THE IMPORTANCE OF CORPORATION TAX POLICY IN THE LOCATION CHOICES OF MULTINATIONAL FIRMS

Part of the Economic Impact Assessment of Ireland's Corporation Tax Policy

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The Importance of Corporation Tax Policy in the Location Choices of Multinational Firms

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Table of Contents

List of Tables

List of Figures

Executive Summary

This paper examines the effects of corporate tax on the location decisions of foreign direct investment. We use data on newly established multinational subsidiaries across 26 European countries from 2005 to 2012 in order to examine the effects of country characteristics, including a range of different estimates of statutory and effective average tax rates, on location decision. Our main findings can be summarised as follows:

- We find a consistent negative effect of the corporate tax rate on the probability of a country being chosen as a location by multinationals.
- We find a highly significant, albeit modest sized, effect of allowing for non-linearity in the effect of the tax structure. In other words, a change in the tax rate will have a larger effect if the starting point is a low rate of tax compared to if the same size change is applied to a higher tax rate.
- A summary of the marginal effects for our main estimates is presented overleaf. These combine the direct and non-linear elements of the estimated effects.
    - Focusing on our benchmark extended model, a one per cent increase in the policy rate would lead to a reduction in the likelihood of choosing a destination of 0.68 per cent.
    - A one per cent increase in the effective average tax rate (EATR) would lead to a reduction in the likelihood of choosing a destination of 1.15 per cent. The use of the EATR picks up variation across countries in taxes due to differences in allowances and exemptions along with the direct effect of the headline tax rate.
- We find large variations in the sensitivity to tax rates across sectors. For manufacturing firms, the effect is similar to the baseline but for service firms the effect is noticeably smaller. Services firms may be more likely to make location decisions based on the need to be close to their identified customer base and this reduces their sensitivity to tax rates.
- When comparing the effect of taxation to other important factors, we find that taxation is the largest single determinant of the location decision.
- Financial sector firms are 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, and has important implications for the potential effect of a tax change in Ireland, given the weight of the financial sector in foreign investment in this country. Firms with greater total assets appear more responsive to corporation taxation in their location decision.
- Combining all effects of tax and country characteristics, Ireland had a 3.1 per cent probability of being chosen as a location for the newly established subsidiaries over the period investigated. For context, Irish GDP is 1.4 per cent of the EU26 total, so this demonstrates the attractiveness of the country as a destination for foreign investment well in excess of its size.

- As a policy experiment, we simulate the possible effect of a number of changes in Irish corporate tax rate on the entry of new multinational subsidiaries. The results can be summarised as follows:
    - If the Irish tax rate had been 15 per cent over the period in our sample, the number of new foreign affiliates entering the country would have been 22 per cent lower.
    - If the tax rate had been 22.5 per cent (the sample average), the number of new foreign affiliates would have been 50 per cent lower.
- Countries with strong market potential, in terms of size and proximity to other large markets, are more likely to be chosen for new subsidiaries. This suggests that more peripheral economies may be at a relative disadvantage in attracting foreign direct investment, unless they are able to compete on other grounds.

Summary of Marginal Effects

Marginal Effects - Summary Table			
	Policy Rate	Mean EATR	Total Tax Rate
Main Model	-0.68	-1.15	-0.56
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
Sector Skill			
High-tech non-financial		-0.47	-0.50
Low-tech non-financial	-0.45	-0.91	-0.46
Sector Type and 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
Notes: Missing cell indicates the effect is insignificant.			

Findings of Policy Experiment

Effect of Changes in Irish Statutory Tax Rate on Location Probability					
	Remain at 12.5%	Change to 15%	Change to 17.5%	Change to 20%	Change to 22.5%
Probability of locating in Ireland	3.12%	2.44%	1.98%	1.65%	1.43%
Change in percentage of new affiliates opened in Ireland	0%	-22%	-37%	-47%	-54%

Chapter 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 business seeking a location for a new investment.

This paper examines the effects of corporate tax on the location decisions of foreign direct investment in Europe, while also accounting for other location choice variables. We use data on newly established multinational subsidiaries across 26 European countries over the period from 2005 to 2012 in order to examine the determinants of country characteristics, including a range of different estimates of statutory and effective average tax rates, on location decisions. The focus here is on the initial decision to establish a new facility in the destination country, and we do not examine the subsequent decision paths that the firm is faced with in terms of the volume of investments or allocation of investments across multiple affiliates.

We extend the existing literature on the effect of corporate taxation on location choices of multinationals both by using a data set that covers a wide range of information on both the source and potential host countries and also 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. 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 per cent increase in the policy rate of corporation tax would lead to a reduction in the conditional location probability of 0.68 per cent. Using the effective average tax rate (EATR), the marginal effect implies a reduction in the probability of 1.15 per cent following a one per cent increase in the tax rate. These combine the direct and non-linear elements of the estimated effects. The use of the average effective tax rate picks up variation across countries

in taxes due to differences in allowances and exemptions along with the direct effect of the headline tax rate.

In terms of other country factors, we find that higher levels of GDP and GDP growth increase the probability of a country being chosen as a location by a multinational, picking up the attractiveness of access to larger and higher-income markets. Market potential, capturing the ease of access to other nearby markets, is also positively linked with location attractiveness but is not always statistically significant. This suggests that more peripheral economies may be at a relative disadvantage in attracting foreign direct investment, unless they are able to compete on other grounds. Infrastructure (as proxied by motorway network coverage) has a positive and significant effect on the probability of location choice.

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. The sectoral composition of a country's foreign investment therefore has significant implications for the potential effect of a tax change. We estimate that when the share of affiliates for each sector in Ireland is controlled for the effects of tax changes are -1.8 for the EATR and -0.9 for the policy rate coefficient, approximately one-third larger than the average effects across all countries. This is due to the larger weight of the financial sector in foreign investment in this country.

Combining all effects of tax and country characteristics, Ireland had a 3.1 per cent probability of being chosen as a location for the newly established subsidiaries over the period investigated. To place this probability in context, we note that Irish GDP is 1.4 per cent of the EU26 total, so we are finding that the attractiveness of the country as a destination for foreign investment is well in excess of what in would expect to get if all of the destination decisions were allocated relative to country size.

The marginal effects reported from the conditional logit estimation used in this report are changes in the probability of a firm choosing a particular location at different points in the distribution of country characteristics. It can be difficult to interpret how this translates to the overall number of new affiliates that would be established or not in the event of a change in the corporate tax rate. In order to better interpret the results therefore, we perform a policy experiment where we simulate the possible effect of a number of changes in Irish corporate tax rate on the entry of new multinational subsidiaries. Over the period 2004-2012, we estimate that there would have been a

reduction of 22 per cent in the probability of Ireland being chosen as a location had the tax rate been 15 per cent and a halving of the probability if the rate had been 22.5 per cent.

The paper is structured as follows: Section 2 reviews the literature on FDI location and, in particular, the link with corporate tax rates. Section 3 describes the data used, including a discussion of the alternative measures available for corporate tax rates. It also describes the methodology used. Section 4 presents the empirical results.

Chapter 2

Background and Literature

There is a large literature which explores the determinants of the location decisions of multinational firms and more specifically focuses on the role of corporate tax in influencing such decisions. In modelling the effect of corporation tax on investment location decisions of multinationals, our work is most relevant to the latter literature but draws heavily on the former in terms of methodology, approach and context.

Deveraux and Griffith (2002; 2003) provide a review of the large body of literature on the effect of corporate taxation on the location of investment capital. While this literature is extensive, and many early studies focus on modelling the flows of foreign capital (Devereux and Freeman, 1995; Billington, 1999; Young, 1999), our work focuses on the binary decision of where to invest. Focusing on this subfield in the literature, there are a number of papers of particular relevance to our research. These studies differ across a number of dimensions, most notably on methodology, the measures of taxation, and country coverage.

Using data on large corporates from the US, Kemsley (1998) jointly models the decision to locate a foreign plant abroad or to export. Measuring taxation using the foreign average tax rate, US statutory rate, as well as foreign tax credits, he finds that firms are more likely to use exports to serve high-tax foreign markets and are also more likely to use exports when foreign tax credits are binding.

Devereux and Griffith (1998) test the effect of taxation on the location of production for a sample of US firms moving into Europe over the period 1980 to 1994. Focusing on both marginal and average effective tax rates, they find a negative and significant effect of taxation on the choice between locations within Europe but not between Europe and non-EU destinations. Their results imply a one per cent increase in the rate of the effective average tax rate in the UK reduces the conditional probability of locating by 1.29 percentage points. The equivalent value for France is 0.5 percentage points and 0.97 percentage points for Germany.

A close paper 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. Using data from Bureau Van Dijk Amadeus (Amadeus) across 33 European economies over the period 1999-2003, they separately model the effect of host economy corporate income tax, host economy dividend withholding taxes and home economy corporate income taxes on the probability of choosing a specific country. A novelty of their research is to separate out the three aforementioned taxation channels as the majority of studies to date have solely focused on host economy corporate income taxes. The methodology uses a conditional logit model controlling for taxation factors,

labour costs, common borders, market size and economic freedom. 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.

A second strand of research that is relevant to our work is the literature that models the location decisions of FDI firms more generally. Basile et al. (2009) use data on 5,509 foreign subsidiaries across 50 European regions in eight European countries over the period 1991-1999 to test the determinants of multinational location choice. Their main research hypothesis is to test the effect of EU structural funds on FDI location decisions. Using a mixed logit approach model, they find that agglomeration economies play a key role in determining location choices but the effects differ by whether the FDI originates within the European Union. They also identify a role for EU structural funds in determining location decisions.

A number of studies have focused on the outward flows of FDI from one country. Chen and Moore (2010) test the effect of firm heterogeneity on the selection of FDI investment locations on a sample of French multinational corporations. They find that the investment of French multinationals into host economies is a function of the investing firm's productivity: the share of higher productivity MNCs in total FDI is greater in economies with a smaller market potential, higher fixed costs of investment or lower import tariffs. Their findings are robust to country and firm specific heterogeneity and endogeneity in the productivity-FDI relationship. Davies et al. (2009) focus on the role played by tax treaties in determining both the propensity to invest and the level of investment across locations for a sample of Swedish multinationals over the period 1965-1998. They find that tax treaties affect the probability of investment in a location but not the volume of investment by FDI firms. They argue that their findings suggest the impact of tax treaties work through a reduction in investor uncertainty rather than a reduction in effective tax rates. Head and Mayer (2004) consider the issue of market potential using a theoretical model of location choice. Their predictions are tested empirically using data on Japanese multinationals. Their results show that market potential matters for location choice but their analysis notes unexplained variation in choices. While not a direct focus in their work, they include corporate income tax as a determinant of the location decision. Using a conditional logit model, they estimate that a one per cent rise in corporation taxation leads to a near five per cent reduction in the probability that a specific region is chosen.

Additional relevant research undertaken by Siedschlag et al. (2013a) modelled 446 location decisions of R&D firms across EU regions over the period 1999-2006. Using Amadeus data, they link location choice to a range of region-specific and country-specific covariates. They find that the probability of location choice of a foreign R&D affiliate is positively affected by increased FDI presence, human capital levels and research capacity and quality. The effects of research are stronger for affiliates of non-European origin. While it is not the focus of their research, they include corporation tax rates as a control. Measuring taxation using the statutory policy rates, they find no significant effects in a majority of specifications. Siedschlag et al. (2013b) also model the location decisions of EU firms on a

cross-regional basis. They focus on firms in the ICT sector over the period 1998-2008 and find that location probability increases with market size, market potential and the presence of other foreign-owned firms. Their research also identifies a role for human capital, income tax, and the size of the services sector. They do not find any effect of corporation taxes with the exception of affiliates of US origin.

Chapter 3

Data and Methodological Approach

3.1 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. We restrict our sample to firms we can identify as foreign owned, in which the owner has an ownership percentage of 50 per cent or more.

We first describe the various tax measures used, then we describe in detail the sample of firms used in the analysis.

3.1.1 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. The sources for each of these variables are presented in Annex 1. We also use the EATR Crossborder as a robustness check.

1. Policy Rate
   The statutory rate charged by the host country government on corporate profits earned by the subsidiary.
2. 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]
3. Total Tax Rate
   This includes all taxes and mandatory contributions payable by businesses after accounting for allowable deductions and exemptions.

[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.

4. 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 per cent in 2005.

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

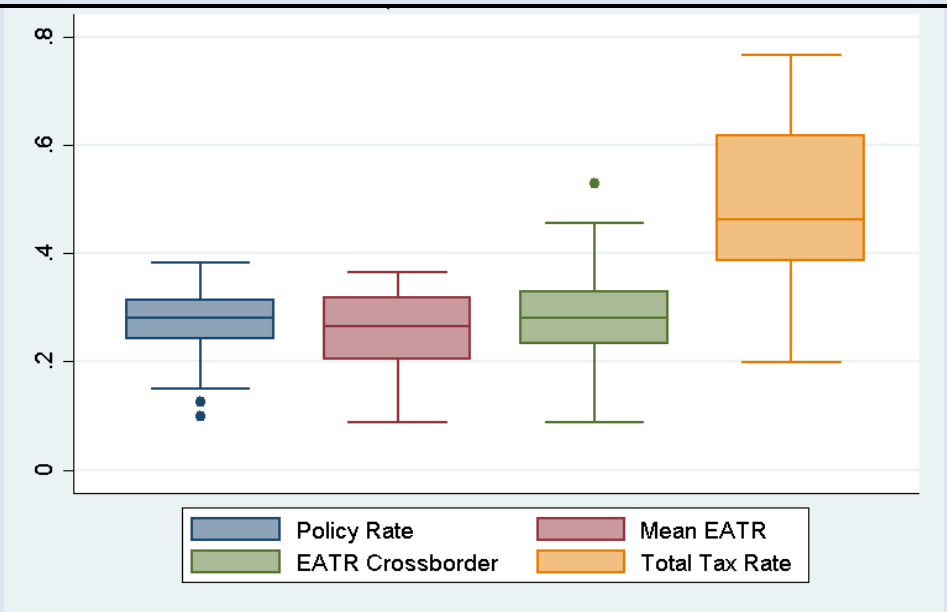
Table 2: Correlation Matrix for Tax Variables

	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.

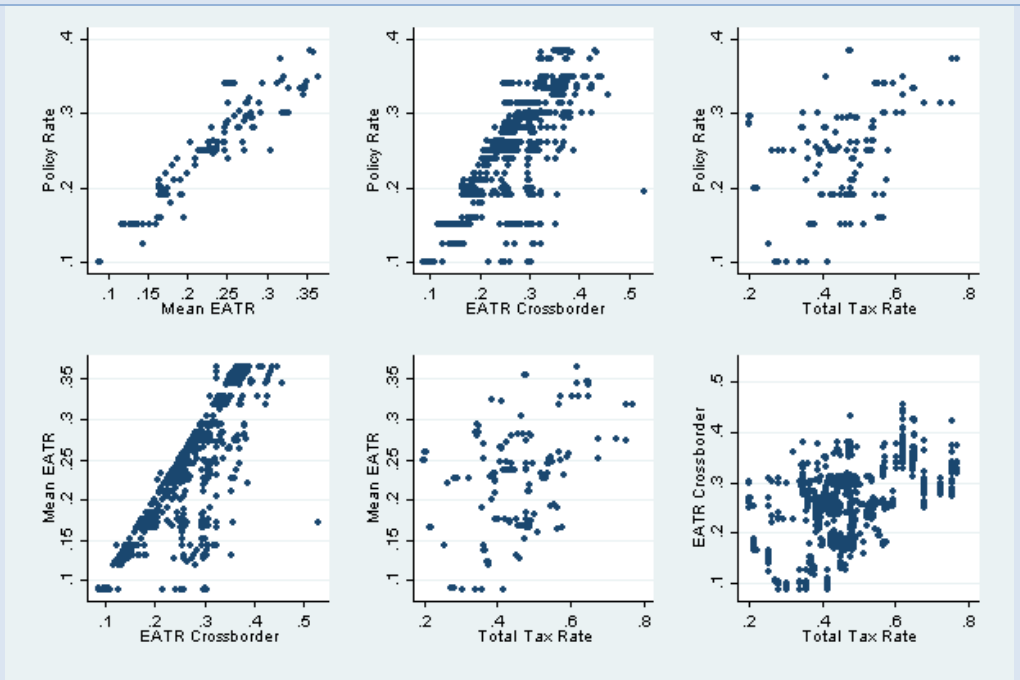
The scatter plots in Figure 2 graphically show the relationships between each pair of tax rates. Interestingly the plot between the Mean EATR and the EATR Crossborder illustrates that the tax payable is at least the Mean EATR of the host country, but may be significantly higher, depending on the home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

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.

3.1.2 Number of Firms by Location of New Foreign Affiliate

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. This includes 130 foreign affiliates opened in Ireland.

Table 3: Number of Firms by Host Country

Country	No of Firms
Austria	101
Belgium	27
Bulgaria	121
Czech Republic	214
Germany	316
Denmark	30
Estonia	66
Spain	320
Finland	40
France	213
Greece	6
Croatia	90
Hungary	14
Ireland	130
Italy	421
Lithuania	36
Latvia	42
Netherlands	249
Norway	104
Poland	142
Portugal	109
Sweden	34
Slovenia	23
Slovakia	48
United Kingdom	342
Total	3,238

3.1.3 Number of Firms by Sector

We aggregate up NACE Rev2 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 sector aggregations are presented in Table 4 below.

Table 4: Sector Aggregation for Regressions		
Sector	Sector Type	Sector Skill
High tech manufacturing	Manufacturing	Hi-tech
Medium tech manufacturing	Manufacturing	Hi-tech
Medium-low tech manufacturing	Manufacturing	Low-tech
Low tech manufacturing	Manufacturing	Low-tech
Knowledge-intensive market services	Services	Hi-tech
High-tech knowledge-intensive services	Services	Hi-tech
Other knowledge-intensive services	Services	Hi-tech
Less knowledge-intensive market services	Services	Low-tech
Construction	Other	Low-tech
Financial Services and Insurance	Financial	Financial
Utilities	Other	Low-tech

The number of firms in each of these sectors is broken down in Tables 5 and 6.

Table 5: Number of Firms by Sector Type		
Sector Type	Number	Percentage
Manufacturing	400	12%
Services	2,020	62%
Financial	639	20%
Other	179	6%

Table 6: Number of Firms by Sector Skill		
Sector Skill	Number	Percentage
Hi-tech	896	28%
Low-tech	1,703	53%
Financial	639	20%

We further disaggregate manufacturing and services into high and low tech in Table 7.

Table 7: Number of Firms by Sector Type & Skill		
Sector Skill	Number	Percentage
High tech manufacturing	176	5%
Low tech manufacturing	224	7%

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.

High tech Services	720	22%
Low tech Services	1,300	40%
Financial	639	20%
Other	179	6%

A large proportion of the Irish firms in our sample are in the Financial Services and Insurance industry. This reflects the growing importance of this sector to the Irish economy.

The number of Irish firms in each of these sectors is broken down in Table 8.

Table 8: Number of Irish Firms by Sector Type & Skill		
Sector Skill	Number	Percentage
High tech manufacturing	3	2%
Low tech manufacturing	4	3%
High tech Services	20	15%
Low tech Services	25	19%
Financial	75	58%
Other	3	2%

3.1.4 Number of Firms by Asset Size

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 9 below.

Table 9: 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%

3.1.5 Number of Firms by Location of Parent Company

Table 10 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 10: Number of Firms by Location of Owner	
Country	Number of Firms
United States of America	478
Germany	319
Luxembourg	273
United Kingdom	249
Netherlands	210
Switzerland	194
France	167
Sweden	146
Spain	123
Italy	117
Cyprus	105
Belgium	93
Austria	92
Denmark	84
Finland	70
Japan	54
Canada	50
Norway	40
Australia	30
Korea, Republic of	30
Ireland	29
Poland	27
Slovakia	27
Portugal	26
Romania	26
Malta	23
Czech Republic	19
Turkey	19
Hungary	18
Estonia	16
Slovenia	16
Lithuania	15
Latvia	15
Croatia	14
Greece	11
Others	13
Total	3,238

If we look at Irish owned firms, we find that they are mainly owned by companies based in the US and UK as can be seen from in Table 11.

Table 11: Number of Irish Firms by Location of Owner	
Country	Total Sample
United Kingdom	50
United States of America	43
Netherlands	7
Luxembourg	6
France	5
Canada	3
Australia	2
Switzerland	2
Cyprus	2
Spain	2
Norway	2
Belgium	1
Germany	1
Denmark	1
Italy	1
Korea, Republic of	1
Portugal	1
Total	130

3.1.6 Number of Firms by Year of Entry

Our year coverage is from 2005-2012 as presented in Table 12. 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 12: 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

3.1.7 Other Variables Used in Regressions

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 Ln GDP.

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 13 contains summary statistics and Table 14 the correlation matrix for all variables used in our analysis.

Table 13: 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
EU15 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 14: 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	EU15 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			
EU15 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

3.2 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, 2004; 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, $\Pi_{ic,}$ are:

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

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:

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

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

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

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:

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

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 (percentage 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 EU15 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 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 one per cent changes the conditional probability of locating in particular country by the estimated value (in per cent). In Chapter 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.

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

Chapter 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 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.

4.1 Baseline Results

We begin with the baseline results presented in Column 1 of Table 15, 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. 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.

Table 14: 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			

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. Although much of this research relates to regional or city level clusters and our data is at a more aggregated level, 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 15 examine how this result is affected by using different measures of the tax rate. Column 2 uses the effective average tax rate (EATR). The other country characteristics have the same pattern as before, apart from labour quality which becomes statistically significant. The EATR is insignificant. In contrast to the policy rate but in line with the EATR results, the total tax rate is not found to be statistically significant.

The first results presented in Table 15 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 16 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 15: 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 17 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 16: 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)
EU15	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, 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 17: 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)
EU15	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 19 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. In 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 18: 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).

To provide context, we use the methodology in Devereux and Griffith (1998) and estimate marginal effects for a selection of other key variables. The effects use the coefficient estimates produced in Table 18. The clearest observation from an evaluation of the relative magnitude of the alternative marginal effects is that corporation tax has the largest effect of all variables estimated. The natural resource dependence is the second highest marginal effect while motorway density is the third largest. From a policy perspective, this evaluation would suggest that multinationals are most sensitive to both the taxation environment and quality of infrastructure when deciding where to locate affiliates. Given these are both within the instruments available to governments, they both should remain a key focus of policy.

Table 19: Marginal Effects on Control Variables			
	Policy rate	Mean EATR	Total Tax Rate
Market Potential	0.126	0.145	0.100
GDP Growth	0.132	0.130	0.192
Distance	-0.040	-0.042	-0.038
Motorway Density	0.309	0.288	0.370
Common Language	0.013	0.015	0.012
Continguity (Common Border)	0.015	0.013	0.021
Colonial Relationship	0.012	0.013	0.011
Natural Resource Dependence	0.372	0.332	0.320
EU15	0.036	0.031	0.032
Corporation tax	-0.689	-1.152	-0.560
Notes: Marginal effects are calculated as β_X x (1/J) x (1-1/J) where J is the number of groups. This follows Devereux and Griffiths (1998) and Greene (2012).			

4.2 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 21. 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 20: 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				

The estimated marginal effects by sector are presented in Table 22 below.

Table 21: 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

4.3 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. 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 22: 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.			

The marginal effects are presented in Table 24.

Table 23: 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

4.4 Policy Experiment

To provide insight into the meaning of our results for policymakers, we undertake a number of simulations which examine the effect of changing the rate of corporation tax on the probability of a firm choosing to locate in Ireland.

To undertake this experiment, we use the predicted probability from the main extended model. These probabilities basically capture the likelihood on average that a firm will chose Ireland relative to all other locations in the choice set. Given the size of Ireland's economy, it is not necessarily the case that it will receive a large absolute number of FDI affiliates but our attractiveness to FDI, and historical success in developing a robust FDI sector, would suggest we should receive a larger share of firms that our economy size would suggest.

To motivate this we present a table of mean location probability from our model and the mean share of GDP. The location probabilities shown are individual probabilities calculated by the

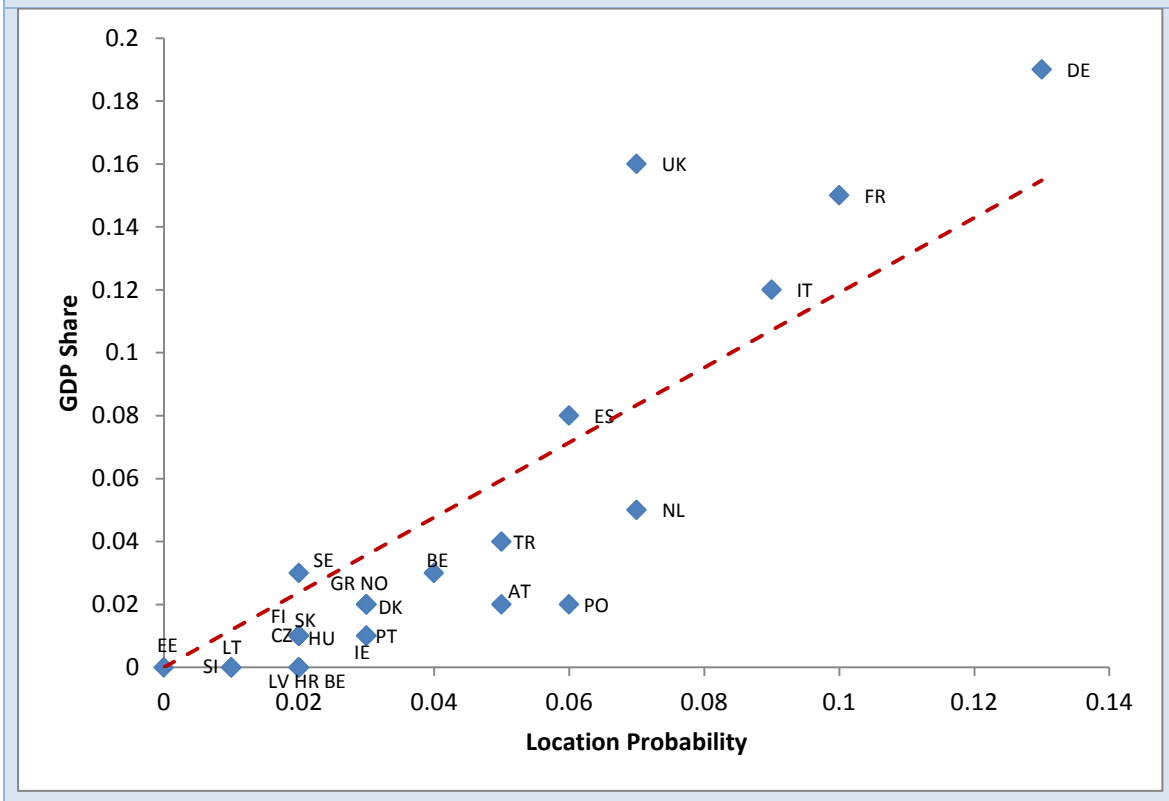
conditional logit model, averaged for each country from the model presented in Table 18. These are not simply the share of affiliates in each country.

Table 24: GDP Share and Location Probability by Country

Country	GDP Share	Location Probability	Share of Affiliates in Sample
Austria	2.1%	4.8%	3.1%
Belgium	2.6%	3.5%	0.8%
Bulgaria	0.2%	2.3%	3.7%
Czech Republic	1.0%	2.4%	6.6%
Germany	19.4%	12.8%	9.8%
Denmark	1.7%	3.3%	0.9%
Estonia	0.1%	0.4%	2.0%
Spain	7.8%	5.7%	9.9%
Finland	1.4%	2.2%	1.2%
France	14.6%	9.6%	6.6%
Greece	1.6%	2.7%	0.2%
Croatia	0.3%	1.6%	2.8%
Hungary	0.7%	2.1%	0.4%
Ireland	1.4%	3.1%	4.0%
Italy	11.8%	8.9%	13.0%
Lithuania	0.2%	1.3%	1.1%
Latvia	0.1%	1.5%	1.3%
Netherlands	4.5%	6.6%	7.7%
Norway	2.1%	3.1%	3.2%
Poland	2.4%	6.1%	4.4%
Portugal	1.3%	3.0%	3.4%
Sweden	2.6%	2.3%	1.1%
Slovenia	0.3%	1.0%	0.7%
Slovakia	0.5%	1.6%	1.5%
United Kingdom	15.8%	7.4%	10.6%

We can see that these series are highly correlated ($\rho = 0.92$), however a trend emerges in that larger countries such as Germany, France, Italy and the UK tend to host less firms than their share of GDP would indicate. This is more clearly illustrated in the following graph. The reverse is true for smaller countries which tend to be over-represented. For instance a firm has a 3.1 per cent chance of locating in Ireland during our sample period, while the Irish share of GDP is only 1.4 per cent. In this chart, countries to the left of the red line receive a lower share of FDI affiliates relative to their GDP share, whereas firms in the right of the line receive a higher share of FDI than their GDP share.

Figure 3: Scatterplot of GDP Share and Location Probability



Given this fact, it would be interesting to see what would happen were Ireland to have had a different headline policy rate during this period. To examine this further we conduct a policy experiment in which the current Irish policy rate of 12.5 per cent is substituted with an alternative tax rates, holding all other control variables and other countries tax rates constant. We then measure the subsequent change in location probability.

As described in the Methodology section, the probability of choosing country c within the conditional logit model can be expressed as follows:

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

In order to simulate the tax change, we first estimate our main model and calculate the country specific location probability. Assuming the vector T_{ic} represents the current policy rate in the larger matrix of controls X_{ic}, for each country within this calculation, we then substitute this vector with T^*_{ic} which contains the new Irish tax rate.

$$T_{ic} \neq T^*_{ic}$$

This vector is then included in a new control matrix X^*_{ic}. The probabilities are then recalculated and the difference expressed as a percentage change over the initial probability. Formally, for each new tax rate we calculate:

$$\frac{P(Y = c|1, \dots, J, X^*_{ic}) - P(Y = c|1, \dots, J, X_{ic})}{P(Y = c|1, \dots, J, X_{ic})}$$

The results are summarised in Table 28 below.

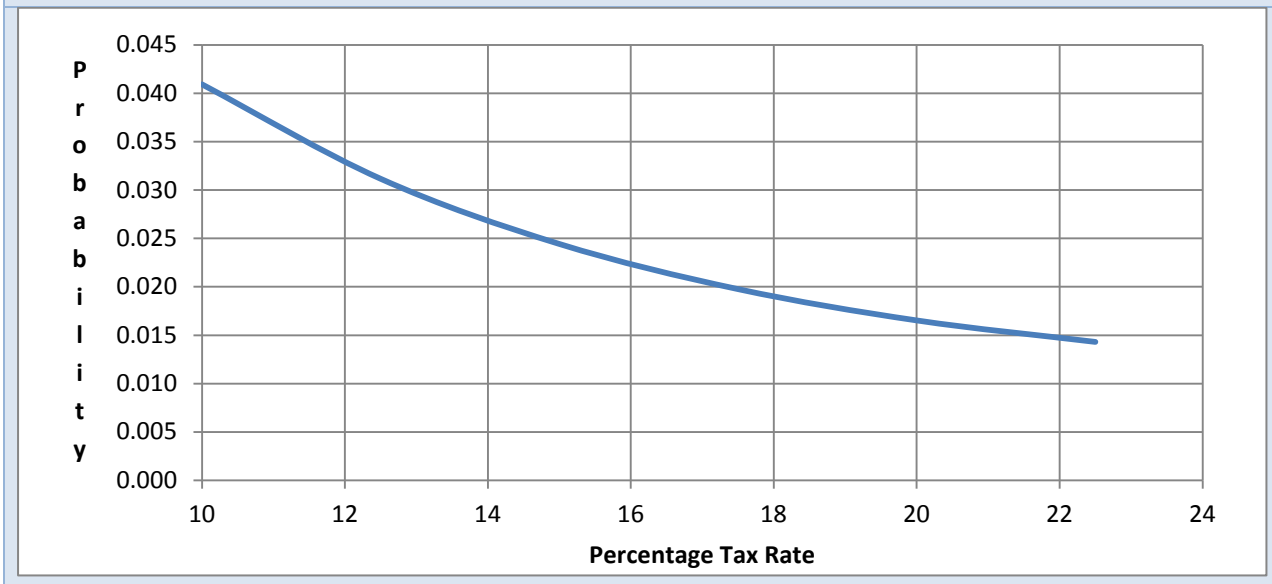
The results indicate that our statutory tax rate is an important factor in location probability. If this rate is lowered the probability of a firm locating in Ireland increases, and as it is raised the probability of firms choosing Ireland decreases.

Table 26: Effect of Changes in Irish Statutory Tax Rate on Location Probability

	Remain at 12.5%	Change to 15%	Change to 17.5%	Change to 20%	Change to 22.5%
Probability of locating in Ireland	3.12%	2.44%	1.98%	1.65%	1.43%
Change in percentage of new affiliates opened in Ireland	0%	-22%	-37%	-47%	-54%

We also see that this effect is non-linear, and the percentage change in probability decreases as the tax rate increases.

Figure 4: Probability of locating in Ireland at different tax rates



We must be careful when interpreting these results. For example, this result means that if Ireland's tax rate had been 15 per cent from 2005-2012, the probability of a firm locating there would have

been reduced by 22 per cent over this period, or alternatively the number of firms locating in Ireland would have been reduced by 22 per cent. This does not imply that if Ireland raised its tax rate to 15 per cent tomorrow, it would lose 22 per cent of new affiliates being opened by multinationals.

4.5 Re-weighting Main Effects for Ireland

A final estimation we conduct to provide policy insight is an attempt to provide an alternative overall marginal effect that better reflects the Irish sample in the data. To do this, we take the average sector marginal effects for manufacturing, services, financial and other and multiply these by the share of affiliates across sectors that choose Ireland. Specifically, this is re-weighted as follows:

$$MFX\_New = MFX_M \times ShareM + MFX_S \times ShareS + MFX_F \times ShareF + MFX_O \times ShareO$$

where MFXi is the marginal effect of the manufacturing, services, financial and other sectors respectively. These are taken from Table 22. The share of affiliates for each sector in the Irish data is presented in the table below. Using these shares and the previous marginal effects, the re-weighted effect which is better balanced for Ireland is approximately -1.8 for the EATR and -0.9 for the policy rate coefficient. The figures presented in the table above should be directly compared to the extended main model outlined in Table 19.

Table 25: Sector MFX Re-calculated using Mean EATR

	Affiliates	Share
Manufacturing	7	0.05
Services	50	0.36
Financial	80	0.57
Other	3	0.02
Mean EATR		-1.79
Policy rate		-0.92

4.6 Robustness Checks

To ensure that our results are robust to considerations of specification and sampling, we undertake a number of robustness checks. The checks are as follows:

R1: Estimate the model including the cross border EATR
R2: Include both the EATR cross border and the mean EATR
R3: Limit the sample to home country firms that are in the OECD
R4: Limit the sample to home country firms that are in the EU28
R5: Remove US firms.
R6: Remove all investment option pairs (home-host) that are never chosen by a firm.

R7: Additional size controls.

Further robustness checks have also been completed which include controls for trade openness, further modelling of labour costs, and labour income taxation and the main results hold in all cases. While not presented here, there results are available on request from the authors.

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.

Table 27 includes the EATR Crossborder in an additional regression. The sample size falls as some firms are missing observations. We also re-estimate the model for the other tax rates on this smaller sample. In all cases, the main results hold with a negative and significant main effect and a positive and significant square term on the corporation tax variable.

Table 26: R1: EATR Crossborder				
Policy rate	-26.434***			
	(4.122)			
Policy rate^2	0.332***			
	(0.075)			
Mean EATR		-37.856***		
		(4.970)		
Mean EATR^2		0.586***		
		(0.091)		
Total Tax Rate			-17.341***	
			(1.728)	
Total Tax Rate^2			0.170***	
			(0.018)	
Crossborder EATR				-28.462***
				(3.647)
Crossborder EATR^2				0.425***
				(0.063)
N	31330	31330	31330	31330
Pseudo R2	0.168	0.166	0.168	0.164
Standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

To further explore the relative effects of EATR Crossborder with the main EATR, both variables are included in the same regression. The results are presented in Table 28. Including this control can ensure the results are not being driven by parent country taxation considerations. The results suggest that the effects are driven by both variables.

Table 27: R2: Decompose EATR Crossborder	
Mean EATR	-26.168***
	(6.01)
Mean EATR^2	0.379 ***
	(0.113)
EATR Crossborder	- 18.977
	(4.228)
Crossborder EATR^2	0.305
	(0.076)
N	31330
Pseudo R2	0.168
Standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

Robustness checks R3, R4, and R5 each estimate the main tax effects on different sub-samples of firms. These checks are motivated by the fact that firms from different jurisdictions may be non-randomly selected into the sample due to data availability. There may also be treaty issues or home country factors that lead firms from different jurisdictions to make systematically different choices. These checks should ensure our results are robust to these considerations. R3 limits the sample to firms whose home country is within the OECD, R4 limits the sample to firms whose home economy is within the EU28 and R5 limits the sample to non-US firms. In all cases, our results hold.

Table 28: R3: Intra OECD Investment			
Policy rate	-9.001***		
	(2.784)		
Policy rate^2	0.133***		
	(0.051)		
Mean EATR		-21.204***	
		(3.660)	
Mean EATR^2		0.466***	
		(0.067)	
Total Tax Rate			-13.892***
			(1.114)
Total Tax Rate^2			0.139***
			(0.011)
N	59859	59859	59859
Pseudo R2	0.151	0.154	0.158
Standard errors in parentheses			
*** p<0.01, ** p<0.05, * p<0.1			

Table 29: R4: Intra EU28 Investment			
Policy rate	-9.945***		
	(2.920)		
Policy rate^2	0.214***		
	(0.053)		
Mean EATR		-20.268***	
		(3.549)	
Mean EATR^2		0.496***	
		(0.064)	
Total Tax Rate			-16.995***
			(1.377)
Total Tax Rate^2			0.171***
			(0.013)
N	47717	47717	47717
Pseudo R2	0.156	0.161	0.167
Standard errors in parentheses			
*** p<0.01, ** p<0.05, * p<0.1			

Table 30: R5: Drop USA Parent			
Policy rate	-17.330***		
	(2.614)		
Policy rate^2	0.324***		
	(0.047)		
Mean EATR		-29.466***	
		(3.029)	
Mean EATR^2		0.618***	
		(0.056)	
Total Tax Rate			-13.161***
			(1.045)
Total Tax Rate^2			0.140***
			(0.011)
N	69796	69796	69796
Pseudo R2	0.144	0.149	0.152
Standard errors in parentheses			
*** p<0.01, ** p<0.05, * p<0.1			

Another robustness check that we undertake tests the robustness of the model to exclusion of host-home country pairs in which no firm actually makes an investment. Excluding these groups should provide a very severe test against including irrelevant alternatives in the choice set of enterprises. The results of our main model on this reduced sample are included in Table 32. While the effects are somewhat weaker for the policy rate, in all cases, our general findings hold.

Table 31: R6: Eliminate No Investment Country Pairs			
Policy rate	-4.238*		
	(2.357)		
Policy rate^2	0.052		
	(0.042)		
Mean EATR		-13.114***	
		(2.829)	
Mean EATR^2		0.281***	
		(0.052)	
Total Tax Rate			-12.524***
			(0.971)
Total Tax Rate^2			0.126***
			(0.010)
N	57594	57594	57594
Pseudo R2	0.101	0.102	0.110
Standard errors in parentheses			
*** p<0.01, ** p<0.05, * p<0.1			

The final robustness check that we include tests the sensitivity of the results to controlling for country size. In this model, we remove the relative GDP and population measures and allow the log of GDP to enter both on its own and with a square term which also controlling for the country specific host population size. This robustness check should help provide extra robustness in the face of alternative specifications on firm size.

Table 32: R7: Additional Size Controls			
Policy rate	-11.901***		
	(2.78)		
Policy rate^2	0.180***		
	(0.051)		
Mean EATR		-20.753***	
		(3.303)	
Mean EATR^2		0.412***	
		(0.059)	
Total Tax Rate			-12.669***
			(1.095)
Total Tax Rate^2			0.120***
			(0.011)
N	57594	57594	57594
Pseudo R2	0.101	0.102	0.110
Standard errors in parentheses			
*** p<0.01, ** p<0.05, * p<0.1			

Chapter 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 research report 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. When comparing the effect of taxation to other important factors, we find that taxation is the largest single determinant of the location decision.

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. The difference in sectoral responsiveness of FDI location to taxation has implications for the composition of the foreign-invested sector and must be taken into account when policymakers are evaluating taxation considerations. If particular sectors are chosen as a policy focus, then their responsiveness of taxation must be evaluated with regard to the basket of other factors which determine their corporate decision as well as their sector specific responsiveness to taxation.

While our research is narrowly focused on the decision where to locate a specific affiliate, there are a number of avenues of additional research that would be complementary and provide additional insight. These include the following:

- Evaluating the impact of corporation taxation on volume of investment flows and the committed capital of the FDI affiliate;

- Testing the impact of corporation tax treatment of financing sources on the financing structure of the investment (the composition of debt, equity and retained earnings used); and
- Evaluating the impact of taxation competition on the decision where to locate the affiliate.

Furthering this current evaluation with research on the aforementioned additional topics would enhance our understanding of how corporation tax affects enterprises' decisions more broadly.

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Annex 1 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, per cent	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, per cent	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, per cent	WDI
Infrastructure	Surface area of paved motorways as a proportion of total land area in km squared, per cent	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, per cent	WDI
EU15 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
EU15 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	EU

	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	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