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Corporate Taxation and Foreign Direct Investment in EU Countries: Policy Implications for Ireland

R. B. Davies, I. Siedschlag and Z. Studnicka

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Ronald B. Davies[a], Iulia Siedschlag[b] and Zuzanna Studnicka[c]

1 Introduction

This research provides new empirical evidence on the impact of corporate taxation and other factors on the attractiveness of Ireland and other EU countries to foreign direct investment (FDI) over the period 2002-2013. In comparison to previous analyses which have considered individual countries as alternative locations,[1] we analyse groups of EU countries with similar characteristics as alternative locations for FDI. In this context, we examine the extent to which Ireland and the United Kingdom (UK) are perceived as similar alternatives with respect to factors that determine the location choice of foreign affiliates. This question is relevant in relation to a possible redirection of FDI in the case of a vote in the UK to leave the EU. In addition to identifying average effects for all FDI projects, we account for the heterogeneity of investors' behaviour by analysing intra-EU investments and investments from outside the EU. Furthermore, we identify and quantify similarities and differences with respect to the effects of corporate taxation and of other factors on the location choice of foreign affiliates in manufacturing and services.

This new empirical evidence suggests how changes in the corporate taxation in Ireland and the UK would potentially affect Ireland's attractiveness to foreign direct investment. While we focus on corporate tax policy, we also highlight the importance of other factors which multinationals consider for the location choice

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a University College Dublin, Oxford Centre for Business Taxation, CES-Ifö. ronbdavies@gmail.com.

b Corresponding author. Economic and Social Research Institute, Department of Economics, Trinity College Dublin. iulia.siedschlag@esri.ie.

c Economic and Social Research Institute, Department of Economics, Trinity College Dublin, KU Leuven. zuzanna.studnicka@esri.ie.

1 This modelling approach implies that each location is perceived as perfectly independent from any other location option. Recent studies include among others Head and Mayer (2004), Devereux et al. (2007), Barrios et al. (2012), Lawless et al. (2014), Barrett et al. (2015), Davies and Killeen (2015).

of foreign affiliates including those which could be influenced by public policy such as production costs and investment in R&D.

The results of this analysis indicate that Ireland and the UK are perceived to be similar as alternative locations for FDI in particular by investors from outside the EU and in services. This result suggests that a possible redirection of FDI from the UK to Ireland would be more likely in services and by investors with headquarters outside the EU.

Consistent with international evidence, we find that on average, the attractiveness of countries to FDI is negatively linked to corporate tax rates. However, corporate investment decisions are based on a range of other factors which influence profitability. The results of this analysis indicate that location characteristics which increase the attractiveness of countries within the EU groups considered include market size, the possibility to access other EU markets from the host country, speaking the same language, being neighbours, and having low production costs. We uncover a non-linear effect of R&D intensity on the attractiveness of countries to FDI. Our results indicate that new FDI projects are likely to locate in countries with a low level of technological development where they benefit from local advantages such as low production costs. This result is consistent with the well established evidence on the intensity of multinational firms in knowledge-based assets that give them an advantage over domestic firms in host countries and allow them to overcome barriers to entry in foreign markets.[2] The non-linear effect implies that, as the R&D intensity increases above a certain threshold,[3] countries with higher levels of technological development are attractive to FDI. As documented by recent evidence, knowledge-sourcing is an increasingly important factor for the location choice of foreign affiliates by multinational firms.[4]

This analysis finds that the effect of corporate taxation on the attractiveness of countries to FDI varies depending on economic sectors. It appears that lower corporate tax rates increase the attractiveness of EU countries to FDI in services, while manufacturing FDI is more likely to locate in larger countries which tend to have higher corporate tax rates such as Germany and France.

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2 See for example Markusen (2002).

3 Our estimates suggest that the turning point for R&D intensity when all new FDI projects are considered is 1.8 per cent of GDP.

4 See for example von Zedtwitz and Gassmann (2002), and Iwasa and Odagiri (2004), and Siedschlag et al. (2013a).

This analysis also shows that given the groups of EU countries considered, investors from EU and non-EU countries value location characteristics differently. While FDI by non-EU investors is more likely in countries with lower corporate tax rates, intra-EU investments are more likely to locate in countries with higher corporate taxes where they benefit from other local advantages. The results indicate that EU investors are seeking low cost locations in other EU countries, while investors from outside the EU are attracted by the possibility to get access to the European Single Market.

Policy analysis based on these research results indicate that the sensitivity of Ireland's attractiveness to FDI with respect to changes in its corporate tax rate is the highest among EU countries in the case of FDI projects by investors from outside the EU. Assuming all other factors would remain unchanged, an increase in Ireland's statutory corporate tax rate by one percentage point (from 12.5 per cent to 13.5 per cent) would be associated with a reduction in its probability of being chosen as a location for FDI projects from non-EU countries by 4.6 per cent.

All else being equal, a more competitive corporate tax rate in the UK would reduce the attractiveness of Ireland especially for FDI from non-EU countries. With everything else unchanged, a reduction of the UK's statutory corporate tax rate by one percentage point (from 20 per cent to 19 per cent) would reduce Ireland's attractiveness to new FDI projects from non-EU countries by 4.3 per cent.

Taken together, these research results indicate that a competitive corporate tax rate is a significant factor for attracting FDI to Ireland, especially from countries outside the EU. In the context of increased international tax competition, Ireland's attractiveness to FDI would benefit from policies aimed at maintaining cost competitiveness and enabling further R&D investment.

The empirical methodology and data used for this analysis are described in Section 2 and the empirical results are presented in Section 3. On the basis of the results of this analysis, Section 4 discusses policy implications for Ireland's attractiveness to FDI. Section 5 concludes.

2 Empirical Methodology and Data

Location choices by multinational firms have been typically analysed using a random utility maximisation econometric framework following McFadden

(1974).[5] In this modelling set-up, investors consider the set of location options and choose the location with the highest profitability among competing options. The profitability of each location option is a function of the location's characteristics.

2.1 Baseline Model Specification

To identify the attractiveness of EU countries to FDI, we use a nested logit model following McFadden (1984). Details of this empirical approach are given in Box 1.

Box 1. Modelling Location Choices by Multinational Firms: A Nested Logit Approach

The nested logit model (NLM) formalised by McFadden (1984) improves on the conditional logit model (CLM) by considering groups of similar locations and thus allowing more flexible substitution patterns across alternative locations.[6] The partition of location options in groups of countries (nests) is based on similar unobserved characteristics that affect profitability. In this empirical set-up, corporate investors make their location decisions in two steps:

(1) the choice between groups of similar locations (nests);

(2) the location choice within nests.

The assumption in the NLM is that of independence between nests (unobserved locational characteristics are not correlated between nests) while non-negative correlation of unobserved locational characteristics within nests is allowed.

In this case, the location probability for option *j* located in nest *k* (P_j^k) is given by the product of the probability of nest *k* to be chosen among *K* nests (P_k) and the probability of location *j* to be chosen given that nest *k* has been chosen ($P_{j/k}$):

$$P_j^k = P_k * P_{j/k} \quad (1)$$

An important parameter in the nested logit modelling framework is a measure of the degree of independence of the unobserved profit among the location options within the nest: a dissimilarity parameter, λ_k. A higher value of λ_k indicates a greater independence and so less correlation among location options within the nest k. If the location options within the nest are perfectly independent (perfectly dissimilar), $\lambda_k = 1$. In this case a nested structure is not needed and the location probabilities could be estimated with the CLM. Low values of λ_k indicate high similarity among location options within the nest and a higher degree of substitution among them. $\lambda_k = 0$ indicates perfect dependence (similarity) among location options.

Values of λ_k between 0 and 1 indicate consistency of the nested structures with profit maximisation for all possible values of the explanatory variables.

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5 Recent reviews of this modelling framework include among others Schmidheiny and Brülhart (2011), Siedschlag et al. (2013a, 2013b), Lawless et al. (2014) and Davies and Killeen (2015).

6 The conditional logit model is based on the assumption of independence of irrelevant alternatives (IIA). This statistical property implies that changes in the location characteristics affect only the distribution of investments across all location options. Analyses of location choice of affiliates by multinational firms using nested logit models include among others Devereux and Griffith and (1998), Crozet et al. (2004) and Siedschlag et al. (2013a).

$\lambda_k > 1$ indicates nested structures consistent with profit maximisation behaviour for some range of the explanatory variables but not for all values. $\lambda_k < 0$ indicates that the model is inconsistent with profit maximisation.[7]

In contrast to the conditional logit modelling, in the nested logit modelling, the *expected* total number of investments depends on the regressors and estimated parameters and it differs from the *observed* total number of firms. A change in a region's locational attractiveness will affect the total number of firms summed across all alternative locations.[8]

The baseline model specification we estimate is as follows:

$$y_{ij} = \begin{Bmatrix} 1, if \pi_{ij} > \pi_{ik}, \forall j \neq k \\ 0, otherwise \end{Bmatrix} \quad (2)$$

The dependent variable y_{ij} is a binary variable equal to 1 if a new foreign affiliate *i* was established in country *j* over the period 2002-2013. π_{ij} is the expected profit for firm *i* in country *j*. Country *j* is chosen if π_{ij} is larger than in any other location option *k*. Since π_{ij} is not known ex-ante by the multinational firm, the probability that country *j* is chosen by firm *i* depends on the likelihood that its profit will be maximised conditional on location characteristics in country *j.*

The expected profit π_{ij} is a function of observed locational characteristics, X_j, and a random term of unobserved profit μ_{ij}:

$$\pi_{ij} = X_j \beta + \mu_{ij} \quad (3)$$

The variable of interest in this analysis is the statutory corporate tax rate at country level. Corporate taxes impact on the cost of capital which in turn influences investment decisions. Existing evidence on the effect of corporate taxation on the location choice of foreign affiliates indicates that higher taxes reduce the likelihood of foreign direct investment.[9]

[7] More details on testing nested structures are provided by Henscher et al. (2005) and Pollak and Wales (1991).

[8] A more detailed discussion of the comparisons between the conditional and nested logit modelling frameworks is given by Schmidheiny and Brülhart (2011).

[9] Previous analyses also examined the effect of the effective average tax rates (EATR) on the location choice of FDI. Given the policy focus of this analysis, our empirical identification is based on the variation across countries of the statutory corporate tax rate which is independent of firm decisions. de Mooij and Ederveen (2003, 2008) provide meta-analyses of international evidence. Recent studies include Barrios et al. (2012) and Lawless et al. (2014).

In addition to corporate taxation, we analyse the attractiveness of Ireland and other EU countries to other factors which have been found to influence the location choice of foreign affiliates.[10] These factors include:

- demand factors such as market size and market access;
- production costs, proxied by GDP per capita;
- technology level and innovation capacity, proxied by the private and public R&D expenditures as percentage of GDP;
- trade and investment costs, proxied by the distance between the home and host countries;
- cultural and geographical proximity, proxied by variables for sharing a common language and for sharing a common border, respectively.

Definitions of the variables used in this analysis are given in Table A1 in the Appendix.

Having tested alternative nested structures on the basis of countries' similarity based on shared history, as well as institutional characteristics, we consider the following four groups of EU countries as location nests which are consistent with the tested random profit maximisation principles:[11]

- *United Kingdom and Ireland*;
- *Core and Northern EU Group*: Austria, Belgium, Denmark, Finland, France, Germany, Luxembourg, the Netherlands, and Norway;[12]
- *Central and Eastern EU Group*: Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia;
- *Southern EU Group*: Greece, Italy, Malta, Portugal, Spain.

2.2 Heterogeneous Effects

The above baseline model specification considers the behaviour of a representative location-seeking investor. However, previous analyses on the location choice of multinational activity in the EU (Siedschlag 2013a, 2013b) have found that the relevance and importance of location characteristics are perceived

[10] Recent reviews of this evidence include among others Fontagné and Mayer (2005), Siedschlag et al. (2013a, 2013b), and Lawless et al. (2014).

[11] As pointed out by Greene (2000), there is no well-defined procedure to identify nested structures. Multiple nested structures are possible and their validity could be tested. Following McFadden (1984), values of λ_k between 0 and 1, indicate consistency of the nested structure with random profit maximisation principles for all values of the explanatory variables.

[12] We consider Norway as a location option together with EU countries given its membership in the European Economic Area (EEA) which makes it part of the European Single Market. Iceland and Lichtenstein are also members of the EEA. These two countries are not included in the analysis due to limited available data. The results of this analysis are unlikely to be affected given the very small size of these two countries.

differently by investors based in the EU and investors from outside the EU, particularly from the US. To account for this heterogeneity of investment behaviour, we analyse and compare the location decisions of investors with headquarters in the EU and those of investors with headquarters outside the EU.

Further heterogeneity in the location decisions by multinational firms is likely to exist across sectors of economic activity (Siedschlag 2013a, 2013b; Lawless et al. 2014; Davies and Killeen 2015). We explore this heterogeneity by analysing separately the location decisions of new foreign affiliates in manufacturing and services.

2.3 Data

The data for this analysis include information at firm and country level from several sources. The firm level information is extracted from the Amadeus dataset provided by Bureau van Dijk. We analyse 18,100 foreign affiliates established in EU countries over the period 2002-2013. We consider newly established foreign affiliates which are directly owned by companies which report non-zero employment and own at least 50 per cent of the voting shares in the newly established enterprises.

The distribution of FDI projects by host countries is shown in Table 1 while Table 2 shows the distribution of FDI projects by country of origin. The top five FDI destinations (accounting for 55 per cent of all new FDI projects) are Germany, the UK, Romania, Italy, and the Netherlands. The top five investing countries are Switzerland, the Netherlands, the US, Germany and Spain (56 per cent of all new FDI projects).

The definitions and data sources of the country level variables are given in Table A1 in the Appendix.

TABLE 1 Number of New Foreign Affiliates by Country of Destination

Country	Number of new foreign affiliates	Share of new foreign affiliates
Germany	3,333	18.40
United Kingdom	2,434	13.44
Romania	1,546	8.54
Italy	1,355	7.48
Netherlands	1,264	6.98
France	969	5.35
Poland	956	5.28
Czech Republic	869	4.80
Austria	788	4.35
Slovakia	786	4.34
Spain	667	3.68
Portugal	462	2.55
Belgium	346	1.91
Ireland	321	1.77
Denmark	308	1.70
Finland	260	1.44
Norway	250	1.38
Hungary	234	1.29
Estonia	194	1.07
Croatia	191	1.05
Latvia	173	0.96
Luxembourg	134	0.74
Bulgaria	94	0.52
Slovenia	56	0.31
Greece	44	0.24
Malta	44	0.24
Lithuania	32	0.18
Total	**18,110**	100.00

Source: Amadeus dataset provided by Bureau van Dijk.

TABLE 2 Number of New Foreign Affiliates by Country of Origin

Origin	Number of new foreign affiliates	Share in total new FDI projects	Origin	Number of new foreign affiliates	Share in total new FDI projects
Switzerland	3,209	17.72	**Cayman Islands**	22	0.12
Netherlands	2,274	12.56	**Croatia**	20	0.11
United States	1,895	10.46	**Malta**	18	0.10
Germany	1,712	9.45	**Romania**	17	0.09
Spain	1,087	6.00	**Virgin Islands, British**	14	0.08
Sweden	995	5.49	**Chile**	9	0.05
Italy	932	5.15	**Bosnia and Herzegovina**	8	0.04
Belgium	707	3.90	**Bangladesh**	7	0.04
United Kingdom	614	3.39	**Mexico**	7	0.04
Japan	482	2.66	**Russia**	7	0.04
Austria	451	2.49	**Argentina**	6	0.03
France	423	2.34	**Egypt**	5	0.03
Denmark	381	2.10	**Indonesia**	5	0.03
Czech Republic	363	2.00	**Moldova**	5	0.03
Hungary	291	1.61	**Taiwan**	5	0.03
Finland	285	1.57	**Venezuela**	5	0.03
Slovak Republic	182	1.00	**Andorra**	4	0.02
Portugal	167	0.92	**Sri Lanka**	4	0.02
Ireland	165	0.91	**Nigeria**	4	0.02
Luxembourg	112	0.62	**Gibraltar**	3	0.02
Israel	93	0.51	**Pakistan**	3	0.02
Turkey	93	0.51	**Saudi Arabia**	3	0.02
Norway	90	0.50	**Angola**	2	0.01
Poland	86	0.47	**Libya**	2	0.01
Lithuania	75	0.41	**Marshall Islands**	2	0.01
China	72	0.40	**Tunisia**	2	0.01
Canada	66	0.36	**Trinidad and Tobago**	2	0.01
Greece	63	0.35	**United Arab Emirates**	1	0.01
Slovenia	55	0.30	**Bahamas**	1	0.01
Bermuda	48	0.27	**Botswana**	1	0.01
India	48	0.27	**Belarus**	1	0.01
Cyprus	46	0.25	**Dominican Republic**	1	0.01
Estonia	45	0.25	**Georgia**	1	0.01
Brazil	42	0.23	**Ghana**	1	0.01
Latvia	42	0.23	**Liberia**	1	0.01
Iceland	36	0.20	**Macedonia**	1	0.01
Hong Kong	35	0.19	**Mauritius**	1	0.01
South Africa	35	0.19	**Malaysia**	1	0.01
Australia	28	0.15	**Peru**	1	0.01
South Korea	28	0.15	**Philippines**	1	0.01
Bulgaria	27	0.15	**San Marino**	1	0.01
New Zealand	24	0.13	**Suriname**	1	0.01

Source: Amadeus dataset provided by Bureau van Dijk.

3 Empirical Results

3.1 All New FDI Projects

Table 3 shows the estimates from nested logit regressions of determinants of the location choice of new foreign affiliates in EU countries over the period 2002-2013. The first column reports the estimates for all investors while columns 2 and 3 show the results for EU investors and investors with headquarters outside the EU.

The results in column 1 indicate that lower corporate tax rates make EU countries more attractive as locations for FDI. Location characteristics that increase countries' attractiveness to FDI over and above the effect of corporate tax rates include: market size, market potential (the possibility to access the European Single Market from the host country), speaking the same language, and being neighbours. GDP per capita captures both production costs and skills. Location probabilities are negatively linked to GDP per capita, suggesting that on average, the attractiveness of low cost locations dominates the attractiveness of locations with high skills.

R&D expenditure intensity has a non-linear effect on the attractiveness of countries to FDI. While at low rates of R&D intensity the effect is negative, as the R&D intensity increases, this negative effect moderates, and once a threshold has been reached, the effect becomes positive. Our estimates indicate that this turning point for R&D intensity is 1.8 per cent of GDP.

The dissimilarity parameters (λ_k) indicate that Ireland and the United Kingdom are perceived as being more similar as location options compared with the other groups of EU countries considered as location nests. Countries within the Southern Europe group and Central and Eastern European countries are more similar as location options compared to the Core and Northern group of EU countries.

The statistical test for the independence of irrelevant alternatives (IIA) indicates that the location options inside the considered groups of countries are not independent. This implies that the nested logit estimates are consistent with the IIA.

TABLE 3 Determinants of the Location Choice for New Foreign Affiliates in EU Countries, 2002-2013

Explanatory variables	All FDI projects	EU investors	Non-EU investors
Corporate tax policy rate	-0.083**	0.153***	-0.532***
	(0.039)	(0.051)	(0.056)
Market size (GDP)	0.345***	0.362***	0.346***
	(0.011)	(0.013)	(0.018)
EU Market potential	0.089***	-0.339***	0.830***
	(0.021)	(0.032)	(0.034)
GDP per capita	-0.524***	-0.633***	-0.034
	(0.021)	(0.027)	(0.053)
Trade costs- distance to home country	-0.451***	-0.653***	0.212***
	(0.015)	(0.019)	(0.043)
Common language	0.386***	0.299***	0.516***
	(0.022)	(0.032)	(0.039)
Common border	0.456***	0.475***	0.653***
	(0.020)	(0.025)	(0.039)
R&D expenditure intensity	-0.369***	-0.344***	-0.693***
	(0.048)	(0.064)	(0.092)
R&D expenditure intensity squared	0.103***	0.066***	0.224***
	(0.012)	(0.016)	(0.022)
Dissimilarity parameters (λ_k)			
United Kingdom and Ireland EU Group	0.444***	0.564***	0.267***
	(0.022)	(0.034)	(0.023)
Core and Northern EU Group	0.637***	0.731***	0.465***
	(0.012)	(0.016)	(0.017)
Central and Eastern EU Group	0.543***	0.653***	0.522***
	(0.017)	(0.020)	(0.038)
Southern EU Group	0.406***	0.458***	0.443***
	(0.013)	(0.018)	(0.022)
Number of observations	436,846	274,341	162,505
Log likelihood	-47383	-30263	-16211
LR test for IIA (λ_k =1)	χ^2 (4) = 917.53***	χ^2 (4) = 442.23***	χ^2 (4) = 530.38***

Source: Authors' estimates.

Notes: Estimates obtained from a nested logit model. Standard errors are in parentheses. ***, **, *, denote p<0.01, p<0.05, p<0.1, respectively. The dependent variable is equal to 1 if a foreign affiliate was established over the period in the host country. Explanatory variables are lagged by one year with respect to the dependent variable. R&D expenditure intensity is in percentages. Trade costs, common language, common border are dummy variables. The rest of the explanatory variables are in logarithms. The country compositions of the EU groups are as follows: *Core and Northern*: Austria, Belgium, Denmark, Finland, France, Germany, Luxembourg, the Netherlands, Norway. *Central and Eastern*: Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia. *Southern:* Greece, Italy, Malta, Portugal, Spain.

3.2 Intra-EU Investment versus Investment From Outside the EU

Table 3 also reports results from separate regressions on determinants of the location choice of new foreign affiliates in EU countries by companies with headquarters in the EU and outside the EU. The evidence suggests that EU and non-EU investors value countries' characteristics differently. FDI by EU investors is more likely to locate in countries with higher corporate tax rates where they can benefit from local advantages such as low production costs and market size. In contrast, investors from outside the EU are deterred by high corporate taxes. While low production costs increase the attractiveness of countries to intra-EU investment, they do not matter for investors with headquarters outside the EU. Other differences in investment behaviour are in relation to the effects of EU market access and trade costs. While in the case of investors with headquarters outside the EU, the location probability increases with access to the European Single Market, intra-EU investments are more likely in countries with small market potential. Also, FDI by non-EU investors is more likely in countries which are more distant, in which case trade costs would be higher.

Taken together, these results suggest that, in the presence of trade costs, countries with a higher EU market potential are particularly attractive to investors with headquarters outside the EU. The results also suggest that while intra-EU investments are efficiency-seeking, FDI by investors from outside the EU are market-seeking.

The dissimilarity parameters indicate that Ireland and the UK are seen as closer location alternatives by non-EU investors compared with EU investors. This result could be explained by the importance of foreign direct investment in both countries by US multinationals. For EU investors, the countries in the Southern EU group are seen as closer substitutes compared to other location options in the other EU groups.

3.3 Differences Across Sectors

The results shown in Table 4 indicate that foreign investors respond differently to corporate taxation in manufacturing and services. On average, FDI in manufacturing is more likely to locate in countries with higher corporate tax rates where they benefit from other local advantages such as low production costs and market size. This result is consistent with the fact that larger countries which are more attractive to investment in manufacturing, such as Germany and France, tend to have higher corporate tax rates. In contrast, the location probability for FDI in services is negatively linked to corporate tax rates.

While on average, higher market potential (access to the European Single Market) increases the attractiveness of countries to FDI in services, it does not matter for the location choice of FDI in manufacturing.

The dissimilarity parameters indicate that Ireland and the UK are perceived as being more similar as location alternatives for FDI in services in comparison to FDI in manufacturing.

Table 5 explores heterogeneous effects in investment decisions across both investors by country of origin and sectors. The results indicate higher statutory corporate tax rates are associated with a higher likelihood of new intra-EU investment in manufacturing, while they do not seem to matter for investors from outside the EU. Investments from non-EU investors in services are less likely in countries with high corporate taxes. The likelihood of investments in manufacturing from non-EU investors also declines with the statutory corporate tax rate.

Market size increases the likelihood of investment in all analysed cases. The different relevance and importance of access to EU markets appears again for EU and non-EU investors. While EU investors are likely to invest in countries with a smaller EU market potential, countries with a higher EU market potential increase substantially the attractiveness to investment by non-EU investors in both manufacturing and services.

TABLE 4 Determinants of the Location Choice for New Foreign Affiliates in EU Countries, Manufacturing and Services, 2002-2013

Explanatory variables	All Investors Manufacturing	Services
Corporate policy tax rate	0.275**	-0.216***
	(0.129)	(0.046)
Market size (GDP)	0.484***	0.340***
	(0.040)	(0.012)
EU Market potential	0.120	0.161***
	(0.077)	(0.023)
GDP per capita	-0.969***	-0.399***
	(0.072)	(0.026)
Trade costs- distance to home country	-0.444***	-0.430***
	(0.051)	(0.018)
Common language	0.468***	0.322***
	(0.076)	(0.024)
Common border	0.468***	0.524***
	(0.064)	(0.024)
R&D expenditure intensity	-0.755***	-0.273***
	(0.176)	(0.055)
R&D expenditure intensity squared	0.234***	0.085***
	(0.043)	(0.013)
Dissimilarity parameters (λ_k) **United Kingdom and Ireland EU Group**	0.755***	0.409***
	(0.111)	(0.024)
Core and Northern EU group	0.613***	0.642***
	(0.039)	(0.014)
Central and Eastern EU Group	0.769***	0.558***
	(0.056)	(0.020)
Southern EU Group	0.387***	0.416***
	(0.040)	(0.015)
Number of observations	47,193	338,284
log likelihood	-5104	-36579
LR test for IIA (λ_k =1)	$\chi2$ (4) = 132.34***	$\chi2$ (4)= 704.78***

Source: Authors' estimates.

Notes: Estimates obtained from a nested logit model. Standard errors are in parentheses. ***, **, *, denote p<0.01, p<0.05, p<0.1, respectively. The dependent variable is equal to 1 if a foreign affiliate was established over the period in the host country. Explanatory variables are lagged by one year with respect to the dependent variable. R&D expenditure intensity is in percentages. Trade costs, common language, common border are dummy variables. The rest of the explanatory variables are in logarithms. The country compositions of the EU groups are as follows: *Core and Northern*: Austria, Belgium, Denmark, Finland, France, Germany, Luxembourg, the Netherlands, Norway. *Central and Eastern*: Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia. *Southern*: Greece, Italy, Malta, Portugal, Spain.

TABLE 5 Determinants of the Location Choice for New Foreign Affiliates by EU and non-EU investors in Manufacturing and Services, 2002-2013

Explanatory variables	EU Investors		Non-EU Investors	
	Manufacturing	Services	Manufacturing	Services
Corporate tax policy rate	0.430***	0.048	0.035	-0.623***
	(0.164)	(0.059)	(0.211)	(0.058)
Market size (GDP)	0.495***	0.351***	0.442***	0.348***
	(0.047)	(0.015)	(0.077)	(0.019)
EU Market potential	-0.326***	-0.278***	0.832***	0.892***
	(0.111)	(0.036)	(0.112)	(0.038)
GDP per capita	-1.086***	-0.516***	-0.601***	0.127**
	(0.091)	(0.032)	(0.125)	(0.063)
Trade costs- distance to home country	-0.634***	-0.633***	0.234	0.191***
	(0.059)	(0.022)	(0.157)	(0.048)
Common language	0.337***	0.256***	0.699***	0.415***
	(0.106)	(0.035)	(0.155)	(0.042)
Common border	0.536***	0.519***	0.354***	0.766***
	(0.078)	(0.029)	(0.130)	(0.045)
R&D expenditure intensity	-0.621***	-0.207***	-1.078***	-0.638***
	(0.222)	(0.074)	(0.350)	(0.103)
R&D expenditure intensity squared	0.177***	0.040**	0.349***	0.210***
	(0.055)	(0.018)	(0.081)	(0.024)
Dissimilarity parameters (λ_k)				
United Kingdom and Ireland EU Group	0.722***	0.541***	0.636***	0.246***
	(0.139)	(0.038)	(0.144)	(0.024)
Core and Northern EU Group	0.652***	0.733***	0.488***	0.479***
	(0.046)	(0.018)	(0.072)	(0.019)
Central and Eastern EU Group	0.848***	0.665***	0.646***	0.565***
	(0.066)	(0.025)	(0.128)	(0.045)
Southern EU Group	0.444***	0.454***	0.320***	0.481***
	(0.053)	(0.061)	(0.058)	(0.026)
Number of observations	30,144	208,884	17,049	129,400
log likelihood	-3270	-22982	-1736	-12929
LR test for IIA (λ_k =1)	$\chi2$ (4) = 74.38***	$\chi2$ (4) = 335.54***	$\chi2$ (4) = 64.15***	$\chi2$ (4)= 408.80***

Source: Authors' estimates.

Notes: Estimates obtained from a nested logit model. Standard errors are in parentheses. ***, **, *, denote p<0.01, p<0.05, p<0.1, respectively. The dependent variable is equal to 1 if a foreign affiliate was established over the period in the host country. Explanatory variables are lagged by one year with respect to the dependent variable. R&D expenditure intensity is in percentages. Trade costs, common language, common border are dummy variables. The rest of the explanatory variables are in logarithms. The country compositions of the EU groups are as follows: *Core and Northern*: Austria, Belgium, Denmark, Finland, France, Germany, Luxembourg, the Netherlands, Norway. *Central and Eastern*: Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia. *Southern*: Greece, Italy, Malta, Portugal, Spain.

We uncover additional heterogeneous effects with respect to the importance of production as well as trade costs. Lower production costs proxied by the GDP per capita attract intra-EU investments in both sectors, while in the case of non-EU investors, this attractiveness factor appears only for investment in manufacturing. Higher levels of GDP per capita increase the attractiveness of EU countries to foreign investment by non-EU investors in services. This result might be related to higher demand for services in countries with a higher level of development.

The dissimilarity parameters indicate that the United Kingdom and Ireland are perceived to be more substitutable locations particularly by investors from non-EU countries and in services.

4 Policy Implications for Ireland

This section analyses policy implications for Ireland's attractiveness to FDI on the basis of the estimates discussed in Section 3.[13]

As shown in Table 6, the sensitivity of EU countries' attractiveness to FDI to changes in corporate tax rates is the highest for Southern EU countries. Ireland appears to be the 9th most sensitive among EU countries when all FDI projects are considered. Assuming all other factors would remain unchanged, a one percentage point increase in Ireland's statutory tax rate (from 12.5 per cent to 13.5 per cent) would be associated with a reduction of its chance to be chosen as a location for new FDI projects by 0.4 per cent.

The sensitivity of Ireland's attractiveness to changes in corporate tax rates appears to be the highest with respect to FDI from non-EU countries and for FDI in services. With everything else unchanged, an increase by one percentage point in Ireland's statutory corporate tax rate would reduce the location probability for investment from non-EU countries by 4.6 per cent, the highest among EU countries, and by 1.2 per cent in the case of FDI in services.

[13] The calculation of the elasticities of location probabilities are based on Greene (2000) and Wen and Koppelman (2001). Details are given in Table A2 in the Appendix.

TABLE 6 Elasticities of Location Probabilities with respect to Countries' Own Corporate Tax Rate

Countries	All FDI projects	EU investors	Non-EU investors	Manufacturing	Services
Malta	-0.7222	1.1776	-4.2349	2.5046	-1.8304
Greece	-0.6439	1.0452	-3.7601	2.2163	-1.6223
Portugal	-0.6222	1.0178	-3.6748	2.1609	-1.5801
Spain	-0.5811	0.9637	-3.4696	2.0197	-1.4863
Italy	-0.4700	0.5876	-2.7894	1.6452	-1.2240
Slovenia	-0.4659	0.7160	-3.1061	1.0953	-1.1802
Estonia	-0.4643	0.7088	-3.0884	1.0860	-1.1720
Czech Republic	-0.4543	0.7068	-3.0532	1.0835	-1.1594
Ireland	**-0.4447**	**0.6506**	**-4.5753**	**0.8971**	**-1.2386**
Croatia	-0.4405	0.6774	-2.9432	1.0378	-1.1168
Luxembourg	-0.4391	0.7067	-3.8482	1.5175	-1.1327
Slovakia	-0.4316	0.6703	-2.8953	1.0264	-1.1025
Norway	-0.4264	0.6803	-3.7068	1.4645	-1.0924
Belgium	-0.4209	0.6973	-3.6524	1.4858	-1.0971
Denmark	-0.4177	0.6716	-3.6464	1.4419	-1.0747
Finland	-0.4126	0.6641	-3.5909	1.4175	-1.0627
Lithuania	-0.4102	0.6272	-2.7303	0.9616	-1.0362
Hungary	-0.4069	0.6305	-2.7291	0.9677	-1.0364
Austria	-0.4067	0.6550	-3.5218	1.4063	-1.0433
Netherlands	-0.4059	0.6643	-3.5197	1.4231	-1.0494
Latvia	-0.4042	0.6173	-2.6890	0.9469	-1.0205
Romania	-0.3944	0.5985	-2.6255	0.9126	-0.9945
France	-0.3855	0.6329	-3.2651	1.3238	-0.9886
Poland	-0.3821	0.5965	-2.5911	0.9159	-0.9819
Germany	-0.3577	0.6018	-2.9811	1.2081	-0.9237
Bulgaria	-0.3433	0.5274	-2.2986	0.8061	-0.8715
United Kingdom	-0.2776	0.5089	-2.0170	0.8687	-0.7475

Source: Authors' estimates.
Note: Elasticities of location probabilities are computed at the country-specific sample means.

Measures to make the UK's corporate tax rate more competitive have been already announced in the Summer Budget in July 2015. Thus, the corporation tax rate will be reduced to 19 per cent from 1 April 2017 and 18 per cent from 1 April 2020. Our results indicate that a reduction by one percentage point of the corporate tax rate in the UK (from 20 per cent to 19 per cent) would reduce Ireland's attractiveness to FDI on average by 0.3 per cent. In this scenario, Ireland's probability of being chosen as location for FDI projects would decline by 4.3 per cent in the case of investors from non-EU countries and by 0.9 per cent in the case of FDI in services.

Taken together, these research results indicate that a competitive corporate tax rate is an important factor for attracting FDI to Ireland, especially from countries outside the EU.

From a policy perspective, in the context of increased international tax competition, policies aimed at maintaining cost competitiveness and fostering further R&D investment would be beneficial for Ireland's attractiveness to FDI.

5 Summary and Conclusion

The results of this analysis indicate that, consistent with international evidence, on average, lower corporate tax rates increase the attractiveness of countries to FDI. However, other location characteristics matter too. Location characteristics that increase the attractiveness of EU countries to FDI over and above the effect of the corporate tax rate include market size, access to the European Single Market, speaking the same language, being neighbours, and having low production costs. We uncover a non-linear effect of R&D intensity on the FDI location choices. On the one hand, multinational firms tend to locate in countries with lower technological development where they benefit from low production costs or market size. However, countries with higher levels of technology development are also attractive to FDI, the attractiveness factor in this case being sourcing advanced research and technologies.

The results also indicate that the effect of corporate taxation on the attractiveness of countries to FDI varies depending on economic sectors. It appears that lower corporate tax rates increase the attractiveness of EU countries to FDI in services while FDI in manufacturing are more likely to locate in larger countries such as Germany and France which tend to have higher corporate tax rates.

This analysis also shows that given the groups of EU countries considered, EU and non-EU investors value location characteristics differently. While FDI by non-EU investors is more likely in countries with lower corporate tax rates, intra-EU investments are more likely to locate in EU countries with higher corporate taxes where they benefit from local advantages such as low production costs and market size. Our results indicate that EU investors are seeking low cost locations in other EU countries, while investors from outside the EU are attracted by the possibility of getting access to the European Single Market.

This analysis finds that Ireland and the UK are perceived to be similar as alternative locations for FDI in particular by investors from outside the EU and in services. This result suggests that a possible redirection of FDI from the UK to Ireland would be more likely in the service sector and by investors from outside the EU.

A higher corporate tax rate would reduce Ireland's attractiveness to FDI particularly by investors from outside the EU and in services. The sensitivity of Ireland's attractiveness to FDI by investors from outside the EU is the highest among EU countries. Our results indicate that, with all other factors unchanged, an increase in Ireland's statutory corporate tax rate by one percentage point (from 12.5 per cent to 13.5 per cent) would be associated with a reduction of its probability of being chosen as a location for FDI projects from countries outside the EU by 4.6 per cent.

A more competitive corporate tax rate in the UK would reduce the attractiveness of Ireland particularly for FDI from non-EU countries. With everything else unchanged, a reduction of the UK's corporate tax rate by one percentage point (from 20 per cent to 19 per cent) would reduce Ireland's attractiveness to new FDI projects from non-EU countries by 4.3 per cent.

Taken together, our research results indicate that a competitive tax rate is a significant factor for attracting FDI to Ireland especially by investors from outside the EU.

In the context of increased international tax competition, policies aimed at maintaining cost competitiveness and enabling further R&D investment would be particularly beneficial for continuing to attract FDI to Ireland.

References

Barrett, A., A. Bergin, J. FitzGerald, D. Lambert, D. McCoy, E. Morgenroth, I. Siedschlag, Z. Studnicka (2015). 'Scoping the Possible Economic Implications of Brexit on Ireland', ESRI Research series No. 48.

Barrios, S., H. Huizinga, L. Laeven, and G. Nicodeme (2012). 'International taxation and multinational firm location decisions', *Journal of Public Economics*, 96(11): 946-958.

Crozet, M., T. Mayer, and J. L. Mucchielli (2004). 'How do firms agglomerate? A study of FDI in France', *Regional Science and Urban Economics*, 34(1): 27-54.

Davies, R. B. and N. Killeen (2015). 'Location decisions of non-bank financial foreign direct investment: Firm-level evidence from Europe', UCD Working Paper No. 2015/26.

de Mooij, R. and S. Ederveen (2003). 'Taxation and foreign direct investment: A synthesis of empirical research', *International Tax and Public Finance*, 10: 673-693.

de Mooij, R. and S. Ederveen (2008). 'Corporate tax elasticities: A reader's guide to empirical findings', *Oxford Review of Economic Policy*, 24(4): 680-697.

Devereux, M. P. and R. Griffith (1998). 'Taxes and the location of production: evidence from a panel of US multinationals', *Journal of Public Economics* 68: 335-367.

Devereux, M., R. Griffith, H. Simpson (2007). 'Firm location decisions, regional grants and agglomeration externalities', Journal of Public Economics, 91 (3-4): 413-435.

Fontagné, L. and T. Mayer (2005). 'Determinants of location choices by multinational firms: A review of the current state of knowledge', *Applied Economic Quarterly* 51: 9-34.

Greene, W.H. (2000). *Econometric Analysis*, 4th Edition, New Jersey, Prentice Hall International, Inc.

Head, K. and T. Mayer (2004). 'Market potential and the location of Japanese investment in the European Union, *Review of Economics and Statistics*, 86(2): 959-972.

Hensher D.A., J. M. Rose, W.H. Greene (2005). *Applied Choice Analysis*, Cambridge University Press.

Iwasa, T., H. Odagiri (2004). 'Overseas R&D, knowledge sourcing, and patenting: An empirical study of Japanese R&D investment in the US', *Research Policy*, 33: 807-828.

Lawless, M., D. McCoy, E. Morgenroth, and C. O'Toole (2014). *The Importance of Corporation Tax Policy in the Location Choice of Multinational Firms.* Dublin: Department of Finance.

Markusen, J. (2002). *Multinational Firms and the Theory of International Trade*, MIT Press, Cambridge and London.

McFadden, D. (1974). 'Conditional Logit Analysis of Qualitative Choice Behaviour', in P. Zarembka (ed.) *Frontiers in Econometrics*, 105-142, New York: Academic Press.

McFadden, D. (1984). 'Econometric analysis of qualitative response models', in Griliches, Z., Intriligator, M. D. (eds.). *Handbook of Economics* vol. II, Elsevier Science Publishers BV.

Pollak, R. A., T. J. Wales (1991). 'The likelihood dominance criterion: A new approach to model selection', *Journal of Econometrics*, 47(2-3): 227-242.

Schmidheiny, K. and M. Brülhart (2011). 'On the equivalence of location choice models: Conditional logit, nested logit and Poisson', *Journal of Urban Economics*, 69: 214-222.

Siedschlag, I., D. Smith, C. Turcu, and X. Zhang (2013a), 'What determines the location choice of R&D activities by multinational firms?', *Research Policy*, 42: 1420-1430.

Siedschlag, I., X. Zhang, and D. Smith (2013b), 'What determines the location choice of multinational firms in the information and communication technologies sector?', *Economics of Innovation and New Technology*, 22(6): 581-600.

Von Zedtwitz, M., O. Gassmann (2002). 'Market versus technology drive in R&D internationalization: four different patterns of managing research and development', *Research Policy* 31(4): 569-588.

Wen, C., F. S. Koppelman (2001). 'The generalized nested logit model', *Transportation Research,* 35: 627-641.

Appendix

TABLE A1 Variables Definitions and Data Sources

Variable	Definition	Data source
Location choice	Binary variable equal to 1 if a foreign affiliate was established in host country, 0 otherwise	Amadeus dataset, Bureau van Dijk
Corporate policy tax rate	Statutory corporate tax rate	KPMG
GDP	GDP in 2005 prices	The World Bank, Economy & Growth Indicators
EU Market potential	The sum of GDP in the host country and the inverse distance-weighted GDP of all location options in the European Union other than the host country.	The World Bank, Economy & Growth Indicators, and CEPII
GDP per capita	GDP in 2005 prices over midyear population in host country	The World Bank, Economy & Growth Indicators
Distance	Distance in km between the host and home country capital cities	CEPII
Common language	Binary variable equal to 1 if home and host countries have a common official primary language, 0 otherwise	CEPII
Common border	Binary variable equal to 1 if home and host countries share a border, 0 otherwise	CEPII
R&D expenditure intensity	Public and private R&D expenditure as per cent of GDP	The World Bank, Science & Technology Indicators

TABLE A2 Direct and Cross-Elasticities of Location Probabilities in Nested Logit Models

Nested structure	Direct elasticity	Cross-elasticity
Location *i* in nest *N*	$\left[(1-P_i)+\left(\frac{1-\lambda_N}{\lambda_N}\right)(1-P_{i/N})\right]\beta X_i$	
Locations *i* and *j* in the same nest *N*		$-\left[P_i+\frac{(\frac{1-\lambda_N}{\lambda_N})P_N P_{i/N} P_{j/N}}{P_j}\right]\beta X_i$

Notes: The computation of direct and cross-elasticities of location probabilities with respect to location characteristics X are based on Greene (2000) and Wen and Koppelman (2001). λ_N is the estimated dissimilarity parameter for nest N. P_i is the location probability for country i. $P_{i/N}$ is the location probability for country i conditional on nest N being chosen. P_N is the location probability for nest N. β is the estimated parameter for location characteristic X..