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Abstract: The corporate tax rate and regime are policy instruments that are the subject of considerable attention for the role they play in attracting foreign multinationals making location decisions across countries. This paper examines the effects of corporate tax on these location decisions of newly established multinational subsidiaries across 26 European countries over an eight year period. We contribute to the existing literature by examining the effects of a non-linear response of firm location decisions to changes in the tax rate. We find that accounting for this non-linearity improves the performance of the model for all of the alternative measures of the tax rate. We also show that there are large variations in the sensitivity to tax rates across sectors and firm size groups. In particular, financial sector firms are more than twice as sensitive to changes in corporation tax rates relative to other sectors.

JEL Code: F23, H25, C25

Key Words: Corporation Tax, Location Choice, Multinational firms, FDI.

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1. Introduction

Firms that operate in a global marketplace are faced with a variety of decisions on how to manage their international activities. One of the first of these is whether to continue to use a domestic base and export their product or service to the foreign markets where it is demanded. At a certain scale, however, it may be more efficient to set up a new affiliate abroad either to improve market access or to reduce the costs of production and avoid the costs associated with exporting. Once a firm has decided to set up a base abroad, it then is faced with the decision of where to locate. A wide range of factors are likely to impact on this decision by the firm. As many of these factors are beyond the control of policy-makers, particular attention has been paid to the role of corporate tax rates as a potential way to increase the attractiveness of a country to businesses seeking a location for a new investment.

This paper examines the effects of corporate tax on the location decisions of multinationals in Europe, while also accounting for other location choice variables. This paper extends the existing literature on the effect of corporate taxation on location choices of multinationals in a number of ways. In contrast to the existing literature which assumes a linear response of firm location decisions to differences in the tax rate, we test for a non-linear response which implies that changes in tax rates at high levels of taxes have less effect. The model is estimated with an extensive database on newly established firms locating across 26 countries and with ownership information identifying them as coming from a potential 48 source countries over the period from 2005 to 2012. This allows us to examine the impact of a considerably wider range of characteristics from the source and potential host countries than has generally been the case in the literature. The size of our dataset allows us to examine differences in the effect of corporate tax rates across sub-groups of firms and sectors.

We find that accounting for potential non-linearity in the tax effect improves the performance of the model for all of the alternative measures of the tax rate. All specifications show a significantly negative effect of taxation on the probability of location choice but a positive squared term shows that the strength of this negative effect moderates as the tax rate increases. In other words, although overall tax has the expected negative effect on location probability, the marginal effect of an increase is lower at higher rates of tax (and conversely a change in the tax rate will have a larger effect on the location probability if the rate is already low).

Our baseline result is a finding that a one percent increase in the statutory or policy rate of corporation tax would lead to a reduction in the conditional location probability of 0.68 percent. Using the effective average tax rate (EATR), the marginal effect implies a reduction in the probability of 1.15 percent following a 1 percent increase in the tax rate. These combine the direct and non-linear elements of the estimated effects.

Looking more deeply into how the tax system affects different types of firm, we find large variations in the sensitivity to tax rates across sectors. For manufacturing firms, we find a significant negative coefficient combined with a smaller positive squared term, with the sizes of the effects being fairly close to those observed in the overall results. For services firms the size of the effect is noticeably smaller than that for manufacturing, suggesting that services firms are more likely to be driven in

their location decisions by the need to be close to their identified customer base and this reduces their sensitivity to tax rates. Financial sector firms appear to be the most sensitive to changes in corporation tax rates with an estimated marginal effect more than double those of the other sectors. This is likely to be a reflection of the more footloose nature of these firms. In terms of firm size, we find that the size of the tax elasticity increases across firm asset size groups showing that higher tax rates are regarded as a greater disincentive to choosing a location by larger firms.

This paper focuses on the binary decision of where to locate a new affiliate by a multinational. It contributes to a wide literature examining the effect of corporate taxation on foreign capital (Devereux and Griffith, 2002, 2003; Devereux and Freeman, 1995; Billington, 1999; Young, 1999) and work that models the location decisions of FDI firms more generally (Basile et al. 2009; Chen and Moore, 2010; Davies et al. 2009). These papers tend to find an inhibiting effect of tax on multinational entry and investment. For example, Devereux and Griffith (1998) tested the effect of taxation on the location of production for a sample of US firms moving into Europe over the period 1980 to 1994 and found a negative and significant effect of taxation on the choice between locations within Europe but not between Europe and non-EU destinations.

A recent paper closely related to ours in terms of data and methodology is Barrios et al. (2012) who consider the effect of host and parent country taxation on the location decisions of European firms. They find a significant and negative effect of the effective rate as well as the host country corporation taxation on the probability of choosing a location. Additionally, they find an independent and strongly negative effect of parent country taxation on foreign subsidiary location decisions, suggesting both host and home country taxation are important determinants of firm operational choices on affiliate locations.

We use a conditional logit model approach to model the decision being taken by a multinational across a range of location options. Using this methodology to analyse the entry of Japanese firms into Europe, Head and Mayer (2005) estimate that a one percent rise in corporation taxation leads to a near 5 percent reduction in the probability that a specific region is chosen.

The paper is structured as follows: Section 2 describes the data used, including a discussion of the alternative measures available for corporate tax rates. Section 3 describes the methodology used. Section 4 presents the empirical results and Section 5 concludes.

2. Data

The data used in our analysis comes from the Bureau Van Dijk Amadeus database, supplemented with FAME data for Ireland and the United Kingdom. Our sample includes information on 3,238 new foreign affiliates across 26 countries for the period 2005-2012. In order to focus on firms with direct ownership control, we restrict our sample to firms we can identify as foreign owned in which the owner has an ownership percentage of 50% or more. We first describe the various tax measures used, then we describe in detail the sample of firms used in the analysis.

Tax variables

We use a number of alternate tax variables; the Policy Rate, the Mean Effective Average Tax Rate (Mean EATR) and the Total Tax Rate. We also use the EATR Crossborder as a robustness check.

- **Policy Rate:** The statutory rate charged by the host country government on corporate profits earned by the subsidiary.
- **Mean EATR:** This is calculated by comparing the cash-flows from a hypothetical, forward-looking investment project in the presence and absence of taxation. It is a weighted average of the effective marginal tax rate and the policy rate, converging towards the policy rate for a highly profitable investment. We use the **mean** EATR as this also accounts for the implications of using different financing sources to fund the investment project, applying a weighting of 0.55 on projects financed by retained earnings, 0.1 on equity and 0.35 on debt. In order to accurately calculate the NPV of the investment, this measure also explicitly considers each country's real interest rate, inflation rate, true economic depreciation rate, and the NPV of capital allowances on different asset types; industrial buildings, intangibles, machinery, financial, inventory[1].
- **Total Tax Rate:** This includes all taxes and mandatory contributions payable by businesses after accounting for allowable deductions and exemptions.
- **EATR Crossborder:** This is calculated in a similar manner to the mean EATR except in an international setting. The approach considers a parent firm located and owned by shareholders in a home country which undertakes an investment in a host country through a wholly-owned subsidiary. It considers taxes levied by the host country government on income earned by the subsidiary and corporate taxes levied by the home country government on the same income and personal taxes levied by the home country government on the shareholders.

Table 1 and Table 2 below display descriptive statistics and the correlation matrix for each tax variable used. As can be seen the Policy Rate and Mean EATR are highly correlated. The EATR Crossborder has a wider range as this measure takes home country taxation into account. The main difference between the EATR Crossborder and the first two measures is the presence of some outliers in the distribution, e.g. the EATR Crossborder for an investment from France into Bulgaria was 52.9% in 2005.

[1] For a detailed example of these calculations for both measures of EATR please see "Section B – Worked Examples" of Spengel et al (2012) report for the EU Commission.

Table 1: Summary Statistics of Tax Variables

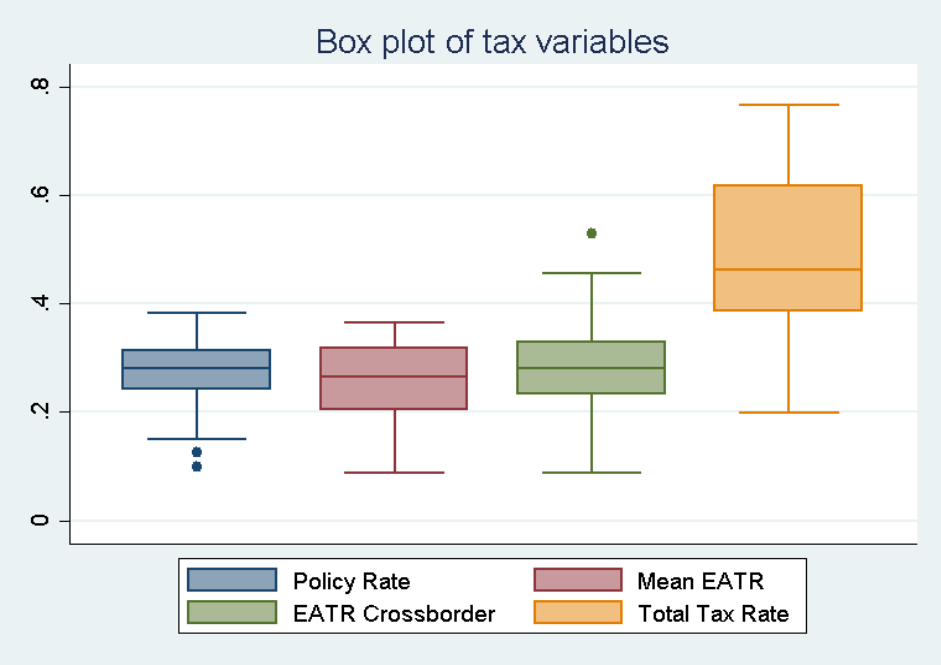
Variable	Source	N	Mean	Std. Dev.	Min	Max
Policy Rate	KPMG	82224	0.237	0.067	0.100	0.384
Mean EATR	EU Commission	82224	0.218	0.064	0.088	0.365
EATR Crossborder	EU Commission	80430	0.247	0.068	0.075	0.532
Total Tax Rate	WDI	82224	0.457	0.116	0.214	0.768

Table 2: Correlation Matrix for Tax Variables

	Policy rate	Mean EATR	EATR crossborder	Total tax rate
Policy Rate	1.00			
Mean EATR	0.94	1.00		
EATR Crossborder	0.71	0.77	1.00	
Total Tax Rate	0.56	0.53	0.41	1.00

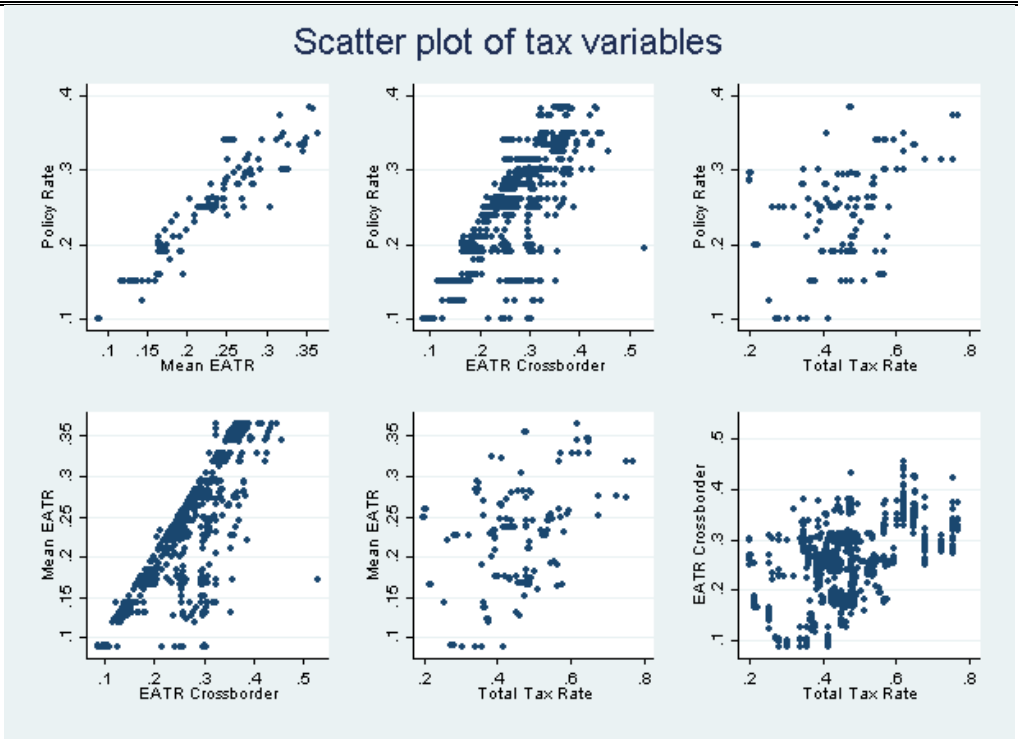
The Total Tax Rate is correlated with the other tax variables but has a much higher mean and wider distribution due to the inclusion of other taxes levied. The box plot in Figure 1 graphically illustrates these distributions. The centre line is the median of the distribution and the upper and lower ends of each box represent the 75th and 25th percentiles respectively. Outliers are denoted by dots to the extreme end of the distribution.

Figure 1 Box Plot of Tax Variables



Source: ESRI analysis of tax data

Figure 2 Scatter Plot of Tax Variables



Source: ESRI analysis of tax data

The scatter plots in Figure 2 graphically show the relationships between each pair of tax rates. Interestingly the plot between the Mean EATR and the EATR Crossborder illustrates that the tax payable is at least the Mean EATR of the host country, but may be significantly higher, depending on the home country taxation rates.

Firm-level Data: Descriptive Statistics

In the following series of tables we describe host and home country coverage, sectoral and firm-level splits that are employed in the analysis and other country-level variables we control for. A full list of variables and their sources is included in Annex 1. A wide range of European countries is included in our analysis as can be seen from Table 3.

Table 3: Number of Firms by Host Country

Country	No of Firms	Country	No of Firms
Austria	101	Ireland	130
Belgium	27	Italy	421
Bulgaria	121	Lithuania	36
Czech Republic	214	Latvia	42
Germany	316	Netherlands	249
Denmark	30	Norway	104
Estonia	66	Poland	142
Spain	320	Portugal	109
Finland	40	Sweden	34
France	213	Slovenia	23
Greece	6	Slovakia	48
Croatia	90	United Kingdom	342
Hungary	14		
Total 3238			

We aggregate up NACE 2 digit sectors into the following broad categories: manufacturing, services, financial, and other (construction and utilities) as well as high-tech and low-tech[2]. The number of firms in each of these sectors is broken down in Tables 4 and 5.

Table 4: Number of Firms by Sector Type

Sector Type	Number	Percentage
Manufacturing	400	12%
Services	2,020	62%
Financial	639	20%
Other	179	6%

Table 5: Number of Firms by Sector Skill

Sector Skill	Number	Percentage
Hi-tech	896	28%
Low-tech	1,703	53%
Financial	639	20%

Amadeus contains Profit and Loss and Balance Sheet information on each firm in the database. However, this is not always very well reported and due to patchy coverage of other variables we can only include data on each firm's total assets. For a set of regressions we group firms by size: Small, Medium and Large. This split is outlined in Table 6 below.

[2] The initial sector aggregation in table 4 is a Eurostat aggregation based on NACE Rev 1.1 codes. For further details see http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/Annexes/htec_esms_an2.pdf

Table 6: Number of Firms by Asset Size

Size	Definition	Number	Percentage
Small	Total Assets less than €250k	950	29%
Medium	Total Assets greater than €250k and less than €3m	804	25%
Large	Total Assets greater than €3m	853	26%
Unknown	No Asset data	631	19%

Table 7 provides information on the location of the parent company. This distribution is broadly as one would expect with OECD countries making up the majority of origin countries. We could only include firms in which the home country was known and could be traced by Bureau van Dijk in their ownership database.

Table 7: Number of Firms by Location of Owner

Country	Number of Firms	Country	Number of Firms
United States of America	478	Australia	30
Germany	319	Korea, Republic	30
Luxembourg	273	Ireland	29
United Kingdom	249	Poland	27
Netherlands	210	Slovakia	27
Switzerland	194	Portugal	26
France	167	Romania	26
Sweden	146	Malta	23
Spain	123	Czech Republic	19
Italy	117	Turkey	19
Cyprus	105	Hungary	18
Belgium	93	Estonia	16
Austria	92	Slovenia	16
Denmark	84	Lithuania	15
Finland	70	Latvia	15
Japan	54	Croatia	14
Canada	50	Greece	11
Norway	40	Others	13
	Total 3238		

Our year coverage is from 2005-2012 as presented in Table 8. One might have expected a significant drop in the number of new affiliates being opened as a result of the financial crisis and subsequent recession in Europe in 2008. We can see this in the 2009 data, however this trend does not continue as we have a higher number of new affiliates opened in 2010 than any other year.

Table 8: Number of Firms by Year of Entry

Year of Entry	No of Firms
2005	389
2006	444
2007	423
2008	439
2009	217
2010	634
2011	486
2012	206
Total	**3,238**

Country-level Control Variables

We use a wide range of country controls in our regressions. Our choice is informed by the literature on firm location decision. To capture information on host country market potential and growth we use inverse distance-weighted GDP and GDP growth respectively. The cost and quality of the labour force is commonly found to be a significant determinant of location choice. We include information on both relative labour cost and the share of the host country labour force with third level education.

Other relative measures included are distance in km between home and host country capital cities, relative GDP per capita and relative population. In our baseline we include only the log of GDP to capture country size. However, in our main extended model, we replace this with the log of relative GDP between the home and host economies. We also conduct a robustness check to control for a non-linear impact of country size by including a squared term with lnGDP.

The lag of FDI stock as a proportion of GDP within each potential host country is used to capture agglomeration as well as potential crowding out by existing FDI firms. As this measure is broad it may also capture potential displacement effects of similar firms. By including the proportion of motorways as a percentage of total land area we have a broad proxy for the level of infrastructure in the host country.

A range of other potential explanatory variables we include are dummy variables to indicate whether the host and home country share a common language, if they shared a colonial relationship at some stage in the past and if they share a border.

We also include a dummy for EU15 membership. Detailed information on variable definitions and source data is contained in Annex 1. Table 9 contains summary statistics and Table 10 the correlation matrix for all variables used in our analysis.

Table 9: Summary Statistics

Variable	Source	N	Mean	Std. Dev.	Min	Max
Location	AMADEUS	82224	0.039	0.194	0	1
Market potential*	WDI, CEPII	82224	23.058	0.895	20.402	24.133
GDP growth	WDI	82224	0.022	0.039	-0.180	0.122
Labour education	WDI	82224	0.266	0.075	0.115	0.415
Relative Labour cost*	AMECO	82224	-0.401	2.470	-6.995	3.421
Agglomeration	WDI	82224	0.513	0.331	0.098	2.044
Distance*	CEPII	82224	7.396	0.943	4.088	9.802
Infrastructure		82224	0.016	0.016	0	0.064
Common language	CEPII	82224	0.068	0.252	0	1
Share border	CEPII	82224	0.096	0.295	0	1
Former colony	CEPII	82224	0.044	0.205	0	1
Natural resources	WDI	82224	0.016	0.032	0	0.219
EU 15 membership	-	82224	0.530	0.499	0	1
Relative Population*	WDI	82224	0.691	2.246	-5.627	5.464
Relative GDP PC*	WDI	82224	0.579	0.863	-3.134	3.076

* Variable in natural logarithm

Table 10: Correlation Matrix for Variables Included in Regressions

	Market potential	GDP growth	Labour education	Relative Labour cost	Agglomeration	Distance	Infrastructure	Common language	Share border	Former colony	Natural resources	EU 15 membership	Relative Population	Relative GDP PC
Market potential	1.00													
GDP growth	0.03	1.00												
Labour education	-0.04	-0.15	1.00											
Relative Labour cost	0.73	0.12	-0.18	1.00										
Agglomeration	-0.01	0.01	0.39	-0.06	1.00									
Distance	-0.80	-0.02	-0.02	-0.59	-0.10	1.00								
Infrastructure	-0.04	-0.19	0.10	-0.14	0.35	-0.14	1.00							
Common language	0.02	-0.04	0.14	-0.05	0.20	-0.20	0.19	1.00						
Share border	0.14	-0.02	0.02	0.09	0.05	-0.44	0.19	0.48	1.00					
Former colony	-0.14	-0.02	0.10	-0.16	-0.01	-0.03	0.02	0.26	0.16	1.00				
Natural resources	0.01	0.00	0.23	-0.05	-0.09	0.00	-0.24	-0.10	-0.05	-0.04	1.00			
EU 15 membership	-0.04	-0.26	0.29	-0.22	0.06	-0.02	0.48	0.24	0.16	0.09	-0.28	1.00		
Relative Population	-0.47	0.01	0.12	-0.49	0.13	0.38	-0.12	-0.12	-0.11	-0.03	0.11	-0.22	1.00	
Relative GDP PC	0.10	0.18	-0.34	0.27	-0.04	0.07	-0.32	-0.11	-0.13	-0.04	-0.19	-0.62	0.01	1.00

3. Methodological approach

To explore the relationship between the location choice of multinationals and corporate tax rates, we draw on the existing literature and use a conditional logit model as in McFadden (1974). This model has been applied empirically in the recent literature both on the wider determinants of location choices of multinationals (Head and Mayer, 2005; Siedschlag et al., 2013a,b) and more specifically on research focusing on the effect of corporation tax on MNE location decisions (Devereux and Griffith, 1998; Barrios et al., 2012). While alternative approaches such as the nested logit model and Poisson models can be used, the conditional logit is the most widely applied in the extant literature. Schmidheiny et al (2011) and Guimaraes et al. (2003; 2004) provide a useful discussion on the relative merits of each when modelling the firm location decision problem.

To model the locational choice facing the enterprise, the firm's problem can be outlined as follows. The profits earned from locating in a particular country, $\Pi_{\mathrm{ic},}$ are:

$$\Pi_{\mathrm{ic},} = \boldsymbol{X_{ic}\beta} + \varepsilon_{ic}$$

Where X is a vector of location specific control variables. The firm therefore faces a choice across destinations which yield different potential returns. It must therefore choose the location, c, across J alternatives which satisfies the condition:

$$\Pi_{\mathrm{ic}} > \Pi_{\mathrm{ij}} \forall \mathrm{j} = 1, \ldots \mathrm{J}\ with\ j \neq c$$

That is Π_{ic} yields the highest profit across all groups. The firm therefore makes the following decision:

$$Y = \begin{Bmatrix} 1 & if & \Pi_{\mathrm{ic}} > \Pi_{\mathrm{ij}} \forall \neq c \\ 0 & & otherwise \end{Bmatrix}$$

In this case Y, the dependent variable, is an indicator of the location choice of Multinational Enterprise (MNE) i, over a set of all possible locations J. It is a function of the location specific characteristics $\boldsymbol{X_{ic}}$. Assuming that the error term ε_{ic} is modelled as a type 1 extreme value distribution, IID across all firms and countries, the probability of choosing country c can be expressed as follows:

$$P(Y = c|1, \ldots, J, \boldsymbol{X_{ic}}) = \frac{e^{\boldsymbol{X_{ic}\beta}}}{\sum_{j=1}^{J} e^{\boldsymbol{X_{ij}\beta}}}$$

The coefficient vector $\boldsymbol{\beta}$ can be estimated using maximum likelihood methods. An important consideration is the selection of control variables in $\boldsymbol{X}$. Following the existing literature, we include the following controls in our baseline model: market potential (distance weighted GDP), ln GDP to capture market size, GDP growth, host economy labour cost, the share of the population with tertiary education (% of labour force) to capture labour quality, the existing stock of FDI (to capture agglomeration and network effects), the density of motorways to capture the quality of infrastructure and the distance between host and home country capital cities.

An extended, more global model includes controls for countries that share a common language, a common border or shared a past colonial link. A dummy for EU-15 is also included while a control for

the share of natural resources is also included. We also include relative GDP, population and labour costs. Standard errors are robust to heteroskedasticity and clustered at the firm level.

When applying non-linear discrete choice models such as the conditional logit, a number of issues arise in calculating the magnitude of effects from the coefficients. Firstly, while the sign on the coefficient is always interpretable as the direction of the effect, the magnitude is not so easily interpreted as the model is non-linear and the effect is dependent on the functional form.

Secondly, developing a single magnitude from a coefficient is non-trivial as there are a number of available methodologies including estimated marginal effects and probability elasticities. Greene (2012) notes that the selection decision between marginal effects and elasticities is mainly a matter of choice, as the sign and significance does not change between the effects. In essence both apply a different positive scaling to the estimated coefficient so no changes occur in relation to the sign of the effect.

Thirdly, there is no consensus in the literature as to which effect is the "industry standard" with some papers reporting marginal effects (Devereux and Griffith, 1998; Barrios et al., 2012) and others reporting probability elasticities (Head and Mayer, 2004). Given our paper is closer to Devereux and Griffith (1998), we report estimated marginal effects. These are calculated as follows:

$$\frac{\partial P(y=c)}{\partial X} = P_c(1-P_c)\beta_X$$

Where P_{c^3} simplifies to 1/J when evaluated at the means of all covariates. In our case, J = 26 representing the number of countries in our choice set. The marginal effects can be interpreted as an increase in variable X by 1 percent changes the conditional probability of locating in particular country by the estimated value (in percent). In section 4, we provide both the coefficients and tables of estimated marginal effects for our tax rates of interest.

In estimating the marginal effects for corporate taxation, consideration must be given to the fact that the variable enters the estimation equation in a non-linear fashion. To estimate an overall marginal effect for corporation taxation, which includes both linear and non-linear terms, we follow Davies et al. (2001) and apply the following calculation:

$$\frac{\partial P(y=c)}{\partial X} = P_c(1-P_c)(\beta_{T1} + 2\beta_{T2}\hat{T})$$

Where β_{T1} is the estimated coefficient on the linear term, β_{T2} is the estimated coefficient on the non-linear term and $\hat{T}$ is the mean tax rate from the sample data.

4. Empirical results

Our first results look at the effects on multinational location decisions for the entire sample of firms, focusing on the effects of various estimates of the corporate tax rate faced by the firm in each

[3] Where Pc = P(y=c) probability the location is chosen amongst the alternatives.

potential country. We then look deeper into the sensitivity of firms in different broad sectors to the location characteristics and to different elements of the tax structure.

Baseline results

We begin with the baseline results presented in Column 1 of Table 11, where we include the statutory policy rate as our measure of corporate tax. Looking at the other country characteristics first, we find the expected positive effect of GDP on the probability of locating in a particular country, picking up the attractiveness of access to larger and higher-income markets. In the initial specification, we also find a positive and significant effect of market potential. This is in line with expectations and captures the attractiveness of larger, closer proximity markets.

Table 11: Estimates of Conditional Logit Model for Multinational Location Choice – Baseline – Linear Tax Rates

	(1)	(2)	(3)
	b/se	b/se	b/se
Market Potential	3.114***	3.221***	3.170***
	(0.334)	(0.337)	(0.330)
Ln GDP	0.684***	0.614***	0.634***
	(0.030)	(0.030)	(0.026)
GDP Growth	-0.628	-0.268	-0.365
	(0.886)	(0.890)	(0.890)
Ln Labour Cost	-0.271***	-0.364***	-0.341***
	(0.049)	(0.049)	(0.044)
Labour Quality	0.510	0.664*	0.720*
	(0.416)	(0.403)	(0.434)
FDI Stock (% of GDP) $_{t-1}$	-0.895***	-0.855***	-0.876***
	(0.080)	(0.078)	(0.084)
Motorway Density	4.743***	3.277**	3.533**
	(1.455)	(1.504)	(1.513)
Ln Distance	-1.283***	-1.289***	-1.285***
	(0.042)	(0.041)	(0.041)
Policy rate	-2.092***		
	(0.603)		
Mean EATR		0.840	
		(0.701)	
Total Tax Rate			0.008
			(0.188)
N	82224	82224	82224
Pseudo R2	0.121	0.120	0.120

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

GDP growth is also insignificant in this initial specification but, as we shall see in the next table, this is not the case when we take into account the non-linearity of the effect of the tax rate. We find the expected negative and significant effect of labour cost on the location decision: in our sample, firms are attracted towards lower labour cost destinations. We find some evidence that labour quality is positively associated with location choice but the effect is weak.

Given that labour cost and GDP per capita are quite strongly correlated, this implies a trade-off facing the firm between access to high-income customers and high wage workers. We do not include GDP per capita in the specification due to this extremely high correlation ($\rho = 0.96$).

We include the lag of the stock of FDI in the economy to capture both agglomeration as well as potential crowding out by existing FDI firms. The literature on agglomeration effects has found evidence that there are benefits to firms to locating in the same regions as other similar firms in order to take advantage of potential spillovers and other externalities such as supplier and labour pools. However, much of this research relates to regional or city level clusters and as our data is at a more aggregated level, it is not surprising that we do not find such an effect. This may perhaps indicate that there is also a competitive effect that offsets the agglomeration benefits, or, perhaps equally likely, that agglomeration externalities are better measured using firm counts at a regional level which we do not have access to. Lagged motorway density is included as a proxy to indicate infrastructure and public investment and has a positive and significant effect on the probability of location choice.

The first tax measure we include in this baseline specification is the country's headline policy rate for corporate profits. We find a significant and negative effect of this rate on the probability of choosing a location. The other columns in Table 11 examine how this result is affected by using different measures of the tax rate. Column 2 uses the effective average tax rate (EATR) and column 3 shows the results for the total tax rate. The other country characteristics have the same pattern as before, apart from labour quality which becomes statistically significant. In contrast to the policy rate both the EATR and the total tax rate are not found to be statistically significant.

The first results presented in Table 11 showed a negative relationship between the probability of location choice and corporate tax rates for only one specification. Our next set of results show that this was almost certainly due to not taking account of non-linearity in the reaction of firms to the tax rate. Table 12 uses the same set of country characteristics as the baseline regressions and the same set of three alternative measures of the corporate tax rate. However, in this set of specifications, we include a squared term for each of the tax rates.

Table 12: Estimates of Conditional Logit Model for Multinational Location Choice – Baseline – Linear Tax Rates

	(1)	(2)	(3)
	b/se	b/se	b/se
Ln GDP	0.704***	0.732***	0.643***
	(0.029)	(0.033)	(0.025)
Market Potential	3.932***	4.674***	3.489***
	(0.364)	(0.390)	(0.331)
GDP Growth	0.986	1.478	3.246***
	(0.890)	(0.916)	(1.005)
Ln Labour Cost	-0.182***	-0.038	-0.533***
	(0.047)	(0.053)	(0.051)
Labour Quality	0.598	-0.428	2.763***
	(0.414)	(0.411)	(0.502)
FDI Stock (% of GDP) $_{t-1}$	-1.154***	-1.032***	-1.082***
	(0.083)	(0.081)	(0.085)
Ln Distance	-1.369***	-1.414***	-1.350***
	(0.043)	(0.044)	(0.042)
Motorway Density	6.623***	5.887***	7.891***
	(1.508)	(1.526)	(1.553)
Policy rate	-21.917***		
	(2.241)		
Policy rate ^{2}	0.382***		
	(0.041)		
Mean EATR		-34.530***	
		(2.879)	
Mean EATR ^{2}		0.665***	
		(0.052)	
Total Tax Rate			-14.519***
			(0.942)
Total Tax Rate ^{2}			0.148***
			(0.010)
N	82,224	82,224	82,224
Pseudo R2	0.125	0.129	0.132

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Taking into account this non-linearity in the effect of the tax rate on firm location decisions improves the performance of the model for all of the alternative measures of the tax rate. All three columns show a significantly negative effect of taxation on the probability of location choice. However, the strength of this negative effect moderates as the tax rate increases, as shown by the positive squared term in all of the specifications. In other words, although overall tax has the expected negative effect on location probability, the marginal effect of an increase is lower at higher rates of tax.

Table 13 examines the robustness of these results by expanding the set of country characteristics relative to the base specification. The additional variables are all expected to increase the attractiveness of a particular location, either by capturing characteristics of the country itself that would make doing business there easier (such as sharing a common border or the availability of natural resources) or by proxying for the closeness of the relationship between countries (such as historical colonial links or common language). We also include the relative population size between home and host economies to capture country size differentials.

Table 13: Estimates of Conditional Logit Model for Multinational Location Choice – Baseline - Quadratic Tax Rates – Extended Model

	(1)	(2)	(3)
Ln GDP	-0.494***	0.080	0.136
	(0.154)	(0.164)	(0.160)
Market Potential	3.401***	3.928***	2.707***
	(0.389)	(0.410)	(0.366)
GDP Growth	3.556***	3.525***	5.184***
	(0.934)	(0.962)	(1.048)
Ln Labour Cost	0.413***	0.036	-0.597***
	(0.140)	(0.153)	(0.145)
Labour Quality	-0.769*	-1.517***	1.823***
	(0.436)	(0.433)	(0.509)
FDI Stock (% of GDP) t-1	-1.004***	-0.936***	-1.008***
	(0.089)	(0.085)	(0.088)
Ln Distance	-1.094***	-1.137***	-1.024***
	(0.053)	(0.053)	(0.050)
Motorway Density	8.342***	7.779***	10.006***
	(1.666)	(1.655)	(1.675)
Common Language	0.348***	0.412***	0.319***
	(0.068)	(0.070)	(0.070)
Contiguity (Common Border)	0.410***	0.348***	0.563***
	(0.067)	(0.067)	(0.064)
Colonial relationship	0.326***	0.355***	0.305***
	(0.064)	(0.064)	(0.065)
Natural resource dependence	10.075***	8.974***	8.665***
	(1.144)	(1.098)	(1.167)
Relative Population	-1.156***	-0.544***	-0.383**
	(0.167)	(0.177)	(0.171)
EU 15	0.966***	0.844***	0.873***
	(0.121)	(0.118)	(0.127)
Policy rate	-18.766***		
	(2.333)		
Policy rate^2	0.299***		
	(0.043)		
Mean EATR		-31.427***	
		(2.741)	
Mean EATR^2		0.605***	
		(0.051)	
Total Tax Rate			-15.222***
			(0.965)
Total Tax Rate^2			0.154***
			(0.010)
N	82,224	82,224	82,224
Pseudo R2	0.138	0.141	0.146

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The effects of the extended specifications are consistent regardless of the measure of the tax rate used. Sharing a common official language, common border or historical colonial links all pick up the extent of linkages between the FDI source and potential host countries and have significantly positive effects on the probability of being chosen as the preferred location by the multinational. The extent of natural resource availability is also a feature positively associated with multinational entry. Relative population carries a statistically significant and negative sign.

Despite increasing the set of possible explanatory variables, we continue to find a significant negative effect of each of the tax rates on the location probability, with a small offsetting positive coefficient on the squared tax rate indicating a lessening of the effect at higher rates. Finally, we add a number of additional relative measures to this extended model which capture the differences between the home and host economies. This includes relative labour cost and relative GDP. Combined with relative distance and relative population, these factors should capture the differential effect between home and host economies that bear influence on the corporate location strategy.

Including these additional controls in Table 14, our main findings hold in all cases with a negative and significant effect of the main tax effect and a positive and significant effect of the squared term. We use this model as our baseline going forward when estimating differences across groups of firms, sectors and presenting the marginal effects.

Table 14: Estimates of Conditional Logit Model for Multinational Location Choice – Quadratic Tax Rates – Extended Main Model

	(1)	(2)	(3)
Market Potential	3.401***	3.928***	2.707***
	(0.389)	(0.410)	(0.366)
GDP Growth	3.556***	3.525***	5.184***
	(0.934)	(0.962)	(1.048)
Labour Quality	-0.769*	-1.517***	1.823***
	(0.436)	(0.433)	(0.509)
Relative Labour Cost	-0.413***	-0.036	0.597***
	(0.140)	(0.153)	(0.145)
FDI Stock (% of GDP) t-1	-1.004***	-0.936***	-1.008***
	(0.089)	(0.085)	(0.088)
Distance	-1.094***	-1.137***	-1.024***
	(0.053)	(0.053)	(0.050)
Motorway Density	8.342***	7.779***	10.006***
	(1.666)	(1.655)	(1.675)
Common Language	0.348***	0.412***	0.319***
	(0.068)	(0.070)	(0.070)
Continguity (Common Border)	0.410***	0.348***	0.563***
	(0.067)	(0.067)	(0.064)
Colonial Relationship	0.326***	0.355***	0.305***
	(0.064)	(0.064)	(0.065)
Natural Resource Dependence	10.075***	8.974***	8.665***
	(1.144)	(1.098)	(1.167)
EU 15	0.966***	0.844***	0.873***
	(0.121)	(0.118)	(0.127)
Relative Population	-0.662***	-0.624***	-0.519***
	(0.035)	(0.039)	(0.032)
Relative GDP	0.494***	-0.080	-0.136
	(0.154)	(0.164)	(0.160)
Policy rate	-18.766***		
	(2.333)		
Policy rate2	0.299***		
	(0.043)		
Mean EATR		-31.427***	
		(2.741)	
Mean EATR2		0.605***	
		(0.051)	
Total Tax Rate			-15.222***
			(0.965)
Total Tax Rate2			0.154***
			(0.010)
N	82,224	82,224	82,224
Pseudo R2	0.138	0.141	0.146

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Interpretation of the coefficients of a conditional logit model can be somewhat difficult so Table 15 makes an adjustment following Davies et al. (2001) to convert the coefficients on the tax variables into marginal effects. Comparing these results to others in the literature such as Devereux and Griffith (1998) our baseline elasticity of 1.15 on the EATR is in line with their finding of 1.26. However, it should be noted that studies examining the effect of taxes on investment volumes tend

to result in higher elasticities, as per DeMooij (2005), but these should not be directly compared to the location probability results here. Additionally, as our methodology employs a non-linear term, this also gives rise to potential variation relative to previous research. It general, given the fact that the decision to invest and the volume of investment chosen are very different from a corporate perspective, it cannot be expected that the elasticities on the location probability (as in this paper) are equal to the investment volume elasticities (which are not dealt with in this paper). An evaluation of whether they are larger or smaller is outside the scope of this particular exercise and it is not clear *a priori* which direction the differences should be.

Table 15: Marginal Effects – Baseline and Extended Models

	Policy rate	Mean EATR	Total Tax Rate
	Baseline (Linear)		
Marginal Effect	-0.07		
	Baseline (Quadratic)		
Marginal Effect	-0.80	-1.26	-0.53
	Extended Main Model		
Marginal Effect	**-0.68**	**-1.15**	**-0.56**

Notes: Marginal effects are calculated as Davies et al. (2001).

Sensitivity Analysis

In this section we provide a further robustness checks[4]. For two of our tax variables, the policyrate and the mean EATR, we apply Extreme Bounds Analysis that was first proposed by Leamer (1983). Extreme Bounds Analysis tests the robustness of the parameter estimates of the key variable, in our case the corporation tax rate, by estimating the model under alternative exclusion restrictions on the set of other explanatory variables. In doing so we follow Sala-i-Martin (1997), who considers the distribution of all resulting estimates rather than just the upper and lower extreme bounds, and McAleer et al. (1985) who argue that selecting a subset of variables to be included in all models, as is sometimes practiced, is arbitrary. Considering the entire distribution of results on the basis of all possible combinations of other explanatory variables provides a strong test of the robustness of our results.

In total we ran the model with 16,383 combinations of the other explanatory variables. The resulting distribution of the estimated coefficients for the tax variables follows a normal distribution with a mean coefficient on the policy rate of -7.285, and -13.478 for the Mean EATR (see Table 16). The 95% confidence interval around the mean of the estimates is relatively small and only encompasses negative values. Furthermore, over 97% of the estimated parameters for EATR and 93% of the

[4] In addition to the robustness checks reported here we also conducted extensive robustness checks byincluding both the EATR cross border and the mean EATR, limiting the sample to home country firms that are in the OECD, home country firms that are in the EU 28, removing the US firms, removing investment option pairs (home-host) that are never chosen by firms, as well as adding additional and re-specified control variables. Across all robustness checks, the effects of the new variables and sample splits are qualitatively the same and in all cases the signs and significance of the tax rate and its squared term remain unchanged although the magnitudes are slightly reduced in some of the specifications.

parameters for the policy rate are negative, with the remaining parameters coming from models with only one or two additional variables that are disregarded in the Sala-i-Martin paper. This sensitivity analysis therefore provides overwhelming evidence of the robustness of our results.

Table 16: Descriptive Statistics for Distribution of Tax-rate Coefficients

Variable	Model runs	Mean	Std. Dev.	95% CI for mean
Policyrate	16,383	-7.285	5.199	[-7.365, -7.205]
Mean EATR	16,383	-13.478	7.470	[-13.592, -13.363]

One concern regarding our estimation is the potential for an endogenous relationship to exist between the statutory tax rate, or the EATR, and the location choice of firms. If countries compete over tax rates, as demonstrated by Devereux et al. (2008) for both the statutory and effective average tax rate, perhaps countries might lower their rates in an effort to attract more firms? If this were the case, this reverse causality would bias our tax rate coefficients.

This is more of a concern when considering backward-looking tax rates. As highlighted by Devereux and Maffini (2007), backward-looking average rates, which may depend on the level of investment and the capital stock, could introduce endogeneity into the regressions as high levels of investment could generate high allowances, reducing the tax liability in that period.

We do not consider this an issue in our analysis as we are using forward-looking tax rates and we examine the extensive margin, not the intensive margin. However, as a robustness check we also estimate our model with the tax variables lagged by one period to further reduce the potential for reverse causality. In table 17 below we report results from our extended main model. We exclude 2005 in order to base our comparison on a consistent sample, as using a lagged tax variable reduces our year coverage in some cases. The table shows that the results using the lagged tax rates, while slightly smaller in absolute size are of the same sign and significance as those of the extended main model indicating that the estimates are robust.

Table 17: Lagged Tax Rates

	Policy rate	Mean EATR	Total Tax Rate
Extended Main Model (2006-2012)			
Tax coefficient	-21.095***	-33.283***	-14.660***
Tax coefficient squared	0.310***	0.606***	0.148***
Extended Main model with Lagged Tax Variables (2006-2012)			
Tax coefficient	-18.4057***	-30.430***	-15.552***
Tax coefficient squared	0.280***	0.527***	0.154***

Sectoral and skill variation in tax response

The results discussed so far have pooled all firms in the sample. However, firms in different sectors may have different reaction functions to differences across many country level characteristics, including those relating to taxation. The results are presented in Table 18 with the estimated marginal effects calculated in Table 19.

We divide firms into four subgroups – manufacturing, services, financial firms and other sectors (primarily utilities and construction) – in order to examine if there are any differences in their sensitivity to the tax measures estimated above. We also separately look at the effects of a high and low technology split in the non-financial sectors as well as at low-tech and high-tech manufacturing and services separately.

The results are quite striking, with large variation in the size of the coefficients across the broad sectors. For manufacturing firms, we find a pattern very similar to that of the total sample, with each of the tax measures having a significant negative coefficient combined with a smaller positive squared term. The estimated coefficients for services firms have the expected negative sign and are statistically significant but the size of the effect is smaller than that for manufacturing. We interpret this as suggesting that services firms are more likely to be driven in their location decisions by the need to be close to their identified customer base and this reduces their sensitivity to tax rates. A similar explanation would also apply to the generally insignificant response to tax rates for the group of other sectors as utilities and construction would be particularly market access driven and immobile.

In contrast to other services firms, financial firms have a much greater sensitivity to taxation. This is likely to be a reflection of the more footloose nature of these firms, given limited fixed assets relative to other sectors and less of a requirement to locate close to their market (particularly for more “back-office” type operations). This could allow these firms greater freedom to choose lower tax locations than is the case for manufacturing and other services firms.

As well as splitting the sample by strict economy sector, we use EC definitions for high-tech and low-tech industries and recalculate the effects for these groupings (excluding the financial sector). We also split the skill categories by manufacturing and services to explore whether there is further heterogeneity beneath the broad aggregation. Interesting we find that low-skill firms are more sensitive to tax rates and this result holds for firms in both the manufacturing and services sectors. It is unclear a-priori whether to expect low-tech or high-tech firms to be more or less sensitive to corporation tax. In line with our findings, high-tech firms may be more inclined to prioritise labour quality or the R&D environment with low-tech firms taking “off-the-shelf” capital structures to the lowest cost (in terms of operating costs and tax considerations) destination. However, it is not necessarily the case that this logic applies across both services and manufacturing firms.

Table 18: Coefficients –Extended Model – By Sector

	Policy rate	Mean EATR	Total Tax Rate	Obs
		Manufacturing		
Coeff Tax	-17.123***	-25.630***	-13.061***	10,123
Coeff Tax Rate ^ 2	0.356***	0.526***	0.140***	
		Services		
Coeff Tax	-8.489***	-20.527***	-12.346***	51,235
Coeff Tax Rate ^ 2	0.211***	0.510***	0.130***	
		Financial sector		
Coeff Tax	-36.832***	-70.170***	-18.188***	16,339
Coeff Tax Rate ^ 2	0.327**	1.086***	0.176***	
		Other (Utilities and construction)		
Coeff Tax	-13.177	-18.240	-19.896***	4,527
Coeff Tax Rate ^ 2	0.276	0.352	0.226***	
		High-tech non-financial		
Coeff Tax	-4.562	-12.740**	-13.647***	22,791
Coeff Tax Rate ^ 2	0.078	0.275***	0.136***	
		Low-tech non-financial		
Coeff Tax	-12.361***	-24.990***	-12.377***	43,094
Coeff Tax Rate ^ 2	0.316***	0.614***	0.137***	
		High-tech Manufacturing		
Coeff Tax	-5.377	-17.878	-11.016***	4,468
Coeff Tax Rate ^ 2	0.127	0.381*	0.112***	
		Low-tech Manufacturing		
Coeff Tax	-25.511***	-32.439***	-14.649***	5,655
Coeff Tax Rate ^ 2	0.528***	0.665***	0.164***	
		High-tech Services		
Coeff Tax	-5.6	-13.637**	-15.052***	18,323
Coeff Tax Rate ^ 2	0.079	0.276**	0.149***	
		Low-tech Services		
Coeff Tax	-10.204***	-25.572***	-11.141***	32,912
Coeff Tax Rate ^ 2	0.289***	0.663***	0.123***	

*** p<0.01, ** p<0.05, * p<0.1

Table 19: Marginal Effects - Main Model – By Sector

	Policy rate	Mean EATR	Total Tax Rate
	Split by Sector Type		
Manufacturing	-0.63	-0.94	-0.48
Services	-0.31	-0.75	-0.45
Financial sector	-1.36	-2.58	-0.67
Other (Utilities and construction)			-0.73
	Split by Sector Skill		
High-tech non-financial		-0.47	-0.50
Low-tech non-financial	-0.45	-0.91	-0.46
	Split by Sector Type & Skill		
High-tech Manufacturing			-0.41
Low-tech Manufacturing	-0.93	-1.19	-0.54
High-tech Services		-0.50	-0.55
Low-tech Services	-0.37	-0.93	-0.41

Firm size

As discussed in the data section, the information on firm characteristics in their year of entry is more limited than our information on entry and reduces the sample size by approximately one-fifth. However, this still leaves a large enough number of firms to allow us to do an interesting comparison of the sensitivity to tax rates of different sized firms, which would be an important consideration for policy makers. The firms are divided into three groups according to the assets of the newly established subsidiary (as discussed in the data section) and the location decision specification run separately for each group. The results are shown in Table 20 with the associated marginal effects presented in Table 21.

We find that across all of our measures of the tax rate there is an increase in the absolute value of the coefficients, showing that higher tax rates are regarded as a greater disincentive to choosing a location by larger firms. In addition, the countervailing positive squared term does not change much across the firm size group.

Table 20: Coefficient Estimates by Firm Size

	Policy rate	Mean EATR	Total Tax Rate
	Size 1 - Small		
Coeff Tax	5.501	-20.149***	-11.449***
	(5.985)	(5.394)	(1.754)
Coeff Tax Rate ^ 2	0.043	0.596***	0.136***
	(0.102)	(0.100)	(0.017)
	Size 2 - Medium		
Coeff Tax	-13.807***	-28.864***	-14.001***
	(4.897)	(5.296)	(1.782)
Coeff Tax Rate ^ 2	0.359***	0.689***	0.157***
	(0.084)	(0.098)	(0.017)
	Size 3 - Large		
Coeff Tax	-26.834***	-36.680***	-12.432***
	(4.358)	(5.329)	(1.933)
Coeff Tax Rate ^ 2	0.414***	0.654***	0.121***
	(0.081)	(0.100)	(0.020)

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Model estimated using all controls as in main extended model.

Table 21: Marginal Effects by Size

	Policy rate	Mean EATR	Total Tax Rate	N
Size 1 – Small		-0.74	-0.42	24,056
Size 2 – Medium	-0.50	-1.06	-0.52	20,350
Size 3 – Large	-0.99	-1.35	-0.46	21,714

5. Conclusions

When companies internationalise their operations, they face many decisions. These include whether or not to export or to locate a plant abroad, where to locate an affiliate if FDI is the chosen method of globalisation, and then the volume of investment once the destination is chosen.

This paper is narrowly focused on evaluating the role of corporation taxation on the location decision of foreign affiliates. It assumes that the firm has chosen FDI as its preferred internationalisation strategy and does not model investment flows. Our focus is therefore on identifying the degree to which corporation tax affects the location decision of foreign multinationals while controlling for a range of other important factors such as infrastructure, market potential, labour market cost and quality and geographic factors.

A number of results emerge. We find a strong negative, but non-linear, effect of taxation on the likelihood of a destination being chosen. The result holds using a range of tax measures including the statutory policy rate, an estimated effective average tax rate, and a total tax rate. The findings are robust to the inclusion of a range of additional control variables and sub-sample splits.

Splitting the sample by sector and by skill type, we find that the financial sector is the most sensitive to changes in the corporation tax rate, following by the manufacturing and services sectors. The utilities and construction sectors appear the least sensitive to corporation tax changes. Across both non-financial services and manufacturing, the location decisions of foreign affiliates in high-tech sectors are less sensitive to corporation taxation changes than firms in low-tech sectors. These heterogeneous impacts across industrial groupings are important to understand the impact of policy changes to corporation taxation across countries.

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6. Annex

Variable Sources and Definitions

Variable Sources and Definitions

Variable	Definition	Source
Location	Dummy variable equal to 1 if subsidiary is located in a country and 0 otherwise	AMADEUS
GDP per capita	Real GDP per capita	WDI
Market potential	The sum of inverse distance-weighed real GDP of all regions other than the host region. Distance is measured as km between host and home country capital cities	WDI, CEPII
GDP growth	Annual GDP growth, percent	WDI
Relative Labour cost	Total compensation of employees divided by total number of persons employed	AMECO
Labour education	Proportion of the labour force with a tertiary education, percent	WDI
Distance	Distance is measured as km between host and home country capital cities	
Agglomeration	Lag of the stock of FDI as a percentage of GDP, percent	WDI
Infrastructure	Surface area of paved motorways as a proportion of total land area in km squared, percent	Eurostat, IRF
Infrastructure 2	Fixed broadband Internet subscribers (per 100 people)	WDI
Common language	Common official primary language	CEPII
Share border	Dummy variable equal to 1 if home and host country share a border and 0 otherwise	CEPII
Former colony	Dummy variable equal to 1 if home and host ever shared a colonial relationship and 0 otherwise	CEPII
Natural resources	Total natural resources rents as a percentage of GDP, percent	WDI
EU 15 membership	Dummy variable equal to 1 if host country is a member of EU15 and 0 otherwise	-
Relative Population	Home country population divided by host country population	WDI
Relative GDP PC	Home country GDP per capita divided by host country GDP per capita	WDI
EU 15 membership	Dummy variable equal to 1 if host country is a member of EU15 and 0 otherwise	-

Tax Variables

Policy rate	High-level policy rate	KPMG, EY
Mean EATR	Griffith and Devereux (2003) methodology. This is a forward looking approach which calculates the reduction in the value of the profit stream for a model company as a result of the application of corporate income tax	EU Commission
EATR crossborder	Similar to the above except in an international setting. This also takes into account corporate taxes and personal taxes levied on the shareholders by the home country government	EU Commission
Total tax rate	*"Total tax rate measures the amount of taxes and mandatory contributions payable by businesses after accounting for allowable deductions and exemptions as a share of commercial profits. Taxes withheld (such as personal income tax) or collected and remitted to tax authorities (such as value added taxes, sales taxes or goods and service taxes) are excluded"*	WDI