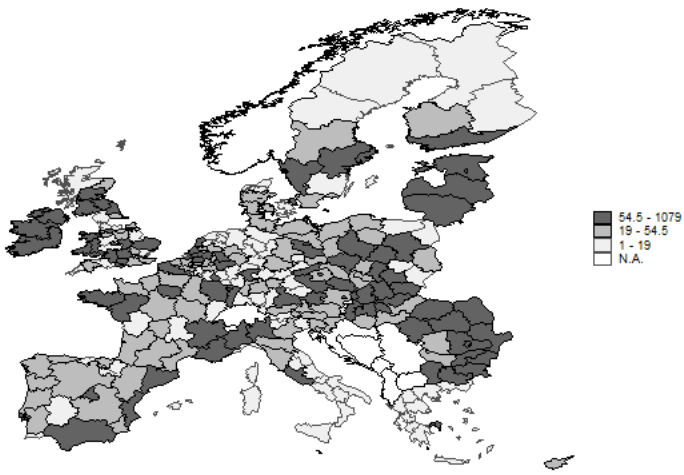
[19]The category 'other' gathers the following business activities: headquarters, business services, R&D, other production activities, other service activities.

[20]The remarkable labor productivity growth experienced by Spanish regions occurred in the context of large employment losses after 2007 (in our database employment losses amounted to a -2.9% employment growth rate each year from 2007 to 2011, in contrast to an average rate of employment losses equal to -0.05% in the EU-15 –without Spain– each year), triggered by the global economic crisis and the burst of the real-estate bubble, as evidenced by other works (see Sanguinetti and Fuentes, 2012, among others).

Figure 1: Regional distribution of international investment projects (sum over the period), 2003-2007



(a) Outward investments



(b) Inward investments

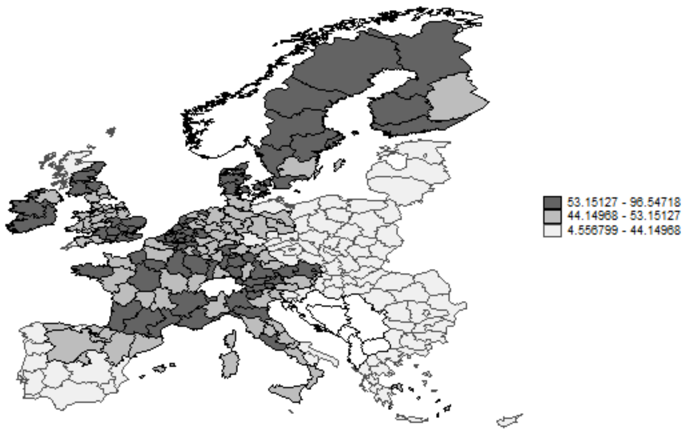
Note: regions have been assigned to quantiles of the cumulative distribution of investments.

Table 2: Descriptive statistics

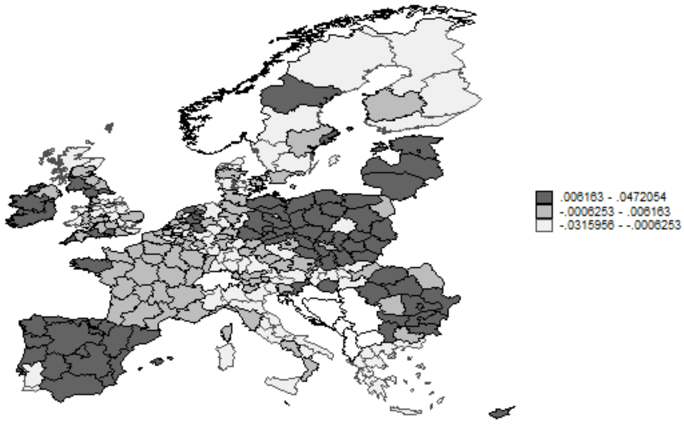
Variable	Notation	Unit	Obs.	Mean	Std. Dev	p10	p25	p50	p75	p90
Labor productivity growth and physical capital deepening										
Four-year (av.) labor prod. growth	$\Delta\overline{y}_{ij,2007-11}$	growth (log, diff)	262	0.00158	0.0152	-0.0151	-0.00734	-0.000495	0.00903	0.0243
Four-year (av.) physical capital deepening	$\Delta\overline{k}_{ij,2007-11}$	growth (log, diff)	262	0.0251	0.0319	-0.0102	0.00693	0.0195	0.0436	0.0617
Foreign direct investments										
Outward FDIs	$\overline{OUT}_{ij,2003-07}$	count, average	262	19.3	52.4	0	0.75	4.5	16.8	41
Outward FDIs - manufacturing	$\overline{OUT}^{man}_{ij,2003-07}$	count, average	262	4.96	11.4	0	0.25	1.5	4.25	12
Outward FDIs - sales	$\overline{OUT}^{sal}_{ij,2003-07}$	count, average	262	6.94	17.6	0	0.25	1.25	6	17
Outward FDIs - other	$\overline{OUT}^{other}_{ij,2003-07}$	count, average	262	7.36	25.9	0	0	1.25	4.75	13.5
Inward FDIs	$\overline{INW}_{ij,2003-07}$	count, average	262	14.3	24	1.25	2.75	6.75	15	32.5
Inward FDIs - manufacturing	$\overline{INW}^{man}_{ij,2003-07}$	count, average	262	3.39	4.37	0.25	0.75	2	4.5	8.75
Inward FDIs - sales	$\overline{INW}^{sal}_{ij,2003-07}$	count, average	262	5.1	11.9	0.25	0.5	1.75	4.25	11.5
Inward FDIs - other	$\overline{INW}^{other}_{ij,2003-07}$	count, average	262	5.83	11	0.25	1	2.25	6	14.5
Other regional characteristics										
Human capital	$hcap_{ij,2007}$	share	262	23.3	8.19	12.4	16.6	23.2	29.1	33.6
Technological capital	$tech_{ij,2007}$	formula	262	0.588	0.727	0.0141	0.0527	0.36	0.812	1.41
Herfindahl-Hirschman index	$hhi_{ij,2007}$	formula	262	0.231	0.0211	0.205	0.218	0.23	0.244	0.258
Total population	$pop_{ij,2007}$	absolute value (thousands people)	262	1,880	1,521	496	1,001	1,501	2,304	3,733
Employment density	$density_{ij,2007}$	formula	262	0.185	0.614	0.0205	0.0323	0.0566	0.128	0.271
Coastal region	$coast$	dummy	262	0.462	0.499	0	0	0	1	1
Capital region	$capital$	dummy	262	0.103	0.305	0	0	0	0	1
Objective 1 region	$obj1$	dummy	262	0.385	0.488	0	0	0	1	1
Employment share in Agriculture	$share^{AGR}_{ij,2007}$	share	262	0.0629	0.0768	0.00886	0.018	0.0347	0.0727	0.159
Employment share in Industry	$share^{IND}_{ij,2007}$	share	262	0.252	0.0719	0.166	0.203	0.243	0.300	0.343
Employment share in Services	$share^{SERV}_{ij,2007}$	share	262	0.685	0.115	0.527	0.623	0.705	0.766	0.812

Notes:
Statistics regarding productivity growth and physical capital deepening are four-year averages over the period 2007-2011
Statistics regarding foreign investments are averages over the period 2003-2007
Statistics regarding control variables refer to year 2007

Figure 2: Regional patterns of (average) labor productivity levels and growth rates, 2007-2011



(a) labor productivity (levels)



(b) labor productivity (growth rates)

Note: regions have been assigned to quantiles of the distribution of labor productivity.

6 Econometric analysis

6.1 Baseline specification

In this section, we explore the role played by the most studied set of determinants of productivity growth differences across European regions: in order to do that, we estimate a reduced version of Equation 1 (without FDIs variables) by OLS. Results are shown in Table 3. We will then investigate the specific role of outward FDIs in the next section.

Physical capital deepening shows a positive and significant correlation (as expected) with labor productivity growth in all regressions (from column 1 to column 10), suggesting that higher productivity growth is associated with the accumulation of physical capital per worker (Badinger and Tondl, 2005). The coefficient associated with the share of population with tertiary education degrees at the beginning of the period is positive and significant (see Martin, 2001; Canova, 2004, among others), both when the proxy for human capital is included alone (column 2) and together with the other regional characteristics (column 10) in the regressions. On the contrary, and somewhat surprisingly, the technological capital of the region (measured as the cumulated number of patent applications over the previous 5 years standardized by the total population), is not significantly correlated with a region's productivity growth. Instead, the negative and significant (column 10) coefficient of the Herfindahl-Hirschman index suggests that regions with a more diversified industrial structure experience a higher productivity growth, pointing to the the existence of some *Jacobian*-type of externalities (see Glaeser *et al.*, 1992; Henderson *et al.*, 1995; Bracalente and Perugini, 2008, among others). Regional size (proxied by the level of population) and employment density (respectively in columns 5 and 6) are, surprisingly, not significantly related with productivity growth. Coastal regions show, on average, higher productivity growth rates than non-coastal regions but the effect is not significant (columns 7 and 10). Capital regions experience significantly higher productivity growth rates (columns 8 and 10), in line with the expected positive effect played by the concentration of economic activity taking place in a country's capital (Moomaw, 1981) and the same is true for regions benefiting from European structural funds (columns 9 and 10), which certainly had a positive effect on laggard European regions (Fiaschi *et al.*, 2009).

Given that previous studies have underlined the relevance of the 'quality' of the industrial structure for explaining differences in regional growth rates (Paci and Pigliaru, 1999; Marelli, 2004; Ezcurra *et al.*, 2005), we also include the employment shares in the manufacturing (together with construction) and services sectors (excluding the employment share in agriculture to avoid multi-collinearity) among the determinants of productivity growth of European regions. Column 11 shows that, *ceteris paribus*, regions with higher shares of employees in the service sectors (at the beginning of the period) show higher productivity growth rates than agriculture-intensive regions (the omitted share), and the same is true for regions with higher shares of employees in the industry sector (even if the coefficient turns out not to be statistically significant)[21]. Interestingly enough

[21]We have also entered one by one the three employment shares in the baseline specification and the results, which are available from authors upon request, are stable. A finer classification of the service sectors is available from Cambridge Econometrics, but this would only increase multi-collinearity problems,

Table 3: Econometric results - Baseline specification without FDIs (OLS)

		1	2	3	4	5	6	7	8	9	10	11
Variable	Coefficient	Dependent variable: $\Delta y_{ij,2007-11}$										
$\Delta\bar{k}_{ij,2007-11}$	β	0.0594*	0.061*	0.0637*	0.062*	0.0572	0.059	0.0576	0.0642*	0.0673*	0.0837***	0.080**
		(0.0359)	(0.0355)	(0.0368)	(0.0354)	(0.0348)	(0.0361)	(0.0361)	(0.0352)	(0.035)	(0.0321)	(0.032)
$hcap_{ij,2007}$	δ_{hcap}		0.00709**								0.00748*	0.00506
			(0.00307)								(0.00385)	(0.00428)
$tech_{ij,2007}$	δ_{tech}			-0.00105							-0.00138	-0.00159
				(0.000901)							(0.00104)	(0.00112)
$hhi_{ij,2007}$	δ_{hhi}				-0.0074						-0.0204*	-0.0303**
					(0.0101)						(0.0115)	(0.0123)
$pop_{ij,2007}$	δ_{pop}					-0.000958					-0.00208	-0.00172
						(0.00107)					(0.00135)	(0.00128)
$density_{ij,2007}$	$\delta_{density}$						0.000133				0.000566	0.0000767
							(0.00063)				(0.000866)	(0.000873)
$coast$	δ_{coast}							0.00115			0.00089	0.000147
								(0.00137)			(0.00148)	(0.0015)
$capital$	$\delta_{capital}$								0.00533**		0.00656**	0.0041
									(0.00227)		(0.00289)	(0.00302)
$obj1$	δ_{obj1}									0.00414**	0.00585***	0.0051***
										(0.00191)	(0.00196)	(0.00191)
$share^{IND}_{ij,2007}$	$\delta_{share^{IND}}$											0.00822
												(0.0231)
$share^{SERV}_{ij,2007}$	$\delta_{share^{SERV}}$											0.0361*
												(0.0185)
Constant	α	-0.00399***	-0.024***	-0.00399***	-0.0153	0.00238	-0.00361	-0.00399***	-0.00459***	-0.00446***	-0.042*	-0.0807***
		(0.00142)	(0.00881)	(0.00146)	(0.0154)	(0.00727)	(0.00224)	(0.00143)	(0.00144	(0.00131)	(0.0237)	(0.0276)
Country dummies	η_j	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Log-likelihood		872	876	873	873	873	872	873	876	875	889	892
Adjusted R^2		0.637	0.645	0.638	0.636	0.637	0.635	0.636	0.645	0.643	0.670	0.674
Observations		262	262	262	262	262	262	262	262	262	262	262
Regions		262	262	262	262	262	262	262	262	262	262	262

Significance levels: * 10%, ** 5%,*** 1%
Cluster-robust standard errors in brackets

in column 11, part of the explanatory power previously attributed (see column 10) to human capital and being the region of the country's capital is picked up by the regional industrial structure, confirming that services- (and industry-)intensive regions also show higher endowments of human capital (Karahasan and Lopez-Bazo, 2013) and are *loci* of cities (capitals) of larger size (Viladecans-Marsal, 2004).

6.2 The role of outward foreign direct investments

In this section we focus on the role played by outward FDIs in enhancing regional productivity growth, estimating Equation 1 by OLS: results are shown in Table 4.

In column (1), we look at the effects of outward foreign direct investments on productivity growth rates, after controlling for the number of investments attracted by the region, physical capital deepening and the vector $\mathbf{z}_{ij,2007}$ of other regional characteristics at the beginning of the period. The sign and statistical significance of the γ coefficient suggests a negative (conditional) correlation between the number of outward FDIs and subsequent regional productivity growth. Conversely, the λ coefficient hints into a positive relationship between inward FDIs and regional productivity growth, even if not statistically significant. It is worth recalling that the correlation between $\overline{OUT}_{ij,2003-07}$ and $\overline{INW}_{ij,2003-07}$ is rather high (0.7594, as reported in Appendix) and, as hinted in Section 3, both variable are correlated with some regional characteristics, such as employment density and human capital. These correlations may explain why λ is rather imprecisely estimated. At the same time, this result suggests that $\overline{OUT}_{ij,2003-07}$ is able to better capture the cross-regional variation in productivity growth.

The negative effect played by outward foreign investments may be the result of different effects exerted by different 'types' of investments. In order to explore this possibility, we introduce in column (2) the number of investments in manufacturing, sales and other business activities.

Interestingly enough, outward investments in manufacturing activities (γ^{man}) are negatively correlated with subsequent productivity growth, while outward investments in sales activities (γ^{sal}) are positively correlated. This is consistent with the idea that even if firms may improve their own productivity by offshoring manufacturing activities (as revealed in a number of studies using firm-level data, such as Branstetter, 2006; Griffith *et al.*, 2006; Debaere *et al.*, 2010; Barba Navaretti *et al.*, 2010), at the local level there may be some negative effects due to possible substitution of domestic suppliers with foreign ones, or even negative spillovers. Conversely, when firms establish sales-related outposts abroad, they may boost productivity in their region, by increasing demand for inputs supplied by firms located at home, and possibly providing positive knowledge externalities, stemming from knowledge acquired in foreign markets (e.g. when firms need to adapt products to foreign markets). Admittedly, an accurate assessment of these various effects would require the use of firm-level data, in order to assess the direct effect of offshoring on productivity and size of the firms investing abroad, and the indirect effects on the size,

without adding much information. Unofortunately, more disaggregated information for manufacturing industries is not available. Results using finer sectoral disaggregation are available from the authors upon request.

Table 4: Econometric results - Outward FDIs and productivity growth (OLS)

		1	2	3	4	5
Variable	Coefficient	Dependent variable: $\Delta\overline{y}_{ij,2007-11}$				
$\overline{OUT}_{ij,2003-07}$	γ	-0.0000402**				
		(0.0000197)				
$\overline{OUT}^{man}_{ij,2003-07}$	γ^{man}		-0.000235**			
			(.000107)			
$\overline{OUT}^{sal}_{ij,2003-07}$	γ^{sal}		0.000172**			
			(0.0000771)			
$\overline{OUT}^{other}_{ij,2003-07}$	γ^{other}		-0.000114**			
			(0.0000522)			
$\overline{OUT}^{intraEU,man}_{ij,2003-07}$	$\gamma^{intraEU,man}$			-0.00029		0.000158
				(0.000235)		(0.000313)
$\overline{OUT}^{intraEU,sal}_{ij,2003-07}$	$\gamma^{intraEU,sal}$			0.000174		0.0000681
				(0.000131)		(0.000153)
$\overline{OUT}^{intraEU,other}_{ij,2003-07}$	$\gamma^{intraEU,other}$			-0.000196		0.0000885
				(0.000129)		(0.000144)
$\overline{OUT}^{extraEU,man}_{ij,2003-07}$	$\gamma^{extraEU,man}$				-0.000431***	-0.000573**
					(0.000153)	(0.000262)
$\overline{OUT}^{extraEU,sal}_{ij,2003-07}$	$\gamma^{extraEU,sal}$				0.000332**	0.000259*
					(0.000138)	(0.000157)
$\overline{OUT}^{extraEU,other}_{ij,2003-07}$	$\gamma^{extraEU,other}$				-0.000165**	-0.000178**
					(0.0000688)	(0.0000811)
$\overline{INW}_{ij,2003-07}$	λ	0.0000749	0.0000905	0.0000489	0.0000952	0.000102
		(0.0000534)	(0.0000589)	(0.0000527)	(0.0000616)	(0.0000624)
$\Delta\overline{k}_{ij,2007-11}$	β	0.0823***	0.0858***	0.0861***	0.0826***	0.0817***
		(0.0313)	(0.0319)	(0.0322)	(0.0316)	(0.0323)
$hcap_{ij,2007}$	δ_{hcap}	0.00475	0.00529	0.00529	0.00491	0.00534
		(0.00433)	(0.00431)	(0.00439)	(0.00425)	(0.00432)
$tech_{ij,2007}$	δ_{tech}	-0.00148	-0.00174	-0.00167	-0.0017	-0.00171
		(0.00109)	(0.00111)	(0.00114)	(0.0011)	(0.00113)
$hhi_{ij,2007}$	δ_{hhi}	-0.0265**	-0.0220*	-0.0245*	-0.0231*	-0.0234*
		(0.0128)	(0.0131)	(0.0134)	(0.0128)	(0.0132)
$pop_{ij,2007}$	δ_{pop}	-0.00161	-0.00173	-0.0015	-0.00185	-0.00203
		(0.00133)	(0.00138)	(0.00137)	(0.00139)	(0.00142)
$density_{ij,2007}$	$\delta_{density}$	0.00028	0.000104	0.000135	0.000121	0.0000219
		(0.00089)	(0.000909)	(0.000893)	(0.000912)	(0.00092)
$coast$	δ_{coast}	0.000132	-0.000173	-0.0000856	-0.000117	-0.0000336
		(0.0015)	(0.00152)	(0.00152)	(0.0015)	(0.00153)
$capital$	$\delta_{capital}$	0.00415	0.00584	0.00611*	0.00526	0.00391
		(0.00348)	(0.00355)	(0.00357)	(0.00366)	(0.00359)
$obj1$	δ_{obj1}	0.00497***	0.00512***	0.00494***	0.00531***	0.00538***
		(0.00193)	(0.00184)	(0.00188)	(0.00185)	(0.00186)
$share^{IND}_{ij,2007}$	$\delta_{share^{IND}}$	0.00267	0.00465	0.00659	0.00307	0.00369
		(0.0233)	(0.0239)	(0.0238)	(0.0236)	(0.0238)
$share^{SERV}_{ij,2007}$	$\delta_{share^{SERV}}$	0.0263	0.0205	0.0263	0.0208	0.0209
		(0.0187)	(0.0189)	(0.019)	(0.0188)	(0.0191)
Constant	α	-0.0656**	-0.0562*	-0.0650**	-0.0569*	-0.0591*
		(0.0298)	(0.0314)	(0.0307)	(0.0311)	(0.0317)
Country dummies	η_j	Yes	Yes	Yes	Yes	Yes
Log-likelihood		894	898	895	899	900
Adjusted R^2		0.676	0.683	0.674	0.685	0.682
Observations		262	262	262	262	262
Regions		262	262	262	262	262

Significance levels: * 10%, ** 5%,*** 1%
Cluster-robust standard errors in brackets

entry/exit and productivity of other local firms[22]. The 'other' category (γ^{other}) shows a negative coefficient, but the result is difficult to interpret, due to the high heterogeneity in terms of 'types' of investments that enter this category.

Despite the small size of the coefficients, the economic relevance of the effects of outward FDIs on regional productivity growth is not negligible. In order to gauge this economic significance, we need to keep in mind that the dependent variable is the yearly growth rate of labour productivity over the period 2007-2011 which, as reported in Table 2, on average is quite low (0.158 percent) and the variables measuring outward FDIs are expressed in number of investments projects. We can trasform the coefficients into elasticities by multiplying them by the ratio between outward investments and labour productivity growth, evalutated at the mean region[23]. Considering that, as reported in Table 2, the average region has 4.96 outward FDI projects in manufacturing ($\overline{OUT}^{man}$) and 6.94 projects in sales activities ($\overline{OUT}^{sales}$), a 10% increase in $\overline{OUT}^{man}$ is associated with drop in regional productivity growth of 7.3% (or 0.116 percentage points) and a 10% increase in $\overline{OUT}^{sales}$ is associated with an increase in regional productivity growth of 7.5% (or 0.119 percentage points).

As for the control variables, results are rather consistent with Table 3. In particular, regions experiencing higher productivity growth are those where physical capital-deepening is more pronounced, with a more diversified industrial structure, hosting the country capital and benefiting from European structural funds.

One interesting question, which bears some policy implications, is whether the the negative effect of outward FDIs in manufacturing and other activities is related to the re-organization of production within the EU, or if it is rather due to shifting production outside the EU. Exploiting the information on the destination country of each project, we were able to construct measures of intra-EU and extra-EU FDIs, again singling them out by business activity. With these new variables, we re-estimate Equation 1, separating those investments directed toward a destination within the EU from those directed outside the EU. First, in columns (3) and (4) we insert the two groups of variables separately in the regressions: results suggest that manufacturing and other investments both within and outside the EU show negative relationships with the home region productivity. However, only those directed outside the EU retain statistical significance (column 4). At the same time only investments in sales activities directed outside the EU are positively correlated with subsequent productivity growth. The two group of variables are clearly very correlated, since regions investing towards non-EU countries are also investing within the EU[24]. When we include all of them jointly in the regression (column 5), it turns out that only the investments directed outside the EU retain statistically significant coefficients,

[22] An interesting example of micro-foundation of regional productivity dynamics is Altomonte and Colantone (2009). However, this study is limited to one country (Romania) and focuses only on the contribution of inward FDIs.

[23] More formally, since $\gamma^{\ell} = \frac{\partial y}{\partial \overline{OUT}^{\ell}}$, with $\ell = man, sal, other$, we can write the elasticity of y with respect to $\overline{OUT}^{\ell}$ as $\xi_{\overline{OUT}^{\ell}} = \frac{\partial y / y}{\partial \overline{OUT}^{\ell} / \overline{OUT}^{\ell}} = \gamma^{\ell} \times \frac{\overline{OUT}^{\ell}}{y}$. Inter alia, one could compute the absolute change in labour productivity growth associate with a percentage increase in $\overline{OUT}^{\ell}$, as $\gamma^{\ell} \times \overline{OUT}^{\ell}$.

[24] As a matter of fact, Pearson's correlation coefficient between investments within the EU and outside it is close to 0.9. (see the correlation matrix in the Appendix).

confirming the signs of the relationships.

All in all, the negative correlation between outwards investments and regional productivity is mainly due to manufacturing (and other activities) investments toward non-EU countries, while investments in sales activities outside the EU show a positive relationship with subsequent productivity growth.

6.3 Robustness checks

In this section we carry out several robustness checks in order to validate the consistency of the main results presented in Table 4.

6.3.1 Outward investments, gross value added and employment growth

While an increase in labor productivity is a desirable outcome for the long term growth of a region, if it was achieved by 'destroying' jobs (the denominator of the labor productivity measure), policy makers would certainly be worried about the short term consequences. We test for this possibility by estimating separate regressions of the growth of gross value added (columns 1 and 2 of Table 5) and employment (columns 3 and 4 of Table 5) on our measure of outward FDIs and the control variables.

Results do not show negative correlation of outward FDI (neither in manufacturing or sales, nor in other types of investments) on employment growth. Conversely, both the negative relationship between manufacturing (and other activities) investments and subsequent productivity growth and the positive one between investments in sales and regional productivity pass completely through subsequent changes in gross value added.

6.3.2 Sample composition

Given that the dependent variable of our analysis is observed and computed through the first four years of the current economic crisis (2007-2011) and given the emerging literature on the relationships between FDIs and the crisis (Alfaro and Chen, 2012), our estimates may actually pick up the specific trends in labor productivity experienced by different regions (and countries) during this peculiar time period. In particular we have in mind countries like Spain, Portugal and Ireland in which labor productivity growth recovery since the beginning of the current crisis has been driven by a fast drop in the level of employment (denominator of the labor productivity measure) instead of significant increases in gross value added (numerator of labor productivity).

While this explanation could probably be excluded already on the basis of results in Section 6.3.1, we re-estimate Equation 1 without Spanish, Portuguese and Irish regions: results are shown in column 2 of Table 6. Even having taken 25 regions off the sample, results are in line with those contained in column 1 (that replicates our main results contained in column 2 of Table 4). The negative relationship between outward investments in manufacturing and productivity growth is confirmed, even if smaller in magnitude and not statistically significant, while the positive one between investments in sales and productivity is smaller in magnitude but robust in terms of statistically significance.

A different issue relates to the level of aggregation of regions in our sample. In particular, while the NUTS 2 level of aggregation provides us with comparable administrative

Table 5: Econometric results - Robustness checks: Outward FDIs, gross value added and employment growth (OLS)

Variable	Coefficient	1	2	3	4
		Dependent variable: $\Delta\overline{gva}_{ij,2007-11}$		Dependent variable: $\Delta\overline{emp}_{ij,2007-11}$	
$\overline{OUT}^{man}_{ij,2003-07}$	γ^{man}	-0.000234**		0.000001	
		(0.0000943)		(0.0000672)	
$\overline{OUT}^{sal}_{ij,2003-07}$	γ^{sal}	0.000148**		-0.0000245	
		(0.0000668)		(0.0000521)	
$\overline{OUT}^{other}_{ij,2003-07}$	γ^{other}	-0.000123**		-0.00001	
		(.0000523)		(.0000394)	
$\overline{OUT}^{intraEU,man}_{ij,2003-07}$	$\gamma^{intraEU,man}$		0.00048		0.000322
			(0.000303)		(0.000222)
$\overline{OUT}^{intraEU,sal}_{ij,2003-07}$	$\gamma^{intraEU,sal}$		0.000096		0.0000279
			(0.000124)		(0.0000913)
$\overline{OUT}^{intraEU,other}_{ij,2003-07}$	$\gamma^{intraEU,other}$		-0.000177		-0.000266***
			(0.000147)		(0.0000953)
$\overline{OUT}^{extraEU,man}_{ij,2003-07}$	$\gamma^{extraEU,man}$		-0.000722***		-0.000148
			(0.000248)		(0.00016)
$\overline{OUT}^{extraEU,sal}_{ij,2003-07}$	$\gamma^{extraEU,sal}$		0.0002		-0.0000584
			(0.000147)		(0.000108)
$\overline{OUT}^{extraEU,other}_{ij,2003-07}$	$\gamma^{extraEU,other}$		-0.0000433		0.000135***
			(0.0000806)		(0.0000424)
$\overline{INW}_{ij,2003-07}$	λ	0.000155**	0.000162**	0.0000641*	0.0000597
		(0.0000611)	(0.0000646)	(0.000037)	(0.0000384)
$\Delta\overline{k}_{ij,2007-11}$	β	0.0317	0.0292	-0.0541**	-0.0525**
		(0.0259)	(0.0260)	(0.0252)	(0.0257)
$hcap_{ij,2007}$	δ_{hcap}	0.00835**	0.00872**	0.00306	0.00339
		(0.00393)	(0.00395)	(0.00369)	(0.00373)
$tech_{ij,2007}$	δ_{tech}	-0.0000321	-0.000187	0.00171	0.00152
		(.000982)	(.000985)	(.00099)	(.000987)
$hhi_{ij,2007}$	δ_{hhi}	-0.0175	-0.0173	0.00457	0.00609
		(0.0119)	(0.012)	(0.01)	(0.0102)
$pop_{ij,2007}$	δ_{pop}	-0.00271*	-0.00294*	-0.000975	-0.000903
		(0.00147)	(0.00153)	(0.000684)	(0.000699)
$density_{ij,2007}$	$\delta_{density}$	-0.000649	-0.000776	-0.000752	-0.000798
		(0.000923)	(0.000924)	(0.00062)	(0.00061)
$coast$	δ_{coast}	0.000783	0.00102	0.000956	0.00105
		(0.00128)	(0.00129)	(0.00124)	(0.00125)
$capital$	$\delta_{capital}$	0.00564	0.00514	-0.000201	0.00123
		(0.00367)	(0.00378)	(0.00242)	(0.00267)
$obj1$	δ_{obj1}	0.00217	0.00251	-0.00295**	-0.00287*
		(0.00191)	(0.00189)	(0.00146)	(0.00148)
$share^{IND}_{ij,2007}$	$\delta_{share^{IND}}$	-0.0225	-0.0237	-0.0271	-0.0274
		(0.0181)	(0.0176)	(0.0181)	(0.0180)
$share^{SERV}_{ij,2007}$	$\delta_{share^{SERV}}$	0.0331**	0.0330**	0.0126	0.0121
		(0.0147)	(0.015)	(0.0164)	(0.0165)
Constant	α	-0.0458	-0.0474	0.0104	0.0117
		(0.0296)	(0.0301)	(0.0250)	(0.0251)
Country dummies	η_j	Yes	Yes	Yes	Yes
Log-likelihood		930	932	973	975
Adjusted R^2		0.822	0.823	0.797	0.798
Observations		262	262	262	262
Regions		262	262	262	262

Significance levels: * 10%, ** 5%,*** 1%
Cluster-robust standard errors in brackets

units across European countries, we are aware that it may contain a non-negligible degree of variability both in terms of geographic and economic 'size' of regions. This is especially true for countries like UK and Germany, where non-metropolitan counties (for example Cheshire, in the case of UK) are compared to much bigger ones (for example, London). Our choice of controlling for the size of the region (in terms of population) should partially account for this issue but, as a further robustness check, we have re-estimated Equation 1 without UK and German regions: results are shown in column (3) of Table 6.

The coefficients associated with outward FDIs, for all types of business activities, are very similar in magnitude to those shown in column (1), even if, due to the remarkable reduction in terms of sample size –as UK and Germany account for 75 regions in our sample, so that observations drop from 262 to 187– coefficients are less precisely estimated: this can be appreciated from the abrupt increase in the standard errors of the γ^{man}, γ^{sal} and γ^{other} coefficients.

6.3.3 Pooled cross-section analysis

Our preferred specification is a cross-section of a four year growth rate in productivity (2007-2011) as a function of the average number of outward FDI project over the preceding four-year period (2003-2007). This allows us to reduce noise and measurement error in growth rates and FDI flows over short periods of time, allows a sufficient amount of time for the effects of FDI on productivity growth to manifest, and helps reduce endogeneity issues. However, by relying on a cross-section, our results may be affected by the specific time period under analysis. As a further robustness check, we present results using three, two and one-year differences. This allows us to exploit the longitudinal dimension of our data, by estimating a pooled cross-section model. In Table 7 we have estimated the effect of outward FDIs on productivity growth either with two (column 2), three (column 3) or eight non-overlapping cross-sections. In each case we have included a vector of year dummies in the regression, in order to control for common shocks to productivity growth that may have affected all regions in the same way in the same year. Results are rather consistent with those in column 2 of Table 4 (and replicated in column 1 of Table 7) based on a single cross-section of four years difference, both in terms of sign and magnitude of the coefficients of outward and inward FDIs. Nonetheless, we acknowledge a decrease in the magnitude of the coefficient γ^{man}, referring to outward investments in manufacturing activities, a decrease in the magnitude and significance of the coefficient γ^{sal} associated with outward FDIs in sales activities which also holds for γ^{other}, the residual category of outward FDIs.

Overall, our robustness checks suggest that the link between outward FDIs and subsequent productivity growth passes through changes in gross value added and not through an undesirable drop in the level of regional employment. Moreover, econometric results seem rather robust to controlling for the 'peculiar' period of time under analysis that embraces the first four years of the current economic crisis and to controlling for the geographic and economic heterogeneity which is 'inherent' to the choice of adopting the NUTS 2 classification. Finally, results are also relatively stable to a pooled cross-section analysis, based on growth rates over shorter periods of time.

Table 6: Econometric results - Robustness checks: sample composition (OLS)

		1	2	3
		Dependent variable: $\Delta\overline{y}_{ij,2007-11}$		
Variable	Coefficient	(a)	(b)	(c)
$\overline{OUT}^{man}_{ij,2003-07}$	γ^{man}	-0.000235**	-0.000153	-0.000291
		(0.000107)	(0.000105)	(0.000207)
$\overline{OUT}^{sal}_{ij,2003-07}$	γ^{sal}	0.000172**	0.000142**	0.000171
		(0.000077)	(0.000071)	(0.000165)
$\overline{OUT}^{other}_{ij,2003-07}$	γ^{other}	-0.000114**	-0.000147***	-0.0000402
		(0.000052)	(0.000054)	(0.000089)
$\overline{INW}_{ij,2003-07}$	λ	0.000090	0.000128**	0.000036
		(0.000059)	(0.000062)	(0.000082)
$\Delta\overline{k}_{ij,2007-11}$	β	0.08581**	0.0697**	0.1703***
		(0.031868)	(0.031818)	(0.048878)
$hcap_{ij,2007}$	δ_{hcap}	0.005291	0.005027	-0.006664
		(0.004306)	(0.004560)	(0.006022)
$tech_{ij,2007}$	δ_{tech}	-0.001739	-0.00207*	0.000934
		(0.001113)	(0.001159)	(0.001364)
$hhi_{ij,2007}$	δ_{hhi}	-0.0220*	-0.01403	-0.0283*
		(0.013112)	(0.013435)	(0.015790)
$pop_{ij,2007}$	δ_{pop}	-0.001732	-0.002012	-0.001906
		(0.001376)	(0.001526)	(0.001466)
$density_{ij,2007}$	$\delta_{density}$	0.000104	-0.000122	0.001329
		(0.000909)	(0.000999)	(0.001236)
$coast$	δ_{coast}	-0.000173	0.000244	-0.000832
		(0.001516)	(0.001673)	(0.002114)
$capital$	$\delta_{capital}$	0.005837	0.003000	0.00842*
		(0.003552)	(0.004021)	(0.004414)
$obj1$	δ_{obj1}	0.00512***	0.003649*	0.004203*
		(0.001839)	(0.002169)	(0.002405)
$share^{IND}_{ij,2007}$	$\delta_{share^{IND}}$	0.004652	0.005941	-0.007390
		(0.023870)	(0.024383)	(0.029004)
$share^{SERV}_{ij,2007}$	$\delta_{share^{SERV}}$	0.020497	0.036412	0.015814
		(0.018925)	(0.018936)	(0.021779)
Constant	α	-0.0562*	-0.0532*	-0.0213
		(0.031431)	(0.032198)	(0.037233)
Country dummies	η_j	Yes	Yes	Yes
Log-likelihood		898	815	641
Adjusted R^2		0.682	0.622	0.718
Observations		262	237	187
Regions		262	237	187

Significance levels: * 10%, ** 5%,*** 1%
Cluster-robust standard errors in brackets

Notes:
(a): Column (1) refers to the entire sample of 262 regions.
(b): Column (2) shows the estimation excluding Spanish, Portuguese and Irish regions.
(c): Column (3) shows the estimation excluding German and UK regions.

Table 7: Econometric results - Robustness checks: pooled cross-section analysis (OLS)

		1	2	3	4
		Dependent variable: $\Delta\overline{y}_{ij,t}$			
Variable	Coefficient	(a)	(b)	(c)	(d)
$\overline{OUT}^{man}_{ij,previous}$	γ^{man}	-0.000235**	-0.000153*	-0.000184*	-0.000268***
		(0.000107)	(0.000089)	(0.000097)	(0.000100)
$\overline{OUT}^{sal}_{ij,previous}$	γ^{sal}	0.000172**	0.000090	0.000098*	0.000101*
		(0.000077)	(0.000057)	(0.000052)	(0.000054)
$\overline{OUT}^{other}_{ij,previous}$	γ^{other}	-0.000114**	-0.000018	-0.000025	-0.000064*
		(0.000052)	(0.000061)	(0.000039)	(0.000036)
$\overline{INW}_{ij,previous}$	λ	0.000090	-0.000051	-0.000026	0.000013
		(0.000059)	(0.000088)	(0.000052)	(0.000046)
$\Delta\overline{k}_{ij,contemporaneous}$	β	0.085811**	0.174715***	0.079862**	0.236682***
		(0.031868)	(0.029467)	(0.031203)	(0.026825)
$hcap_{ij,beginning}$	δ_{hcap}	0.005291	0.002845	0.011630***	-0.005137
		(0.004306)	(0.003666)	(0.003503)	(0.003587)
$tech_{ij,beginning}$	δ_{tech}	-0.001739	-0.004732***	-0.004260***	-0.003115***
		(0.001113)	(0.001049)	(0.001068)	(0.001137)
$hhi_{ij,beginning}$	δ_{hhi}	-0.022042**	-0.011187	-0.001337	0.004837
		(0.013112)	(0.012865)	(0.011428)	(0.012935)
$pop_{ij,beginning}$	δ_{pop}	-0.001732	0.000644	0.000483	0.001525
		(0.001376)	(0.000957)	(0.000895)	(0.000946)
$density_{ij,beginning}$	$\delta_{density}$	0.000104	0.000366	0.000189	-0.000542
		(0.000909)	(0.000792)	(0.000763)	(0.000772)
$coast$	δ_{coast}	-0.000173	-0.003525***	-0.002883**	-0.003387**
		(0.001516)	(0.001257)	(0.001112)	(0.001356)
$capital$	$\delta_{capital}$	0.005837	0.012332***	0.005223	0.018464***
		(0.003552)	(0.003717)	(0.003361)	(0.003781)
$obj1$	δ_{obj1}	0.005116***	0.001276	0.000750	0.002019
		(0.001839)	(0.001796)	(0.001458)	(0.002030)
$share^{IND}_{ij,beginning}$	$\delta_{share^{IND}}$	0.004652	0.039152*	0.029891	0.023426
		(0.023870)	(0.022951)	(0.018394)	(0.023680)
$share^{SERV}_{ij,beginning}$	$\delta_{share^{SERV}}$	0.020497	0.012839	0.011891	-0.004138
		(0.018925)	(0.020398)	(0.015367)	(0.019749)
Constant	α	-0.056168**	-0.043037	-0.048553**	0.012944
		(0.031431)	(0.033273)	(0.024325)	(0.030685)
Country dummies	η_j	Yes	Yes	Yes	Yes
Year dummies	τ_t	No	Yes	Yes	Yes
Log-likelihood		898	1500	1890	4470
Adjusted R^2		0.68	0.33	0.14	0.14
Observations		262	523	785	2090
Regions		262	262	262	262

Significance levels: * 10%, ** 5%,*** 1%
Cluster-robust standard errors in brackets

Notes:
(a): Column (1), for aim of comparison, shows the results contained in column 2 of Table 4.
(b): Column (2) refers to two three-year non-overlapping cross-sections: 2011-08 and 2008-05.
(c): Column (3) refers to three two-year non-overlapping cross-sections: 2011-09, 2009-07, 2007-05.
(d): Column (4) refers to eight one-year non-overlapping cross-sections, i.e. from 2011-10 to 2004-03.

7 Concluding remarks

Despite the increasing evidence of integration of sub-national economies in the global arena, and the positive role of multinational firms for economic prosperity in local economies documented in a number of recent studies, evidence on the relationship between outward orientation of regions and their economic performance is lacking.

Exploiting an original and extensive dataset on international investment projects, we investigate the relationship between outward foreign investments and productivity growth in a sample of 262 European (NUTS 2) regions. In particular, we explain productivity growth differences across European regions over the period 2007-2011 with the number of outward investment projects over the period 2003-2007, controlling for the number of incoming projects by foreign multinational firms and other region-specific characteristics. This long-difference specification helps reduce noise and measurement error which may characterize productivity growth and FDI flows over one or two years periods, and it ensures a relatively long period of time for FDI to exert an impact on productivity growth. At the same time, it allows us to account for regional heterogeneity in the level of productivity and FDI stock, and control for some of the residual heterogeneity by introducing country-fixed effects and some regional characteristics. This, together with the fact that FDI flows are averaged over the four-year period preceding the period when we observe labour productivity growth, should lessen concerns about endogeneity. However, we cannot exclude that some residual element of endogeneity remain, and this prevents us from making strong causal statements.

Furthermore, a word of caution about the data used (fDi Markets) is also needed. While this is probably the only source of data that allows some comparison of a proxy of outward investments (in different business functions and for a relatively long period of time) at the regional level across Europe, it has some limitations. First, information on the value of investment projects is estimated for a large number of cases, so in this paper we prefer to rely on the number of projects, which is clearly an imperfect measure if there is a systematic tendency of some regions to engage in larger projects. Second, projects are assigned to the legal unit of the parent company making the investments, which is not always located in the same region as the actual plants. This forces us to assume that outward investments affect productivity of the home region of the legal unit of the firm, and this may be a strong assumption in some cases of large multi-plant MNEs. Third, fDi Markets collects only information on greenfield projects, so it does not allow to test for the effects of outward investments occurring through acquisitions of firms in foreign countries. Despite these limitations, given the scarcity of previous evidence on the home region effect of outward FDIs, we believe that this paper provides interesting and most needed evidence into the association between outward investments and home region productivity growth.

Results support the idea that outward FDIs may be negatively associated with subsequent productivity growth at the regional level. However, this finding hides some heterogeneous effects exerted by different types of investments. In fact, while foreign investments in manufacturing are negatively associated with productivity growth (especially when directed towards non-EU countries), investments in sales-related activities are positively associated with subsequent productivity growth. Overall, the re-organization of production within the EU does not significantly affect productivity growth at the regional level, while moving manufacturing activities outside the EU may ultimately have a negative effect on the productivity growth of EU regions. Results provide support to the thesis of those warning against the risks of de-industrialization of the EU, and would call for the importance of maintaining a strong manufacturing base in Europe, as advocated, among others, by the European Commission (European Commission, 2012, 2014) in some recent communications. At the same time, our evidence points to the importance of a structured outward orientation of EU firms. To the extent that opening up marketing, distribution and sales posts abroad is an important tool to boost home region productivity growth, it becomes crucial for EU firms to be able to overcome the costs of such internationalization strategy.

More generally, our findings suggest that investing abroad may affect productivity in the home region, through some reallocation effect. In fact, it is most likely that outward investments in marketing, distribution and sales activities contribute to increase the overall sales of the internationalizing firms and (possibly) their suppliers. As a matter of fact, this type of investments usually do not substitute production at home, and instead they increase the market penetration of the firm. To the extent that such firms (and their suppliers) are relatively more productive than the average firm in the region, an increase in overall sales contributes to increase aggregate productivity. This hypothesis, which as been referred to as the micro-foundation of regional disparities (Altomonte and Colantone, 2009) cannot be directly corroborated with the evidence provided in this paper –because it would require firm-level data aggregated at the regional level– but this would be a very interesting direction for future research along the lines of this paper.

Acknowledgments

The authors wish to thank two anonymous referees for their useful remarks on a previous version of the paper. The usual disclaimer applies. Financial support from the Italian Ministry of University and Research (PRIN 2009 Project on 'Production, R&D and knowledge offshoring: economic analyses and implications for Italy') (Castellani) and the Spanish Ministry of Science and Innovation (project MINECO ECO2011-27619, co-financed with FEDER) (Pieri) is greatly acknowledged.

References

Alfaro L. and Chen M. X. (2012) Surviving the Global Financial Crisis: Foreign Ownership and Establishment Performance, *American Economic Journal: Economic Policy* **4**(3), 30–55.

Altomonte C. and Colantone I. (2009) Firm heterogeneity and endogenous regional disparities, *Journal of Economic Geography* **8(6)**, 779–810.

Audretsch D. B. and Feldman M. P. (2004) Knowledge spillovers and the geography of innovation, in Henderson J. V. and Thisse J. F. (Eds.) *Handbook of Regional and Urban Economics*, vol. 4, pp. 2713–2739, Elsevier, North-Holland.

Badinger H. and Tondl G. (2005) The factors behind european regional growth. trade, human capital and innovation, *Review of Regional Research (former Jahrbuch fur Regionalwissenschaft)* **25 (1)**, 67–89.

Barba Navaretti G., Castellani D. and Disdier A.-C. (2010) How does investing in cheap labour countries affect performance at home? france and italy, *Oxford Economic Papers* **62 (2)**, 234–260.

Barba Navaretti G. and Venables A. J. (2004) *Multinational Firms in the World. Economy*, Princeton University Press.

Basile R., Benfratello L. and Castellani D. (2013) Geoadditive models for regional count data: An application to industrial location, *Geographical Analysis* **45**(1), 28–48.

Basile R., Castellani D. and Zanfei A. (2008) Location choices of multinational firms in europe: The role of eu cohesion policy, *Journal of International Economics* **74**, 328–340.

Benhabib J. and Spiegel M. (1994) The role of human capital in economic development: evidence from aggregate cross-country data, *Journal of Monetary Economics* **34**, 143–174.

Bitzer J. and Görg H. (2009) Foreign direct investment, competition and industry performance, *The World Economy* **31**(2), 221–233.

Bobonis G. J. and Shatz H. J. (2007) Agglomeration, adjustment, and state policies in the location of foreign direct investment in the united states, *The Review of Economics and Statistics* **89**(1), 30–43.

Boschma R. and Iammarino S. (2009) Related Variety, Trade Linkages, and Regional Growth in Italy, *Economic Geography* **85**(3), 289–311.

Bracalente B. and Perugini C. (2008) The components of regional disparities in europe, *The Annals of Regional Science* **44 (3)**, 621–645.

Branstetter L. (2006) Is foreign direct investment a channel of knowledge spillovers? evidence from japan's fdi in the united states, *Journal of International Economics* **68**(2), 325 – 344.

Bronzini R. and Piselli P. (2009) Determinants of long-run regional productivity with geographical spillovers: The role of r&d, human capital and public infrastructure, *Regional Science and Urban Economics* **39**, 187–199.

Canova F. (2004) Testing for convergence clubs in income per capita. a predictive density approach, *International Economic Review* **45 (1)**, 49–78.

Cantwell J. A. (1995) The globalisation of technology: What remains of the product cycle model?, *Cambridge Journal of Economics* **19**(1), 155–74.

Castellani D., Jimenez A. and Zanfei A. (2013) How remote are r&d labs? distance factors and international innovative activities, *Journal of International Business Studies* **44**(7), 649–675.

Castellani D., Meliciani V. and Mirra L. (2014) The determinants of inward foreign direct investment in business services across european regions, *Regional Studies* **forthcoming**.

Castellani D. and Pieri F. (2013) R&D offshoring and the productivity growth of European regions, *Research Policy* **42**(9), 1581–1594.

Castellani D. and Zanfei A. (2006) *Multinational Firms, Innovation and Productivity*, Edward Elgar, Cheltenham.

Ciccone A. (2002) Agglomeration effects in europe, *European Economic Review* **46**(2), 213–227.

Ciccone A. and Hall R. E. (1996) Productivity and the density of economic activity, *American Economic Review* **86**, 54–70.

Cingano F. and Schivardi F. (2004) Identifying the sources of local productivity growth, *Journal of the European Economic Association* **2**(4), 720–742.

Crescenzi R., Pietrobelli C. and Rabellotti R. (2013) Innovation drivers, value chains and the geography of multinational corporations in europe, *Journal of Economic Geography* **forthcoming, 10.1093/jeg/lbt018**.

Crespo N., Fontoura M. P. and Proenca I. (2009) Fdi spillovers at regional level: Evidence from portugal, *Papers in Regional Science* **88**(3), 591–607.

Crozet M., Mayer T. and Mucchielli J.-L. (2004) How do firms agglomerate? a study of fdi in france, *Regional Science and Urban Economics* **34**(1), 27–54.

D'Agostino L. M., Laursen K. and Santangelo G. D. (2013) The impact of r&d offshoring on the home knowledge production of oecd investing regions, *Journal of Economic Geography* **13**(1), 145–175.

DEBAERE P., LEE H. and LEE J. (2010) It matters where you go. outward foreign direct investment and multinationals' employment growth at home, *Journal of Development Economics* **91**(2), 301–309.

DETTORI B., MARROCU E. and PACI R. (2012) Total factor productivity, intangible assets and spatial dependence in the european regions, *Regional Studies* **46**(10), 1401–1416.

DRIFFIELD N. (2004) Regional policy and spillovers from fdi in the uk, *The Annals of Regional Science* **38**, 579–594.

DRIFFIELD N., LOVE J. H. and TAYLOR K. (2009) Productivity and labor demand effects of inward and outward fdi on uk industry, *The Manchester School* **77**, 171–203.

DRIFFIELD N., MENGHINELLO S. and PROPRIS L. D. (2010) Industrial districts, inward foreign investment and regional development, *Journal of Economic Geography* **10 (4)**, 539–558.

DUNNING J. H. and NARULA R. (1996) The investment development path revisited, *Foreign direct investment and governments: Catalysts for economic restructuring* pp. 1–41.

EUROPEAN COMMISSION (2012) A stronger european industry for growth and economic recovery, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions COM(2012) 582, Brussels.

EUROPEAN COMMISSION (2014) For a european industrial renaissance, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions COM(2014) 14/2, Brussels.

EZCURRA R., GIL C., PASCUAL P. and RAPUN M. (2005) Regional inequality in the european union: Does industry mix matter?, *Regional Studies* **39(6)**, 679–697.

FIASCHI D., LAVEZZI A. M. and PARENTI A. (2009) Productivity dynamics across european regions: the impact of structural and cohesion funds, Discussion Papers 2009/84, Dipartimento di Scienze Economiche (DSE), University of Pisa, Pisa, Italy.

FOSFURI A. and MOTTA M. (1999) Multinationals without advantages, *Scandinavian Journal of Economics* **101**(4), 617–30.

GAMBARDELLA A., MARIANI M. and TORRISI S. (2008) How 'provincial' is your region? openness and regional performance in europe, *Regional Studies* pp. 1–13.

GIRMA S. and WAKELIN K. (2007) Local productivity spillovers from foreign direct investment in the u.k. electronics industry, *Regional Science and Urban Economics* **37**(3), 399–412.

GLAESER E., KALLAL H., SCHEINKMAN J. and SHLEIFER A. (1992) Growth in cities, *Journal of Political Economy* **100**, 1126–1152.

Greenaway D. and Kneller R. (2007) Firm heterogeneity, exporting and foreign direct investment, *Economic Journal* **117**(517), F134–F161.

Griffith R., Harrison R. and Van Reenen J. V. (2006) How special is the special relationship? using the impact of u.s. r&d spillovers on u.k. firms as a test of technology sourcing, *American Economic Review* **96**(5), 1859–1875.

Halpern L. and Murakozy B. (2007) Does distance matter in spillover?, *The Economics of Transition* **15**, 781–805.

Hamida L. B. (2013) Are there regional spillovers from fdi in the swiss manufacturing industry?, *International Business Review* **22**(4), 754–769.

Helpman E., Melitz M. and Yeaple S. (2004) Export versus FDI with heterogeneous firms, *American Economic Review* **94**(1), 300–316.

Henderson J., Kuncoro A. and Turner M. (1995) Industrial development of cities, *Journal of Political Economy* **103**, 1067–1090.

Karahasan B. C. and Lopez-Bazo E. (2013) The spatial distribution of human capital: Can it really be. explained by regional differences in market access?, *International Regional Science Review* **36(4)**, 451–480.

Krugman P. (1993) *Geography and Trade*, MIT Press, Cambridge, MA.

Mankiw N. G., Romer D. and Weil D. (1992) A contribution to the empirics of economic growth, *Quarterly Journal of Economics* **107**, 407–437.

Marelli E. (2004) Evolution of employment structures and regional specialisation in the eu, *Economic Systems* **28(1)**, 35–59.

Martin R. (2001) Emu versus the regions? regional convergence and divergence in euroland, *Journal of Economic Geography* **1 (1)**, 51–80.

Moomaw R. L. (1981) Productivity and city size: A critique of the evidence, *The Quarterly Journal of Economics* **96 (4)**, 675–688.

Mullen J. and Williams M. (2007) Foreign direct investment and regional productivity spillovers in us manufacturing, *Review of Urban & Regional Development Studies* **19**(3), 185–196.

Narula R. and Dunning J. (2010) Multinational Enterprises, Development and Globalization: Some Clarifications and a Research Agenda, *Oxford Development Studies* **38**(3), 263–287.

Nicoletti G. and Scarpetta S. (2003) Regulation, productivity and growth: Oecd evidence, *Economic Policy* **18**(36), 9–72.

Paci R. and Pigliaru F. (1999) European regional growth: Do sectors matter?, in Adams J. and Pigliaru F. (Eds.) *Economic growth and change. National and regional patterns of convergence and divergence*, Edward Elgar, Cheltenham.

Paci R. and Usai S. (2000) Technological enclaves and industrial districts: An analysis of the regional distribution of innovative activity in europe, *Regional Studies* **34**(2), 97–114.

Petit M.-L. and Sanna-Randaccio F. (2000) Endogenous r&d and foreign direct investment in international oligopolies, *International Journal of Industrial Organization* **18**(2), 339–367.

Sanguinetti J. S. M. and Fuentes A. (2012) An analysis of productivity performance in spain before and during the crisis: Exploring the role of institutions, *OECD Economics Department Working Papers* **973**.

Vahter P. and Masso J. (2007) Home versus host country effects of fdi: Searching for new evidence of productivity spillovers, *Applied Economics Quarterly (formerly: Konjunkturpolitik)* **53**(2), 165–196.

van Pottelsberghe de la Potterie B. and Lichtenberg F. (2001) Does foreign direct investment transfer technology across borders?, *Review of Economics and Statistics* **82**, 490–97.

Venables A. J. (1996) Equilibrium locations of vertically linked industries, *International Economic Review* **37**(2), 341–59.

Viladecans-Marsal E. (2004) Agglomeration economies and industrial location: city-level evidence, *Journal of Economic Geography* **4(5)**, 565–582.

Outward Investments and Productivity
Evidence from European Regions

Davide Castellani[*] Fabio Pieri[†]

November 2014

Online appendix

Empirical specification

This section illustrates the rationale of the specification proposed in Equation 1 in the text and estimated in our empirical exercise. We start by assuming a linear relation between regional productivity and the stock of outward and inward FDI, allowing for the possibility of a time lag of h periods.

$$y_{it} = \alpha + \beta k_{it} + \gamma OUT_{i,\tau}^{stock} + \lambda INW_{i,\tau}^{stock} + \eta_i + u_{it} \tag{1}$$

where y_{it} and k_{it} are the (log of) labour productivity and capital-labour ratio in region i at time t, $OUT_{i,\tau}^{stock}$ and $INW_{i,\tau}^{stock}$ are the stock of outward and inward FDI in region i at time $\tau = t - h$, η_i is a regional fixed-effect, and u_{it} is the error term.

By taking differences over time we can eliminate the regional fixed effect. It is convenient to take differences between t and τ, since it yields an equation where there is no overlap between the periods used to compute the growth rate of productivity and the change in the stock of outward and inward FDI. We denote this difference as Δ_{start}^{end}. The equation in differences looks as follows:

$$\Delta_{\tau}^{t} y_{it} = \beta \Delta_{\tau}^{t} k_{it} + \gamma \Delta_{\tau-h}^{\tau} OUT_{i,\tau}^{stock} + \lambda \Delta_{\tau-h}^{\tau} INW_{i,\tau}^{stock} + \Delta_{\tau}^{t} u_{it} \tag{2}$$

Due to the lack of information on FDI stocks, we need to assume that the number of outgoing and incoming investments projects, as recorded by fDi Markets, from/into each region over the period between $\tau - h$ and τ –which we denote as $OUT_{i,\tau-h\rightarrow\tau}$ and $INW_{i,\tau-h\rightarrow\tau}$— can be a proxy for the change of the stocks of outward and inward FDIs, respectively, over the same period. This assumption is subject to two major criticisms. First, we do not allow any depreciation in the FDI stock. Second, we assume that all

[*]Department of Economics, University of Perugia, Via A. Pascoli 20, 06123 Perugia (Italy); Centro Studi Luca d'Agliano, Milan (Italy); Centre for Innovation, Research and Competence in the Learning Economy (CIRCLE), Lund (Sweden); davide.castellani@unipg.it

[†]*Corresponding author*: Departamento de Economia Aplicada, Universitat de Valencia, Avinguda dels Tarongers s/n, 46022, Valencia (Spain); fabio.pieri@uv.es

investments projects are of the same size, in terms of invested assets. As it is shown in Table 1, the correlation between FDI flows and the number of projects recorded by fDi Markets at the country level is remarkably high, so we believe the assumption may hold. Then, our specification becomes:

$$\Delta_\tau^t y_{it} = \beta \Delta_\tau^t k_{it} + \gamma OUT_{i,\tau-h\to\tau} + \lambda INW_{i,\tau-h\to\tau} + \Delta_\tau^t u_{it} \tag{3}$$

In order to make results comparable when using different h (as in the section reporting the performed robustness checks), we can take averages of $\Delta_\tau^t y_{it}$, $\Delta_\tau^t k_{it}$, $OUT_{i,\tau\to t}$ and $INW_{i,\tau\to t}$. We denote the averaged variables with an overline. As discussed in Section 3 in the text, we can augment Equation 3 with a constant (α), a vector of country fixed effect (η_j) and of regional characteristics at the beginning of the period ($\mathbf{z}_{i,\tau}$).

$$\Delta_\tau^t \overline{y}_{it} = \alpha + \beta \Delta_\tau^t \overline{k}_{it} + \gamma \overline{OUT}_{i,\tau-h\to\tau} + \lambda \overline{INW}_{i,\tau-h\to\tau} + \eta_j + \delta \mathbf{z}_{i,\tau} + \Delta_\tau^t u_{it} \tag{4}$$

For $h = 4$, given the time structure of our data, we are left with $t = 2011$, $\tau = 2007$ and $\tau - h = 2003$, which then yields Equation 1 in the text:

$$\Delta \overline{y}_{ij,2007-11} = \alpha + \beta \Delta \overline{k}_{ij,2007-11} + \gamma \overline{OUT}_{ij,2003-07} + \lambda \overline{INW}_{ij,2003-07} + \delta \mathbf{z}_{ij,2007} + \eta_j + \epsilon_{ij,2007-11}.$$

Physical capital-labor ratio

We have included a physical capital deepening term ($\Delta k_{ij,2007-11}$) in Equation 1 in the text as the rate of change of the physical capital-labor ratio, in order to control for changes in regional factor shares. The physical capital-labor ratio has been computed as the ratio of the regional physical capital stock to regional employment (in thousands of employees). The physical capital stock at the regional level, has been obtained applying the perpetual inventory method (PIM) to the series of gross fixed capital formation (GFCF) in the region (at constant 2005 prices in millions of euro) contained in the ERD database (last release, 2013). We followed the methodology proposed by Hall and Mairesse (1995), and the physical capital stock at the beginning of the first year has been defined as below:

$$K_{ij,t=1} = \frac{I_{ij,t=1}}{g_{ij} + \delta}, \tag{5}$$

where $I_{ij,t=1}$ is the value of GFCF observed in region i in the first year of the series[1], g_{ij} is the rate of growth of GFCF in the region from 1995-2002, and δ is depreciation rate which has been set equal to 7.5%[2]. Physical capital stock in the second year and onward has been computed using the following formula:

$$K_{ij,t} = (1 - \delta) \cdot K_{ij,t-1} + I_{ij,t}. \tag{6}$$

The variable has been included in growth rates in the econometric analysis, $\Delta k_{ij,2007-11}$.

[1] We start computing the physical capital stock series at 1995, even if in the econometric analysis we use the values from 2007 to 2011. The main motivation relates to the possibility of resting on more reliable values for the physical capital stock calculated as in the Equation 6.

[2] As robustness checks we also computed the physical capital stock assuming depreciation rate of 5% and 10%, and we did not register significantly different results.

Other regional characteristics

This paragraph provides details on how some of the additional regional characteristics contained in the $\mathbf{z}_{ij,2007}$ vector – i.e. the level of human capital, the stock of technological capital, the regional industrial mix and its degree of concentration/diversification, the regional employment density – have been built.

- The endowment of human capital ($HCAP_{ij,2007}$) has been proxied by the share of population aged 25 or more (in thousands of people) with tertiary-type education degree (ISCED 5-6) in each region. Information comes from the EURD dabase, maintained by Eurostat. The value has been included in log in the econometric analysis, $hcap_{ij,2007}$.

- The stock of technological capital ($tech_{ij,2007}$) has been proxied by the ratio of the stock of patent applications to the total population (in thousands of people) in the region. The stock —recovered using information on the number of patent applications from each European region to the European Patent Office (EPO), which is available in the EURD database, maintained by Eurostat[3]— has been computed as the sum of the patent applications in all sectors in the previous five years:

$$TECH_{ij,2007} = \sum_{t=2002}^{2007} PATAPP_{ij,t}. \tag{7}$$

  The ratio has been included in log in the econometric analysis, $tech_{ij,2007}$.

- We have controlled for the degree of concentration/diversification of the regional industrial mix. Following the literature (see Cingano and Schivardi, 2004, among others), we have used the Herfindahl-Hirschman index computed as follows:

$$HHI_{ij,2007} = \sum_{s} SH^2_{sij,2007} = \sum_{s} \left(\frac{Employment_{sij,2007}}{Employment_{ij,2007}} \right)^2, \tag{8}$$

  where $SH_{sij,2007}$ are the employment shares in five broad sectors 's' of the regional economy: (1) agriculture, hunting, forestry and fishing; (2) industry (energy and manufacturing); (3) construction; (4) non-market services; (5) distribution, transportation and commercial services; (6) financial services and other services. The HHI index is equal to '1' for regions with all their employees concentrated in one sector and tends to '0' in the case of more diversified regional structures. The $HHI_{ij,2007}$ enters in log in the econometric analysis, $hhi_{ij,2007}$.

- We calculate a measure of employment density $DENSITY_{ij,2007}$ as the ratio between total regional employment (in thousands of employees) over regional area (in square kilometers). $DENSITY_{ij,2007}$ enters in log in the econometric analysis, $density_{ij,2007}$.

[3]Data on patent applications are regionalized on the basis of investors' residence: in the case of multiple investors proportional quotas have been attributed to each region.

- We have taken account of the regional industrial structure by introducing the share of employment in three broad sectors of the economy, i.e. Agriculture, Industry and Services. Each share has been computed in the following way:

$$share_{ij,2007}^{s*} = \frac{Employment_{s*ij,2007}}{Employment_{ij,2007}} \tag{9}$$

  where where $s* = \{AGR, IND, SERV\}$ and $Employment_{ij,2007}$ and $Employment_{s*ij,2007}$ denote, respectively, total employment of the region i in country j (thousands of employees) and total employment in the $s*th$ sector of the regional economy (thousands of employees).

Correlation matrix

Table 1 provides the matrix of Pearson's correlation coefficients among the variables included in the econometric analysis.

List of regions

This paragraph provides the list of NUTS 2 regions which has been considered in the econometric analysis (Table 2).

Table 1: Correlation matrix

	Four-year (av.) Lab. prod. growth	Four-year (av.) Phys. cap. deepening	Inward FDIs	Outward FDIs	Outward FDIs man.	Outward FDIs sal.	Outward FDIs other	Human capital	Tech. capital	H-H index	Total pop.	Emp. density	Coastal region	Capital region	Obj. 1 region	Emp. share industry	Emp. share services
Four-year (av.) Labor prod. growth	1																
Four-year (av.) Physical capital deepening	0.3111	1															
Inward FDIs	0.1636	0.1416	1														
Outward FDIs	-0.0602	-0.0448	0.7594	1													
Outward FDIs - manufacturing	-0.1111	-0.0888	0.6124	0.9306	1												
Outward FDIs - sales	-0.0445	-0.0389	0.6917	0.9562	0.9023	1											
Outward FDIs - other	-0.0426	-0.0250	0.7961	0.9627	0.8283	0.8567	1										
Human capital	0.0794	-0.1491	0.2560	0.2953	0.2739	0.2809	0.2856	1									
Technological capital	-0.2395	-0.5066	0.0197	0.2816	0.3691	0.2934	0.2074	0.5387	1								
Herfindahl-Hirschman index	-0.2902	-0.1525	0.1105	0.2336	0.1826	0.2032	0.2540	0.2609	0.2462	1							
Total population	0.1429	-0.0350	0.4194	0.3444	0.3631	0.3812	0.2774	0.0543	0.0885	-0.0594	1						
Employment density	-0.0827	-0.2480	0.3704	0.4117	0.3702	0.3820	0.4101	0.2940	0.3377	0.3264	0.3746	1					
Coastal region	-0.0977	0.0879	-0.1232	-0.0748	-0.1050	-0.0414	-0.0770	0.0960	-0.0604	0.1183	-0.0882	-0.1736	1				
Capital region	0.1161	0.0613	0.5944	0.4081	0.3516	0.3544	0.4296	0.2813	0.0167	0.0914	0.1632	0.3454	0.0385	1			
Objective 1 region	0.2138	0.3755	-0.0146	-0.2282	-0.2778	-0.2337	-0.1802	-0.4693	-0.7604	-0.2919	-0.0239	-0.383	0.0213	-0.0105	1		
Employment share - industry	0.2482	0.1344	-0.1170	-0.2490	-0.1767	-0.2139	-0.2804	-0.5091	-0.2793	-0.5785	0.0954	-0.3316	-0.3030	-0.2178	0.3523	1	
Employment share - services	-0.2190	-0.4156	0.1487	0.2969	0.2675	0.2805	0.2920	0.6397	0.6693	0.5554	-0.0146	0.4894	0.2246	0.2391	-0.6039	-0.7542	1

Notes:
Variables regarding productivity growth and physical capital deepening are four-year averages over the period 2007-2011
Variables regarding foreign investments are averages over the period 2003-2007
Variables regarding control variables refer to year 2007

Table 2: List of the 262 regions considered, by country

NUTS	Name	NUTS	Name	NUTS	Name	NUTS	Name
Austria		**Germany**		ITH3	Veneto		Castilla y León
AT11	Burgenland (A)	DE11	Stuttgart	ITH4	Friuli-Venezia Giulia	ES42	Castilla-la Mancha
AT12	Niederösterreich	DE12	Karlsruhe	ITH5	Emilia-Romagna	ES43	Extremadura
AT13	Wien	DE13	Freiburg	ITI1	Toscana	ES51	Cataluña
AT21	Kärnten	DE14	Tübingen	ITI2	Umbria	ES52	Comunidad Valenciana
AT22	Steiermark	DE21	Oberbayern	ITI3	Marche	ES53	Illes Balears
AT31	Oberösterreich	DE22	Niederbayern	ITI4	Lazio	ES61	Andalucia
AT32	Salzburg	DE23	Oberpfalz	ITF1	Abruzzo	ES62	Región de Murcia
AT33	Tirol	DE24	Oberfranken	ITF2	Molise	ES70	Canarias
AT34	Vorarlberg	DE25	Mittelfranken	ITF3	Campania	**Sweden**	
Belgium		DE26	Unterfranken	ITF4	Puglia	SE11	Stockholm
BE10	Brussels	DE27	Schwaben	ITF5	Basilicata	SE12	Östra Mellansverige
BE21	Prov. Antwerpen	DE30	Berlin	ITF6	Calabria	SE21	Smaland med öarna
BE22	Prov. Limburg (B)	DE41	Brandenburg-Nordost	ITG1	Sicilia	SE22	Sydsverige
BE23	Prov. Oost-Vlaanderen	DE42	Brandenburg-Südwest	ITG2	Sardegna	SE23	Västsverige
BE24	Prov. Vlaams Brabant	DE50	Bremen	**Latvia**		SE31	Norra Mellansverige
BE25	Prov. West-Vlaanderen	DE60	Hamburg	LV00	Latvia	SE32	Mellersta Norrland
BE31	Prov. Brabant Wallon	DE71	Darmstadt	**Lithuania**		SE33	Övre Norrland
BE32	Prov. Hainaut	DE72	GieBen	LT00	Lithuania	**United Kingdom**	
BE33	Prov. Liege	DE73	Kassel	**Luxembourg**		UKC1	Tees Valley and Durham
BE34	Prov. Luxembourg (B)	DE80	Mecklenburg-Vorpommern	LU00	Luxembourg	UKC2	Northumberland, Tyne and Wear
BE35	Prov. Namur	DE91	Braunschweig	**Malta**		UKD1	Cumbria
Bulgaria		DE92	Hannover	MT00	Malta	UKD6	Cheshire
BG31	Severozapaden	DE93	Lüneburg	**Poland**		UKD3	Greater
BG32	Severen tsentralen	DE94	Weser-Ems	PL11	Lódzkie	UKD4	Lancashire
BG33	Severoiztochen	DEA1	Düsseldorf	PL12	Mazowieckie	UKD7	Merseyside
BG34	Yugoiztochen	DEA2	Köln	PL21	Malopolskie	UKE1	East Riding and North Lincolnshire
BG41	Yugozapaden	DEA3	Münster	PL22	Slaskie	UKE2	North Yorkshire
BG42	Yuzhen tsentralen	DEA4	Detmold	PL31	Lubelskie	UKE3	South Yorkshire
Cyprus		DEA5	Arnsberg	PL32	Podkarpackie	UKE4	West Yorkshire
CY00	Cyprus	DEB1	Koblenz	PL33	Swietokrzyskie	UKF1	Derbyshire and Nottinghamshire
Czech Republic		DEB2	Trier	PL34	Podlaskie	UKF2	Leicestershire, Rutland and Northants
CZ01	Praha	DEB3	Rheinhessen-Pfalz	PL41	Wielkopolskie	UKF3	Lincolnshire
CZ02	Strední Cechy	DEC0	Saarland	PL42	Zachodniopomorskie	UKG1	Herefordshire, Worcestershire and Warks
CZ03	Jihozápad	DED4	Chemnitz	PL43	Lubuskie	UKG2	Shropshire and Staffordshire
CZ04	Severozápad	DED2	Dresden	PL51	Dolnoslaskie	UKG3	West Midlands
CZ05	Severovýchod	DED5	Leipzig	PL52	Opolskie	UKH1	East Anglia
CZ06	Jihovýchod	DEE0	Sachsen-Anhalt	PL61	Kujawsko-Pomorskie	UKH2	Bedfordshire, Hertfordshire
CZ07	Strední Morava	DEF0	Schleswig-Holstein	PL62	Warminsko-Mazurskie	UKH3	Essex
CZ08	Moravskoslezko	DEG0	Thüringen	PL63	Pomorskie	UKI1	Inner London
						UKI2	Outer London
Estonia		**Greece**		**Portugal**		UKJ1	Berkshire, Bucks and Oxfordshire
EE00	Estonia	EL11	Anatoliki Makedonia, Thraki	PT11	Norte	UKJ2	Surrey, East and West Sussex
Finland		EL12	Kentriki Makedonia	PT15	Algarve	UKJ3	Hampshire and Isle of Wight
FI1D	Itä-Suomi	EL13	Dytiki Makedonia	PT16	Centro (PT)	UKJ4	Kent
FI1B	Etelä-Suomi	EL14	Thessalia	PT17	Lisboa	UKK1	Gloucestershire, Wiltshire and North Somerset
FI19	Länsi-Suomi	EL21	Ipeiros	PT18	Alentejo	UKK2	Dorset and Somerset
FI1C	Pohjois-Suomi	EL22	Ionia Nisia	**Romania**		UKK3	Cornwall and Isles of Scilly
FI20	Aland	EL23	Dytiki Makedonia	RO11	Nord-Vest	UKK4	Devon
France		EL24	Sterea Ellada	RO12	Centru	UKL1	West Wales and The Valleys
FR10	Ile de France	EL25	Peloponnisos	RO21	Nord-Est	UKL2	East Wales
FR21	Champagne-Ardenne	EL30	Attiki	RO22	Sud-Est	UKM2	Eastern Scotland
FR22	Picardie	EL42	Notio Aigaio	RO31	Sud	UKM3	South Western Scotland
FR23	Haute-Normandie	EL43	Kriti	RO32	Bucuresti	UKM5	North Eastern Scotland
FR24	Centre	**Hungary**		RO41	Sud-Vest	UKM6	Highlands and Islands
FR25	Basse-Normandie	HU10	Közép-Magyarország	RO42	Vest	UKN0	Northern Ireland
FR26	Bourgogne	HU21	Közép-Dunántúl	**Slovakia**		**Netherlands**	
FR30	Nord-Pas-de-Calais	HU22	Nyugat-Dunántúl	SK01	Bratislavský	NL11	Groningen
FR41	Lorraine	HU23	Dél-Dunántúl	SK02	Západné Slovensko	NL12	Friesland(NL)
FR42	Alsace	HU31	Eszak-Magyarország	SK03	Stredné Slovensko	NL13	Drenthe
FR43	Franche-Comté	HU32	Eszak-Alföld	SK04	Východné Slovensko	NL21	Overijssel
FR51	Pays de la Loire	HU33	Dél-Alföld	**Slovenia**		NL22	Gelderland
FR52	Bretagne	**Ireland**		SI01	Vzhodna Slovenija	NL23	Flevoland
				SI02	Zahodna Slovenija		
FR53	Poitou-Charentes	IE01	Border, Midlands and Western	**Spain**		NL31	Utrecht
FR61	Aquitaine	IE02	Southern and Eastern	ES11	Galicia	NL32	Noord-Holland
FR62	Midi-Pyrýnées	**Italy**		ES12	Principado de Asturias	NL33	Zuid-Holland
FR63	Limousin	ITC1	Piemonte	ES13	Cantabria	NL34	Zeeland
FR71	Rhone-Alpes	ITC2	Valle d'Aosta/Vallée d'Aoste	ES21	Pais Vasco	NL41	Noord-Brabant
FR72	Auvergne	ITC3	Liguria	ES22	Comunidad Foral de Navarra	NL42	Limburg(NL)
FR81	Languedoc-Roussillon	ITC4	Lombardia	ES23	La Rioja	**Denmark**	
FR82	Provence-Alpes-Cote d'Azur	ITH1	Provincia Autonoma Bolzano-Bozen	ES24	Aragón	DK01	Hovedstaden
FR83	Corse	ITH2	Provincia Autonoma Trento	ES30	Comunidad de Madrid	DK02	Sjalland
						DK03	Syddanmark
						DK04	Midtjylland
						DK05	Nordjylland
						Total	**262**

References

CINGANO F. and SCHIVARDI F. (2004) Identifying the sources of local productivity growth, *Journal of the European Economic Association* **2**(4), 720–742.

HALL B. H. and MAIRESSE J. (1995) Exploring the relationship between r&d and productivity in french manufacturing firms, *Journal of Econometrics* **65**, 263–293.