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Abstract

We examine the attractiveness of European Union regions for location of multinationals in the Information and Communication Technologies (ICT) sector. Using data on 8,543 foreign subsidiaries established in 229 regions of the European Union over the period 1998-2008 we find that on average, the location probability increases with regional demand, agglomeration economies, technological development, flexibility of labour markets, and information technology infrastructure. The determinants of the location choice of ICT multinationals are different for regions in Western Europe and Central and Eastern Europe. While in Western Europe, regions with higher GDP per capita are preferred for both ICT multinationals in manufacturing and service sectors, in Central and Eastern Europe, regions with lower GDP per capita attract the bulk of ICT multinationals in the service sector. Unemployment rates appear negatively correlated with the probability of location in the whole European Union and Western Europe, while they increase attractiveness for regions in Central and Eastern Europe. Some determinants are also found to have heterogeneous effects on multinationals from different countries. In particular, US multinationals are not sensitive to labour costs while EU multinationals respond to this factor negatively.

JEL classification: F23; O33; R38.

Key words: Foreign direct investment; Information and Communication Technologies; Location choice; Conditional logit; Nested logit; European Union.

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1 Introduction

Since the mid -1990s, dynamic growth has been associated with specialisation in ICT-producing and ICT-using industries (van Ark and Inkaar, 2005; Barrios and Navajas Cawood, 2008). Furthermore, it has been shown that ICT-producing sectors tend to promote technological change and innovation (Becchetti et al., 2003; Carlsson, 2004; Hollenstein, 2004).

Information and Communication Technologies (ICT) are at the core of the knowledge-driven economy and there is growing evidence to suggest that ICT-linked knowledge, innovation and technological changes are strong determinants of growth differentials and the ability of countries to benefit from globalization. While earlier studies have found little evidence of a link between ICT and output growth, more recent studies point to a positive effect of ICT investment on output growth (Oliner and Sichel 2000; Daveri 2001; Roeger 2001; van Ark 2001; Pilat and Lee 2001; OECD 2001).

The renewed Lisbon Strategy agreed in March 2005 put a special emphasis on the role ICT can play in boosting growth, competitiveness and cohesion in the European Union (EU). In relation to this, on the 1st of June 2005 the European Commission has launched a five-year comprehensive strategy - "i2010"- to foster growth and jobs in the ICT sector[1]. This initiative contains a package of proactive policies to promote an open and competitive digital economy. A large amount of EU expenditure over the period 2007-2013 has been allocated to ICT investment. In particular, the European Commission has earmarked € 1,8 billion annually for research priorities in the area of Information Society and Technology as part of the 7th Framework Programme (FP7) and a further € 825 million on a specific programme focused on ICT policy support, which is a new programme within the Competitiveness and Innovation Programme (CIP).

Furthermore, there has been an increasing internationalisation of ICT activity which raises a number of questions which are of interest and relevance both for research and policy making: Where are the ICT multinational enterprises located in the European Union? Who are the main foreign investors in the ICT activity in the European Union? What factors drive the location choice of multinational ICT activity?

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[1] "i2010-A European Information Society for Growth and Employment", Commission of the European Communities, COM(2005) 229,http://ec.europa.eu/information_society/eeurope/i2010/key_documents/

The analysis of the location choice of foreign investment has focused on multinational enterprises (MNEs). It assumes that factors driving location decisions do not vary across sectors. Many studies have focused on one country and analyzed the location choice of MNEs within that country.

This paper analyses the determinants of the location of multinational enterprises in the ICT sector across European Union regions. Our sample includes 8,543 foreign affiliates of multinational enterprises (MNEs) in the ICT sector located in 229 regions in the European Union over the period 1998-2008. The firm-level data source is the *Amadeus* database.

The novelties of this paper are threefold. First, we provide fresh empirical evidence on the determinants of the location choice of multinationals in the ICT manufacturing and services across EU regions. Second, we use an improved econometric methodology to account for spatial dependence in the location choice. Third, we account for the heterogeneity of foreign investors by allowing the probability of investing in a specific region to be different depending on the country of origin of foreign investors.

Our results suggest that on average, the probability of locating in an EU region (NUTS 2) increases with the size of demand (market potential), agglomeration economies (positive spillover effects from existing firms in the ICT sector), technological development (R&D expenditure), flexibility of labour markets, and information technology infrastructure. The determinants of the location choice of ICT multinationals are different for regions in Western Europe (EU15) compared to those in Central and Eastern Europe (EU10). While in Western Europe, regions with higher GDP per capita are the preferred locations for ICT multinationals in both the manufacturing and service sectors, in Central and Eastern Europe, regions with lower GDP per capita attract the bulk of ICT service multinationals. A negative competition effect from domestic ICT firms is found in Western Europe for the service sectors. Unemployment rates appear negatively correlated with the probability of location in the whole EU and Western Europe, while they increase attractiveness for regions in Central and Eastern Europe. Some determinants are also found to have heterogeneous effects on multinationals from different countries. In particular, US multinationals are not sensitive to labour costs while EU multinationals respond to this factor negatively.

The remainder of this paper is organised as follows. Section 2 discusses theoretical and empirical foundations on the location choice of multinational enterprises. Section 3 presents the empirical methodology and model specifications. Section 4 describes the data and summary statistics of the main variables. Section 5 discusses the empirical results. Finally, Section 6 concludes.

2 Theoretical and Empirical Background

Industrial location is a consequence of the interaction between various economic agents and economic forces. Two strands of literature shed light on this issue with different focuses on particular economic agents and forces. The first and earlier strand is the literature on multinational enterprises' activities, which originates from Caves (1971) and Dunning (1971). MNEs shift production across countries through the channel of FDI, which can be either "vertical" or "horizontal" in nature. Through horizontal FDI MNEs gain access to foreign markets without incurring trade costs between countries[2]. Via vertical FDI, MNEs can avail of lower factor prices in host countries. [3] More recently, an export-platform motivated FDI was formalised in Ekholm et al. (2007) and the model is highly relevant to MNEs' FDI into a free-trade area, such as the European Union. This strand of literature highlights the motivations for MNE's FDI and its importance as it contributes to the global or regional production location.

The second strand of literature, the New Economic Geography (NEG) focuses on the geographic distribution of overall economic activities. [4] According to this literature, the exact location pattern is decided by the interaction of trade costs between regions and the pecuniary externalities generated inside the IRS industry. Since the pecuniary externalities play a central role in the distribution of economic activities, the literature is in sharp contrast to the Marshall-type theory which sees the distribution as a consequence of technological externalities between firms and also the Neo-classic trade theory that addresses the determinant roles of technological differences and factor endowments. Some important NEG models [5] show that agglomeration benefits are generated in the IRS industry if firms cluster in one region through various mechanisms.[6] On the

[2] See Brainard (1993) and Markusen and Venables (1998, 2000) for theoretical explanations.
[3] See Helpman (1984) and Helpman and Krugman (1985) for example.
[4] The increasing-return-to-scale (IRS) industry is a central subject of the NEG theory.
[5] Krugman (1991), Venerables (1996), Baldwin (1999) and Puga (1999) for example.
[6] For instance, Krugman (1991) demonstrates that higher market demand ("backward" linkage) and lower nominal wage rates ("forward" linkage) in an agglomerated region create centripetal force to self-reinforce the agglomeration trend. Other mechanisms include the upstream-down stream linkages (in Venerable, 1996) and endogenous capital accumulation (in Baldwin, 1999).

other hand, dispersion forces also exist, such as competition in local product market, which lowers price and competition in labour market that raises labour costs.

Hence, we see the first literature suggesting that MNEs are an important element in industrial location and both literatures establish the roles of market access, factor prices and industrial agglomeration in attracting firms into different regions.

The location choice of MNEs, subject to the aforementioned economic factors has been put into examination empirically in many studies using a discrete-choice framework. Of particular relevance to our work are studies that focus on the location choice of MNEs across several European countries, at region[7] and country level: for example, Devereux and Griffith (1998) for US MNEs in 3 European countries; Basile et al. (2003) on EU and US MNEs' investments in 55 NUTS 1 regions in 8 EU countries; Head and Mayer (2004) for Japanese firms in 9 EU countries at the NUTS 1 level; Disdier and Mayer (2004) for French MNEs in Western Europe and Eastern Europe; Crozet et al. (2004) for foreign investments in French regions; Defever (2006) for MNEs' investment projects in 23 European countries; Pusterla and Resmini (2005) for high-tech and low-tech investments in four Central and Eastern European countries; Mataloni (2007) for US MNEs in the EU; Mayer et al. (2007) for French-owned investments made home and abroad and finally Barrios and Cawood (2008) for the ICT producing sectors in the EU25.

The importance of local goods markets on the probability of one region or country being chosen by MNE investors is confirmed in most research. The evidence on the roles of labour costs is mixed. For example, wage rates are generally found to be negatively associated with the location choice of new establishments, but the effect may also be positive or insignificant (Devereux and Griffith, 1998; Barrios et al., 2003, Pusterla and Resmini, 2005 and Mataloni, 2007). Several arguments are proposed to explain the positive effect of wage rates. For instance, wage rates work as a signal on the quality of labour, and consequently foreign MNEs would accept high wages in order to secure skilled labour.[8] The positive wage effect on FDI may also reflect an "industry bias" or "skill bias" in the data. Békés (2005) suggests that MNEs are most likely to be

[7] Regional level studies are normally conducted at different NUTS level. NUTS stands for Nomenclature of Territorial Units for Statistics, the official regional classification system developed by EUROSTAT to facilitate regional study in the European Union. Current version of the NUTS classifies 25 member states at the NUTS 0 (country level), and then further decomposes these countries into 89 regions at the NUTS1 level, 255 regions at the NUTS2 level and 1,221 regions at the NUTS3 level.

[8] Moreover, Guimaraes et al. (2002) argue that wage effects may be significant between countries but not necessarily important across regions within one country if investors have already decided on the country in which to invest.

in the high-tech sectors where the wage is high or, they are bringing superior technologies to host countries and consequently are hiring more skilled or managerial workers than domestic firms. Agglomeration forces are seen as playing an important role in many studies. For example, Bartik (1985), Head et al. (1995) and Mataloni (2007) find that the existence of regional manufacturing activities encourages new manufacturing investments. In addition to that, foreign MNEs are more likely to set up their new plants in the locations where business already exist from the same country or even the same business group.[9] However, the results are not uniform for regions within countries[10] and across countries of the EU.[11]

A major methodological difference divides the aforementioned studies into two types: the ones assuming that all alternative locations are perfectly independent of each other, and the ones that assume certain level of correlation between alternatives. Obviously the second type is more capable of capturing the substitution pattern of alternatives in the real world. Most of the recent studies cited here are of the second type. [12] They choose to group alternative locations into several nests according to the similarity of the alternatives [13], thus the correlation is accommodated inside the nests.

Following those empirical studies, we use discrete-choice models on the ICT sectors and apply nesting structures on alternative regions.

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9 For example, Japanese firms tend to locate in the regions with other firms from the same industrial group, or Keiretsu.

10 For example, Hogenbirk and Narula (2004) find that when comparing the Randstad region (the agglomerated region containing large cities, major ports and airports) with the rest of the Netherlands, the presence of local business seems to work as a deterrent for new foreign establishments.

11 Disdier and Mayer (2004), using data on French MNEs, find that industrial agglomeration is less important as a factor influencing their location-choice decisions in Central and Eastern Europe than in Western Europe.

12 With an exception of Barrios and Cawood (2008).

13 Defever (2006) does not apply any nesting structure on alternative locations, but rather assuming that the effects of alternative-specific variables vary across individuals. This is a more flexible way to tackle the correlation between alternatives.

3 Empirical Methodology

We employ two discrete-choice models to study the location choice of MNEs. The first one is the conditional logit model (CLM), as proposed in McFadden (1974). Given the simple structure of the probability function of the CLM, it has been widely used to study the problems of consumer's choice, travel mode choice and location choice of FDI.

Suppose there are J alternatives available to individual i and the individual needs to make a single choice amongst all alternatives in order to maximise his utility U_{ij}. The utility of choosing alternative j can be expressed as a function of all observable characteristics of the alternative, X'_{ij}, with an unobservable part of utility. Therefore, we can write

(1) $$U_{ij} = X'_{ij}\beta + \varepsilon_{ij}.$$

ε_{ij} is the unobservable utility or simply the error term of the utility function. McFadden shows that, if (and only if) $\varepsilon_{ij}, \forall j = (1,...,J)$ follows a type I extreme value distribution IID across all individuals and alternatives, the probability of alternative h being chosen by i has the logit form:

(2) $$\Pr(y = h \mid 1,...,J) = \frac{\exp(X'_{ih}\beta)}{\sum_J \exp(X'_{ij}\beta)}.$$

The simple IID assumption over the error term gives the CLM a unique property called "Independence from Irrelevant Alternatives (IIA)". Simply put, the choice made between any pair of two alternatives amongst J alternatives is independent of the rest of the alternatives. However, it is often found that IIA cannot hold in many discrete-choice cases. For instance, if the error term contains an unobservable individual preference towards some alternatives, which share common characteristics that are again unobservable to researchers, the error terms of these alternatives will correlate with each other and thus IIA is violated. [14]

In order to account for the correlation among utilities generated from alternatives, a nesting structure can be imposed on the alternatives. The structure assumes that alternatives can be grouped into several nests according to similarity of those alternatives, therefore correlation of utilities is allowed within a nest, but not between nests. The nesting structure leads to a group of

[14] Train (2003) terms such kind of error term structure as "error components".

flexible models called nested logit models (NLM), where the error term follows one of generalised extreme value (GEV) distributions (see Ben-Akiva, 1973, Train, 1986, Train *et al*, 1987 and Forinash and Koppelman, 1993).

Following Heiss (2002), let the error term in Eq. (1) follow a generalised extreme value distribution. Denote $\tau_k = \sqrt{1-\rho_k}$, where ρ_k is the correlation of alternatives in nest k, thus τ_k measures the independence of alternatives in nest k. If $\tau_k = 1$, the alternatives are perfectly independent of each other, and if $\tau_k = 0$, perfect dependence exists. One can further write the log sum of utilities generated from alternatives in nest k as

(3) $$IV_k = \ln \sum_{j \in n_k} \exp(U_{ih} / \tau_k)$$

IV is the inclusive value of nest k (denoted by n_k). Therefore, τ_k is also called the *IV* parameter of n_k. The probability function of alternative h in nest k being chosen is the product of the probability of choosing nest k [$\Pr(k)$] and the conditional probability of choosing h given k is chosen [$\Pr(h \mid k)$]. The function can be expressed as follows

(4) $$\Pr(y = h \mid 1,...,J) = \Pr(h \mid k)\Pr(k) = \frac{\exp(U_h / \tau_h)}{\exp(IV_h)} \frac{\exp(\tau_h IV_h)}{\sum_K \exp(\tau_k IV_k)},$$

where τ_h and IV_h are the *IV* parameter and the inclusive value for the nest containing alternative h.

It can be shown that the probability ratio of any two alternatives from two different nests contains factors related to the utility of other alternatives in those two nests (through the presence of the inclusive value) but the probability ratio of any two alternatives within the same nest does not contain factors of other alternatives in that nest. [15] That is to say, IIA is allowed within nests, but not across nests.

Finally, the choice of nesting structures is multiple. Sometimes natural nesting structures arise as in the location case: country-region based nests. Otherwise, regions or countries can be partitioned depending geographic and economic similarity of them. However, Greene (2002, pp727) points out that there is no systematic way to identify a best structure amongst all possible

[15] See Train (2003), Chapter 4, pp 84.

nests. Fortunately, there exists a boundary for the NLM to be consistent with the Random Utility Maximisation (RUM) framework - the IV parameter τ_k has to be bounded between 0 and 1 (Heiss, 2002). In the case of $\tau_k = 1$, alternatives in a nest are completely independent of each other, thus nesting becomes unnecessary and the NLM collapses into the CLM. On the other hand, if $\tau_k = 0$, alternatives in a nest are perfect substitutes to each other and only the nest becomes a valid alternative.

Model Specifications and Econometric Issues

The dependent variable is the location choice of each MNE over 246 regions. Following other empirical studies of location choice, we use market potential to proxy the potential demand from a region and its adjacent regions. This measure is introduced in Harris (1954) in order to capture the spatial correlation between regions. We expect a positive effect from this variable on the probability of location.

On the supply side, we use GDP per capita to proxy regional labour costs. The potential complication is that GDP per capita also reflects regional development, in terms of labour skills and technological development (the "signal" function). There may also exist "industry bias" or "skill bias" in the data. Due to these factors the percentage of manufacturing workers holding tertiary education degrees is used to control for labour skills and total R&D expenditure of business and government or ICT patent applications to control for technological development. The expected effects of these two variables are positive. One additional control variable for labour-market conditions is the unemployment rate, which can proxy the potential local labour pool or the institutional rigidity in labour market. Depending on which factor is prevailing, the overall effect of unemployment is hard to predict *a priori.*

Industrial agglomeration is also an important determinant in the location choice of MNEs, as implied by theoretical models and identified in empirical studies. The first measure of industrial agglomeration is the number of foreign-owned firms in both the ICT manufacturing sectors and service sectors depending on which sectors we examine. Being close to other foreign-owned firms in the same sector allows MNEs to avail of the benefits from information sharing on the local business environment for foreign investment (Banerjee, 1992 and Head et al., 1995 and 1999 discuss such information-sharing function), technology spillover amongst MNEs and inter-firm linkage of intermediate input and output. The above-mentioned sources generate a positive effect on MNEs' location choice. On the other hand, a substantial presence of foreign investment in a region may also lead to serious competition in the local markets. Local labour, land and infrastructure can be bid up and thus reduce MNEs' propensity to invest in such region (as argued in Crozet et al., 2004). Therefore, we do not hold an *a priori* belief on the overall effect of this industrial agglomeration measure.

We also introduce the number of domestic-owned firms to proxy local business presence. By the same logic, the effect of this variable is ambiguous. However, we suggest that the negative competition effect of local business, if it exists, would be stronger in the service sectors than in the manufacturing sectors because the computer-related services, post and telecommunication services are non-tradable, in addition, the service sectors are more labour intensive than the manufacturing sectors. Therefore, the competition for local demand and local labour would be more intense for the former sectors. The number of total firms (both domestic and foreign owned) is also used in order to test the robustness of agglomeration effects. All three measures of agglomeration variables are spatially lagged in the same way as market potential. We deem these spatially-lagged agglomeration variables as an improvement on previous studies on location choice, usually they do not take into account spatial correlation of agglomeration between regions or countries (except Crozet et al., 2004 and Basile et al., 2008, 2009).

The last regional variable is internet subscribers per 100 inhabitants. This variable is used to model the location choice of ICT service sectors because it can be seen as a valid indicator of information technology infrastructure, which is crucial for the ICT services (Barrios and Cawood, 2008).

At country level, we proxy policy effects with the statutory corporate tax rate which was often found to be important in MNEs' location choice decisions across countries (Devereux and Griffith, 1998, Head and Mayer, 2004 and Mataloni, 2007 for example).

All explanatory variables are lagged to account for the fact that implementation of investment decisions are in practice lagged. Specifically, explanatory variables are averages over the period 1995 to 2002. Also, lagging the variables alleviates the issue of simultaneity in estimation. All explanatory variables, other than the ones in percentage form are transformed into logarithms. Therefore, their coefficients can be interpreted as average probability elasticity (APE). The APEs can be obtained by multiplying the coefficient of the CLM by a parameter equal to $(1-\frac{1}{L})$, or multiplying the coefficient of the NLM by the parameter $\frac{1}{L}[\sum_{K}(\frac{J_{n_k}}{\tau_j}-\frac{1}{\tau_j})+K-1]$. L is the number of regions in the choice set. Since there are up to 246 regions in the choice set, the first parameter is close to unity.[16] K is the number of nests at upper level of the choice set and J_{n_k} is the number of regions in nest k. For the derivation of the APE for the NLM see Appendix 1. For the variables expressed in percentages, their APEs are evaluated at the mean values of those variables.

We present two full models for the ICT manufacturing sectors and the service sectors respectively. In Eq. (5), R&D expenditure is replaced by the number of ICT patent applications, and in both equations, total firms will replace foreign firms and domestic firms in alternative specifications.

$$\Pr(y=j\,|\,1,...,J)=\Lambda(\textit{market potential}, \textit{GDP per ca.}, \textit{foreign firms}, \textit{domestic firms}, \textit{education}, \textit{unemployment rate}, R\&D\ \textit{expenditure}, \textit{statutory tax rate}) \quad (5)$$

$$\Pr(y=j\,|\,1,...,J)=\Lambda(\textit{market potential}, \textit{GDP per ca.}, \textit{foreign firms}, \textit{domestic firms}, \textit{education}, \textit{unemployment rate}, \textit{internet users}, \textit{statutory tax rate}) \quad (6)$$

Definitions and sources of country and region-level explanatory variables are given in

Table A1 in Appendix 2. Tables A2a and A2b show the descriptive statistics of the region and country-level variables respectively.

[16] See Head et al. (1995) and Head and Mayer (2004) for the derivation of average probability elasticity.

4 Firm-level Data

Our data set contains 8,944 foreign affiliates of multinational enterprises in the ICT sectors located in 246 regions in the European Union and established in the period from 1998 to 2008 (inclusive). The data is obtained from the *Amadeus* database, which is by far the most comprehensive database of European firm accounts[17]. The choice of foreign affiliates is based on the fact that MNEs are able to make their location choice in multiple countries or regions. This makes it possible to study country and region-level characteristics that affect the attractiveness of countries and regions. A foreign affiliate is defined as a firm having one foreign shareholder with at least 10 per cent of voting share. This definition is in line with IMF and OECD's definitions of "foreign direct investment enterprise" (IMF, 1993). The ICT sectors include, according to NACE industrial classification, five sectors at 2-digit level as follows:

30 Manufacture of office machinery and computers

32 Manufacture of radio, television and communication equipment and apparatus

33 Manufacture of medical, precision and optical instruments

64 Post and telecommunications

72 Computer and related activities

Each of the qualified firms is regarded as a location choice made by MNEs during the period from 1998 to 2008. This period allows us to include both the EU15 countries and the new EU countries in MNEs' location-choice set. [18] We choose to examine the location choice at region level rather than country level because MNEs do not only look at the characteristics of countries when making their location choices. Rich information about regional characteristics is also

[17] *Amadeus* is a firm-level database published by electronic publisher Bureau van Dijk. It contains data for over 11 million firms located in 45 European countries. The data cover basic profile, the balance sheet, profit and loss account, financial ratios and ownership structure of a firm.

[18] The EU15 countries are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the UK. New EU countries are Bulgaria, Cyprus, Czech, Estonia, Hungary, Latvian, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia. We do not include Cyprus and Malta in this study because *Amadeus* shows there is no ICT firm established during the period in Cyprus and nine ICT firms located in Malta are not foreign-owned.

available. Specifically, we observe each location choice in one of 246 NUTS 2 regions in 25 EU countries. [19]

The ICT sectors contain three manufacturing sectors[20] (30, 32 and 33) and two service sectors (64 and 72). We study the manufacturing and service sectors separately because the location choice of MNEs in these two groups may be affected by different country-level and region-level characteristics, or the same characteristic may affect the MNEs differently. For instance, we can expect that manufacturing MNEs are more likely to be attracted by industrial agglomeration and R&D expenditures while the service MNEs may prefer good infrastructure of information technologies. Market potential may be more important for the service MNEs but less relevant for the manufacturing MNEs, given that their products are tradable.

The ICT manufacturing sectors include 1,342 foreign affiliates. The geographic distribution of these firms across countries is detailed in Table A3. The distribution is highly uneven. For all three 2-digit sectors, Germany received the largest number of new firms of all EU25 countries, while among the EU10 countries, Romania received the largest number of new firms. If the firms are broken down by ownership, looking at all three sectors, the UK received the largest number of MNEs from the US, and Germany received the largest number of MNEs from the EU and other countries (except for NACE 30). Furthermore, it is worth noting, that foreign ownership is consistent across the three sectors. For instance, the firms owned by US MNEs account for about 24 to 29 per cent of all firms in each sector. That share varies from 47 to 53 per cent for EU MNEs and 23 to 27 per cent for other MNEs.

Table A4 presents the shares of new firms in each country across sectors. The cumulative shares for the EU15 and EU10 countries reveal that the new firms created in the EU10 account for 16 (NACE 33) to 24 per cent (NACE 30) of all firms created in the EU25.

In comparison to the manufacturing sector, the ICT service sectors contain a larger number of foreign affiliates - 7,602. Table A5 reports the geographic distribution of the ICT service MNEs across the EU25 countries. Among them, the UK received the largest number of firms in both NACE 64 and 72 sectors in terms of total firms or by ownership, while Romania received the

[19] Total 269 NUTS 2 regions are defined for the 25 EU countries while we only observe the firms located in 246 NUTS 2 regions.
[20] The manufacturing sectors are ICT producing sectors; we focus on these sectors because they are likely to foster technological change and innovation.

largest number of firms among the EU10 countries. Again we can see that foreign ownership is consistent for the two service sectors.

Table A6 reports the shares of firms in each country. The sums of shares for the EU15 and EU10 countries reveal that the new firms created in the EU10 accounted for 13.4 (NACE 72) to 18.9 per cent (NACE 64) of all firms created in EU25.

The highly-skewed geographic distribution of the ICT industries at country level is also documented in Barrios and Cawood (2008). The difference is that they use employment as the subject and do not include Bulgaria or Romania.

5 Empirical Results

We begin with the estimates of conditional logit models CLM which we use as benchmark.

The Location of ICT Producing Manufacturing: Conditional Logit Models

Table 1 reports the results for determinants of the location choice of MNEs in ICT manufacturing sectors. Model 1 is a baseline model with only market potential, GDP per capita and agglomeration variables. GDP per capita has a significantly negative coefficient. The spatially-lagged numbers of foreign firms and domestic firms have significantly positive coefficients. These results suggest that new investments of MNEs are attracted by the presence of both foreign-owned and domestic firms but discouraged by labour costs. However, the coefficient of market potential is not significant. In Models 2 and 3, two more variables controlling for labour market conditions enter the baseline model, namely, education attainment of the labour force and the unemployment rate. Looking at the two new variables first, we see that educational attainment affects the probability of a region being chosen positively, second the negative effect of the unemployment rate indicates that institutional rigidity in labour market reduces the attractiveness of a region to MNEs. These findings are in line with the high-tech feature of the ICT sectors - MNEs in these sectors deem the skill level as an important factor, rather than the access to the labour pool. [21] After controlling for the skill and institutional features of the labour market, GDP per capita shows an even stronger negative effect in Model 2 and 3, while market potential becomes positive and significant.

[21] Statistic evidence reported in Barrios and Cawood (2004) supports our argument. They report that the share of employees with university degree is ranging from 32.2 per cent to 50.2 per cent for the ICT manufacturing sectors in the EU25, while the share for non-ICT sectors is 25.2 per cent.

In Models 4 and 5, we include two measures of R&D level along with the statutory tax rate. The two R&D variables enter the model separately because they are highly correlated. Both measures, total R&D expenditure and the number of patent applications from ICT sectors had positive effects on the attractiveness of regions. The coefficients are all significant at the 1 per cent level and are of the same magnitude. This is strong evidence suggesting that local technology development is a crucial determinant of MNEs' location choice. Since a certain level of benefits of technology level comes from inter-firm spillovers, we see that the positive effects of agglomeration of foreign and domestic firms are reduced.

The statutory corporate tax rate shows significantly positive coefficients in Model 4 and 5. Such a tax effect is also found in Basile et al. (2008), who find that the corporate tax rate affects location choice positively. We argue that the finding is reasonable for two reasons: i) a high tax rate can be compensated by better supply of public goods and ii) MNEs are able to reduce or avoid the tax burden in high tax rate countries using intra-firm transfer pricing and other financial tools (see Swenson, 2001, Clausing, 2003 and Huizinga and Laeven, 2005 for related empirical studies), therefore, they may be not sensitive to the negative effect of the tax rate.

Finally, in Model 6 we replace the agglomeration variables of foreign and domestic firms with a single variable for the total number of foreign and domestic firms. The coefficient of this variable is significantly positive. [22] Given that a number of explanatory variables have missing values for some NUTS2 regions, for Model 4, 5 and 6, seventeen regions are dropped from the choice set and consequently, 1,272 firms out of 1,342 firms remain in the sample for 229 NUTS2 regions.[23]

The coefficients of the country or region-level determinants can be converted into the average probability elasticities (APEs) using the method discussed in Section 3.2. That means that the coefficients of these variables can be roughly read as elasticities. For instance, the coefficients of market potential across the six specifications range from 0.2 to 0.5, meaning that for a one per cent increase in market potential in an average region, the probability of this region being chosen by MNEs will increase by 0.2 to 0.5 per cent. Other variables in log form can also be interpreted in this way. While in terms of those variables in percentage forms, their APEs are evaluated at the

[22] We also estimate the same set of models with non-spatially-lagged agglomeration variables as a robustness check. Similar results are found. These results are available from authors upon request.
[23] These dropped regions are located in Denmark (three regions, that is to say, all Danish regions), Germany (four regions), the UK (two regions), Slovenia (two regions, that is to say, all Slovenia regions) and Bulgaria (six regions, that is to say all Bulgaria regions).

mean value of each variable. For instance, in the cases of tertiary education attainment, if the share of workers with tertiary education of a region increases by one per cent, the probability of this region being chosen would increase by 0.8 to 1 per cent. Similarly, one per cent increase in the statutory tax rate will lead to 0.3 to 0.5 per cent increase in the location probability. On the other hand, one per cent increase in the unemployment rate will reduce the probability of location by 0.5 to 0.6 per cent.

The Location of ICT Service Sectors: Conditional Logit Models

Table 2 reports the results of location choices in the ICT service sectors. Model 1 is a baseline model, where market potential and the agglomeration of foreign and domestic firms have significantly positive effects, while GDP per capita has a significantly negative effect.

In Models 2 and 3, education attainment is positively correlated with the probability of a region being chosen, while the unemployment rate reduces the location probability. In the last three columns, the number of internet users shows a significantly negative effect on the location choice (Model 4). The statutory tax rate has conflicting effects in Models 5 and 6. The agglomeration of total firms shows a positive effect. For the same reason of missing values, 7,271 out of 7,602 firms remain in the sample and they locate in 229 NUTS2 regions.

Again, the coefficients of market potential, GDP per capita and agglomeration variables can be directly read as APEs. The APE of education attainment is ranging from 2 to 2.5 per cent and that of the unemployment rate from minus 0.3 to minus 0.7 per cent.

Models 4 – 6 (Table 1) for ICT manufacturing sectors and Models 5 and 6 (Table 2) for ICT service sectors will be used to estimate the NLM in the next step.

Estimates of Nested Logit Models

In order to estimate the NLM, regions need to be partitioned into different nests. Disdier and Mayer (2004) use an East Europe – West Europe nesting structure. In Basile et al. (2003) and Basile et al. (2007) European regions are grouped into several nests, such as Anglo (UK and Ireland), Iberic (Spain and Portugal), core and periphery, North or South Europe and even in individual countries. Mataloni (2007) uses a natural country - region nesting structure. Based on these studies, we explore several nesting structures. For instance, the EU15-EU10 nest takes into account the difference of the EU member states in institutions and economic development, as well as the geographic feature. The UK and Ireland are grouped into the same nest due to a common language, which may make these two countries particularly attractive to US MNEs. Other nests mainly take into account the geographic similarity and include Nordic[24], South[25], East[26], and a broadly-defined North Europe nest[27]. Finally the natural partition of countries is applied.

The decision of which nesting structure qualifies is based on two criteria: first the IV parameters need to be in the 0-1 range and second, a model with smaller Bayesian Information Criterion (BIC)[28] is preferred. Due to space constraints, the IV parameters and the BICs for various nesting structures are not reported[29]. To estimate NLM models, based on overall results, we decide to apply the following structures for ICT manufacturing: UK/Ireland – rest of regions and North-South-East; for the ICT service sectors we select the following structures: North-South-East; EU15-EU10.

The Location Choice of ICT Manufacturing Sectors: Nested Logit Models

Table 3 reports the results of the NLM for the full sample in three models and two nesting structures. Looking at the first nesting structure (UK-Ireland - the rest of regions), the three alternative models yield consistent estimates for region and country - level determinants of the location choice. MNEs are more likely to locate their new investments in regions with a larger market potential, with more firms from the same sectors, better labour quality, higher R&D level, higher tax rate, lower labour costs and lower unemployment rate. The results are also consistent with those obtained with the CLM shown in Table 1. However, the NLM estimates are much smaller than the CLM estimates, suggesting that if not accounting for the correlation between alternatives, the CLM results might be biased upward. We also test the validity of IIA using a likelihood-ratio (LR) test that all τ s of a model are jointly equal to unity. Chi-square statistics of the LR test are reported at the bottom of Table 3. For the three models, the H_0 of IIA is rejected at the 1 per cent level. Moreover, the IV parameters for the three models are all smaller than 1. In

[24] Finland, Sweden.
[25] Spain, Portugal, Italy and Greece.
[26] The EU10 countries excluding Bulgaria.
[27] UK/Ireland, Nordic and West European countries.
[28] $BIC = -2\ln L + k\ln(n)$, where L is the log-likelihood of a model, k is the number of variables and n is the number of observations. BIC rewards large likelihood but penalises the loss of degree of freedom due to more variables in the model. See Schwarz (1978) for discussion.
[29] The results are available upon request from the authors

the last three columns, the second nesting structure (North-South-East) leads to consistent estimates with those from the first nesting structure (UK-Ireland – the rest of regions), however the magnitude of the coefficients are much larger in the second nesting structure (North-South-East). Considering that the IV parameters in this latter nesting structure are closer to unity, the coefficients should converge to those of the CLM.

The coefficients of the NLM can also be converted into APE by multiplying the coefficients by a parameter (see Section 3.2). The range of APEs for all variables with statistically significant coefficients are summarised as follows for the two nest structures and three models. An increase in market potential by one per cent for an average region leads to an increase in the probability of this region being choosing by MNEs by 0.2 to 0.6 per cent. An increase in GDP per capita by one per cent leads to a decrease in the location probability by 0.6 to 1 per cent. An increase in the agglomeration variable of foreign-owned firms by one per cent leads to an increase in the location probability by 0.2 to 0.3 per cent. An increase in the agglomeration variable of domestic-owned firms by one per cent leads to an increase in the probability by 0.2 to 0.4 per cent. An increase in the agglomeration variable of total firms by one per cent leads to an increase in the location probability by 0.3 to 0.5 per cent. An increase in tertiary education attainment by one per cent leads to an increase in the location probability by 0.8 to 0.9 per cent. An increase in the unemployment rate by one per cent leads to a decrease in the location probability by 0.2 to 0.6 per cent. An increase in R&D expenditure by one per cent leads to an increase in the location probability by 0.1 to 0.2 per cent. An increase in the number of patent applications by one per cent leads to an increase in the location probability by 0.1 to 0.2 per cent. An increase in the statutory tax rate by one per cent leads to an increase in the location probability by 0.3 to 0.9 per cent.

Firm heterogeneity effects: US MNEs versus EU MNEs

Motivated by Basile et al. (2003) and Hogenbirk and Narula (2004) [30], we also explore the possibility of firm-level heterogeneous behavior in location choice, which might occur due to the country of origin of MNEs. The location choice model is estimated separately for US MNEs and

[30] Basile et al. (2003) find that, when investing in EU countries, US MNEs treat regions within a country as equivalent substitutes, whereas the location decision of EU MNEs respond to regional differences. Hogenbirk and Narula (2004) find that US and Japanese MNEs prefer the Randstad region in the Netherlands, while EU MNEs prefer the regions which border other EU countries.

EU MNEs using the same model specifications. The results are reported in Table 4. Only the first nest of regions is used for US MNEs because no other nesting structure can generate the IV parameters within the 0 - 1 range.

Looking at the first six columns the main differences between the two types of MNEs are reflected on the following variables. Market potential has a significantly positive impact on EU MNEs, but no impact on US MNEs. In terms of labour market conditions, US MNEs are not affected by labour costs, while EU MNEs are. On the other hand, the effects of labour quality and the unemployment rate are the same for both US MNEs and EU MNEs: positive or none. In terms of agglomeration, both types of agglomeration have larger impacts on EU MNEs' location choices than on US MNEs'. Moreover, foreign firms have a much weaker effect on US MNEs' location choice than domestic firms do which is also true for EU MNEs. The finding shows that both US MNEs and EU MNEs benefit from agglomeration with foreign or domestic firms, but EU MNEs benefit more. If one thinks about a French-owned firm and a US-owned firm both located in Germany, the former is more likely to interact with domestic firms than the later because its French parent perhaps is more familiar with the German business environment or has a long history of doing business in Germany. By the same logic, the French-owned firm is also more likely to interact with other foreign firms in Germany because most of the foreign firms are from other European countries. Turning to R&D development, there is rather weak evidence suggesting that US MNEs are attracted by regional R&D development because the coefficient is only significant at the 10 per cent level. In contrast, a positive influence of R&D development on EU MNEs is evident. This suggests that US MNEs rely more on their own in-house R&D activities and therefore do not count on spillover effects from local R&D activities to the same degree. Finally, the statutory tax rate appears to impact positively on the location choice of US MNEs, but it has no effect on EU MNEs.

Location Choices in the EU15 and EU10 Regions

There is one concern related to the pooling of location choices made in the EU15 and EU10 countries. Significant differences might exit between the EU15 and EU10 countries in terms of country and region-level characteristics (as described in Tables A2a and A2b) and institutional structure. Therefore, when MNEs are considering the location of new investments, they may treat initially the EU15 and EU10 as separate alternatives. Once they decide in which broad area to invest, they then look at each country or region within the chosen area. Disdier and Mayer (2004) found that French MNEs did treat the EU15 and Central and Eastern Europe as distinct alternatives and consequently they respond to country-level determinants of the two groups of countries in different ways. On the basis of this consideration, we decide to separate the location choices made in the EU15 and EU10 in order to explore any difference that may exist in the two areas.

Table 5 reports the results for location choices made in the EU15 and EU10 countries. Two nesting structures (Nest 1: Anglo-North[31]-South[32] and Nest 2: Anglo-West[33]-Periphery[34]) apply to the EU15 area, and one nesting structure (Nest 3: country-region) applies to the EU10 area[35]. The choices of these nesting structures are based on the IV parameters and BIC as well.[36] Comparing these results with the results for the location choices made in the EU15 and EU10 areas, two major differences emerge. First, market potential has a highly significant and positive impact on MNEs in the EU15 area. This is consistent with the findings for the full sample. However, it shows a marginal negative impact on MNEs in the EU10 area. This finding suggests that MNEs' location choices of manufacturing facilities in the EU10 are not driven by local demand. We believe that this is caused by the fact that such facilities constitute a part of MNEs' global production network and are involved in the lower end in the vertical production chain, that is to say, assembly and packaging. Second, GDP per capita always has a highly significant and positive effect for the location choice made in the EU15 regions, with education attainment, the unemployment rate and the R&D level controlled for. We think this finding reflects the correlation of GDP per capita and the high-tech nature of the ICT manufacturing sectors in the EU15. The multiple controls of skill and R&D are not sufficient to absorb the positive effect from labour costs, though they themselves have expected effects (except R&D expenditures). On the other hand, when making location decisions in the EU10 area, MNEs are not affected by GDP per capita, only marginally attracted by education attainment but positively affected by the

[31] The nest includes Sweden, Finland, Austria, Belgium, the Netherlands, Germany, France, Luxembourg.
[32] The nest includes Spain, Portugal, Italy and Greece.
[33] The nest includes Austria, Belgium, the Netherlands, Germany, France, Luxembourg.
[34] The nest includes Sweden, Finland, Italy, Portugal, Spain and Greece.
[35] Although the IV parameters of the country-region nesting structures does not comply with the requirement of the RUM framework, this structure is the only one amongst all candidate structures we tried that produces significant Chi2. Therefore, we see the results of this nesting structure are indicative.
[36] To save space we do not report the IV parameters and BIC of all candidate nesting structures explored. The results are available upon request.

unemployment rate and R&D expenditure. These findings suggest that in the EU15 area, MNEs are mainly looking for high quality labour in order to match their technical level in production, but in the EU10 area, MNEs are mainly attracted by larger labour-force pool, instead of labour skill level.

Further, in the EU15 area, MNEs are more likely to choose countries with a higher statutory tax rate, but in the EU10 area, MNEs are not affected by the tax rate. Economists take different views regarding the positive effect of the corporate tax rate. For instance, Bénassy-Quéré et al. (2000) argues that a higher tax rate is associated with better provision of public goods. Baldwin and Krugman (2004) provide a theoretical explanation that with the existence of agglomeration benefits, states can apply a high tax rate while still retain a high level of investments. Therefore, it is possible for MNEs to choose those countries with high tax rates. Another explanation lies in the variation of the tax rates across countries in the two areas. In the EU15, the tax rates are ranging from 11 per cent (Ireland) to 45.4 per cent (Germany), while in the EU10 they range from 18 per cent in Hungary to 35.7 per cent in Slovakia. The two extreme cases in the EU15 possibly make the identification of the tax effect much easier.

One additional point needs attention is that for the country-region nesting structure, the τ s for Estonia, Lithuania, and Latvia are unity because there is only one NUTS2 region in each of these countries, hence regional correlation does not exist and such nest is called “degenerated”.

The Location of ICT Multinationals in the Service Sectors: Nested Logit Estimates

Table 6 reports the results for the full sample with two alternative models and two alternative nesting structures. Looking at the IV parameters first, Models 5 with two nesting structures are all consistent with the RUM framework. Models 6 are all not consistent with this framework. Hence our discussion focuses on the Models 5 only. The results from the NLM indicate a picture of how MNEs reacted to various region and country-level determinants that is consistent with the picture that is produced by the CLM in Table 2. MNEs are attracted by better market access, agglomeration, labour quality, but they are less likely to choose regions with high labour costs and high unemployment rate. However, the effects of internet users and the statutory tax rate are ambiguous, which prevents us from drawing a definite conclusion for these two variables.

The APEs of the variables for Model 5 are as follows (except for internet users and the tax rate): an increase in market potential by one per cent for an average region leads to an increase in the probability of this region being choosing by MNEs by 0.5 to 0.8 per cent. An increase in GDP per capita by one per cent leads to a decrease in the location probability by 0.8 to 1.2 per cent. An increase in the agglomeration variable of foreign-owned firms by one per cent leads to an increase in the location probability by 0.4 to 0.5 per cent. An increase in the agglomeration variable of domestic-owned firms by one per cent leads to an increase in the location probability by 0.1 per cent. An increase in the agglomeration variable of total firms by one per cent leads to an increase in the location probability by 0.3 to 0.4 per cent. An increase in tertiary education attainment by one per cent leads to an increase in the location probability by 2 to 2.4 per cent. An increase in the unemployment rate by one per cent leads to a decrease in the location probability by 0.2 to 0.8 per cent.

In addition to the identified determinants, the EU15-EU10 nesting structure is proved to be appropriate for the study of the ICT service sectors' location behaviours. A similar pattern is also confirmed in Disdier and Mayer (2004). They find that the institutional differences are the major cause of the "East-West divide". [37]

US MNEs versus EU MNEs

Differences with respect to US and EU MNEs are shown in Table 7. The IV parameters suggest that for US MNEs, only Model 5 of nesting structure 2 may provide indicative estimates, which are comparable with those of EU MNEs. The major differences of two types of MNEs are that US MNEs are not sensitive to labour costs, while EU MNEs are negatively affected by this factor. The effect of labour quality is approximately three times higher for US MNEs than for EU MNEs. Agglomeration of foreign firms has a much greater influence on US MNEs than on EU MNEs and agglomeration of domestic firms has no effect on US MNEs. However, the effects of the two types of agglomeration on EU MNEs are all significant. The number of internet users has rather ambiguous effects on US MNEs but it certainly affects EU MNEs negatively. Finally the tax rate has a negative effect on US MNEs but positive effect on EU MNEs.

[37] In some preliminary estimations, we find that the similar variables measuring institutional variations across countries show unexpected negative effect. Therefore, we decide not to include such variables.

It would be interesting to compare the location choices of US and EU MNEs in the ICT manufacturing sectors. In those sectors, the positive impact of foreign firms is much stronger on both US and EU MNEs, while in the service sectors, we have exactly reversed effects. However, the heterogeneous pattern with respect to labour costs is consistent for the two sectors: US MNEs are not sensitive to it but EU MNEs do react to it negatively.

Location Choice in the EU15 and EU10 Regions

Table 8 shows that both the location choices made in the EU15 and EU10 areas are positively influenced by market potential, the agglomeration of foreign firms and education attainment. However, the negative effect of domestic firms in the EU15 area is rather unusual, which confirms our assumption that competition in the market of less tradable ICT services may deter foreign firms from entering local markets and such a competition effect arises primarily from domestic firms. Domestic firms appear to attract MNEs in the EU10 area. The observed negative effect of agglomeration in the case of EU15 regions contrasts to most of other empirical studies (except Hogenbirk and Narula, 2004, where they find competition effect from domestic business presence[38]). Disdier and Mayer (2004) find a weaker agglomeration effect in CEECs than in the EU15 and interpret the finding as being driven by strong competition effect in the CEECs (equivalent to the EU10).

The effects of GDP per capita and the unemployment rate are different in the EU15 and EU10 areas respectively. It can be seen that in the EU15 area, MNEs are using labour cost as the signal of labour quality and they are looking for regions with more flexible labour market, while MNEs in the EU10 area are interested in regions with low labour cost and a larger labour pool. Recall the similar location pattern is observed for the ICT manufacturing sectors in two areas separately (Table 5).

Turning to the policy variables, MNEs are more likely to locate in the EU15 regions with a higher statutory tax rate, but less likely to do so in the EU10 regions. The effect of internet users is ambiguous in the EU15 area, while it is consistently positive in the EU10 area.

[38] When comparing the Randstad region (the agglomerated region containing large cities, major ports and airports) with the rest of the Netherlands, the presence of local business seems to work as a deterrent for new foreign establishments.

6 Summary and Concluding Remarks

We briefly summarise the major findings and highlight some differences in the location choice of MNEs in the ICT producing and service sectors and in the EU15 and EU10 regions:

First, when we look at location choices made in the European Union (EU25), it appears that regions with a high level of market potential attract more multinationals in ICT manufacturing and services. When we separate the EU15 and EU10, we find that, in the case of the ICT manufacturing sectors, this effect is driven by location choices taken place in the EU15, but not in the EU10.

Second, with respect to labour markets conditions, while in the EU15, MNEs appear attracted by more flexible labour markets and high-skill labour , in EU10, MNEs were attracted by the advantage of low labour costs and a larger labour pool. This result suggests that underlying technological contents of new investments made EU15 and EU10 might be different.

Third, in the ICT service sectors there is a negative agglomeration effect coming from the presence of domestic firms in the EU15, but not in the EU10. The effect of domestic firms in the manufacturing sectors is never negative, no matter which geographic area we examine. One potential explanation is that competition might be stronger in the service sectors.

Fourth, a high statutory tax rate is generally associated with a higher probability of choosing a region in the manufacturing sectors, but it does discourage new investments in the service sectors in the EU15.

Finally, in terms of firm-level heterogeneity, we find that US MNEs are not affected by labour costs, while EU MNEs are negatively affected by this factor.

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Table 1. Determinants of Location Choice (CLM, ICT Manufacturing Sectors, EU25)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Market potential	0.098	0.172***	0.385***	0.306***	0.311***	0.474***
	(0.061)	(0.059)	(0.066)	(0.072)	(0.071)	(0.069)
GDP per capita	-0.138**	-0.365***	-0.633***	-0.649***	-0.682***	-0.900***
	(0.066)	(0.068)	(0.078)	(0.080)	(0.080)	(0.075)
Foreign firms	0.479***	0.418***	0.339***	0.319***	0.327***	
	(0.024)	(0.026)	(0.029)	(0.032)	(0.031)	
Domestic firms	0.368***	0.347***	0.300***	0.210***	0.199***	
	(0.029)	(0.028)	(0.028)	(0.035)	(0.036)	
Total firms						0.327***
						(0.049)
Education attainment		0.038***	0.044***	0.043***	0.042***	0.048***
		(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
Unemployment rate			-0.057***	-0.054***	-0.049***	-0.064***
			(0.008)	(0.009)	(0.009)	(0.009)
R&D expenditure				0.142***		0.229***
				(0.048)		(0.046)
Patent applications					0.142***	
					(0.042)	
Statutory tax				0.015***	0.013**	0.009*
				(0.005)	(0.005)	(0.005)
Pseudo R2	0.085	0.093	0.097	0.098	0.097	0.093
Number of observations	307508	291288	291288	291288	288517	291288

Notes: The dependent variable is equal to 1 if firm i is located in region j and zero for all other regions. Standard errors in parentheses. *** statistically significant at the 1 per cent level, ** statistically significant at the 5 per cent level, * statistically significant at the 10 per cent level. The coefficients can be read as the average probability elasticities.

Table 2. Determinants of Location Choice of ICT Service Sectors (EU25)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Market potential	0.399***	0.470***	0.553***	0.537***	0.514***	0.817***
	(0.022)	(0.019)	(0.022)	(0.023)	(0.024)	(0.021)
GDP per capita	- 0.335***	-0.774***	-0.893***	-0.828***	-0.853***	-1.216***
	(0.025)	(0.024)	(0.030)	(0.038)	(0.038)	(0.035)
Foreign firms	0.577***	0.450***	0.410***	0.408***	0.437***	
	(0.007)	(0.007)	(0.009)	(0.009)	(0.011)	
Domestic firms	0.250***	0.121***	0.100***	0.094***	0.074***	
	(0.012)	(0.011)	(0.011)	(0.011)	(0.012)	
Total firms						0.363***
						(0.016)
Education attainment		0.094***	0.100***	0.100***	0.103***	0.119***
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Unemployment rate			-0.027***	-0.032***	-0.030***	-0.073***
			(0.004)	(0.004)	(0.005)	(0.004)
Internet users				-0.131***	-0.054	-0.066
				(0.047)	(0.049)	(0.042)
Statutory tax					0.019***	-0.008***
					(0.003)	(0.002)
Pseudo R2	0.162	0.193	0.194	0.194	0.194	0.175
Number of observations	1741208	1665059	1665059	1665059	1665059	1665059

Notes: The dependent variable is equal to 1 if firm i is located in region j and zero for all other regions. Standard errors in parentheses. *** statistically significant at the 1 per cent level, ** statistically significant at the 5 per cent level, * statistically significant at the 10 per cent level. The coefficients can be read as the average probability elasticities.

Table 3. Determinants of Location Choice (NLM, the ICT Manufacturing Sectors, EU25)

	Full sample					
	Nest 1			Nest 2		
	Model 4	Model 5	Model 6	Model 4	Model 5	Model 6
Market potential	0.091***	0.098***	0.119***	0.265***	0.219***	0.477***
	(0.029)	(0.030)	(0.036)	(0.067)	(0.066)	(0.075)
GDP per capita	-0.244***	-0.255***	-0.308***	-0.446***	-0.401***	-0.784***
	(0.044)	(0.046)	(0.058)	(0.091)	(0.085)	(0.106)
Foreign firms	0.080***	0.089***		0.256***	0.247***	
	(0.018)	(0.018)		(0.035)	(0.032)	
Domestic firms	0.158***	0.161***		0.170***	0.140***	
	(0.020)	(0.021)		(0.034)	(0.033)	
Total firms			0.228***			0.274***
			(0.031)			(0.058)
Education attainment	0.015***	0.016***	0.016***	0.031***	0.029***	0.034***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.005)
Unemployment rate	-0.008*	-0.008*	-0.009*	-0.042***	-0.034***	-0.050***
	(0.004)	(0.004)	(0.005)	(0.008)	(0.008)	(0.009)
R&D expenditure	0.056***		0.085***	0.097**		0.178***
	(0.019)		(0.023)	(0.039)		(0.042)
Patent application		0.044**			0.114***	
		(0.018)			(0.033)	
Statutory tax	0.011***	0.011***	0.012***	0.014***	0.012***	0.008**
	(0.002)	(0.002)	(0.003)	(0.004)	(0.004)	(0.004)
IV Parameters						
UK/Ireland	0.312***	0.318***	0.359***			
All rest countries	0.392***	0.399***	0.426***			
North				0.819***	0.767***	0.887***
South				0.587***	0.533***	0.630***
East				0.833***	0.783***	0.864***
Number of firms	1272	1272	1272	1272	1272	1272
Number of regions	229	229	229	229	229	229
Number of observations	291288	291288	291288	291288	291288	291288
Log likelihood	-6201.8	-6194.8	-6221	-6217.1	-6205.3	-6249.8
Chi2 for H0: IIA	62.4***	56.8***	93.9***	31.9***	35.9***	36.1***
BIC	12529.5	12515.4	12555.2	12572.5	12548.9	12625.5

Notes: The dependent variable is equal to 1 if firm i is located in region j and zero for all other regions. Standard errors in parentheses. *** statistically significant at the 1 per cent level, ** statistically significant at the 5 per cent level, * statistically significant at the 10 per cent level. Chi2 is the statistics of the likelihood-ratio test of the hypothesis that IIA holds.

Table 4. Determinants of Location Choice (NLM, the Manufacturing Sectors, EU25)

	US MNEs			EU MNEs					
	Nest 1			Nest 1			Nest 2		
	Model 4	Model 5	Model 6	Model 4	Model 5	Model 6	Model 4	Model 5	Model 6
Market potential	0.024	0.030	0.037	0.145**	0.167***	0.185**	0.191**	0.160**	0.297***
	(0.023)	(0.025)	(0.027)	(0.061)	(0.064)	(0.076)	(0.079)	(0.078)	(0.079)
GDP per capita	-0.023	-0.031	-0.035	-0.403***	-0.424***	-0.496***	-0.410***	-0.365***	-0.579***
	(0.029)	(0.031)	(0.033)	(0.095)	(0.099)	(0.131)	(0.105)	(0.099)	(0.107)
Foreign firms	0.042**	0.048**		0.106***	0.129***		0.152***	0.160***	
	(0.020)	(0.022)		(0.033)	(0.035)		(0.037)	(0.034)	
Domestic firms	0.082***	0.086***		0.163***	0.166***		0.139***	0.121***	
	(0.029)	(0.031)		(0.033)	(0.035)		(0.040)	(0.039)	
Total firms			0.117***			0.233***			0.178***
			(0.043)			(0.048)			(0.054)
Education attainment	0.007**	0.007**	0.007**	0.009**	0.010**	0.010**	0.013***	0.014***	0.014***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Unemployment rate	-0.000	-0.000	0.000	-0.012	-0.011	-0.014	-0.024***	-0.018**	-0.028***
	(0.003)	(0.004)	(0.003)	(0.008)	(0.008)	(0.010)	(0.009)	(0.008)	(0.009)
R&D expenditure	0.025		0.036*	0.130***		0.176***	0.146***		0.191***
	(0.016)		(0.019)	(0.043)		(0.055)	(0.047)		(0.048)
Patent application		0.018			0.094**			0.132***	
		(0.016)			(0.037)			(0.040)	
Statutory tax	0.004**	0.004**	0.003	0.004	0.003	0.006	0.007	0.006	0.006
	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
IV Parameters									
UK/Ireland	0.140**	0.149**	0.149**	0.411***	0.413***	0.472***			
All rest countries	0.160***	0.167***	0.171***	0.549***	0.558***	0.583***			
North							0.667***	0.620***	0.674***
South							0.413***	0.378***	0.393***
East							0.685***	0.651***	0.664***
Number of firms	347	347	347	608	607	608	608	607	608
Number of regions	229	229	229	229	229	229	229	227	229
Number of observations	79463	78769	79463	139232	137789	139232	139232	137789	139232
Log likelihood	-1583.7	-1584.4	-1591.2	-3007.9	-3002.6	-3016	-2997.36	-2987.8	-3007.347
Chi2 for H0: IIA	39.0***	36.6***	69.2***	7.8**	6.8**	10.5***	28.8***	36.5***	27.9***
BIC	3280.3	3281.5	3283.9	6134.2	6123.6	6138.6	6125	6105.8	6133

Notes: The dependent variable is equal to 1 if firm i is located in region j and zero for all other regions. Standard errors in parentheses. *** statistically significant at the 1 per cent level, ** statistically significant at the 5 per cent level, * statistically significant at the 10 per cent level. Chi2 is the statistics of the likelihood-ratio test of the hypothesis that IIA holds.

Table 5. Determinants of Location Choice (NLM, the Manufacturing Sectors)

	EU15						EU10		
	Nest 1			Nest 2			Nest 3		
	Model 4	Model 5	Model 6	Model 4	Model 5	Model 6	Model 4	Model 5	Model 6
Market potential	0.300***	0.251***	0.316***	0.393***	0.371***	0.400***	-1.073*	-0.050	-0.622
	(0.085)	(0.080)	(0.082)	(0.100)	(0.095)	(0.092)	(0.564)	(0.472)	(0.450)
GDP per capita	0.563***	0.538***	0.576***	0.547***	0.522***	0.609***	1.151	0.075	0.481
	(0.150)	(0.142)	(0.152)	(0.180)	(0.176)	(0.199)	(0.751)	(0.629)	(0.607)
Foreign firms	0.087**	0.080**		0.073*	0.068*		0.515**	0.441*	
	(0.037)	(0.034)		(0.041)	(0.039)		(0.201)	(0.228)	
Domestic firms	0.228***	0.188***		0.266***	0.236***		0.260	0.641***	
	(0.061)	(0.055)		(0.079)	(0.074)		(0.181)	(0.221)	
Total firms			0.322***			0.378***			0.551***
			(0.077)			(0.102)			(0.201)
Education attainment	0.020***	0.017***	0.019***	0.017***	0.014***	0.015***	0.020	0.066	0.061*
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.037)	(0.048)	(0.036)
Unemployment rate	-0.033***	-0.024***	-0.032***	-0.034***	-0.027**	-0.032***	0.111**	0.058	0.110**
	(0.010)	(0.009)	(0.010)	(0.011)	(0.011)	(0.012)	(0.043)	(0.038)	(0.047)
R&D expenditure	0.061		0.066	0.060		0.063	0.602***		0.548***
	(0.041)		(0.041)	(0.046)		(0.048)	(0.213)		(0.211)
Patent application		0.103***			0.090**			0.201	
		(0.037)			(0.042)			(0.696)	
Statutory tax	0.014***	0.012**	0.010**	0.009	0.007	0.005	-0.068	0.073	0.024
	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.072)	(0.070)	(0.049)
IV Parameters									
Anglo	0.870***	0.812***	0.859***						
North	0.730***	0.692***	0.743***						
South	0.590***	0.546***	0.602***						
Anglo				0.982***	0.950***	0.989***			
West				0.807***	0.786***	0.849***			
Periphery				0.666***	0.636***	0.708***			
CZ							1.282***	1.676***	1.434***
EE							1	1	1
HU							1.055***	1.556***	1.166***
LT							1	1	1
LV							1	1	1
PL							1.538***	1.615***	1.461***
RO							2.126***	1.823***	1.965***
SK							0.025	0.021	0.037
Number of firms	1047	1046	1047	1047	1046	1047	225	225	225
Number of regions	183	181	183	183	181	183	46	46	46
Number of observations	191601	189326	191601	191601	189326	191601	10350	10350	10350
Log likelihood	-4799.3	-4786.1	-4800.5	-4798.7	-4786.3	-4798.8	-725.2	-729.7	-730
Chi2 for H0: IIA	48***	49.6***	63.4***	49.3***	49.2***	66.9***	23.2***	20.8***	25.9***
BIC	9732.4	9705.9	9722.7	9731.2	9706.3	9719.1	1579.9	1588.8	1570.9

Notes: The dependent variable is equal to 1 if firm i is located in region j and zero for all other regions. Standard errors in parentheses. *** statistically significant at the 1 per cent level, ** statistically significant at the 5 per cent level, * statistically significant at the 10 per cent level. Chi2 is the statistics of the likelihood-ratio test of the hypothesis that IIA holds. The IV parameters for Estonia (EE), Lithonia (LT) and Latvia (LV) are the unity because there is only one region in each country and the within-nest correlation is set to be unity.

Table 6. Determinants of Location Choice (NLM, the ICT Service Sectors EU25)

	Full Sample			
	Nest 1		Nest 2	
	Model 5	Model 6	Model 5	Model 6
Market potential	0.325***	1.672***	0.472***	1.283***
	(0.020)	(0.331)	(0.027)	(0.092)
GDP per capita	-0.487***	-2.251***	-0.760***	-1.946***
	(0.035)	(0.389)	(0.048)	(0.151)
Foreign firms	0.299***		0.399***	
	(0.011)		(0.016)	
Domestic firms	0.062***		0.071***	
	(0.007)		(0.011)	
Total firms		0.720***		0.624***
		(0.142)		(0.050)
Education attainment	0.061***	0.245***	0.090***	0.189***
	(0.003)	(0.048)	(0.005)	(0.015)
Unemployment rate	-0.013***	-0.172***	-0.026***	-0.088***
	(0.003)	(0.038)	(0.004)	(0.009)
Internet users	0.022	-0.463***	-0.028	-0.670***
	(0.030)	(0.172)	(0.051)	(0.109)
Statutory tax	0.014***	-0.039***	0.017***	-0.028***
	(0.002)	(0.012)	(0.003)	(0.004)
IV Parameters				
EU15	0.655***	2.043***		
EU10	0.525***	2.684***		
North			0.915***	1.652***
South			0.834***	1.743***
East			0.881***	1.668***
Number of firms	7271	7271	7271	7271
Number of regions	229	229	229	229
Number of observations	1665059	1665059	1665059	1665059
Log likelihood	-31781.1	-32565.9	-31824.9	-32472.4
Chi2 for H0: IIA	98.3***	50.3***	10.8**	237.4***
BIC	63705.5	65260.7	63807.3	65088

Notes: The dependent variable is equal to 1 if firm i is located in region j and zero for all other regions. Standard errors in parentheses. *** statistically significant at the 1 per cent level, ** statistically significant at the 5 per cent level, * statistically significant at the 10 per cent level. Chi2 is the statistics of the likelihood-ratio test of the hypothesis that IIA holds.

Table 7. Determinants of Location Choice (NLM, the ICT Service Sectors, EU25)

	US MNEs		EU MNEs			
	Nest 2		Nest 1		Nest 2	
	Model 5	Model 6	Model 5	Model 6	Model 5	Model 6
Market potential	0.554***	19.553	0.229***	0.773***	0.303***	0.658***
	(0.088)	(35.240)	(0.021)	(0.093)	(0.027)	(0.045)
GDP per capita	0.269	1.394	-0.329***	-1.299***	-0.479***	-1.038***
	(0.194)	(4.034)	(0.036)	(0.163)	(0.044)	(0.072)
Foreign firms	0.606***		0.215***		0.264***	
	(0.069)		(0.012)		(0.014)	
Domestic firms	0.047		0.088***		0.107***	
	(0.029)		(0.009)		(0.012)	
Total firms		6.714		0.437***		0.392***
		(11.593)		(0.058)		(0.033)
Education attainment	0.132***	3.207	0.034***	0.103***	0.043***	0.076***
	(0.020)	(5.794)	(0.003)	(0.013)	(0.003)	(0.006)
Unemployment rate	-0.052***	-3.029	-0.008***	-0.069***	-0.020***	-0.043***
	(0.016)	(5.655)	(0.003)	(0.011)	(0.004)	(0.006)
Internet users	-0.232	-18.019	-0.049	-0.208**	-0.073	-0.313***
	(0.174)	(32.334)	(0.033)	(0.082)	(0.048)	(0.072)
Statutory tax	-0.022***	-1.570	0.011***	0.003	0.013***	0.002
	(0.008)	(2.879)	(0.002)	(0.003)	(0.002)	(0.003)
IV Parameters						
EU15			0.528***	1.083***		
EU10			0.373***	1.012***		
North	1.161***	23.072			0.683***	0.954***
South	1.533***	43.938			0.482***	0.720***
East	2.120***	51.001			0.545***	0.793***
Number of firms	1845	1845	3722	3722	3722	3722
Number of regions	229	229	229	229	229	229
Number of observations	422505	422505	852338	852338	852338	852338
Log likelihood	-7196.1	-7373	-17021.2	-17378.6	-17027.7	-17329
Chi2 for H0: IIA	70.8***	237.7***	94.7***	12.3***	81.6***	111.6***
BIC	14534.6	14758.4	34178.9	34880.1	34205.6	34794.5

Notes: The dependent variable is equal to 1 if firm i is located in region j and zero for all other regions. Standard errors in parentheses. *** statistically significant at the 1 per cent level, ** statistically significant at the 5 per cent level, * statistically significant at the 10 per cent level. Chi2 is the statistics of the likelihood-ratio test of the hypothesis that IIA holds.

Table 8. Determinants of Location Choice (NLM, the ICT Service Sectors)

	EU15				EU10	
	Nest 1		Nest 2		Nest 3	
	Model 5	Model 6	Model 5	Model 6	Model 5	Model 6
Market potential	0.395***	0.612***	0.436***	0.555***	0.229***	0.456***
	(0.020)	(0.023)	(0.027)	(0.030)	(0.065)	(0.119)
GDP per capita	0.796***	0.727***	0.845***	0.935***	-0.759***	-1.045***
	(0.042)	(0.043)	(0.055)	(0.065)	(0.108)	(0.177)
Foreign firms	0.215***		0.120***		0.174***	
	(0.010)		(0.014)		(0.028)	
Domestic firms	-0.055***		-0.008		0.053**	
	(0.008)		(0.011)		(0.022)	
Total firms		0.077***		0.069***		0.306***
		(0.015)		(0.017)		(0.073)
Education attainment	0.029***	0.047***	0.032***	0.039***	0.055***	0.079***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.006)	(0.012)
Unemployment rate	-0.042***	-0.082***	-0.043***	-0.054***	0.013***	0.008
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.008)
Internet users	0.076*	-0.307***	0.027	-0.112***	0.205**	0.314***
	(0.040)	(0.037)	(0.042)	(0.043)	(0.079)	(0.110)
Statutory tax	-0.009***	-0.038***	-0.002	-0.005**	0.035***	0.107***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.011)	(0.025)
IV Parameters						
North	0.606***	0.679***				
South	0.453***	0.492***				
Anglo			0.687***	0.814***		
North			0.550***	0.583***		
South			0.469***	0.517***		
Central Europe					0.267***	0.401***
Baltic countries + RO					0.313***	0.464***
Number of firms	6281	6281	6281	6281	990	990
Number of regions	183	183	183	183	46	46
Number of observations	1149423	1149423	1149423	1149423	45540	45540
Log likelihood	-25029.7	-25420	-25017.2	-25050.3	-2426.8	-2439.4
Chi2 for H0: IIA	270***	119.7***	295.2***	859***	21.2***	7**
BIC	50199	50965.6	50187.8	50240.2	4960.9	4975.3

Notes: The dependent variable is equal to 1 if firm i is located in region j and zero for all other regions. Standard errors in parentheses. *** statistically significant at the 1 per cent level, ** statistically significant at the 5 per cent level, * statistically significant at the 10 per cent level. Chi2 is the statistics of the likelihood-ratio test of the hypothesis that IIA holds.

Appendix 1: Derivation of Average Probability Elasticity of the Nested Logit Model

Rewrite the utility function of individual i choosing alternative $h \in n_k$ be $U_h = X_h'\beta + \varepsilon_h$ (subscript i is dropped to keep the formula concise). Let x_h be one variable of interest and it enters X_h' in its logarithm. The corresponding coefficient of $\ln x_h$ is β_x. Denote τ_h the inclusive value parameter for the nest where alternative h lies in. Rewrite and simplify Equation (4) by inserting Equation (3) into (4) where is applicable and denote $\exp(U_h/\tau_h) = \exp(\bullet)$ and $\exp[\tau_h \ln \sum_J \exp(U_h/\tau_h)] = \exp(\bullet\bullet)$, we have

$$\text{(A1)} \quad \begin{aligned} \Pr_h &= \Pr_{h|k}\Pr_k = \frac{\exp(U_h/\tau_h)}{\sum_J \exp(U_h/\tau_h)} \frac{\exp[\tau_h \ln \sum_J \exp(U_h/\tau_h)]}{\sum_K \exp[\tau_j \ln \sum_J \exp(U_j/\tau_j)]} \\ &= \frac{\exp(\bullet)}{\sum_J \exp(\bullet)} \frac{\exp(\bullet\bullet)}{\sum_K \exp(\bullet\bullet)}. \end{aligned}$$

The probability elasticity w.r.t. x_h is

$$\text{(A2)} \quad \begin{aligned} e_{x_h} &= (\Pr_h)'_{x_h} \frac{x_h}{\Pr_h} = (\Pr_{h|k}\Pr_k)'_{x_h} \frac{x_h}{\Pr_{h|k}\Pr_k} \\ &= \left(\frac{\Pr'_{h|k}}{\Pr_{h|k}} + \frac{\Pr'_k}{\Pr_k}\right) x_h \end{aligned}.$$

Starting with $\frac{\Pr'_{h|k}}{\Pr_{h|k}}$, straightforward derivation leads to following two results,

$$\begin{aligned} \frac{\Pr'_{h|k}}{\Pr_{h|k}} &= \frac{e(\bullet)\frac{1}{\tau_h}\frac{\beta_x}{x_h}\sum e(\bullet) - e(\bullet)\frac{1}{\tau_h}\frac{\beta_x}{x_h}e(\bullet)}{[\sum e(\bullet)]^2} \cdot \frac{\sum e(\bullet)}{e(\bullet)} \\ &= \frac{\beta_x}{\tau_h x_h}\frac{\sum e(\bullet) - e(\bullet)}{\sum e(\bullet)} = \frac{\beta_x}{\tau_h x_h}(1 - \Pr_{h|k}) \end{aligned}$$

and

$$\begin{aligned} \frac{\Pr'_k}{\Pr_k} &= \frac{e(\bullet\bullet)\tau_h \frac{1}{\sum e(\bullet)} e(\bullet)\frac{\beta_x}{\tau_h x_h}\sum e(\bullet\bullet) - e(\bullet\bullet)e(\bullet\bullet)\tau_h \frac{1}{\sum e(\bullet)} e(\bullet)\frac{\beta_x}{\tau_h x_h}}{[\sum e(\bullet\bullet)]^2} \cdot \frac{\sum e(\bullet\bullet)}{e(\bullet\bullet)} \\ &= \frac{\beta_x}{x_h}\frac{e(\bullet)}{\sum e(\bullet)}\frac{\sum e(\bullet\bullet) - e(\bullet\bullet)}{\sum e(\bullet\bullet)} = \frac{\beta_x}{x_h}\Pr_{h|k}(1 - \Pr_k) \end{aligned}.$$

Substituting $\frac{\Pr'_{h|k}}{\Pr_{h|k}}$ and $\frac{\Pr'_k}{\Pr_k}$ into Equation (A2), we have

$$e_{x_h} = \frac{\beta_x}{\tau_h}(1-\Pr_{h|k}) + \beta_x \Pr_{h|k}(1-\Pr_k).$$

The subscript h can be replaced with j to represent any alternative $j \in n_k, \forall j = (1,...,J)$.

To obtain the sum of e_{x_j} over any alternative $l \in L$, we firstly sum up e_{x_j} within each nest to get

$$\begin{aligned}
\sum\nolimits_{J \in n_k} e_{x_j} &= \frac{\beta_x}{\tau_j}\sum\nolimits_{J \in n_k}(1-\Pr_{j|k}) + \beta_x(1-\Pr_k)\sum\nolimits_{J \in n_k}(\Pr_{j|k}) \\
&= \frac{\beta_x}{\tau_j}(J_{n_k} - 1) + \beta_x(1-\Pr_k) \\
&= \beta_x(\frac{J_{n_k}}{\tau_j} - \frac{1}{\tau_j} + 1 - \Pr_k)
\end{aligned},$$

where J_{n_k} is the number of alternatives in nest n_k. Then sum up $\sum\nolimits_{J \in n_k} e_{x_j}$ over nest $k \in K$ to get

$$\begin{aligned}
\sum\nolimits_K \sum\nolimits_{J \in n_k} e_{x_j} &= \beta_x[\sum\nolimits_K(\frac{J_{n_k}}{\tau_j} - \frac{1}{\tau_j}) + \sum\nolimits_K(1-\Pr_k)] \\
&= \beta_x[\sum\nolimits_K(\frac{J_{n_k}}{\tau_j} - \frac{1}{\tau_j}) + K - 1]
\end{aligned}.$$

Finally, the average probability elasticity for L alternatives w.r.t. x is

$$\bar{e}_x = \frac{\beta_x}{L}[\sum\nolimits_K(\frac{J_{n_k}}{\tau_j} - \frac{1}{\tau_j}) + K - 1].$$

Appendix 2. Descriptive Statistics of Explanatory Variables and Firm Data

Table A1. Explanatory variables

Variable	Description	Source
Region level		
Market potential	GDP of a region and its adjacent regions, for which their GDP are inversely weighed by their distance to the first region.	Cambridge Econometrics and own calculation
GDP per capita	GDP per capita, in Euro.	Cambridge Econometrics
Agglomeration of ICT sectors (domestic and foreign-owned)	Number of ICT manufacturing firms (ICT service firms). Two narrow measures include foreign-owned firms with foreign owner has at least 10 per cent share or domestic firms. A broad measure includes both domestic and foreign-owned firms. All three types of agglomeration variables are specially-lagged (see Section 3.2 for details).	*Amadeus*
Tertiary education attainment	The proportion of workers in the labour force holding a tertiary degree or above.	Eurostat
Unemployment rate	The unemployment rate for worker force.	Cambridge Econometrics
R&D expenditure	Regional R&D expenditure of both business and government at 1995 USD (million).	Eurostat
Patent applications	Number of patent applications of ICT sectors to the European Patent Office.	Eurostat
Country level		
Internet users	Internet users per 100 inhabitants.	World Development Indicators (WDI), World Bank
Statutory tax rate	Statutory top corporate tax rate at country level.	World Tax Data Base

Table A2a. Descriptive Statistics of Explanatory Variables (region level)

Full sample	Market potential	GDP per capita (euro per ca.)	Agglomeration of ICT manufacturing firms (foreign owned)	Agglomeration of ICT service firms (foreign owned)	Agglomeration of ICT manufacturing firms (domestic and foreign owned)	Agglomeration of ICT service firms (domestic and foreign owned)	The unemployment Rate (%)	R&D expenditure	Patent applications
Mean	32,492.5	15,729.3	26.8	99.6	123.6	325.0	9.6	412.6	50.7
Standard deviation	38,489.8	9,052.0	50.6	273.0	177.9	533.1	5.2	824.3	129.9
Maximum	367,658.2	45,895.6	435	2,432	1,323	4,355	28.2	8,883.2	1,033.4
Minimum	763.5	1,176.8	0	0	0	0	2.2	0.0	0.0
EU15 countries									
Mean	36,879.3	18,106.9	27.3	111.5	134.3	349.2	9.0	489.5	64.0
Standard deviation	40,016.8	6,588.8	51.1	300.1	182.6	513.6	5.1	897.1	143.8
Maximum	367,658.2	45,591.3	435	2,432	1,323	3,618	28.2	8,883.2	1,033.4
Minimum	763.5	6,548.8	0	0	0	0	2.5	0.0	0.1
Eu10 countries									
Mean	6,923.6	3,811.6	26.0	56.7	86.1	240.5	12.1	85.8	1.5
Standard deviation	4,566.4	5,620.1	49.7	121.2	156.2	607.1	5.4	137.1	2.7
Maximum	22,152.0	42,610.0	312	779	1,077	4,355	25.2	709.6	15.0
Minimum	2,947.0	1,176.8	0	0	1	3	2.2	0.9	0.0

Table A2b. Descriptive Statistics of Explanatory Variables (country level)

Full sample	Internet users (per 100 inhabitants)	Statutory tax rate (%)
Mean	13.8	31.2
Standard deviation	8.6	7.2
Maximum	33.5	45.4
Minimum	2.9	11.0
EU15 countries		
Mean	18.2	33.0
Standard deviation	8.3	7.7
Maximum	33.5	45.4
Minimum	5.7	11.0
EU10 countries		
Mean	7.5	28.5
Standard deviation	4.5	5.5
Maximum	16	35.7
Minimum	3.4	18.0

Table A3. Geographic Distribution of ICT Manufacturing Firms (number of firms, by ownership and industry)

Industry	NACE 30				NACE 32				NACE 33			
Ownership	**Total**	US	EU	Other	**Total**	US	EU	Other	**Total**	US	EU	Other
AT	**4**	0	3	1	**13**	1	11	1	**26**	1	20	5
BE	**3**	0	2	1	**12**	4	6	2	**8**	5	2	1
BG	**1**	0	0	1	**18**	2	15	1	**7**	0	6	1
CZ	**4**	0	2	2	**9**	0	6	3	**9**	2	7	0
DK	**4**	1	2	1	**11**	0	10	1	**16**	0	9	7
EE	**0**	0	0	0	**10**	1	9	0	**2**	0	1	1
FI	**0**	0	0	0	**2**	1	1	0	**9**	1	5	3
FR	**5**	1	2	2	**44**	18	14	12	**52**	20	21	11
DE	**45**	10	25	10	**127**	26	53	48	**210**	56	84	70
GR	**0**	0	0	0	**3**	0	3	0	**2**	1	1	0
HU	**1**	0	1	0	**10**	2	6	2	**2**	0	2	0
IE	**11**	6	4	1	**5**	2	2	1	**23**	9	12	2
IT	**11**	2	8	1	**20**	5	13	2	**31**	12	16	3
LV	**1**	0	1	0	**0**	0	0	0	**1**	0	0	1
LT	**0**	0	0	0	**1**	0	1	0	**0**	0	0	0
LU	**0**	0	0	0	**0**	0	0	0	**1**	1	0	0
NL	**8**	1	3	4	**16**	3	7	6	**27**	10	8	9
PL	**16**	2	14	0	**12**	0	9	3	**33**	6	23	4
PT	**2**	0	2	0	**2**	0	1	1	**7**	1	3	3
RO	**24**	4	12	8	**32**	2	23	7	**57**	0	46	11
SK	**0**	0	0	0	**1**	0	1	0	**0**	0	0	0
SI	**0**	0	0	0	**0**	0	0	0	**1**	0	1	0
ES	**7**	2	4	1	**8**	0	6	2	**7**	2	3	2
SE	**2**	0	2	0	**8**	4	2	2	**7**	1	5	1
GB	**45**	18	16	11	**84**	35	24	25	**162**	72	55	35
Total	**194**	47	103	44	**448**	106	223	119	**700**	200	330	170

Notes: 30: manufacture of office machinery and computers. 32: manufacture of radio, television and communications equipment and apparatus. 33: manufacture of medical, precision and optical instruments and clocks. Ownership: US - owned by US MNE parent; EU - owned by EU parent; Other - owned by MNE parent from the rest of the world.

Table A4. Geographic Distribution of ICT Manufacturing Firms (share, by industry)

Industry Ownership	% 30 Total	% 32 Total	% 33 Total	% 30+32+33 Total
AT	2.1	2.9	3.7	2.9
BE	1.5	2.7	1.1	1.8
BG	0.5	4.0	1.0	1.8
CZ	2.1	2.0	1.3	1.8
DK	2.1	2.5	2.3	2.3
EE	0.0	2.2	0.3	0.8
FI	0.0	0.4	1.3	0.6
FR	2.6	9.8	7.4	6.6
DE	23.2	28.3	30.0	27.2
GR	0.0	0.7	0.3	0.3
HU	0.5	2.2	0.3	1.0
IE	5.7	1.1	3.3	3.4
IT	5.7	4.5	4.4	4.9
LV	0.5	0.0	0.1	0.2
LT	0.0	0.2	0.0	0.1
LU	0.0	0.0	0.1	0.0
NL	4.1	3.6	3.9	3.9
PL	8.2	2.7	4.7	5.2
PT	1.0	0.4	1.0	0.8
RO	12.4	7.1	8.1	9.2
SK	0.0	0.2	0.0	0.1
SI	0.0	0.0	0.1	0.0
ES	3.6	1.8	1.0	2.1
SE	1.0	1.8	1.0	1.3
GB	23.2	18.8	23.1	21.7
Total	100.0	100.0	100.0	100.0

Table A5. Geographic Distribution of ICT Service Firms
(number of firms, by ownership and industry)

Industry	NACE 64				NACE 72			
Ownership	**Total**	US	EU	Other	**Total**	US	EU	Other
AT	**21**	5	15	1	**171**	17	123	31
BE	**20**	5	15	0	**105**	20	76	9
BG	**19**	2	15	2	**71**	4	58	9
CZ	**16**	2	14	0	**61**	7	49	5
DK	**39**	6	20	13	**160**	33	95	32
EE	**6**	0	4	2	**30**	3	20	7
FI	**7**	2	5	0	**45**	7	31	7
FR	**44**	13	21	10	**287**	90	166	31
DE	**192**	27	108	57	**1049**	198	551	300
GR	**12**	1	9	2	**25**	6	19	0
HU	**3**	1	2	0	**7**	2	5	0
IE	**42**	10	26	6	**190**	76	96	18
IT	**26**	6	14	6	**112**	31	68	13
LV	**2**	0	2	0	**0**	0	0	0
LT	**3**	0	3	0	**8**	1	4	3
LU	**2**	0	2	0	**29**	1	16	12
NL	**42**	10	26	6	**173**	46	84	43
PL	**26**	2	21	3	**80**	13	64	3
PT	**8**	2	6	0	**41**	5	32	4
RO	**154**	31	79	44	**593**	90	420	83
SK	**1**	1	0	0	**0**	0	0	0
SI	**0**	0	0	0	**1**	1	0	0
ES	**66**	18	41	7	**219**	38	151	30
SE	**13**	4	3	6	**108**	21	44	43
GB	**447**	134	160	153	**2826**	906	1148	772
Total	**1211**	282	611	318	**6391**	1616	3320	1455

Notes: 64: post and telecommunications; 72: computer and related activities. Ownership: US - owned by US MNE parent; EU - owned by EU parent; Other - owned MNE parent from the rest of the world.

Table A6. Geographic Distribution of ICT Service Firms (share, by industry)

Industry Ownership	% 64 Total	% 72 Total	% 64+72 Total
AT	1.7	2.7	2.2
BE	1.7	1.6	1.6
BG	1.6	1.1	1.3
CZ	1.3	1.0	1.1
DK	3.2	2.5	2.9
EE	0.5	0.5	0.5
FI	0.6	0.7	0.6
FR	3.6	4.5	4.1
DE	15.9	16.4	16.1
GR	1.0	0.4	0.7
HU	0.2	0.1	0.2
IE	3.5	3.0	3.2
IT	2.1	1.8	1.9
LV	0.2	0.0	0.1
LT	0.2	0.1	0.2
LU	0.2	0.5	0.3
NL	3.5	2.7	3.1
PL	2.1	1.3	1.7
PT	0.7	0.6	0.7
RO	12.7	9.3	11.0
SK	0.1	0.0	0.0
SI	0.0	0.0	0.0
ES	5.5	3.4	4.4
SE	1.1	1.7	1.4
GB	36.9	44.2	40.6
Total	100.0	100.00	100.0