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National boundaries and the location of multinational firms in Europe*

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Abstract. Using data on 5,102 subsidiaries established in the period 1991–1999, we examine the location choice of multinational firms of different nationalities in 47 regions of five EU countries. In particular we estimate a nested logit model and find that European multinationals consider regions across different countries as relatively closer substitutes than regions within national borders. This is consistent with the hypothesis that European regions compete to attract foreign direct investments relatively more across than within countries. However, in line with previous studies, we also find that national boundaries still play some role in choices made by non-European multinationals.

JEL classification: F23, O52, R30

Key words: Europe, multinational firms, location, discrete choice models

1 Introduction

Over the last two decades, the European Union has attracted more than 40% of total world flows of foreign direct investments (FDIs), becoming the largest recipient of multinational activity (Unctad 2006). Accelerating economic integration played an important role in this process (Neven and Siotis 1996; Barrel and Pain 1999). In particular, falling trade barriers increased the gains from concentrating manufacturing activity in few locations to use as export-platforms or from re-organizing production through international vertical fragmentation (Motta and Norman 1996; Neary 2002, 2006). Furthermore, one could expect that European integration with the dismantling of trade barriers, free movement of people, goods and capital and the strong

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reduction of state aids, has contributed in making country boundaries more blurred.[1] In this regard, Fatas (1997) finds that national borders have seen their economic significance reduced over time as the process of integration has contributed increasing cross-border correlations in regional business cycles within the European Union. However, actual or perceived national specificities might still matter in different respects, hindering competition across borders. For example, a number of studies (see Rodriguez-Pose 1999; and Meliciani 2006, among others) show that European regions have been characterized by a very slow process of income convergence across countries and by a lack of income convergence within countries. Concerning international trade patterns, there is also evidence that border effects are still significant and that the home bias in consumption is rather high (Head and Mayer 2000; Chen 2004). From this perspective, one may wonder whether (and to what extent), within an integrated economic area, such as the EU, national boundaries still matter for the location behaviour of multinational firms (MNFs). One way to look at this issue is to ask whether regions belonging to different countries are actually competing to attract foreign investors. For instance, an Italian region, such as Emilia Romagna, competes for attracting foreign investments more with Lombardia than with regions having similar characteristics but belonging to other countries, such as Bayern or Catalonia? This question has evident implications for national and regional policy. In fact it provides key information for identifying the proper level of intervention (whether national, regional or supra-national) for the selection, control and support of multinational activities in Europe.

This paper addresses this question by analysing the location choices of 5,102 affiliates of MNFs between 1991 and 1999 over a set of 47 NUTS 1 regions in five EU countries (France, Germany, Italy, Spain and the United Kingdom).[2] In particular, we estimate a nested logit (NL) model of MNFs' location choices and test whether foreign investors consider regions within national boundaries closer substitutes than regions across borders. This is done by grouping regions into country-nests and by testing whether the inclusive value parameter of the NL model falls in the 0–1 interval. From this specific point of view, this paper extends and generalizes the results obtained by Head and Mayer (2004), who estimate an NL model of the location choice of 452 Japanese-owned affiliates in 57 EU regions during the period 1984–1995. For this sample of foreign investors, which is smaller than ours and focused on firms originating from Japan only, their analysis supports a country-region nesting structure, thus suggesting that the degree of substitution between profitability from different locations is larger within than across national borders.[3] In this paper, we analyse investors from different nationalities, including European MNFs locating their activities in foreign countries within the EU, as well as non-European investors (originating mainly from the US and Japan). We also relax some restrictions imposed on the estimation of the NL model (i.e., allowing for different magnitudes of the inclusive value parameters for the different nests). We find that regions within national borders are not considered as closer substitutes than regions belonging to different countries. This holds especially for intra-Europe investments (which account for about 60% of all inward FDIs in Europe), while the border effect plays some role in choices made by non-European MNFs. This result has implications both in terms of policy and of specification of location choice models. On the one hand,

[1] As noted by Krugman (1991 p. 8): "as Europe becomes a unified market, with free movement of capital and labor, it will make less and less sense to think of the relations between its component nations in terms of the standard paradigm of international trade. Instead the issues will be those of regional economics".

[2] NUTS is an acronym for Nomenclature of Units for Territorial Statistics which indicates a hierarchical classification of administrative areas used by the official European statistical office (Eurostat). In particular, NUTS 0 units correspond to countries, while NUTS 1 regions are socio-economic areas grouping together so-called basic areas (NUTS 2 regions) and, in the context of our analysis, represent the best solution to the trade-off between complexity and exhaustiveness.

[3] It is worth noting that this result is not emphasized in Head and Mayer's work, as it is not at central stage in their analysis. In fact, the issue of the country-region nesting structure is more of an *a priori* assumption, which is eventually confirmed by the data, in a study focused on the determinants of location decisions of Japanese MNFs, and of the role of market potential as an attractor of FDIs in particular.

it supports the idea that within an integrated Europe, regions compete significantly across borders to attract foreign investors. On the other hand, it implies that empirical models of the location choice of MNFs in Europe based on a country-region nesting structure would produce biased results due to the incorrect specification of substitution patterns.[4]

The rest of the paper is organized as follows. Section 2 describes the empirical model. Section 3 illustrates data. Section 4 discusses the econometric results. Section 5 concludes.

2 Econometric model

Location choices can be modelled in the random utility maximization (RUM) setting, where it is assumed that firm i chooses location j if it yields the highest utility (or profit) among the set of available alternatives, that is $\pi_{ij} > \pi_{il}$ $\forall l \neq j$ $(l = 1, \ldots, L)$. As we illustrate in the Appendix, different assumptions on the unobserved portion of profits yield different discrete choice models. The literature on firms' location choice has mainly estimated conditional logit (CL) and nested logit (NL) models.[5]

In this study, we estimate an NL model, where 50 elemental choices (regions) are grouped into 5 nests. We refer to the Appendix for a more detailed discussion of NL models. Suffice here to recall that a key quantity in NL is the inclusive value (IV), which measures the profit that a firm can expect to obtain from locating in any region within nest k. It turns out that the estimated parameter associated with the IV (λ_k) reflects the degree of dissimilarity among unobserved portions of utility within a nest, with lower λ_k indicating more similarity (or in other words, closer substitution in location decisions) (Train 2003). An estimated IV parameter in the 0–1 interval implies that alternatives within the same nest are closer substitutes than alternatives outside the nest. We will use this condition to assess whether national boundaries matter, by grouping regions into country nests and testing whether the corresponding parameter λ_k is significantly lower than 1. A λ_k parameter greater than 1 suggests that alternatives are more similar across than within nests, as the variance in the unobserved profits (i.e., dissimilarity) among alternatives in the same nest is greater than the variance of alternatives across nests[6] (see the Appendix). Daly and Zachary (1979) and McFadden (1979) demonstrate that if λ_k is between 0 and 1 for all k, the model is consistent with profit maximizing behaviour, while $\lambda_k >$ 1 generally implies that firm behaviour would not be consistent with profit maximization (Train 2003, p. 85).[7] Furthermore, as shown in a Monte Carlo experiment by Herriges and Kling (1997), λ_k greater than one determines also a significant bias in the coefficients estimated for the location determinants.

[4] In Basile et al. (2008) this issue is addressed by estimating a mixed-logit model, which allows a more flexible pattern of substitution between the profit stemming from different regions and helps reduce this specification error.

[5] Carlton (1983) first estimated a discrete choice model to analyse the location of new industrial branch plants in the United States. A number of applications of CL and NL models on the location choice of new foreign-owned plants have been proposed thereafter. Many studies analyse location within the US (see, for example, Coughlin et al. 1991; Head et al. 1995, 1999; Friedman et al. 1996), but recent contributions address FDI in Europe. Most of them analyse location within individual European countries (see, for example, Guimarães et al. 2000; Basile 2004; Crozet et al. 2004; Barrios et al. 2006; Békés 2007; Devereux et al. 2007), but others address it in a multi-country framework. For example, Devereux and Griffith (1998) analyse the choice between FDI and export as a means to serve the European market and the location of FDI among different European countries, while Disdier and Mayer (2004) analyse French investments in Eastern and Western European Countries. Instead, Head and Mayer (2004) study location choices at the NUTS 1 level for nine countries, but their analysis is confined to Japanese investors, while Pusterla and Resmini (2005) focus on location choices among Transition Countries.

[6] We thank Tiziano Razzolini for pointing this out to us.

[7] For $\lambda_k > 1$, the model is consistent with profit maximization only for some range of the explanatory variables. Herriges and Kling (1996) provide tests of consistency of NL with profit maximization when $\lambda_k > 1$, but they argue that for applications with several alternative groups, the acceptable range for the λ_ks does not extend much beyond the unit interval. Given the relatively high number of choices (47) and nests (5), in our application we will maintain the unit interval as the acceptable range for the λ_ks.

The parameter λ_k can differ across nests, reflecting different correlation among unobserved factors within each nest, but many empirical works have constrained λ_k to be the same for all the nests (see, for example, Head and Mayer 2004), indicating that the correlation is the same within each nest. In this paper we estimate both a restricted and an unrestricted NL model and test, using a likelihood ratio statistics, whether these constraints are reasonable.

3 Data

Our analysis exploits a dataset (Elios), built at the University of Urbino, which collects information from Dun & Bradstreet's *Who owns whom* on a large sample of firms active in Europe. In particular, we have data on firms establishing affiliates in the five largest EU countries (France, Germany, Italy, Spain and the United Kingdom), which *inter alia* accounted for about 60% of total inward FDI flows in the EU 15 over the 1990s. Since three-quarters of the remaining 40% go to Belgium and the Netherlands, which attract mainly financial and service activities, we are rather confident that our sample picks up a very important share of foreign manufacturing activities established in Europe over the 1990s.[8]

For each firm we have information on the name and country of the ultimate owner, the sector of activity (2-digit SIC), location and year of establishment. Exploiting the information on the country of the ultimate owner, we identify foreign-owned firms and we restrict our analysis to those which were established over the 1991 to 1999 period. We end up with a sample of 5,102 foreign-owned firms located in 47 NUTS 1 regions of the countries considered.[9] The cross-country distribution of foreign investments in our dataset is largely consistent with inward FDI flows registered by Eurostat over the same period (Table 1), though investments in France are slightly underrepresented, while the share of new affiliates which, according to our sample, were established in the UK is slightly larger than the actual flow of inward FDI.[10] As concerns the area of origin of investors, Table 2 reveals that 57.5% are from EU 15, while 26.4 and 4% of affiliates

Table 1. FDI flows by country of destination in the period 1991–1999

Source	Elios		Eurostat
	N. of new affiliates of foreign MNFs	%	Inward FDI flows
France	867	17.0%	30.0%
Germany	1,368	26.8%	28.3%
Italy	295	5.8%	4.6%
Spain	484	9.5%	11.5%
United Kingdom	2,088	40.9%	25.6%
Total	5,102	100.0%	100.0%

8 These are the only countries covered by the Elios dataset. The main reason behind this selection is that downloading data from *Who owns whom* has been a very costly a lengthy process, so extraction was limited to the largest European countries.

9 Some of the literature has stressed that location determinants and the spatial distribution of multinationals may differ according to the different modes of entry. In particular, a key distinction has been made between *greenfield* investments and merger and acquisitions (see for example O Huallachain and Reid 1997, for the case of Japanese investors in the US, or Basile 2004, for the case of foreign investments in Italy). Unfortunately, *Who owns whom* does not provide any information on the share of ownership, nor on the type of the investment, so that we cannot identify different location patterns for wholly owned vs shared ownership ventures, nor for greenfield vs acquisitions.

10 This may have to do with the fact that Elios data are counts of new initiatives and, thus, cannot account for the different size of investments. It may well be the case that in the 1990s, France attracted investments larger, on average, than the UK.

Table 2. FDI flows by area of origin and country of destination in the period 1991–1999 (percentage values)

Source	Elios					Eurostat				
Variable	Number of new affiliates of foreign MNFs					FDI flows				
Area of origin	World	EU15	US	JPN	Other	World	EU15	US	JPN	Other
France-Germany-Italy-Spain-UK	100	57.5	26.4	4.0	12.1	100	63.7	24.4	0.5	11.5
EU 15						100	64.0	19.1	2.2	14.8
By country of destination										
France	100	69.0	16.5	3.0	11.5	100	67.5	17.7	0.8	13.9
Germany	100	57.9	23.6	2.8	15.7	100	50.6	27.3	0.1	22.0
Italy	100	68.5	18.0	4.1	9.5	100	77.9	7.8	0.9	13.4
Spain	100	76.0	14.0	3.9	6.0	100	69.7	17.3	2.4	10.7
United Kingdom	100	46.6	36.4	5.2	11.8	100	55.7	35.3	0.1	8.9

in our sample have parent companies in the US and Japan, respectively, and the latter tend to invest more intensively in the UK. The comparison with the origin of inward FDIs recorded by Eurostat suggests that our sample is well balanced also in this respect. Finally, it is worth commenting on the regional distribution of investments. Although we cannot benchmark it with any official statistics, the distribution of our sample is remarkably similar to the one reported in Head and Mayer (2004) (see Table 3 in this paper and Table A.1 in Head and Mayer) and reveals a concentration of new foreign affiliates in the economic core of each country.[11]

For the econometric analysis of the location choice, we integrate data from the Elios dataset with information gathered from other sources. For each of the 5,102 affiliates in our sample, the response variable takes value 1 for the region where the firm has actually established and zero for all the other possible locations. The choice set is as large as 47 regions, but is smaller in the case of affiliates whose parent company is located in one of the five EU countries, since we exclude locations in the home country (namely, in the case of German, Italian and UK MNFs the choice set reduces to 36 regions, in the case of French MNFs to 39, while for Spanish MNFS it is 41). A large set of explanatory variables has been selected following the vast empirical literature on foreign firms' location choices (see Table 4 for the variable list and detailed description). In particular, we include measures of regional market size (total value-added and per-capita GDP) and market potential (distance-weighted sum of the size of GDP of all other regions in our sample), agglomeration economies (stock of all firms and foreign firms in the same sector-region of each firm in our sample),[12] MNF experience (number of affiliates established in a region belonging to the same parent of each firm in our sample), labour market characteristics (average regional wages, schooling and unemployment rates), R&D intensity and population density. We also consider indicators of EU regional policy (namely the amount of Structural Funds allocated to the region in the period 1989–1993 and an indicator taking value one for regions eligible of Objective 1 Funds) as well as a proxy of the level of public infrastructure in the region.

[11] In particular, the major regions of destination of foreign investors are: South East (with London as the major city), West Midlands (Birmingham) and North West (Manchester) in the UK; Nordrhein-Westfalen (Bonn, Dusseldorf, Cologne), Baden-Wurttemberg (Stuttgart), Bavaria (Munich), Hessen (Frankfurt) in Germany; Comunidad de Madrid (Madrid) and Este (Barcelona) in Spain; Ile de France (Paris) in France; Lombardy (Milan) in Italy.

[12] We include also spatial lags of agglomeration economies, by computing a distance-weighted measure of agglomeration in other regions.

Table 3. Distribution of new foreign investments of European and non-European MNFs in the period 1991–1999, by NUTS 1 region. Percentage values

Country/Region	European MNFs 1991–1999	non-European MNFs 1991–1999	Country/Region	European MNFs 1991–1999	non-European MNFs 1991–1999
Germany			Italy		
– Baden-Wuerttemberg	3.0	1.8	– Nord Ovest	0.3	0.3
– Bayern	2.6	2.3	– Lombardia	1.9	1.3
– Berlin	0.5	0.3	– Nord Est	0.5	0.0
– Bremen	0.1	0.1	– Emilia Romagna	0.3	0.2
– Hamburg	0.5	0.6	– Centro	0.3	0.1
– Hessen	2.3	2.2	– Lazio	0.1	0.1
– Niedersachsen	1.2	0.8	– Abruzzo Molise	0.1	0.1
– Nordrhein-Westfalen	4.5	3.3	– Campania	0.1	0.0
– Rheinland-Pfalz	0.8	0.4	– Sud	0.1	0.0
– Saarland	0.1	0.1	– Sicilia	0.1	0.0
– Schleswig-Holstein	0.6	0.4	– Sardegna	0.0	0.0
Spain			United Kingdom		
– Noroeste	0.3	0.1	– North	0.5	1.2
– Noreste	0.8	0.5	– Yorkshire-Humberside	1.3	1.5
– Com. de Madrid	1.9	1.4	– East Midlands	1.5	1.8
– Centro	0.4	0.0	– East Anglia	0.5	1.0
– Este	2.7	0.8	– South East	7.8	15.6
– Sur	0.3	0.2	– South West	0.9	1.6
France			– West Midlands	2.1	3.5
– Ile de France	2.8	1.7	– North West	1.6	2.5
– Bassin Parisien	1.9	1.0	– Wales	0.5	0.9
– Nord Pas de Calais	0.8	0.4	– Scotland	0.7	1.9
– Est	1.8	0.4	– Northern Ireland	0.2	0.2
– Ouest	0.8	0.6	Total	100.0	100.0
– Sud Ouest	1.0	0.4			
– Centre Est	1.6	1.0			
– Mediterranee	0.6	0.2			

Source: Elios (University of Urbino).

4 Results

4.1 Country-region nesting structure

In this section we test the hypothesis that national boundaries matter for the location behaviour of MNFs, that is, we try to assess whether foreign investors consider regions within national borders closer substitutes than regions across borders. As discussed above, we address this question by estimating a NL model imposing a country-region nesting structure and by testing whether all IV parameters fall in the 0–1 interval. Thus, we have five nests (one for each country), each including a different number of regions (see Table 3 for the list of regions in each country). In Table 5 we report the IV parameters resulting from each regression. As illustrated in Section 2, these parameters reflect the substitution patterns (or correlation) between profits stemming from different regions as emerging from the residuals of the model. We do not show all the estimated coefficients associated with the variables in the model, both to save space and because, as we will see, the nesting structure that we have imposed is not always consistent with profit maximization and, thus (as argued in Section 2), coefficient estimates may be biased. Regressions results will be presented for the sub-samples of European and non-European MNFs.

Table 4. Variable list and description

Variable	Description	Source
	Regional characteristics	
Market size	Log of value added in region j	Cambridge Econometrics
Market potential	Log of the sum of value added in all regions $r \neq j$ weighted by the inverse Euclidean distance between the major cities in r and j	Elaborations on Cambridge Econometrics
Per capita GDP	Log of (regional GDP/population)	Cambridge Econometrics and Eurostat
Overall agglomeration	Log of the number of establishments in region j (and sector s). Also spatial lags are considered	Elios
Foreign firms' agglomeration	Log of the cumulative number of foreign-owned firms within region j (and sector s). Also spatial lags are considered	Elios
MNF Experience	Log of the number of firms in region j controlled by the same parent of firm n	Elios
Wages	Log of (wages/total employment)	Eurostat
Population density	Log (regional population/total area in Km^2 of the region)	Eurostat
R&D intensity	Log (regional R&D expenditures at 1995/regional value added)	Eurostat
Secondary school enrolment ratio	Log (students enrolled in sec. school at 1995/total pop. aged 10–19)	Eurostat
Unemployment rate	Log of unemployment rate	Eurostat
Structural funds	Log of European Structural Funds expenditure allocated to the region over the period 1989–1993	European Commission
Objective 1 region	1 if the region is within Obj.1, 0 otherwise	
Public infrastructure	Index of infrastructure stock in region j at 1985	Confindustria
	National policy and institutional variables	
Corporate tax rate	Log of national effective average corporate tax rate	Institute for Fiscal Studies
Tax wedge on employment	Log of (sum of social contributions, income taxes and consumption duties over total employment)	Martinez-Mongay C. (2000)
Bureaucracy	Log of (bureaucracy does not hinder business activity; 0 = less efficient; 10 = more efficient)	IMD
Labour regulations	Log of (labour regulations hiring and firing practices, minimum wages, . . . do not hinder business activity; 0 = more restrictive; 10 = less restrictive)	IMD
Legal system and intellectual property right	Log of (patents and copyright protection is adequately enforced in your country; 0 = less effective; 10 = more effective)	Frazer Institute

Likelihood ratio (LR) statistics will also be reported, in order to test two restricted versions of the NL model. The first (NLr) imposes a common IV parameter for all nests, while the second is the conditional logit model (CL) where all IV parameters are set to one.

We estimate two different specifications of our NL model. Specification A includes only regional variables, thus leaving the maximum unobserved heterogeneity in profitability stemming from each nest. In this case, the correlation between profits from locating in regions within the same country is determined by both national and regional unobserved factors. Examples of the first are national institutional quality and national policies, which affect the attractiveness of each region within a country. An example of unobserved regional factor is the promotion activity

Table 5. Nested logit regressions using countries as nests

Specification A: Only regional characteristics (see Table 4 for the variable list and description)

Sample	European firms		non-European firms	
N. firms	3,349		1,753	
	Coeff.	Std.Err.	Coeff.	Std.Err.
Unrestricted NL				
IV parameters				
Germany	1.228	(0.066)***	0.978	(0.078)
Spain	1.271	(0.107)**	0.847	(0.121)
France	1.164	(0.071)**	0.876	(0.080)
Italy	0.925	(0.066)	0.720	(0.093)***
UK	1.112	(0.071)	1.043	(0.082)
Restricted NL				
IVk = IV	1.132	(0.029)***	1.021	(0.071)
Log-likelihood				
NL	−10,118.7		−4,944.5	
CL	−10,145.5		−4,953.9	
NLr	−10,143.0		−4,953.8	
LR Tests:				
NL vs CL	53.56	[0.000]	18.93	[0.002]
NL vs NLr	48.56	[0.000]	18.85	[0.001]
NLr vs CL	5.00	[0.025]	0.09	[0.769]

Specification B: Regional characteristics, national tax policy variables and national institutional variables (see Table 4)

Sample	European Firms		non-European firms	
	Coeff.	Std.Err.	Coeff.	Std.Err.
Unrestricted NL				
IV parameters				
Germany	1.168	(0.071)**	0.955	(0.089)
Spain	1.178	(0.105)*	0.768	(0.113)**
France	0.960	(0.067)	0.833	(0.085)*
Italy	0.977	(0.074)	0.736	(0.104)**
UK	1.060	(0.071)	0.949	(0.084)
Restricted NL				
IVk = IV	1.029	(0.057)	0.895	(0.073)
Log-likelihood				
NL	−10,089.5		−4,933.3	
CL	−10,098.3		−4,938.1	
NLr	−10,098.2		−4,937.4	
LR Tests:				
NL vs CL	17.52	[0.004]	9.61	[0.087]
NL vs NLr	17.34	[0.002]	8.07	[0.089]
NLr vs CL	0.18	[0.671]	1.53	[0.215]

Notes: The dependent variable is equal to 1 if firm *i* is set in region *j* and zero for all regions different from *j*. CL refers to a conditional logit model, where all *IV* parameters are constrained to 1. NLr refers to a specification where $IV_l = IV_k$ for all countries *l* and *k*. The symbol (*) denotes confidence levels for the hypothesis that *IV* parameters are different from 1: * $p < 0.10$ and ** $p < 0.05$, *** $p < 0.01$. P-values for LR statistics are reported in squared brackets.

carried out by a regional development agency (RDA) to attract FDIs within a specific area. Let us illustrate the difference between the two effects. On the one hand, the probability of locating in region *j* of country *k* may go up if the institutional context in country *k* is more conducive to FDI than in any other country. On the other hand, the substitution pattern would tell us how much the probability of locating in region *j* would be affected by a change in attractiveness of other regions. For example, if territorial marketing in Catalonia is improved, does the probability of locating in Emilia Romagna decrease? What if RDA activity is improved in Bayern or in Lombardia? The region-country NL specification would impose the same cross-elasticity (that is the same substitution pattern) for all regions outside the nest (Catalonia and Bayern) and a common (although different from the previous one) substitution between regions within the same country.[13]

The country-specific effect on the attractiveness of each region is accounted for in specification B which includes two measures of national policy (the average effective corporate tax rate and the tax wedge on labour compensation) as well as three proxies of the effectiveness of national institutions (namely measures of the efficiency of public administration, the degree of labour market regulation and the effectiveness of the legal system).

Results reported in Table 5 suggest the following. First, the unrestricted NL performs better than both the CL and the NLr. In fact, the LR statistics rejects the restrictions imposed by both models, in both specifications and in all sub-samples.

When controlling for country characteristics – in specification B – the model approaches a CL (although the LR still rejects the CL model against the NL), as the value of the estimated IV parameters for Spain, France, Italy and the UK become not statistically different from 1. However, in the case of Germany the IV parameter remains significantly higher than one. Third, this pattern appears to be driven by European MNFs, for which the IV parameters are generally larger, while in the case of non-European investors we find that IV parameters are significantly lower than one for three out of five countries (France, Italy and Spain) and for the other two countries (Germany and the UK) IV parameters are not statistically different from one.

Summing up, our results suggest that, a country-region nesting structure is not consistent with a profit maximizing behaviour, in the case of EU MNFs setting-up foreign plants within the five largest EU countries. So, either we assume that these do not choose location sites according to a process of maximization of expected profits, or we conclude that the country-region nesting structure does not depict their investment process of MNFs in Europe. This can be seen also considering that IV parameters greater than one imply that firms would consider regions belonging to different countries as closer substitutes than regions within national boundaries. Thus, everything else equal, regions would compete relatively more with other locations across borders to attract foreign investors. For non-European MNFs investing in the EU, the IV parameters are never (significantly) larger than one and they are indeed lower than one for France, Italy and Spain (specification B). This is consistent with a decision process where non-European MNFs first choose the country where they want to set up production activities in Europe, then decide in which region, within the country, they establish their affiliates. In fact, these firms would consider regions within the same country as closer substitutes than regions across national boundaries.

4.2 North-South nesting structure

Results from the previous section suggest that in the case a given EU region becomes less attractive for a EU MNF, this firm would not be more likely to locate production to another

[13] In the CL model these two elasticities would collapse, so that a change in the attractiveness of any region *l* would have the same effect on the probability of locating in region *j*.

region within the same national boundaries. Rather, they would be more likely to locate in another country. In statistical terms, substitution is higher across countries (nests) than within national boundaries. Another way of looking at this issue is to define nests spanning different countries and provide 'positive' evidence that within those nests substitution is higher. As noted by Louviere et al. (2000), many nesting structures are plausible and it is difficult to assess to what extent one is better than the other in behavioural/statistical terms. It is worth stressing that it is beyond the purpose of this paper to single out the best nesting structure.[14] We rather need to test and see whether some meaningful aggregations of regions (spanning national boundaries) are also characterized by a higher degree of internal similarity (in terms of profits firms can extract from localizing their activities) than in the case of national aggregates. In this perspective, we aggregated countries with similar geo-economic characteristics, by creating two broad nests, which group together regions belonging to Northern countries (UK, France and Germany) and to Southern ones (Italy and Spain). As shown in Table 6, this structure turns out to be consistent with profit maximizing behaviour both for European and non-European MNFs since all IV parameters are either equal or lower than one. In other words, we support the view that MNFs consider Iberic and Italian regions closer substitutes with each other than with German, French or UK regions. Similarly, for example, French regions are perceived as more similar to German ones, but different from Spanish regions.

In Table 7 we report the full set of coefficients on location determinants for the sample of European and non-European investors obtained using the North-South nesting structure. Results suggest that agglomeration of (all and foreign) firms as well as MNF experience affect positively the location choice of both European and non-European MNFs. The two groups of investors are also attracted by lower corporate tax rate, by an efficient legal system, by looser regulation on the labour market and by the amount of structural funds received (although the coefficient on the latter two variables is badly measured in the case of non-European multinationals). Although, differences between European and non-European MNFs also emerge first, as concerns market-related variables, consistently with the idea that EU MNFs have invested in other EU countries mainly to re-organize production and efficiently serve the whole EU market, they place significant weight on market potential. Conversely, non-EU MNFs seem more attracted towards richer markets (with higher per capita income). Second, some measures of agglomeration economies play a peculiar role for EU MNFs. In particular, population density has a positive and relatively sizable impact on location choices, while higher density of transport infrastructure within a region seems to discourage location of MNFs. The latter may reflect the fact that the available measure of infrastructure fails to capture the inter-regional dimension. The spatial lag in agglomeration economies from foreign multinationals is strong and positive in the case of EU MNFs, thus indicating that agglomeration externalities generated by the stock of foreign plants operating in the same industry span regional boundaries. Finally, concerning country variables, tax wedges on labour have a

[14] It is important to remember that both inferential and Bayesian approaches have been developed to identify the nesting structure which would be most supported by the data (Poirier 1996; Hensher et al. 2005). However, as the number of alternatives rises, the number of possible nests increases dramatically, making the implementation of such a search rather cumbersome (Verlinda 2005). Furthermore, even if one were able to find the most appropriate nesting structure, this would still accommodate rather simple patterns of correlation among alternatives. For example, it would not allow one alternative to belong to more than one nest. A more general approach to capturing substitution patterns in the discrete choice problems is represented by mixed logit models, which are considered the frontier techniques to estimate discrete choice models (Train 2003). In a companion paper (Basile et al. 2008), we estimate a mixed logit model on the same dataset used here and investigate the determinants of location choices of MNFs investing in Europe and show that substitution patterns among regions are the result of a combination of factors and could hardly be captured by relatively simple nesting structures. In particular, an MNF considers regions where it has a similar experience (measured by the number of affiliates already located in the regions), which share similar population density and which are located at similar distance from the home country, as closer substitutes.

Table 6. Nested logit regressions specifying nests across national boundaries

Specification A: Only regional characteristics (see Table 4 for the variable list and description)

Sample	European firms		non-European firms	
N. firms	3,349		1,753	
	Coeff.	Std.Err.	Coeff.	Std.Err.
Unrestricted NL				
IV parameters				
NORTH	1.043	(0.064)	0.903	(0.079)
SOUTH	0.887	(0.073)	0.714	(0.108)***
Restricted NL				
IVk = IV	1.152	(0.066)**	1.070	(0.081)
Log-likelihood				
NL	−10,145.5		−4,953.9	
CL	−10,133.0		−4,948.4	
NLr	−10,142.6		−4,953.5	
LR Tests:				
NL vs CL	25.04	[0.000]	11.02	[0.004]
NL vs NLr	19.12	[0.000]	10.20	[0.006]
NLr vs CL				

Specification B: Regional characteristics, national tax policy variables and national institutional variables (see Table 4)

Sample	European firms		non-European Firms	
N. firms	3,349		1,753	
	Coeff.	Std.Err.	Coeff.	Std.Err.
Unrestricted NL				
IV parameters				
NORTH	0.910	(0.064)	0.950	(0.100)
SOUTH	0.880	(0.080)	0.797	(0.128)
Restricted NL				
IVk = IV	0.921	(0.064)	1.026	(0.008)***
Log-likelihood				
NL	−10,098.3		−4,938.1	
CL	−10,097.4		−4,935.7	
NLr	−10,097.7		−4,938.1	
LR Tests:				
NL vs CL	1.70	[0.427]	4.92	[0.086]
NL vs NLr	0.54	[0.763]	4.84	[0.089]
NLr vs CL				

Notes: The dependent variable is equal to 1 if firm *i* is set in region *j* and zero for all regions different from *j*. CL refers to a conditional logit model, where all *IV* parameters are constrained to 1. NLr refers to a specification where $IV_l = IV_k$ for all countries *l* and *k*. The symbol (*) denotes confidence levels for the hypothesis that *IV* parameters are different from 1: * $p < 0.10$ and ** $p < 0.05$, *** $p < 0.01$. P-values for LR statistics are reported in squared brackets.

negative and significant effect on the location of non-European firms (as expected), but are positive and significant in the European sample. This may have to do with the fact that most EU MNFs pay relatively high tax wedges on labour in their home countries, so a high tax wedge in the host country may not discourage location. Surprisingly, an efficient bureaucracy do not seem to increase the likelihood of location for non-EU MNFs.

Table 7. The determinants of MNFs location decisions in Europe – nested logit regressions
Specification B: Regional characteristics, national tax policy variables and national institutional variables

	EU MNFs		Non-EU MNFs	
	Coeff.	Std.Err.	Coeff.	Std.Err.
Regional variables				
Market size	–0.040	(0.071)	0.030	(0.115)
Market potential	0.417	(0.172)**	–0.541	(0.311)*
Per capita GDP	0.328	(0.226)	0.685	(0.363)*
Structural funds	0.028	(0.019)	0.064	(0.030)**
Objective 1 region	–0.013	(0.117)	0.219	(0.174)
Public infrastructure	–0.450	(0.164)***	–0.187	(0.246)
Overall agglomeration	0.377	(0.060)***	0.402	(0.097)***
Foreign firms' agglomeration	0.323	(0.064)***	0.392	(0.100)***
Overall agglomeration (spatial lag)	–0.872	(0.305)***	0.161	(0.445)
Foreign firms' agglomeration (spatial lag)	0.754	(0.326)**	0.230	(0.468)
MNF Experience	1.199	(0.087)***	1.338	(0.147)***
Wages	0.005	(0.130)	0.264	(0.192)
Secondary school enrolment ratio	–0.097	(0.243)	0.535	(0.351)
Unemployment rate	–0.071	(0.092)	–0.055	(0.129)
Population density	0.298	(0.097)***	0.082	(0.158)
R&D intensity	–0.016	(0.056)	0.081	(0.086)
Country variables				
Corporate tax rate	–0.826	(0.191)***	–0.664	(0.324)**
Tax wedge on employment	0.842	(0.352)**	–1.412	(0.679)**
Bureaucracy	0.757	(0.176)***	0.009	(0.268)
Labour regulations	–0.470	(0.137)***	–0.326	(0.224)
Legal system and IPR	1.532	(0.385)***	2.076	(0.632)***
IV parameters				
North	0.910	(0.064)	0.950	(0.100)
South	0.880	(0.080)	0.797	(0.128)
N. firms	3,349		1,753	
Log-Likelihood	−10,098.3		–4,938.1	

Notes: The dependent variable is equal to 1 if firm *i* is set in region *j* and zero for all regions different from *j*. CL refers to a conditional logit model, where all *IV* parameters are constrained to 1. NLr refers to a specification where $IV_l = IV_k$ for all countries *l* and *k*. The symbol (*) denotes confidence levels for the hypothesis that *IV* parameters are different from 1: * $p < 0.10$ and ** $p < 0.05$, *** $p < 0.01$. P-values for LR statistics are reported in squared brackets.

5 Concluding remarks

This paper analyses the location choice of MNFs in Europe. Most previous studies focused on location decisions within single countries, often analysing locations at a rather geographically disaggregated level, but making the hypothesis that firms choose regions within and not across countries. In other words, firms are usually assumed to choose countries first and then decide in which region within that country they locate their activities. The process of European integration is making this perspective rather narrow, since regions can be expected to compete with other regions both within and across national boundaries for the attraction of FDIs. This study provides empirical support to this latter view by showing that in most circumstances, country boundaries do not matter for location choices of MNFs. In fact, estimating a nested logit model on a sample of 5,102 foreign firms locating in 47 European regions over the 1991–1999 period, we find that MNFs tend to consider regions across countries in Europe as closer substitutes than regions within national boundaries. This suggests that, when taking location decisions, MNFs perceive the EU as a relatively (albeit not completely) integrated area, rather than as a collection of independent countries and EU regions compete with other locations across national boundaries (within the EU) to attract foreign plants. This holds particularly true for European MNFs, which account for more than 60% of all foreign investments in the EU, while we find some evidence of a country effect in the case of location choices of non-European firms. By providing evidence on location decisions of a large number of MNFs regardless of their nationality, this paper provides a considerable extension of previous research efforts and helps provide a more general view of foreign investment patterns in Europe.

Our results have important implications for policies aimed at attracting foreign investors in the EU. In fact, we submit that, to the extent that MNFs consider regions belonging to different countries as closer substitutes than regions within national boundaries, regional authorities face the big challenge of an increased territorial competition from regions across borders. However, a word of caution may be in order here, since our analysis is limited to only five EU 15 countries and it does not include any region from new Member States, which have attracted a considerable amount of FDI in the last decade. Future research should then possibly extend the present analysis and see whether and to what extent border effects are more or less relevant in more recent years and in the context of the enlarged Europe.

Appendix Random utility maximization and discrete choice models

Location choices can be modelled in the random utility maximization (RUM) setting, where it is assumed that firm i chooses location j if it yields the highest utility (or profit) among the set of available alternatives, that is $\pi_{ij} > \pi_{il}\ \forall l \neq j\ (l = 1, \ldots, L)$. Decomposing the profit firm i realizes from location site (region) j (π_{ij}) into a deterministic part (V_{ij}) that depends linearly on observable attributes of the region ($\boldsymbol{X}$) and a stochastic part ε_{ij}

$$\pi_{ij} = V_{ij} + \varepsilon_{ij} = \beta' X_{ij} + \varepsilon_{ij} \tag{1}$$

profit maximization then implies that firm i chooses location j if

$$V_{ij} - V_{il} > \varepsilon_{il} - \varepsilon_{ij} \tag{2}$$

Under the assumption of independently and identically distributed (*iid*) error terms, with type I extreme-value distribution, the probability of choosing location j is

$$P_{ij}^{CL} = \exp(V_{ij}) \Big/ \sum_{l=1}^{L} \exp(V_{il})\ \forall l \neq j\ (l = 1, \ldots, L) \tag{3}$$

This is known as the conditional logit (CL) model (McFadden 1974). A major drawback of this model is the assumption of independence of irrelevant alternatives (IIA), according to which the odds of choosing between any pair of alternatives are independent of the characteristics of any other alternative in the choice set. A behavioural implication of IIA is that all pairs of alternatives share the same degree of substitution (i.e., they are symmetric) which amounts to assuming that all the information in the random component is equal in quantity and relationship between pairs of alternatives and that the cross-alternatives covariance in the error term is equal to zero (Hensher et al. 2005). This assumption would be violated if, for example, different groups of regions had similar unobservable characteristics, so that the error terms would be positively correlated across choices. For example, in this work we test whether some (unobserved) country effect occurs. If this is the case, the choice would not be made among symmetric substitutes, as the degree of substitution between regions within national boundaries might be higher than across countries. More generally, the IIA assumption may be implausible in location choice analysis, as adjacent locations may have similar unobservable characteristics, which make them interdependent. Failing to account for this correlation would lead to biased estimates.

The nested logit (NL) model partially solves this problem by allowing for some correlation between errors within mutually exclusive groups (nests), while maintaining the hypothesis of no correlation across nests. The IIA assumption, thus, holds across nests but not within them. In other words, a change in the attractiveness of region *j* would increase the probability of locating in other regions within the same nest relatively more than the probability of locating outside the nest. Alternatives within the same nest are then closer substitutes than choices placed in different nests. To illustrate, let us assume that the *J* alternatives are grouped into *K* country nests, that is, each alternative belongs to a nest B_k.

Thus, the probability that firm *i* chooses region *j* is the product of two logit probabilities: the conditional probability of choosing *j* (known as the *lower* model), given that nest *k* has been selected ($P_{j|B_k}$), times the marginal probability of choosing nest *k* (P_{B_k}, known as the *upper* model):[15]

$$P_j^{NL} = P_{j|B_k} \times P_{B_k} = \frac{\exp\left[(V_j)/\sigma^l\right]}{\sum_{m \in B_k}\left[(V_m)/\sigma^l\right]} \times \frac{\exp(IV_k/\sigma_k^u)}{\sum_k \exp(IV_k/\sigma^u)} \tag{4}$$

where σ^l is the variance in unobserved profit of the alternatives (i.e., the degree of heterogeneity or dissimilarity) within nest *k* (superscript *l* indicates that this is the variance in the lower model), while σ^u is the heterogeneity between alternatives in the upper model, i.e., between nests. A key quantity in NL is the inclusive value ($IV_k = \sigma^l \ln \Sigma_{j \in B_k} \exp\left[(V_j)/\sigma^l\right]$), which measures the profit that a firm can expect to obtain from locating in any region within nest *k* and links the upper and the lower model by bringing in the former information from the latter. Rearranging terms we obtain (Anderson et al. 1992; Hensher and Greene 2002)

$$P_j^{NL} = P_{j|B_k} \times P_{B_k} = \frac{\exp\left[(V_j)/\sigma^l\right]}{\sum_{m \in B_k}\exp(V_m/\sigma^l)} \times \frac{\frac{\sigma^l}{\sigma^u}\ln \sum_{m \in B_k}\exp(V_m/\sigma^l)}{\sum_k \frac{\sigma^l}{\sigma^u}\ln \sum_{m \in B_k}\exp(V_m/\sigma^l)} \tag{5}$$

In equation (5), one can identify only the ratio $\lambda = \sigma^l/\sigma^u$, but not the individual variances, so some normalization is required. If we set $\sigma^u = 1$, we have what Hensher and Greene (2002) label as the RU2, implemented in the econometric software NLOGIT 3.0, used in this analysis. Under this normalization, we get the following specification of the NL, as it is presented in most econometric textbooks (such as Train 2003; Cameron and Trivedi 2005):

$$P_j^{NL} = P_{j|B_k} \times P_{B_k} = \frac{\exp\left[(V_j)/\lambda_k\right]}{\sum_{m \in B_k}\exp(V_m/\lambda_k)} \times \frac{\exp(\lambda_k IV_k)}{\sum_k \exp(\lambda_k IV_k)} \tag{6}$$

Additional nest-specific covariates *Z* can also be included in the upper model. In this case, the probability of choosing nest *k* would be $P_{B_k} = \exp(\gamma' Z_k + \lambda_k IV_k)/\Sigma_k \exp(\gamma' Z_k + \lambda_k IV_k)$.

It turns out that $1 - \lambda_k$ is a measure of correlation of the error components from different choices within the same nest. As long as $\lambda_k \to 1$, the correlation within a nest approaches zero,

[15] To simplify notation, we drop the subscript *i*. The reader should be aware that each firm has its own probability, and the likelihood function is derived from the product of all the individual probabilities over all alternatives.

while $\lambda_k \rightarrow 0$ indicates substantial correlation within a nest. In other words, the estimated parameter associated with the IV (λ_k) reflects the degree of dissimilarity among unobserved portions of utility within a nest, with lower λ_k indicating more similarity, hence closer substitution (Train 2003). This is evident if we consider that $\lambda = \sigma^l/\sigma^u$: a larger λ_k denotes relatively higher heterogeneity in the lower model, namely, between alternatives in nests k, than between one alternative in nest k and other alternatives in a different nest. $\lambda_k = 1$ is a critical value, for which alternatives within and between nests display the same degree of heterogeneity. This the case of the CL model, where all alternatives are considered as equally dissimilar. The goal of the NL is to create nests where alternatives are relatively more similar, namely, display a higher degree of substitution. Therefore, a correctly specific NL model should exhibit $\lambda_k < 1$. If λ_k is greater than 1, the degree of dissimilarity within nest k, is larger than the dissimilarity between alternatives belonging to different nests. This reveals that the NL is not correctly specified. Daly and Zachary (1979) and McFadden (1979) demonstrate that if λ_k is between zero and one for all k, the model is consistent with profit maximizing behaviour, while $\lambda_k > 1$ generally implies that firm behaviour would not be consistent with profit maximization (Train 2003, p. 85).[16] Furthermore, as shown in a Monte Carlo experiment by Herriges and Kling (1997), λ_k greater than one also determine a significant bias in the coefficients estimated for th**e** location determinants.

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[16] For $\lambda_k > 1$, the model is consistent with profit maximization only for some ranges of the explanatory variables. Herriges and Kling (1996) provide tests of consistency of NL with profit maximization when $\lambda_k > 1$, but they argue that for applications with several alternative groups, the acceptable range for the λ_ks does not extend much beyond the unit interval. Given the relatively high number of choices (47) and nests (5), in our application we will maintain the unit interval as the acceptable range for the λ_ks.

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