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Agglomeration economies, local cluster and foreign direct investments a pilot study for Emilia Romagna region

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Abstract

This article evaluates the determinants of FDI location in Italy. The focus of this pilot investigation is on the specific characteristics of municipalities located in the Emilia Romagna region over the period 2002-2007. A negative binomial estimation model is employed. It is found that the concentration of foreign economic activity is positively related to knowledge variables (i.e. R&D investments, the presence of a university and the presence of a district area) and productive structure variables (i.e. capital stock, labour cost and business services). Traditional infrastructural characteristics such as highways, railways and seaports, often regarded as important location determinants, are not robust with respect to the specification of the estimating equation.

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1. Introduction

Although Foreign Direct Investment (FDI) inflows into Europe have substantially grown over the last decade, Italian regions account for a very small portion of such increase. Recent empirical studies have attempted to understand the reasons for such a sluggish performance and pointed out the relevance of some "country-specific" characteristics such as the (in)efficiency of the bureaucratic system and the (mal)functioning of the judicial system (Bronzini, 2004; Guerin and Manzocchi, 2007; Basile et al., 2008;). Along with country-specific characteristics and the availability of tangible resources, recent literature seeking to examine inward FDI attractiveness has begun to focus on the importance of knowledge spillovers and agglomeration economies.

The focus of this pilot study is on the specific characteristics of municipalities located in the Emilia Romagna region,[1] which might attract Multinational Enterprises (MNEs). These include both institutional characteristics and location-specific factors – often intangible in their nature – which shape the local production system. With reference to this latter aspect, the immobile and embedded nature of tacit or uncodified knowledge (that requires proximity in order to be disseminated) should be considered as a key factor in the attraction of FDI.

The aim of this research is, therefore, to explain the location patterns of foreign firms at the municipality level. In order to address this research question, we define an economically motivated statistical model, building on Coughlin and Segev (2000) and attempt to single out the key municipal characteristics that might attract/hinder the localisation of FDI. Our baseline model is estimated using a negative binomial estimation model. The amount of FDI in a specific municipality (i.e. our dependent variable) primarily depends on the levels of the municipality's characteristics that affect profits relative to the levels of these characteristics in other municipalities. These can be classified as those related to the *production structure* and the *geographical and infrastructural characteristics* of the municipality.

Alongside these variables, we shall include in our analysis a set of *knowledge spillovers* related variables. Specifically, we consider R&D knowledge spillovers (i.e. knowledge spilled-over by R&D activities conducted by local firms situated in the municipality area), university-related knowledge spillovers (i.e. possible knowledge flows from universities located in the municipality) and district-related knowledge spillovers (i.e. informal knowledge flows within an industrial district operating in the municipal area). These additional variables should capture the immobile and embedded nature of tacit or uncodified knowledge mentioned above.

The remainder of the paper proceeds as follows: in section 2 we provide an overview of earlier theoretical and empirical studies on location determinants of FDI. Section 3 describes the methodology and the data used in the research. Section 4 provides results and section 5 concludes.

[1] Emilia Romagna is an administrative region of Northern Italy comprising the two historic regions of Emilia and Romagna. It is divided into nine provinces (Bologna, Ferrara, Forlì-Cesena, Modena, Parma, Piacenza, Ravenna, Reggio Emilia and Rimini); the region's capital city is Bologna. Emilia Romagna covers an area of 22,446 km^2 with a population of about 4.4 million inhabitants. Today, it is considered to be one of the richest and most developed regions in Europe and has the third highest GDP per capita in Italy. Moreover, it is the third top Italian region in terms of foreign control of manufacturing plants showing the best performance over the last decade as for FDI attractiveness: a fact that provides a strong argument in favour of the selection of this region for conducting our pilot study.

2. FDI location determinants: an overview of the literature

As mentioned in the introduction, for the purpose of this study we classify FDI location determinants in three groups: first, determinants related to the *production structure* of a region;[2] second, determinants related to *geographical and infrastructural* characteristics of a region; third, *knowledge spillovers* determinants. As we shall argue, in the explanation of the determinants of MNEs localisation, whereas much attention has been devoted to the first two groups, little attention has so far been given to 'unconventional' forms of attraction, such as knowledge activities. In this paper we attempt to fill this gap by placing due attention on a set of *knowledge related* FDI localisation determinants.

2.1 Determinants related to the production structure of the region

When making an investment decision, foreign investors are influenced both by production costs and inputs' quality available in the region – that is wage rates, the quality of labour, the unionisation rate and the unemployment rate.

The empirical evidence on the impact of labour costs on FDI has produced mixed results so far. Cheap production inputs are obviously a major attraction for foreign investors, thus a negative relationship between labour costs and inward FDI is expected (Coughlin et al., 1991; Coughlin and Segev, 2000; Wei and Liu 2001). However, labour cost might also have a significant positive correlation with FDI (Head et al., 1999; Guimaraes et al., 2000; Pelegrin, 2003) because higher wages may signal higher skills that foreign investors typically seek. Other things being equal, regions with a skilled labour force (or high human capital) tend to be more attractive for foreign firms, especially in manufacturing activities. As a case in point, evaluating the impact of industry and state specific economic conditions on inward FDI in several U.S. states for the 1974-1991 period, Axarloglou (2004) finds that the quality of the local labour force, along with the efforts to improve this quality, is pivotal in attracting FDI inflows.

Another characteristic of regional labour markets is the degree of unionisation. Some authors consider the search for a low rate of unionisation a key element in location decisions (Kornecki and Ekanayake, 2011). However, Coughlin et al. (1991) considered the effect of unionisation as uncertain *a priori* and found empirically that, in the US, a higher rate of unionisation is actually associated with greater presence of FDI. In fact, a higher level of unionisation may indicate better organisation, greater dynamism and greater production efficiency in the work force.

A further characteristic of labour markets that might affect FDI localisation decisions is the regional unemployment rate. To the extent that the unemployment rate is an indicator of labour availability that exerts a dampening influence on wages, high unemployment rates are likely to be positively related to FDI. On the other hand, higher unemployment rates could deter foreign direct investment because they might increase the amount that a firm must pay in unemployment insurance premiums or reflect less-competitive industrial conditions (i.e. strong rigidities in the labour market) and a lower quality of life (Coughlin et al. 1991; Woodward, 1992; Kornecki and Ekanayake, 2011).

[2] The term region here refers to the geographical unit of the analysis – i.e. the area in which MNEs might decide to localise. As mentioned in the introduction, the disaggregation level of the analysis conducted in this paper is the municipality, hence region refers to municipality.

Besides labour market characteristics, an additional determinant of FDI localisation, which refers to the production structure of the region, relates to the concentration of services such as professional services, banking services, communication services, and scientific and technological assets in urban areas. Guimares et al. (2000) showed the existence of a positive and significant relation of these elements with foreign location, whereas Woodward (1992) found a not statistically significant relation.

2.2 Determinants related to geography and infrastructure

Horizontal FDI is typically interested in the size of the targeted market: the larger the economic size of a region, the more FDI the region should attract. Using regional income as a proxy of market size, several empirical studies (Woodward, 1992; Hill and Munday, 1992; Mariotti and Piscitello, 1995; Head et al., 1999; Bronzini, 2004; Mollick et al., 2006) found a positive and significant relationship between regional market size and FDI. However, Mariotti and Piscitello (1995) and Guimaraes et al. (2000) suggested that the explanatory power of this variable tends to be lower at the local level, because it is unlikely that the market served by foreign firms will coincide with the boundaries of the region under consideration, given the ease of access to neighbouring zones.

Alongside market size, a well-developed transportation infrastructure not only reduces the costs of importing components and machinery and exporting or distributing output, but also facilitates the cost of communication between foreign affiliates and parent firms, thus lowering the costs of an effective management control of affiliates. For example, the more developed the road system is in a region, the easier the access to markets is and the lower the transportation costs are. This means that the incentive to invest in that region is greater. Empirical support for the importance of transportation networks in the attraction of FDI has been presented by Sun et al. (2002), Bronzini (2004), Barrios et al. (2006), and Mollick et al. (2006).

2.3 Determinants related knowledge spillovers

The emergence of intellectual capital as a key strategic asset has brought about a progressive change in the location needs of enterprises, from traditional motives such as access to markets and natural resources, to access to knowledge-intensive assets in order to increase firms' ownership advantages (Dunning, 1998). Since geographic proximity matters in transmitting tacit knowledge (Audretsch, 1998), it has been observed that locating in an area with scientific and technological assets provides access to economic knowledge spillovers (Cantwell, 1989).

A tightly-linked aspect is the relation between FDI and firms' clusters, which are typically characterised by the presence of effective channels of tacit knowledge flows and collective learning activities.[3] It is worth noting that clusters and FDI are two interdependent phenomena: on the one hand, MNEs could generate spillover effects in clusters by providing access to assets, skills and technology to the domestic firms within the clusters (De Propis and Driffield, 2006);

[3] This gap in the literature is particularly relevant for a country like Italy, traditionally characterised by the presence of rather cohesive and highly specialised clusters (or industrial districts as they are commonly called).

on the other hand, clusters may attract FDI since they provide access to resources, technologies and markets (Porter, 1998).

As far as the Italian case is concerned, research on the relative appeal of regions for FDI is still limited, in particular with regard to the role of clusters and knowledge spillovers as drivers of inward FDI. The few exceptions to this literature void are Bronzini (2004) and De Propris et al. (2005) who examined the relationship between industry-specific local industrial systems and the location of inward FDI, finding evidence that specialised geographic areas do indeed attract FDI.

3. Statistic model and data description

In the literature, several modelling approaches have been used to examine the role of agglomeration economies on the location choices by foreign firms: e.g. Ordinary Least Squares method (Boudier-Bensabaa, 2005), conditional logit model (Head *et al.,* 1995; Crozet *et al.*, 2004), Tobit (Bronzini, 2004), Poisson (Fox, 1996) and negative binomial regression model (Coughlin and Segev, 2000; Meyer and Nguyen, 2005).

These estimation techniques have been applied to FDI aggregated at various levels. In the US, researchers typically looked at the state level (see, among others, Glickman and Woodward, 1987) and, more frequently in recent years, at the county level (see, for instance, Woodward, 1992; Smith and Florida, 1994). However, it is a well-known fact that many other dimensions can be considered; these include industry, source country, and mode of FDI (Merger&Acquisition, Joint Venture, New plant).

In line with other recent studies in this field (Coughlin and Segev, 2000; Meyer and Nguyen, 2005; Thanh Dinh, 2008), in this paper we evaluate the determinants of FDI location, by using the negative binomial regression model, which can be considered an extension of the Poisson model. A Poisson distribution is frequently used to characterize processes that generate non-negative integer outcomes. In this regard, the number of foreign plants locating in a specific area, especially since the count is zero in many municipalities, is a reasonable candidate for a Poisson distribution.

Note that the Poisson model imposes the restriction that the dependent variable's mean and variance should be equal. This proposition can be tested and, if the test should indicate otherwise, researchers can employ a negative binomial distribution, which allows the dependent variable's variance to exceed its mean. This will be our case exactly.

Hence, we shall estimate a negative binomial model, where the dependent variable will be the number of foreign firms localised in a specific municipality and the independent variables will capture the probability that an MNE selects a specific municipality for its investment.

As mentioned earlier, this study refers to location choices by foreign firms in Emilia Romagna. Although the choice to restrict the analysis to one single region was guided by the wish to conduct a pilot investigation, the choice of Emilia Romagna was not a trivial one. In fact, this region is the third top Italian region in terms of foreign control of manufacturing plants showing the best performance over the last decade with regard to FDI attractiveness (i.e. from 2001 to 2009 the foreign presence in Emilia Romagna has increased by 14.2%) (Reprint, 2010).

The empirical analysis included in this paper has been conducted using a dataset obtained from the merging of different statistical sources. First, we used AIDA database provided by Bureau

Van Dijk from which we gathered firm-level data such as sales, costs and number of employees, value added, tangible fixed assets, R&D investments, sector of activity, and ownership status. All financial data have been aggregated to the municipality level and are in real values.[4] The dataset has been integrated with information on some specific aspects of the municipality, such as size, population, universities, seaports, airports, and highways, coming from various additional sources: Italian municipalities website (*Comuni Italiani*); the Italian National Institute of Statistics (ISTAT); and other domestic sources. The data employed covers the period 2002-2007.

Table 1. Variables description and sources

	Description	***Sources***
Dependent variable		
FDI	Number of FMNEs in the municipality*	AIDA
Independent variables*		
Productive structure		
K	Total firms' capital stock in the municipality	AIDA
L_cost	Total firms' labour cost in the municipality	AIDA
B_ser	The cumulative number of workers employed in business services in the municipality	AIDA
Knowledge variables		
Local_R&D	Amount of local firms' R&D investments by municipalities	AIDA
University	Dummy variable equal to 1 if the municipality has university and 0 otherwise.	
District	Number of firms in the district activity j by municipality on total regional firms in the same activity j.	ISTAT
Geography and Infrastructures		
Size	Size of the municipality in Km^2	ISTAT
Market size	Value added per head of population	AIDA
Highways	Dummy variable equal to 1 if the municipality is provided by a highway service and 0 otherwise	Autostrade per l'Italia
Railways	Dummy variable equal to 1 if the municipality has railway facilities served by Trenitalia Cargo, and 0 otherwise	Ferrovie dello Stato
Seaports	Dummy variable equal to 1 if the municipality has a seaport and 0 otherwise	Comuni_Italiani

* FMNEs are considered all firms that are majority owned, wholly owned or whose main known shareholder is foreign.
** All financial variables are expressed in logarithms.

[4] All financial variables were expressed in real values by using PPI index (National Institute of Statistics - ISTAT).

Table 1 provides a summary describing all variables used and the respective statistical sources. The available independent variables have been classified in three sub-groups, which are those identified in the literature review in Section 2: variables related to the production structure of the municipality, variables related to the possible knowledge spillovers occurring in the municipality, and finally a set of variables regarding the geography and the infrastructure of the municipality.

As for the first group of independent variables, we consider a set of variables that describes the *production structure* of the municipality. We use information on total capital stock (*K*) in the municipality and on the labour cost (*L_cost*), measured as the ratio between per worker cost and the per worker value added. Estimates comprise also a variable (*B_serv*) which provides information on the number of workers employed in business services.

We then introduce a set of *knowledge* variables, which should capture the amount of knowledge available in a municipality, since we believe that the higher the amount of knowledge available in a municipality is, the more attractive such an area should be to firms and, more importantly, to MNEs. In order to measure the available amount of knowledge in a municipality, we construct a variable (*Local_R&D*) which is the sum of domestic firms' R&D investments. Along with this variable, we also introduce a dummy variable (*University*) which takes the value of one if there is a university in the municipality and zero otherwise.[5] This represents, we believe, an additional source of knowledge which might spill-over from a public source. Finally, we include in the knowledge-related set of independent variables *District* defined as the number of firms in the district activity *j* by municipality on total regional firms in the same activity *j*. Although this variable does not provide direct information on knowledge, it gives insights into the presence (and relative size) of local networks of relationships that facilitate the flows of knowledge (especially when it remains of a tacit nature) created and accumulated by firms within a district by means of formal and informal learning processes. Since firms increase the stock of knowledge by combining access to internal and external sources of learning and knowledge exchange, industrial districts play a crucial role in facilitating knowledge exchanges and in increasing complementarities among firms' innovation activities. This therefore significantly boosts the systemic accumulation of knowledge, knowledge spillovers and systemic innovation processes (Menghinello et al., 2010).

Finally, we consider a set of geographical and infrastructural variables. These should provide insights on the geographic and economic dimension of each municipality (we include *size* measured in squared kilometres and *market_size* measured as the log of value added over population) as well as information on the available transportation infrastructures (i.e. *highways*, *seaports* and *railways*).[6] These are widely considered to be attractors of international investments and should positively affect revenue prospects. Table 2 provides some descriptive statistics of our sample.

[5] Note that in the region there are four Universities: The University of Bologna, The University of Ferrara, The University of Modena and Reggio Emilia, The University of Parma. Moreover, The University of Bologna has branches in five municipalities (Bologna, Forlì, Cesena, Rimini and Ravenna) and The University of Modena and Reggio Emilia has branches in two municipalities (Modena and Reggio Emilia). This adds up to nine municipalities in which a university is active.

[6] Among infrastructural variables we did not include airports, since this variable was highly correlated to the variable University, as airports and universities are localised in practically the same municipalities.

Table 2. Basic descriptive statistics

	N	*Minimum*	*Maximum*	*Mean*	*Standard deviation*
Dependent variable					
FDI	1996	0	24	0.4308617	1.519375
Independent variables					
Productive structure					
K	1996	7.028	22.151	16.690	2.052
L_cost	1911	6.721	14.407	10.653	0.487
B_serv	1996	0.000	4129.000	67.885	256.180
Knowledge variables					
Local_R&D	1210	1.342	17.910	11.961	2.349
University	1996	0	1	0.027	0.162
District	1996	0	1	0.286	0.452
Geography and Infrastructures					
Size	1984	3.170	652.890	65.493	61.481
Market size	1983	2.064	12.445	8.070	1.228
Highways	2029	0	1	0.254	0.436
Railways	2029	0	1	0.033	0.177
Seaports	1984	0	1	0.042	0.201

4. Negative binomial model results and interpretation

Before moving on to the analysis of our preliminary findings, two shortcomings in our pilot study should be noted that suggest caution is necessary when interpreting our results. First, our sample covers a six-year period (2002-2007) and, as noted elsewhere (Coughlin and Segev, 2000), six years of data may not be sufficient to generate robust estimates. Second, there are indeed some variables that have been omitted when describing the geographical and infrastructural characteristics of the municipality (e.g. in an extended version of this paper, it would be useful to include variables related to the distance of each municipality from the closest airport, seaport and railway-station). We intend to address both these limitations in a future version of this study, which will look at a wider timespan and consider a broader set of independent variables. Bearing these limitations in mind, we shall now present our pilot study findings in the remainder of this section.

The results of two negative binomial regressions are presented in Table 3. Three variables in Model 1 were removed to construct Model 2. Following Coughlin and Segev (2000), we removed variables which were not statistically significant and tested if their inclusion contributed much to the explanatory power of the model.

For both models, we tested whether the negative binomial model was superior to the Poisson model. As mentioned in section 3, a Poisson model is one in which the alpha value is constrained to zero. In Table 3 we report a likelihood ratio test that alpha equals zero – i.e. the likelihood ratio test comparing this model to a Poisson model. In both Model 1 and Model 2, the associated chi-squared values suggest that alpha is non-zero and that the negative binomial model is therefore more appropriate than the Poisson regression.

Table 3. Negative Binomial Regressions results (2002-2007)

	Model 1		*Model 2*	
	NBR coefficients (z-score)	***Cluster robust coefficients*** (z-score)	***NBR coefficients*** (z-score)	***Cluster robust coefficients*** (z-score)
Independent variables				
Productive structure				
K	*0.559**** *(8.05)*	*0.559**** *(4.50)*	*0.554**** *(8.96)*	*0.554**** *(4.72)*
L_cost	0.693** (2.32)	0.693** (2.11)	0.684** (2.29)	0.684** (2.18)
B_ser	2.755** (3.00)	2.755* (1.66)	2.804** (3.05)	2.804* (1.80)
Knowledge variables				
Local_R&D	0.108*** (3.31)	0.108*** (2.24)	0.112*** (3.43)	0.112** (2.32)
University	0.856*** (4.07)	0.856*** (2.04)	0.729*** (4.17)	0.729** (2.04)
District	1.529 (1.18)	1.529* (1.82)	1.457 (1.12)	1.457 * (1.85)
Geography and Infrastructures				
Size	-0.001 (-1.18)	-0.001 (-0.74)		
Market_size	0.506*** (5.37)	0.506*** (2.76)	0.505*** (6.49)	0.505** (3.11)
Highways	0.053 (0.49)	0.053 (0.33)		
Railways	-0.021 (-0.17)	-0.021 (-0.10)		
Seaports	-0.361* (-1.81)	-0.361* (-1.68)	-0.444** (-2.30)	-0.444** (-2.82)
Likelihood Ratio Significance level	8.89 (0.001)		11.22 (0.000)	
Pseudo R^2	0.30		0.30	
N. of observations	1194	1194	1194	1194

*** Statistically significant at the 1% level. ** Statistically significant at the 5% level. * Statistically significant at the 10% level.

For each model we present coefficients (and standard errors) obtained with the negative binomial regression model, as well as those obtained using cluster robust standard errors (using municipality as clustering variable). Both models fit the data well. The pseudo-R^2 is in both cases 0.30, suggesting that it is difficult to make a strong case in favour of one of the two models in terms of explanatory power. Overall, our explanatory variables coefficients and their significance levels are exceptionally consistent across the two models, a fact that strengthens our findings.

As for the variables related to the productive structure of the municipality, we can see that the firms' capital stock has a positive and highly significant impact upon FDI localisation. This result is in line with the theory. On the labour side, the variable *L_cost* also has a positive coefficient, which is again statistically significant at 5% level. This means that for each increase in the labour cost, the expected number of multinational firms localised in a specific municipality rises marginally. Although apparently counterintuitive, this result probably reflects the decision of MNEs to localize in those municipalities where labour force productivity is higher. As for the cumulative number of business services, this variable has a strong positive impact upon MNEs localisation and is significant at 5% level (which drops to 10% when cluster robust coefficients are considered).

Turning to knowledge determinants, this set of explanatory variable seems to explain many of the localisation decisions made by foreign-owned manufacturing firms. All variables' coefficients are statistically significant and positively signed. Specifically, the presence of a University has a positive and highly significant impact on FDI localisation. By the same token, an increase in local firms' R&D investments has a negative effect on the number of MNEs operating in the municipality. As for the *District* variable, this has a large positive impact on FDI, which is statistically significant (at 10% level), but only with regard to the cluster robust regression model.

A rather different picture emerges when looking at geographical and infrastructural determinants. Most of these variables are not significant and have been rolled out in the second model. In appearance, market size is by far the most relevant variable in the set. As for infrastructural determinants, only the presence of a port has a significant effect – although it shows a negative sign, suggesting a (counterintuitive) hindering effect on FDI localisation.[7]

5. Conclusions

In this pilot study, we have investigated the determinants of MNEs' localisation in the Emilia Romagna region using municipality level data. Our preliminary findings pointed to the relevance

[7] Note that reported results may be affected by unobserved municipality-level heterogeneity. Hence, in order to perform a robustness check of our findings, we attempted to estimate our model with municipality fixed effects. However, this test did not produce significant results. In fact, five variables (*University*, *Size*, *Highways*, *Railways* and *Seaports*) were dropped, leading to the loss of a considerable number of observations. This occurs because fixed effects regression uses only information from changes within a municipality and it would seem that, for a large part of our data, there are no such changes. Since there are only a few observations then left, the fixed effects model did not work. An alternative way to control for fixed municipality effects would require including the full set of province dummies in our estimates. As we performed this second robustness check, we observed that our key findings were confirmed, though the significance of the estimated coefficients generally decreased. Both regressions are available from the author upon request.

of what we labelled *knowledge spillovers* determinants and specifically showed a strong (and statistically significant) positive effect of local R&D investments, the presence of Universities, and also the presence of Districts in a municipality. The productive structure of the municipality also helps to explain the localization of foreign-owned firms, suggesting the presence of an 'efficiency wage' effect – i.e. MNEs tend to localise in those municipalities where the labour cost, and therefore productivity, is higher. As for geographical and infrastructural variables, only market size seems to positively affect MNEs localisation. With the exception of seaports (which have a negative and significant coefficient), infrastructural variables are never significant; this would suggest that foreign investment decisions are not affected by the infrastructural characteristics of a municipality. This finding could be due to the fact that we are considering only one region and that, therefore, distances among municipalities are perceived as being too small – i.e. even when a municipality lacks railways or highways, if these infrastructures are available in a nearby municipality, this would not hinder FDI localisation. As mentioned above, we would like to control for this problem in a future version of this paper, introducing variables related to the distance of each municipality from the closest airport, seaport and railway-station.

Although these results are only preliminary, they are encouraging and indicate that we are looking at the right determinants and, specifically, that knowledge is a key driver of MNEs localisation in Italy. Further analysis should be conducted along these lines of enquiry, extending the investigation to the whole country and putting extra effort into better defining infrastructural variables. We believe that this pilot work sets the agenda for our future research.

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