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Tax Planning by Firms
and Tax Competition by Governments

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January 27, 2008
Tax Planning by Firms
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Thesis submitted to Trinity College, Dublin
in fulfilment of the requirements for the degree of
Doctor of Philosophy (Ph.D)

June 2007
Declaration

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Acknowledgements

First and foremost, I would like to thank Professor Frances Ruane for her expert supervision of this thesis. Professor Ruane has been a constant source of intellectual inspiration and encouragement throughout this dissertation.

Financial assistance from the Institute for International Integration Studies (IIIS) at Trinity College Dublin, and particularly funding from Depfa Bank Plc is all gratefully acknowledged. In addition, the generous funding of the Department of Economics for conferences and courses has greatly improved this thesis.

To all the participants at the conferences and seminars, including the graduate seminar series at Trinity; the Irish Economic Association Conference; the Global Finance Conference; the Spring Meeting of Young Economists in Hamburg; the Public Economics UK Conference; and particularly workshops at the Oxford University Centre for Business Taxation; thank you for your time and comments. Professor Paul Walsh and Dr Franco Mariuzzo of Trinity College both provided useful comments at the series of Micro-Data Seminars which they coordinated.

Outside of Trinity I have benefited from useful discussions with Professor Jim Hines (University of Michigan), Professor Fritz Foley (Harvard University) and Mary Walsh (PriceWaterhouseCoopers).

I am also grateful to Professor Alan Matthews and Professor Andrew Somerville who were heads of the Economics department during my time as a postgraduate and were at all times helpful. In addition. Professor John O'Hagan, as depart-
mental head of Graduate Studies, provided a forum for postgraduate interaction.

Professor Dermot McAleese, Dr Francis O'Toole, Professor Frances Ruane, Dr Sébastien Wälti and Professor John O'Hagan provided me with valuable experience as their teaching assistant on the Intermediate Economics and Economy of Ireland courses.

I would like to thank my fellow graduate students for making the graduate experience at Trinity so pleasurable. In particular, Liam Delaney, William Hynes, Olivia Mollen, Keith Walsh and Haiyan Wang were close friends throughout.

To Michael Kitson (Cambridge University) who introduced me to economics, Dr Syria Iyer (Cambridge University) who has been a constant source of support throughout this thesis and all my friends, particularly the economists, from St Catharine's College, Cambridge - thank you, I have learned so much from our times together.

A special thanks must go to my family, particularly my parents who had the foresight to encourage me to continue studying and provided enormous support throughout. I will be forever indebted to you both.

To Maria and all my friends, thank you for your patience and all the good times we had along the way. I don't see any reason why they should stop just because I'm finally getting a job!
Summary

This thesis investigates tax planning by firms and tax competition by governments. We begin in Chapter 1 by outlining the background, motivation and plan of the thesis.

Chapter 2 reviews the relevant existing literature. This begins with a review of the canonical tax competition model. Estimates of the tax burden suggest an important role for multinational firms in explaining international tax reforms. Mindful of the variety of tax planning strategies available to multinational firms, we review estimates of the relative importance of tax planning by firms in explaining trends in tax burdens. We finish our review of the literature with a discussion of some recent papers which investigate the tax planning decisions made by firms.

In Chapter 3, we propose a model of how multinational firms decide how much tax to pay. Since tax planning is a risky endeavor, we show that firms will trade-off the risks of tax planning against the benefits of a lower effective tax rate (ETR). We estimate the gradient of the trade-off using a large panel of multinational firms. The risks of tax planning are proxied by the variability of firms' ETRs, measured as the coefficient of variation of the firms' annual ETRs. Our estimates suggest a non-linear trade-off such that only significant variability in ETRs is compensated by lower ETRs.

Chapter 4 examines the multinational firm's decision on how much tax to pay when its performance is benchmarked against competitors. This is captured in a modified theory of yardstick competition. The model predicts a positive correlation across the ETRs of similar firms. We test this using a spatial econo-
metric model which relates each firm's ETR to a weighted average of similar firms. The results indicate asymmetric responses by firms. Multinationals with above-average ETRs reduce them, whilst multinational firms with low ETRs do not mean-revert. The magnitude of the reaction is quantitively small, although statistically highly significant.

In Chapter 5, we model a bargaining game between the government and a multinational firm. Our model predicts that multinational firms investing in industries favoured by the government will be able to bargain for a lower ETR on profits. We test this prediction using a large sample of foreign subsidiary data and we elicit government preferences for specific industries using unique survey data. We find that, on average, foreign subsidiaries in 'targeted' industries bargain for 1 percent lower ETRs. However, when we allow the intensity of targeting to vary with the statutory tax rate (STR) of each country, we find that subsidiaries in target industries have substantially lower ETRs in high STR countries. In contrast, low STR countries appear able to extract economic rents from foreign investments in target industries.

Finally, in Chapter 6, we review the contribution of this thesis.
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Chapter 1

Introduction

This thesis investigates tax planning by multinational firms and tax competition by national governments. It is motivated by the role of multinational firms as catalysts for tax competition. We propose that understanding tax competition requires us to be cognisant of the range of strategies available to both multinational firms and governments. We contribute to the modern literature on tax competition by investigating a number of issues which surround how firms make choices over how much tax to pay, and how governments make choices over how to tax firms.

The inspiration for this thesis sprung from the remarkable episode of economic growth experienced by Ireland since the late 1980s. Whilst the causes of this growth spurt are complex and numerous, the confluence of two factors were arguably integral to the country’s economic success. First, Ireland’s corporate tax rate since the middle of the 20th century has been unusually low compared to neighbouring countries. This policy began in 1956 with the Export Profit Tax Relief which allowed 100 percent relief from taxation for profits from manufactured exports. The European Economic Community (EEC), and later the Euro-
pean Union (EU), expressed reservations about this discriminatory treatment of export profits. In response, the Irish government implemented a corporate tax rate of 10 percent for all profits from manufacturing and internationally traded services. This regime was phased in between 1981 and 1990, and extended to businesses located in the International Financial Services Centre (IFSC) in the late 1980s. Further disquiet from the EU led to the implementation of a uniform 12.5 percent corporate tax rate on all profits in 2003, with a guarantee that the earlier preferential treatment would be phased out by 2010 at the latest.

The second militating factor in Ireland’s economic success has been the worldwide increase in capital mobility that has characterised the post-war period. In particular, there has been an enormous growth in the activity of multinational firms. In Ireland’s case a significant amount of FDI originated from US multinational firms seeking an export platform from which to serve the European market. Whilst a number of factors made Ireland an attractive location from which to do this, the low corporate tax rate has repeatedly been cited as among the most important.

The confluence of internationally mobile capital with a low domestic corporate tax rate has resulted in a transformation of the Irish economy. Real GDP growth averaged 10 percent between 1995-2000, driven by large increases in investment and employment in the foreign owned manufacturing sector. The net stock of FDI in Ireland increased by 370 percent between 1990-2000 (UNCTAD, 2004) and by 2001, 49 percent of employment in manufacturing was accounted for by multinational subsidiary companies (an increase of 42 percent since 1991) (Ruane and Ugur, 2005). Equally important has been the huge increase in corporate tax revenue collected from multinational firms. As an indication, it is estimated that Microsoft’s contribution to the Irish Revenue Commissioners totalled $300m out of a total amount collected in Ireland of $5.3 billion. This tax
payment alone is estimated to have funded almost 5 percent of the governments total expenditure in 2006.

Clearly the activities of multinational firms have been an instrumental part of Ireland's economic growth. One important measure of the tangible benefits multinational firms have realised from investment in Ireland is a lower tax burden on profits. For example, in 2006, Google saved over €100m in corporate taxes by locating operations in Ireland. This was equivalent to an 8 percent reduction in the firm's effective tax rate from 39 percent to 31 percent. Microsoft, through its subsidiary Round Island One based in Dublin, was able to reduce its corporate tax bill by $500m in 2005. This was reflected in a fall in Microsoft's global effective tax rate from 33 percent in 2004 to 26 percent by 2005.

The gains enjoyed by Ireland and the multinational firms located here have also impacted on other countries. Sullivan (2004) reports that between 1999-2002 US multinationals increased profits in countries with no taxes or low taxes by 68 percent, whilst sharply reducing profits recorded in other countries where they engage in substantial business activity. He estimates that for 5 large, industrial countries (Canada, France, Germany, Italy and the UK) the profits of US multinationals operating within their borders fell by 25 percent, from $72 billion in 1999 to $54bn in 2002. These five countries accounted for 44 percent of foreign sales, 44 percent of foreign invested capital and 56 percent of employee compensation in 2002. Despite the substantial business activity remaining in these countries, only 21 percent of foreign profits were declared inside their borders. This equates to a substantial loss of corporate tax revenue and has prompted concern among governments that there will be a 'race to the bottom' in corporate tax revenue.

Corporate tax competition may be expected to be particularly intense among European countries. The creation of the Single European Market, the introduc-
tion of the Euro and the increasing trend towards wider and deeper integration increases the salience of corporate tax rate differences. In particular, as the non-tax differences between European countries become narrower, multinational firms may find it easier to relocate to the lowest tax countries in Europe. This has prompted calls for a harmonisation of corporate tax rates, or more recently, a consolidation of the corporate tax base. In any case, it is difficult to assess the likely impact of increased European integration or the proposed policy reforms. However, what is certain is that multinational firms will play a dominant role whatever the outcome. For this reason, it is essential that we have a keen understanding of the principal determinants of multinational firms' decisions with regard to corporate taxation.

Economic theory provides a useful tool to analyse and evaluate the potential welfare effects of tax competition. In Chapter 2, we discuss the theoretical tax competition literature, beginning with a exposition of the canonical tax competition model. Whilst this theoretical literature has spawned a vast array of models, empirical research has been much slower to emerge. This has been unfortunate since the empirical research to date has significantly shaped the formulation of theory and our understanding of the scale and scope of tax competition. In particular, estimates of trends in country-level effective tax rates have pointed to the important role of multinationals in explaining the dynamic of tax competition. This has led to a proliferation of recent models which incorporate multinational firms into the standard models of tax competition. We review some of the empirical studies which attempt to estimate the relative importance of tax setting by governments and the behavioural responses of multinationals. What emerges is the importance of multinational firms' tax planning in reducing ETRs in the most recent period. This is corroborated by anecdotal evidence of extensive tax planning by these firms. Therefore, a
critical determinant of tax competition will be the role of taxation, or the ‘tax strategy’ of the multinational firm. We review some recent papers in this area, and pursue the topic more fully in the remaining chapters of this thesis.

Our analysis begins in Chapter 3. We propose a simple model of a tax director who’s compensation is directly related to the firm’s ETR. He/she can choose between a certain income without tax planning and an uncertain one should he/she choose to engage in tax planning strategies. As in any choice under uncertainty, we show that the tax director will seek some compensation for the risks of tax planning. In this context it will be in the form of a lower ETR for the firm and a consequent increase in his/her personal income. Alternatively put, the model predicts that some firms may choose to pay marginally more taxes to avoid the risks of tax planning. We then estimate the size and significance of risk compensation from data on a large panel of multinational firms’ ETRs. We use the variability of firms’ ETRs as a proxy for the riskiness of the firms’ tax strategy. Our results suggest that there is a statistically significant trade-off between the firm’s ETR and the riskiness of its tax strategy. The amount of risk compensation is small at low levels of variability in ETRs, however, at high levels of variability firms appear to receive quantitively significant amounts of risk compensation for incremental increases in risk. These results suggest multinational firms are ‘tax optimisers’ rather than ‘tax minimisers’.

The evidence in Chapter 3 suggests that not all multinational firms will seek to minimise taxes. In fact, minimising taxes may not always be in shareholders’ best interests. At the same time, the fact that shareholders cannot observe the efforts of management to ensure they deliver an ETR consistent with maximising shareholder value, means that management may exert suboptimal effort to reduce corporate taxes. In Chapter 4, we show that relative performance evaluation of firms by shareholders can ensure that management act in shareholders’
best interest. In other words, we examine the multinational firm's decision on how much tax to pay when its performance is benchmarked against competitors. This is captured in a modified theory of yardstick competition. The model predicts a positive correlation across the ETRs of similar firms. We test this using a spatial econometric model which relates each firm's ETR to a weighted average of similar firms. The results indicate asymmetric responses by firms. Multinationals with above-average ETRs reduce them, whilst multinational firms with low ETRs do not mean-revert. The magnitude of the reaction is quantitively small, although statistically highly significant.

Chapter 5 describes a model in which the government can discriminate between different types of foreign subsidiaries. This need not take the form of explicit discrimination but could include less rigorous enforcement of tax policy. We model the interaction between multinational firms and the government over the tax burden in a bargaining model. Our model predicts that multinational firms investing in industries favoured by the government will be able to bargain for a lower ETR on profits. We test this prediction using a large sample of foreign subsidiary data. We elicit government preferences for specific industries using unique survey data. We find that, on average, foreign subsidiaries in 'targeted' industries bargain for 1 percent lower ETRs. However, when we allow the intensity of targeting to vary with the statutory tax rate (STR) of each country, we find that subsidiaries in target industries have substantially lower ETRs in high STR countries. In contrast, low STR countries appear able to extract economic rents from foreign investments in target industries.

Finally, some house-keeping notes are worth mentioning. The focus of this thesis is on multinational firms since they are an important feature of tax com-
petition. Therefore our theoretical and empirical analysis is always framed with multinational firms in mind. In particular, the data used in the empirical parts of this thesis comprise only of consolidated multinational firm accounting data (Chapters 3 and 4) or unconsolidated subsidiary-level accounting data (Chapter 5). Where we refer to these entities as ‘firms’ it should be clear whether we are referring to either the consolidated multinational firm, multinational firms’ subsidiaries or both. Tax planning is broadly defined in this thesis as all actions taken towards the amount of taxation paid by the firm. In this definition, we include tax avoidance, tax evasion and all tax strategies adopted by firms. The agents responsible for firms’ tax strategy are referred to either as managers (in the terminology of the corporate finance literature) or tax directors (a more specific description used in the corporate sphere). Finally, the key variable of interest in this thesis is the firm’s effective tax rate (ETR) measured annually from company financial statements. Therefore, in Appendix A, we provide a discussion of the definition of the ETR and assess its merits and limitations in the context of this thesis.
Chapter 2

Tax Planning by Firms and Tax Competition by Governments

2.1 Introduction

We begin this chapter with a brief review of the canonical tax competition model. The adverse welfare consequences of tax competition identified in this model provides the motivation for further study of this phenomenon. We relate the predictions of the tax competition model to the observed trends in corporate tax reforms. In particular, the trend of simultaneous tax rate cutting and tax base broadening documented by Devereux (2007). These estimates of developments in the tax burden indicate an important role for multinational firms in explaining international tax reforms.
We then review some recent studies which investigate the relative importance of tax planning by multinational firms. This review reveals the scale of options that firms have to engage in economically significant tax planning and therefore one of the interesting questions to emerge is how do firms make the decision over how much tax to pay?

The tax planning choice by firms is dealt with in a small and emergent literature termed the 'agency perspective' on corporate taxation (Desai et al., 2005). We review this literature which explicitly models the interactions between managers and shareholders in the context of the firm's corporate tax policy.

The organisation of this chapter can be summarised as a steady progression from the 'macro-models' of corporate tax competition down to the 'micro-models' of firms' decision making over tax planning. We begin in Part 2.2 with an exposition of the canonical tax competition model. Part 2.3 reviews the complementary empirical literature which tests the predictions of the tax competition model. The most recent studies reveal the importance of multinationals in explaining trends in tax policy by governments. Therefore, in Part 2.4 we review the papers which estimate the relative importance of firms' tax planning in the context of tax competition. This review reveals the role of tax planning for tax competition. We extend on this theme in Part 2.5 and consider the 'agency perspective' of corporate taxation. Finally, we draw conclusions in Part 2.6.
2.2 The Theory of Corporate Tax Competition

The literature on tax competition has its origins in an assertion by Oates (1972) when he argued that competition for business investment by governments using lower taxes may lead to an under-provision of public goods and services. His reasoning was relatively straightforward: public goods and services require financing through taxation, however higher taxes deter business investment, with the implication that the cost of raising taxes is not completely measured by the revenue collected but also includes the lower wages, lower employment and lost tax revenue. The additional costs of higher taxes represent a fiscal externality and their presence means that the marginal cost of public good provision is now higher, and the level of provision lower, compared to a situation in which business investment could not relocate. These insights provided the foundation stone for the canonical model of tax competition developed simultaneously by Zodrow and Mieszkowski (1986) and Wilson (1986), and hereafter referred to as the Zodrow-Mieszkowski-Wilson model.

The Zodrow-Mieszkowski-Wilson model is composed of a large number of identical regions, representing countries or jurisdictions. The regions are all populated by the same number of identical individuals and we assume that labour is immobile, so there is no emigration or immigration between countries. Each agent has an endowment of capital which is used in production and enters the production function with decreasing marginal productivity. The representative agents have private consumption comprised of labour income from working and capital income from the after-tax rate of return they earn on their individual endowment of capital. Each agent gains utility from private consumption and also from a public good produced by the government.

The government finances the provision of the public good through a tax on the capital employed in production. Therefore, the government faces a budget
constraint such that the level of public good provision cannot exceed tax revenue. Of course, the government can alter the rate of tax to provide varying levels of public goods and services. We assume that the government is benevolent and sets the tax rate on capital to maximise the representative agent's utility.

If capital is fixed and cannot easily be relocated then the tax levied on capital is equivalent to a lump sum tax and the cost of increasing public expenditure by one unit is exactly equal to the change in the agents' private income which is now lower by the same amount. Since the government acts benevolently on behalf of the agents, it will pursue increases in public expenditure (and therefore increases in capital taxation) so long as the marginal utility of public spending to the agent is in excess of the marginal utility of private expenditure. The optimum point is that at which the marginal utility of public and private spending is equal and this will determine the optimum level of public goods and services provision. The government will therefore increase the tax rate on capital until this optimal point is reached.

This conclusion changes significantly once we allow capital to be mobile across the regions. Now, given that each agent can invest their capital endowment domestically or abroad they will choose the destination which offers the highest after-tax return on capital. Furthermore, any region which increases the tax on capital income will only be able to sustain its current stock of capital if this is followed by an equal increase in the gross rate of return on capital in order for the after tax return to equal the world interest rate. However, since no one region can influence their rate of return (they are all small regions) the equalisation of returns takes place through a capital outflow. The aggregate capital stock of the region is reduced, thus increasing the marginal productivity of capital until such a point as outflows of investment have equilibrated the domestic after tax rate of return with the world interest rate.
The equalisation of the return on capital is not without consequence. In particular, there are two consequences which will impact on the economic welfare of the agents in the higher tax region. Firstly, the aggregate capital stock will be lower. This means that the marginal product of labour is lower, implying a reduction in the wage rate or an increase in unemployment. To the extent that lower wages and/or unemployment reduce the amount of private consumption that the agent can undertake, the agent's utility is lower. Secondly, since capital has exited the region there is now a smaller domestic capital stock from which to collect taxes. Excepting the higher rate collected on inframarginal units, tax revenues will now be lower with the consequent negative impact on public good provision by the government. When capital was not mobile between regions, these two costs were not present and a higher tax rate translated one-for-one into a reduction in the after-tax return to capital. There was no reduction in the aggregate capital stock and thus wages and tax revenues were not reduced. However, with mobile capital, when the government increases the tax rate the relationship between increased public good provision and the reduction in private spending is no longer one-for-one. Instead, each unit of public good expenditure now costs more than a unit reduction of private expenditure. That is, the marginal cost of public funds (MCPF) is greater than unity.

Mindful of the fiscal externalities from tax policy, governments will set the tax rate where the marginal cost of increasing public expenditure by one unit (the MCPF) is equal to the increase in marginal utility from switching resources from private spending to public spending through an increase in the tax rate. However, since the MCPF will be greater than unity, the marginal utility of public spending must be larger than the marginal utility of private consumption in equilibrium. This is the source of inefficiency in the model and captures how under capital mobility, governments will set taxes at a lower level than is
sufficient to provide the welfare-maximising level of public goods.

The Zodrow-Mieszkowski-Wilson model captures the concerns of policymakers that the increase in international capital mobility observed in the post-war period will limit their ability to provide public goods and services. Furthermore, an extension of the model to allow for strategic interaction between governments in tax-setting has captured fears of the much vaunted ‘race to the bottom’ in corporate tax rates. Strategic interaction in a tax competition model depends on the number of countries being relatively small. The implication of a smaller number of countries is that these countries are now able to affect the after-tax return to capital which was previously taken as given by each country. As a result, the capital stock in any given country is affected not only by its own tax rate but by the tax rate of all other countries. Because the impact of a change in the tax rate depends on tax rates elsewhere, the optimal value depends on these other tax rates. Therefore, we have a reaction function which gives each region’s best response to the choices of the other regions (see, for example, Devereux et al., 2005).

There have been a variety of other extensions to the basic Zodrow-Mieszkowski-Wilson model. These have included asymmetric countries, more than one tax instrument, Leviathan policymakers and Tiebout models. Since the contribution of this thesis is not in the domain of country-level models of tax competition we refer the reader to the comprehensive reviews in Wilson (1999) and Fuest, Huber and Mintz (2003).
2.3 Empirical Evidence on Corporate Tax Competition

The Zodrow-Mieszkowski-Wilson model presents an empirically testable prediction: if capital mobility increases we should observe a decrease in the tax rate on capital. It is also possible to estimate a reaction function to test models of strategic interaction between governments. We begin our review of the empirical literature by examining evidence for changes in capital mobility, the pre-condition for tax competition in the Zodrow-Mieszkowski-Wilson model. Both direct and indirect evidence suggests that capital mobility has increased, particularly since the 1980s. We therefore turn to evidence for the consequent reductions in corporate tax rates which are predicted by the model. Measuring corporate tax rates emerges as a significant issue in empirical studies. However, by using stylized models of the effective tax rate it is possible to isolate some evidence of specific reforms in corporate taxation coincident with the trend of increasing capital mobility. The nature of these reforms point to a more nuanced interpretation of the Zodrow-Mieszowski-Wilson model which must incorporate discrete investment choices by multinational firms.

Trends in Capital Mobility

An increase in capital mobility is a precondition for tax competition in the Zodrow-Mieszkowski-Wilson model. The first issue for empirical studies therefore is to establish a measure of changes in capital mobility. This is surprisingly difficult as it is not clear how we should best define capital mobility. Several studies use an index of openness to capital flows such as the 14 point scale developed by Quinn (1997). These indices attempt to capture the decline of capital controls and the ease of foreign investment. In general, they show an increase in openness since the 1980s.
Alternative evidence from capital mobility can sourced from observed capital flows. Navaretti and Venables (2004) calculate an index of the change in FDI inflows, world GDP and exports since 1970. As shown in Figure 2.1 (replicated from their book), inflows of FDI grew much faster than either trade or income. This trend has been particularly marked in the period since 1985. Between 1985-1999, worldwide real GDP increased at an annual rate of 2.5%, worldwide exports by 5.6%, whilst worldwide real inflows of FDI increased by 17.7%.

Trends in Tax Rates

Empirical studies must also choose a measure of the corporate tax rate. The Zodrow-Mieszkowski-Wilson model specifies that the appropriate tax rate is the marginal tax rate. From an empirical perspective it is not clear which measure of the marginal tax rate should be examined. The statutory tax rate captures the proportion of an additional unit of capital income that will be appropriated as taxation, and in this way it approximates the marginal tax rate. However, the statutory tax rate alone does not capture the multitude of additional features of the tax code which can impact on the marginal tax rate. Specifically, tax reforms may be either (a) structural or (b) parameter adjustments (Griffith and Klemm, 2004). Structural tax reforms refer to changes in the principle of taxation such as how foreign income should be taxed, whether interest should be deductible, whether capital allowances should be given etc..., and structural reforms are relatively rare. Parameter adjustments specify the exact nature of the tax code, delineating the rate of taxation, the proportion of capital allowances etc...To capture these elements of tax reform researchers have typically opted to calculate an effective tax rate (ETR) which more closely captures the tax rate and tax code. One of the earliest attempts at calculating an ETR was by King and Fullerton (1984). Their method is consistent with the Zodrow-Mieszkowski-Wilson model in that they calculate a marginal tax rate.
based on a neo-classical model of investment where the firm increases investment up until the point where the marginal cost of capital is equal to the marginal product of capital.

Devereux, Griffith and Klemm (2002) calculate estimates of the effective marginal tax rate (EMTR) for EU and G7 countries over the last two decades. Following King and Fullerton their effective tax rate measure focuses on the effect of capital allowances on the marginal tax rate. Their estimates of the EMTR show that it has been remarkably stable since 1973. This is in direct contrast to the predictions of the Zodrow-Mieszkowski-Wilson model which predicts a fall in the marginal tax rate as capital mobility increases. Two potential explanations may be able to reconcile this seeming conflict. First, it may be that capital mobility has not increased significantly to elicit a response by governments in altering their EMTR. This is perhaps unlikely since most statistics point to an increase in capital mobility. Second, and more likely, is that the marginal tax rate does not adequately capture how governments have altered tax rates in an attempt to attract capital investment. This requires a shift away from the Zodrow-Mieszkowski-Wilson model where the emphasis is on marginal investment and towards a model that more explicitly recognises the nature of capital investments, particularly foreign direct investment (FDI).

Simultaneous tax rate cutting and base broadening

The relative failure of the EMTR to respond to an increase in capital mobility led researchers to examine more closely the underlying assumptions of the Zodrow-Mieszkowski-Wilson model. Perhaps most striking is the incongruity of the nature of capital investment in their model and the reality of foreign direct investment. Specifically, FDI is more closely approximated by a discrete and lumpy investment of capital across countries, much less so by a continuous and fluid movement of capital. Discrete capital investment suggests that the
appropriate tax rate governments will adjust to incentivise FDI will be the effective \textit{average} tax rate (EATR) rather than the EMTR. This suggests that the impact of tax is not at the margin but on average, and the EATR should be measured as the proportion of total economic rent appropriated in taxation.

Devereux, Griffith and Klemm (2002) extend the King and Fullerton (1984) methodology in order to calculate the EATR as the percentage of economic rent captured by taxation for a hypothetical investment project\(^1\). Their estimates allow us to trace major developments in the tax system across countries and over time.

The data show that the EATR has moved significantly over the period, declining in the 1980s although exhibiting more stability in the 1990s and in the more recent period. These changes have been driven by a falling statutory tax rate with a simultaneous broadening of the tax base (reductions in capital allowances). This means that the EATR for profitable projects has fallen significantly although remained stable for low or break-even projects. This trend is consistent with the desire of governments to attract multinational firms since FDI is typically in highly profitable projects due to the proprietary assets of multinational firms (see, for example, Dunning, 1981). Therefore, by lowering the statutory tax rate and reducing allowances the government can reduce the EATR of projects that are of above average profitability and increase the EATR of those projects of below average profitability. This allows the government to attract multinational investment whilst compensating by collecting more taxation from lower profitability projects. Devereux et al. (2002) provides some initial evidence that more profitable firms are more mobile. However, they also suggest that multinational firms may have greater bargaining power with gov-

\(^1\)Specifically, they consider a mature manufacturing firm that has an after-tax required rate of return of 10 percent, is subject to an economic depreciation rate of 12.25 percent for plant and 3.61 percent for buildings, allowing them to calculate the appropriate investment allowances.
ernments and may therefore have the ability to extract more favourable tax treatment than lower profitability, less mobile firms (we provide evidence for this in chapter 5).

In a similar vein, Bond (2000) interprets the rate-cutting and base-broadening trend to be the optimal tax policy reaction to the existence of mobile and highly profitable firms. In a formal model Becker and Fuest (2005) show that the optimal policy depends on how profitable mobile firms are relative to immobile firms. If the marginal firm is more profitable than the average firm in the country then a tax rate cut accompanied by a broadening of the base is optimal. The intuition is that this policy redistributes the tax burden from mobile to immobile firms and thus allows the government to retain the mobile firm without suffering revenue losses.

**Preferential Tax Treatment**

An obvious alternative for governments would be to directly discriminate between the mobile and immobile firms. However, explicit preferential taxation regimes in the European Union and OECD countries have been outlawed (EC, 1998; OECD, 1998). Despite this, it is unclear from a theoretical perspective whether the elimination of preferential regimes is optimal. Keen (2001) shows that overall tax competition may be intensified, and total revenues reduced, if governments are forced to abandon tax concessions to specific firms or industries. Janeba and Smart (2003) qualify this conclusion when the total tax base is not fixed and Haupt and Peters (2005) show that revenues need not decrease if investors have a home bias in investment. In a recent paper, Bucovetsky and Hauffer (2006) incorporate the analysis of Keen (2001) in a model of tax competition between countries of different sizes. They find that imposing non-discrimination is welfare reducing for the large and the small country, thus showing that the original result from Keen (2001) is robust.
Whilst tax legislation which offers preferential treatment to specific firms or industries has been disallowed, there remain other avenues through which preferential treatment may take place. Cremer and Galivari (2000) propose that enforcement is an additional policy instrument and include it in a model of tax competition. In their model, tax revenues are determined by both tax rates and the government's audit policy. Tax competition takes place over the tax rate and the audit probability in each country. The outcome is a suboptimal level of tax enforcement along with the standard result of sub-optimally low taxes and public good provision.

Peralta, Wauthy and Ypesele (2003) model government enforcement of arms-length transfer pricing rules. In their model, the government can give preferential tax treatment to multinationals by not enforcing the OECD arms-length principle for transactions between related parties. The authors assume that each country abides by the non-discrimination code and does not therefore directly discriminate between mobile and immobile firms. Therefore, the cost to attracting a mobile firm in the model is high as the country must lower the tax rate on all firms and thus stands to lose significant amounts of revenue. Instead, one country optimally decides not to enforce the arms-length principle in order to host a multinational firm while maintaining high taxes on the immobile firm.

Despite the theoretical advances, there is relatively little empirical evidence on the size and significance of the preferential tax treatment of firms. Vandenbussche and Tan (2005) investigate whether there is empirical evidence for tax discrimination between mobile (multinational firms) and immobile capital (domestic firms) using firm-level data on the effective tax rates (ETRs) of foreign and domestic firms in Belgium between 1993-2002. Their results reveal that, after controlling for self-selection of multinationals into low tax activities, multinational firms in Belgium have an ETR that is 73.7 percent lower than the
average ETR of a domestic Belgium firm.

Focusing on multinational subsidiaries, Grubert (2001, 2003) and Altshuler and Grubert (2004, 2005) analyse whether there is evidence of preferential treatment of subsidiaries in certain industries. They use data on corporate tax returns filed by 1,751 U.S. multinational firm affiliates for the year 1996. Using this data, Grubert et al. investigate the determinants of the subsidiaries' ETRs. They find that the statutory tax rate (STR) is an important determinant of subsidiaries' ETRs. Subsidiaries incorporated in the last five years have lower ETRs, suggesting that this may be due to incentives designed specifically for new FDI. The data are particularly well-suited to analysing the trade patterns of the affiliates, and they exploit this to investigate whether subsidiaries with potential trade benefits to a host country experience lower ETRs. This is a particularly important issue for the developing countries in the Grubert at al. dataset. They find that export-oriented subsidiaries experience significantly lower ETRs, whilst subsidiaries importing components from the U.S. receive less favourable tax treatment. They suggest that the favourable taxation of exporting subsidiaries may also be explained by the fact that they possess mobile intangibles that are more sensitive to taxes. Using data on the parent of the affiliate, Grubert et al. find that parent R&D intensity increases the tax burden on affiliates. This suggests that host governments may be able to extract some rents from R&D intensive operations that are dependent on local knowledge and skills. Finally, when a dummy variable for electronics and computers is added, the coefficient is negative suggesting that more mobile activities attract more favourable tax treatment. With respect to the latter, without data on the precise preferences of governments towards FDI in specific industries, they can only speculate on the industries which government are likely to positively tax discriminate towards.
2.4 Tax Planning by Firms

The important role of multinational firms in tax competition means that we should be aware of the role that tax plays in multinational firms' decision making. A vast quantity of research has been conducted in the last decade on how multinational firms respond to corporate taxation. These papers have studied the significance of firm location, transfer pricing, debt-shifting, royalty payments and ownership structures. As Hines (1999) notes, all of the investment, financial and organisational strategies adopted by firms, and extensively pursued in the academic literature, are motivated by one concern: the desire for the multinational firm to lower its tax burden. However, whilst these studies provide indirect evidence for tax competition, there are very few studies which assess the relative importance of the behavioural responses of multinationals compared to the tax policy responses of government in determining tax competition.

Estimating the importance of Tax Planning

In a series of papers by Grubert (2001, 2004) and Altshuler and Grubert (2004, 2005), the authors attempt to assess the relative importance of tax planning by multinational firms and tax competition by governments. Their approach is US centric and is motivated by the fall in the average effective tax rate (AETR) on US multinationals' income earned abroad. In this respect, Grubert, Randolph and Rousslang (1996) estimated that US manufacturers experienced a reduction in the AETR on their foreign source income from 36 percent in 1984 to 25 percent in 1992. They find that this downward movement is not explained by changes in income or dividend repatriation patterns, or by changes in the location of real investments, but primarily by reductions in country average

\[ \text{AETR} = \frac{\text{total tax payments}}{\text{pre-tax profits}} \]

\[ \text{EATR} = \frac{\text{total tax payments}}{\text{projected pre-tax profits}} \]

Empirical evidence on these strategies is reviewed in Hines (1999) and Devereux (2006). The AETR is an empirical measure of the tax burden on investment calculated as the ratio of tax payments to pre-tax profits. It is distinct from the EATR which is calculated for a hypothetical investment project.
tax rates which closely paralleled the reduction in the U.S. statutory corporate tax rate in 1986. Desai (1999) also finds a significant fall in the AETR of US foreign source income between 1982 and 1995. His explanation focuses on the role of the US as a large capital exporter which can trigger tax competition among neighbouring countries when it lowers its corporate tax rate. Altshuler and Goodspeed (2002) estimate tax reaction functions to test this hypothesis and find that the US tax rate, along with neighbouring countries' tax rates, can explain downward movements in individual country tax rates. These studies are broadly consistent with the other tests which find evidence of strategic tax competition.

In a significant advancement, Grubert (2001, 2004) begins a re-examination of the AETR of US firms' foreign operations by allowing for multinational firms' tax planning activities to act as an explanatory factor in reducing the foreign tax burden rather than focusing exclusively on government tax policy changes. He argues that past studies of corporate tax competition have failed to incorporate important features of both government and corporate behaviour, instead focusing on narrowly defined, hypothetical and country-specific effective average and marginal tax rates. Specifically, he contends that a failure to integrate even the simplest tax planning strategies employed by multinationals (transfer pricing and debt-shifting); ignoring the specific tax treatment of royalties and other intangible income; the use and abuse of finance affiliates; and, firm-specific tax provisions for certain firms within a country; can lead to highly misleading results on country-level estimates of the tax burden. Integrating each of these features is a complex task and Grubert's approach is to simulate them to show how their inclusion can result in widely varying tax burden estimates. For example, his simulation results find that accounting for debt shifting can lower a foreign subsidiary's AETR by more than 3 percent, whilst managing royalty

\[\text{See, for example, Devereux, Lockwood and Redoano (2005)}\]
payments can lead to an additional 2 percent reduction with an additional 1 percent available through a simple transfer pricing strategy. These simulation results point to the importance of tax planning by multinational firms in studies of tax competition, particularly when tax planning can reverse the results of the tax burdens estimated at the country-level.

Altshuler and Grubert (2004, 2005) investigate whether it is company tax planning or country tax competition that can better explain the decrease in the foreign AETR of US multinationals. They use confidential tax return data which show that the AETR for US multinationals' foreign operations fell by 12 percent between 1980 and 2000, with a particularly large drop between 1998 and 2000. They hypothesize that classic tax competition forces between countries can explain the downward trend in the AETR up until 1998, but argue that in the most recent period company tax planning has greater explanatory power. To analyse this, they split the data sample into two separate periods: 1992-1998 and 1998-2000. They test the classic tax competition model by looking for responses of countries to changes in their share of US FDI. The dependent variable is the change in the country’s AETR over the period and the primary independent variable is the percentage change in that country’s share of US FDI in the preceding period (1984-1992). They also control for the country’s initial (1990) AETR and use a dummy variable to identify small countries. This basic specification will identify tax competition if the coefficient on the change in capital share is negative since this suggests that it was those countries which lost most FDI that subsequently responded by reducing their AETRs. The results corroborate their prediction and the coefficient estimate on the country’s change in US FDI share is negative suggesting a classic tax competition result. In addition, those countries with higher initial tax rates cut the tax burden on US investment the most. The small country dummy variable indicates that those
countries facing a more elastic supply of US FDI also lowered their rates more than the average country. Therefore, for the period 1992-1998, the authors conclude that tax competition can explain the fall in the foreign income tax burden.

Altshuler and Grubert then extend the period of analysis to include data for the year 2000. They also include the statutory tax rate as an additional explanatory variable designed to capture multinational firms' incentives to engage in tax planning. Their reasoning is that the higher the statutory tax rate the greater is the incentive for the company to strip income out of the country, and therefore the extent to which company responses can explain decreases in the country's AETR will be estimated by the coefficient on the statutory tax rate. Specifically, if country tax-setting behaviour is driving the AETR reductions then we would not expect the statutory tax rate to be correlated with changes in the AETR. Countries with high statutory tax rates and low AETRs would not find it pressing to lower their AETR to attract investment and therefore the initial statutory tax rate should not be a significant explanatory variable unless company tax planning is important. The regression results suggest that whilst the statutory tax rate is unimportant in the early period, it is quantitively and statistically significant in explaining the change in the AETR in the most recent period (1998-2000).

In a further examination of tax planning by US multinationals, Altshuler and Grubert (2005), estimate that by 2002 multinational firms were saving approximately $7 billion per year by using tax planning strategies, which amounts to 4% of the FDI income of these companies, and 15% of their foreign tax burden. In addition, they find that the AETR of US foreign subsidiaries has become less correlated with the statutory tax rate of the local country over time, suggesting the rising importance of tax planning in determining tax burdens. It appears that
tax planning by firms may becoming a more important dynamic than tax competition between countries, however more detailed research is needed to bolster this conclusion.

Methods of Tax Planning

There is also evidence that tax planning encompasses a much broader range of activities than those studied in the extant literature. Furthermore, these alternative methods of tax planning appear to be at least as significant in terms of reducing tax burdens. Our limited knowledge of these tax planning schemes is largely due to the confidential nature of tax strategies and tax investigations which make it difficult to glean information about the variety of methods companies use to shield income from taxation. However, a recent paper by Graham and Tucker (2005) provides a fascinating insight into 44 tax shelters used between 1975 and 2000. They find that the median shelter provided an annual tax shield for the firm of $350 million which equates to a deduction of more than $1 billion per year or 9 percent of total asset value. This gives an idea of how economically significant tax planning by firms is.

In some exploratory regressions, Graham and Tucker find that larger, more profitable and more R&D intensive firms are the ones more likely to use a tax shelter. These determinants are consistent with results from Desai, Foley and Hines (2006) who find a similar set of variables determines a multinational firm’s tax haven activity. However, Graham and Tucker also point to the risks of tax planning with an example of GlaxoSmithKline and the IRS’s demand that it owes the government $5.2 billion in back taxes and penalties related to a transfer pricing strategy dating back to 1989 (Chapter 3 examines the trade-off that multinational firms make between risky tax planning and a lower ETR).

\(^5\)See Hines (1999) and Devereux (2006) for a review of these methods.
Determinants of Firms' ETRs

Returning to a more broader examination of the tax burden on firms, there is a complementary literature in the field of accounting which investigates the determinants of firm-level ETRs. Gupta and Newbery (1997) provide a comprehensive review of the theory and evidence in this area. Early studies were largely univariate and focused on the importance of firm size on the ETR, however more recent papers have used a multivariate approach. We first review potential determinants of ETRs before discussing the main results from the multivariate studies.

There are two competing reasons why firm size may affect the ETR of a given firm. On one hand, the political cost theory posits that larger firms are more visible and therefore more susceptible to tighter regulation and enforcement of tax rules (Watts and Zimmerman, 1986). Alternatively, it is plausible to argue that larger firms have potentially more bargaining power with government to lobby for more favourable tax treatment. Larger firms are also likely to have the ability to devote greater resources to tax planning. In this sense we may expect the firm's ETR to vary inversely with its size. A number of studies including Zimmerman (1983), Siegfried (1972), Porcan (1986) and Wilkie and Limberg (1990) have investigated this issue, however, there is no consensus among the results that have emerged. This may be not least due to the univariate nature of these studies in which important correlated variables are omitted from the analysis.

Other potentially important determinants of firm-level ETRs are those relating to the financial characteristics of firms. For example, we might expect that firms with higher leverage ratios will have lower ETRs due to the tax deductibility of interest payments versus non-deductible dividends. Firms that are more capital intensive may also have lower ETRs since the tax system typically
provides capital allowances which permit a portion of the total capital investment to be written off against taxation. To the extent that other firms may be more intensive in intangible assets they may face a comparatively higher tax burden as there is no such provision for writing off intangible assets. Although in the case of multinational firms, intangible assets may permit greater tax planning latitude as they are more easily shifted between jurisdictions compared to capital goods. A firm’s foreign operations may also be an important determinant of its ETR since these operations may be in countries which have a tax rate that is either above or below the domestic tax rate. Ownership structure may also influence the ETR of the firm in the sense that when managers have greater ownership they have stronger incentives to reduce tax expenses in order to increase cash flows available to shareholders. Managers are also likely to face high powered incentives to reduce the ETR when their compensation is linked to the post-tax earnings performance of the firm. In both these cases, managerial incentives may directly impact ETRs. Finally, it is possible that some corporations will have a more aggressive policy towards tax minimisation. Since tax avoidance presents risks as well as rewards, the culture of the organisation towards this tradeoff can be an important determinant of the firm’s ETR.

Gupta and Newbery (1997) test a number of determinants of firm-level ETRs using a balanced panel of 655 US firms observed between 1982-1985 and 1987-1990, the two sides of the Tax Reform Act (TRA) 1986 in the US. They measure the ETR as the ratio of tax expenses to book income and include the following explanatory variables: firm size (natural logarithm of total assets); leverage (ratio of long term debt to total assets); capital intensity (percentage of property, plant and equipment in total assets); inventory investment (inventory as a proportion of total assets), R&D intensity (R&D expenses to Net Sales) and finally, the return on assets (defined as pre-tax income divided by total assets). The
results suggest that the fixed effect explains a significant portion of the variation in ETRs. Among the explanatory variables, the return on assets is positive and significant suggesting progressivity in the corporate tax system. The effect of size is positive and significant pre-TRA 1986, with the reverse effect post-TRA 1986. Leverage was negative and significant as expected, as was capital intensity. Inventory investment was negative and significant, indicating that those firms more intensive in inventories of goods as opposed to capital investment (e.g. retailers and wholesalers) face higher taxes as a result. These results are also robust when the sample is split by industry and the equation re-estimated.

Mills, Erickson and Maydew (1998) examine the effect of firms' investments in tax planning on firms' ETRs. They regress the firm's ETR on independent variables including the investment in tax planning, firm size, a dummy variable if the firm has foreign assets, a leverage variable, the level of fixed assets and the inventory intensity of the firm. They find that greater investment in tax planning and higher leveraged firms have lower ETRs. They find that foreign assets are associated with higher ETRs and that size has a negative impact.

Some papers have focused exclusively on multinational firms. Among these papers is Rego (2004) who uses a sample of over 5,000 multinational firms to test three hypotheses: first, do the worldwide ETRs of multinationals vary by size? Second, do firms with greater pre-tax income avoid proportionately more tax than lower income firms? Thirdly, are more extensive foreign operations correlated with the multinational firm’s ETR? The results indicate that larger and more profitable multinational firms with more extensive foreign operations have lower ETRs.

More detailed studies are provided by Harris (1993) and Klassen et al. (1993) using public data on a cross-section of US multinationals. They focus on the effects of the TRA 1986 and investigate how multinationals responded by exam-
ining recorded tax payments. However, Shackelford (1993) concludes that both these studies use tests which lack power and therefore cannot determine whether multinationals do use income shifting techniques to lower their worldwide ETR. Whilst these studies are useful in identifying what factors may determine ETRs, the results are subject to significant endogeneity bias as the firm’s ETR and several of the explanatory variables will be jointly determined thus biasing the OLS coefficients. Therefore, as Dyreng, Hanlon and Maydew (2005) note, they can only be interpreted as 'exploratory' results.

2.5 Agency Models of Corporate Taxation

In this part, we examine how firms make choices over the level of tax planning to engage in. We begin by reviewing some survey evidence on the role of taxation within the firm. In order to understand how tax planning choices are made, we outline the seminal tax evasion model by Allingham and Sandmo (1972). This describes how individuals make decisions about how much tax to pay. We then discuss how this model can be used to illuminate the firm’s choice over tax planning. The most recent models of corporate tax planning explicitly model the separation of ownership and control in a principal-agent version of the Allingham-Sandmo model. These models are discussed along with some evidence in their support.

There is substantial anecdotal and survey evidence that the role of the corporate taxation within the firm has changed in the recent period. This has seen the corporate tax department shift tack from a compliance centre to a profit centre. Hollingsworth (2002) conducted a survey of tax departments in the manufacturing sector to elicit the role of taxation. She found that 86 percent of survey respondents cited the most common method of evaluating the performance of the tax department as the savings they achieved. Of these, 63 percent
said that this measure directly impacted the compensation of tax department personnel. The ETR was also a key performance measure, cited by 58 percent of respondents, and of these, 58 percent indicated that it was also important in determining their compensation. Phillips (1999) also provides evidence that managerial compensation contracts are often specified such that managers earn a bonus for achieving lower ETRs, and finds a relationship between these compensation contracts and firms' ETRs.

The modern economics literature on tax avoidance and evasion provides a useful conceptual framework for analysing the role of taxation within the firm. In a seminal paper, Allingham and Sandmo (1972) modelled how an individual decides how much tax evasion to undertake as a choice under uncertainty. In their model the individual maximises his/her expected utility by engaging in an optimal amount of tax evasion given the probability of being caught and penalised; the size of the penalty if caught; and, the individual’s degree of risk aversion. A similar conceptual approach can be useful in the context of a firm deciding how much tax evasion to undertake, and it provides a useful framework for thinking about (legal) tax avoidance and compliance issues too⁶. In this sense, companies choose how much legal tax planning they are willing to undertake. This is sometimes termed ‘creative compliance’ and it is facilitated by a complex tax code which is subject to interpretation. Thus firms can choose how aggressively they wish to interpret the tax code in their own favour and how much they wish to seek tax advantages in the law that were not anticipated by legislators.

Assuming that the probability of detection and penalty for non-compliance is constant, firms will still differ in their tax burdens as the preferences of managers or shareholders for aggressive tax planning will vary across firms. Some tax

⁶For a review of models of corporate tax evasion from an industrial organisation perspective, see Cowell (2004).
payers may choose an amount of avoidance and/or evasion consistent with their sense of duty or a perception of fairness. However, as Slemrod (2003) notes, it is unknown how much corporate tax compliance is motivated by a sense of civic duty. Furthermore, a manager's own preferences should not take priority over maximising after-tax cashflows for shareholders. This is essentially the argument by Friedman (1970) who would view managers which do not seek and use all legal avenues to minimise the tax burden on profits as essentially giving a gift to the government. This is not optimal, however, since if shareholders wished to make a donation to the government they can do so individually and should not be compelled by the actions of the firm. Despite this, it is not always the case that tax minimisation will unquestionably increase shareholder value. Aggressive tax strategies may damage a firm's image in the eyes of customers and/or investors and thus there may be an optimal amount of tax planning to maximise shareholder returns.

The existence of a separation of ownership from control is one feature of corporate tax planning that is not part of the Allingham-Sandmo model. Recent theoretical models have used the principal-agent framework to gain insights into corporate tax compliance. These models have been grouped under the title 'agency perspective on corporate tax avoidance' or the 'corporate governance view of taxation'. Chen and Chu (2005) were the first to investigate corporate tax evasion in a principal-agent model. Their focus is specifically on tax evasion, and the illegal nature of this activity drives the predictions of their model. Specifically, they model a situation in which the firm owner (principal) must design a wage contract to incentivise the manager (agent) to engage in unobservable and costly effort to increase after-tax profits. An efficient contract would involve state-contingent payoffs such that the manager gets a higher wage when he/she exerts effort and receives additional compensation if they are
caught for tax evasion and subject to penalties. However, including a payoff in the contract for illegal activity is not feasible since the contract would not be enforceable ex-post as it is predicated on an illegal act. As a result, the manager must be compensated ex-ante in his wage contract. This makes the contract incomplete in the sense that the agent's pay will be the same regardless of whether tax evasion is detected or not and it thus plays the double role of rewarding effort and the risk of tax evasion. As a consequence, there is a distortion to the agent's incentive to exert effort and a resultant loss in efficiency. The implication of this model is that even if the expected tax savings from evasion are positive, the principal will not necessarily choose to evade taxes since the efficiency loss from incentivising tax evasion may outweigh the potential benefits.

Crocker and Slemrod (2005) also use a principal-agent model to capture the contractual relationship between the shareholders of the firm and the Chief Financial Officer (CFO) who will determine the firm's tax policy. They assume that the CFO has private information about legal tax avoidance opportunities and also has discretion to engage in (illegal) tax evasion. The choice that the CFO makes over engagement in tax evasion and avoidance will be determined by the incentives in his compensation contract with shareholders. Shareholders should optimally design the CFO's compensation contract such that he will reduce the company's effective tax rate net of the costs of penalties if tax evasion is detected. Crocker and Slemrod (2005) characterise the optimal contract and use their model to determine how the contract changes when the penalties are imposed on shareholders versus directly on the tax director.

The empirical evidence on corporate tax evasion or non-compliance is relatively small. In one of the first comprehensive studies, Hanlon, Mills and Slemrod (2005) use confidential Inland Revenue Service (IRS) audits and appeals
data merged with tax returns to estimate the relationship between noncompliance and the characteristics of the firms detected. They find that larger firms are less likely to be compliant, and suggest that this is consistent with the fact that larger firms have more opportunities available for tax non-compliance. They also find that a greater proportion of intangible assets predicts increased levels of non-compliance. This finding is consistent with the evidence in Grubert and Slemrod (1998) in which they find that Puerto Rican subsidiaries of US parents with more intangible assets engage in greater amounts of transfer pricing.

In a paper which investigates managerial preferences for tax evasion, Joulfaian (2000), finds that compared to compliant firms, non-compliant firms are 3 times more likely to be managed by executives who have understated their personal income taxes. His dataset is a matched sample of corporate and personal income tax returns for US firms in 1987. Joulfaian uses a Tobit regression model to identify the determinants of non-compliance. He finds that, apart from the positive relationship between personal and corporate non-compliance, firms with higher marginal tax rates are also more likely to be non-compliant. In addition, he finds that the size of non-compliance is significantly greater for these executives. And, in a similar result to Hanlon, Mills and Slemrod (2005), he finds that larger firms are also less likely to be tax compliant.

Desai, Dyck and Zingales (2003) investigate another dimension of corporate tax compliance as it relates to corporate governance. Their focus is on the complementarity between tax avoidance or evasion and expropriation of firm income by managers. Specifically, they present a model which focuses on managerial opportunism in the context of diverting resources from shareholders to themselves. Desai et al. begin by arguing that engaging in tax avoidance necessarily means complicating the operation of the business if the firm is to successfully avoid detection. Managers will not wish to reveal to shareholders how they
have lowered the tax burden for fear that they will get detected, and even if they were to reveal the mechanism, the mechanics of the tax evasion method may not be comprehensible to the average shareholder. In this way, tax avoidance provides managers with the opportunity to divert earnings, manipulate earnings or conceal obligations of the firm in order to enrich themselves. Therefore, undertaking tax avoidance can reduce the costs of managerial diversion of resources or reduce the likelihood that they will be detected.

Desai and Dharmapala (2004) extend this argument by developing a simple model that analyses how greater manager incentive compensation affects the amount of tax sheltering activity and managerial rent-diversion. They find that the impact of an increase in incentive compensation depends on the extent of 'technological complementarities' between diversion and sheltering. The two activities are complementary if the costs of diversion to the manager are lower when tax sheltering is higher (and vice-versa). Thus the nature of the complementarity between these two activities determines how managerial incentives translate into greater or less amounts of tax sheltering and rent-diversion. Whilst this prediction for the impact of high-powered incentives is ambiguous since it is dependent on the complementarities, Desai and Dharmapala suggest that for firms with good corporate governance, a manager with stronger incentive compensation will engage in greater amounts of tax avoidance. The intuition is that managers will be more focused on increasing firm value when incentive compensation is used, and crucially, the better governance structures at the firm mean that there is a more favourable trade-off between the positive and negative impact of tax sheltering for a given level of complementarity for the better governed firm. In a sample of 943 US firms, the authors find that increases in incentive compensation tends to reduce the level of tax sheltering and the link between incentive compensation and sheltering is mediated by the
corporate governance characteristics of the firm.

In all of these models it is assumed that there is an elastic supply of tax evasion or avoidance opportunities. However, it is worth noting the increased availability of sophisticated financial instruments which facilitate aggressive tax planning (Slemrod, 2003). Slemrod suggests that this has been aided by the consolidation of the largest accountancy firms which are able to spread the fixed development costs of tax-saving products over a larger number of clients.

2.6 Conclusion

This chapter has traced the development of the literature on corporate taxation from the 'macro-models' of corporate tax competition to the more 'micro-models' which investigate how individual firms make tax planning decisions. Our objective has been two-fold: first, to demonstrate the importance of multinational firms in studies of tax competition; and second, to review the current knowledge of how multinational firms may make tax planning decisions. Our view is that understanding the role that taxation plays within the multinational firm is critical to understanding tax competition more broadly.

To this end, in the next chapter, we investigate how multinational firms weigh the risks of tax planning against the benefits of a lower ETR. In chapter 4, we show that competition between firms means that an important determinant of the multinationals ETR is likely to be the movements in the ETR of it's closest competitors. Chapter 5 investigates the interaction between multinational firms and governments when there is bargaining over the ETR of a subsidiary's profits and governments have preferences for certain industries.
Figure 2.1: Trends in World GDP, exports and FDI inflows

Notes:

1. The data are index numbers set equal to 100 in 1970 and transformed into a logarithmic scale.

Chapter 3

The Risks and Rewards of Corporate Tax Planning

3.1 Introduction

Understanding the role of taxation within the firm is important to determine the likely scope and scale of tax competition. The decisions that managers make with respect to tax planning can have a direct impact on tax revenues and on economic welfare more broadly. Recent survey evidence collected from tax directors suggests that the firm's effective tax rate (ETR) is a key performance measure and that evaluation of the tax function and the compensation of tax personnel is directly related to firms' ETRs (Hollingsworth, 2002; Phillips, 2003). This provides an incentive for tax directors to lower their firm's ETR and thus will be a first-order impetus for tax competition.

However, reducing the ETR is not costless and this perhaps explains why there remain significant disparities in the ETRs of firms which persist over time\(^1\).

\(^1\)See, for example, the long-run firm-level ETRs presented in Dyreng, Hanlon, Maydew, 2006.
In particular, the risks of tax planning mean that uncertainty over future tax liabilities may limit efforts to minimise the firm’s ETR. Recent survey evidence found that nearly 75 percent of a sample of 474 tax directors cited controlling ‘tax risk’ as an important measure of their performance (Ernst & Young, 2006). Furthermore, it found that since the last survey in 2004, 54 percent of tax directors said they have become more risk averse. Therefore, to understand the role of taxation within the firm we must be cognisant of both the risks and rewards of the various tax strategies available.

The rewards from tax planning emanate from the numerous provisions and incentives in the tax code that allow, and often encourage, firms to reduce corporate taxes. There are many areas in which the law is complex and open to alternative interpretations. This allows firms to choose how aggressively they wish to interpret the tax legislation. Furthermore, multinational firms, by the nature of their international activities, have greater scope for tax planning opportunities by exploiting cross-country differences in tax systems. The risks, however, range from imprisonment or severe penalties for evasion (e.g. ENRON) to the requirement to restate earnings and pay taxes deemed not paid. For example, in 2005, the Inland Revenue Service (IRS) in the US claimed that GlaxoSmithKline Plc., owes $5.2 billion in back taxes and penalties related to a transfer pricing strategy dating back to 1989 (Graham and Tucker, 1999). There is also evidence that the greater uncertainty attributable to aggressive tax planning may have negative implications for firm value (Hanlon and Slemrod, 2007).

In this chapter, we directly model the choices of tax directors in determining the firm’s ETR. We use a model of choice under uncertainty to capture the risks associated with tax planning. The tax director’s income varies (inversely) with the firm’s ETR. He/she can choose between a predictable ETR when no tax
planning is engaged in, or to engage in tax planning in an effort to reduce the ETR and thus boost his/her income. In the latter case, the decision to engage in tax planning means that the ETR is no longer predictable as the outcome of tax planning is uncertain. As a result, the tax director will only bear this ‘tax risk’ if the expected savings from tax planning are sufficiently positive to compensate for the risks they are taking. We show that the risk compensation required will vary positively with the expected variability of the firm’s ETR. Aggressive tax planners can expect to experience greater variability in their firm’s ETR (and thus in his/her personal income) and thus they will require a larger risk premium (in the form of a lower ETR and thus higher personal income) to participate in aggressive tax planning. Conversely, some tax directors will choose to forfeit potential tax savings and instead deliver a higher, although more predictable ETR, and thus earn a lower, although less risky, personal income.

We test for evidence of a risk-return trade-off in tax planning using a large panel of multinational firm-level ETRs spanning the period 1996-2005. Our aim is to estimate the risk premium derived from the theoretical model. That is, we aim to estimate the gradient of the trade-off between the level and variability of firms’ ETRs. We proxy for risk by using the coefficient of variation\(^2\) of each firm’s annual ETR. This measure enters as an explanatory variable in an empirical model of firms’ ETRs.

Our results suggest that there is a non-linear tradeoff between firms’ ETRs and their variability. Specifically, we find that the level of risk compensation is small for small increases in the variation of ETRs, however, it increases at a non-linear rate such that large increases in the variability of ETRs are compensated with statistically significant lower ETRs. This is consistent with the notion that some ‘natural’ variability in ETRs is to be expected and is not likely to attract risk compensation, whilst significant variation in ETRs is compensated

\(^2\)Otherwise termed ‘unitized risk’.
with lower ETRs.

The rest of this chapter is organised as follows: In part 3.2 we propose a simple theoretical model of the risk premium related to firms’ ETRs. In Part 3.3 we describe an empirical strategy to estimate the size of the risk premium from a large dataset of firm-level ETRs. Part 3.4 presents the results and we conclude in Part 3.5.

3.2 Theoretical Motivation

Our theoretical model is predicated on the observation that there are both risks and rewards to tax planning. We explicitly model the firm’s tax director who is responsible for the firm’s ETR and is rewarded commensurately with his/her success. Thus, the tax strategy of the firm is determined by the preferences that the tax director has over his/her own personal income. The tax director decides the degree of tax planning the firm will engage in. We assume that the tax director chooses between engaging in tax planning or no tax planning. Tax planning is a risky endeavor, and as such, the firm’s ETR and therefore the tax directors personal income will be uncertain. In contrast, when no tax planning is undertaken we assume the firm’s ETR is certain and so too is the tax director’s personal income. Therefore, we model the tax director’s decision as a choice between a non-stochastic level of personal income $Y$ versus a stochastic level of personal income $\tilde{Y}$ where $\tilde{Y} = Y + \epsilon$; $E(\tilde{Y}) = \mu$ and $\epsilon \sim (0, \sigma^2)$. Thus a shock ($\epsilon$) to the firm’s ETR caused by either a positive or negative assessment of the firm’s tax planning efforts will directly impact on the tax director’s income.

If the tax director is (globally) risk averse such that his von-Neumann-Morgenstern utility function is strictly concave at all income levels, then he/she

\footnote{Sometimes referred to as the firms tax planning 'aggressiveness' (see Hanlon and Stenbrod (2007).}
must be offered a risk premium for accepting the risks of tax planning. Alternatively put, he/she will be willing to accept a lower income in order to avoid the risks of tax planning (similar to paying an insurance premium). The absolute risk premium (\( \pi \)) will be the difference between the expected income of the tax director under tax planning and the non-stochastic income when no tax planning is undertaken:

\[
\pi = E(\bar{Y}) - \bar{Y}
\]  

(3.1)

Thus the tax director engaging in risky tax planning receives an expected income which exceeds that of the non-tax planning tax director by \( \pi \). The term \( \pi \) represents the expected compensation for the more variable income of the tax director engaged in tax planning. Alternatively, it can be interpreted as the extra amount of income the non-tax planning tax director is willing to forfeit to avoid the uncertainty of tax planning.

We define the utility function of the tax director as a continuously differentiable function of the tax director’s income \( U(Y) \) with \( dU/dY > 0 \) and \( d^2U/d^2Y < 0 \) assuming risk aversion. The non-stochastic amount \( (\bar{Y} - \pi) \) is the certainty equivalent of the risky outcome \( (Y + \epsilon) \). That is:

\[
E(u(Y + \epsilon)) = u(\bar{Y} - \pi)
\]

(3.2)

To solve for the amount of risk compensation (\( \pi \)) we follow Pratt (1964) and take a Taylor expansion around the expected utility of \( Y + \epsilon \) up to the second order:

\[
Eu(Y + \epsilon) \approx Eu(Y) + Eu'(Y)(\epsilon) + \frac{1}{2} Eu''(Y)(\epsilon)^2
\]

(3.3)
\[ E(u(Y)) \approx u(E(Y)) + \frac{1}{2} \epsilon^2 u''(E(Y)) \]  

(3.4)

And, similarly we can take a Taylor expansion around the utility of the certainty equivalent \( u(\bar{Y} - \pi) \):

\[ Eu(\bar{Y} - \pi) \approx Eu(\bar{Y}) + Eu'(\bar{Y})(\pi) \]  

(3.5)

By the definition of the risk premium given earlier it must be the case that Equation (3.4) and Equation (3.5) are equal. Furthermore, since \( \text{Var}(\epsilon) = E(\epsilon)^2 - (E(\epsilon))^2 = E(\epsilon)^2 \) we can solve for the risk premium:

\[ \pi = \frac{1}{2} A \sigma \]  

(3.6)

where \( A = -\frac{u''(\mu)}{u'(\mu)} \) the degree of absolute risk aversion and \( \sigma = E(\epsilon)^2 \).

This is the standard equation for a risk premium as derived by Pratt (1964) and Arrow (1965). In the context of our model, the risk premium identified in Equation (3.6) represents the difference in the expected ETR of firm’s engaged in tax planning versus those which are not. Ceteris paribus, the difference in the ETRs of these firms will be increasing in the expected variability (\( \sigma \)) of the firm’s ETR. Thus we can estimate the size of the risk premium using a measure of the variability of the firm’s ETR.

### 3.3 Empirics

We now consider how to operationalise an empirical model to estimate the size of the risk premium identified in Equation (3.6). We first discuss the data used in this chapter, before describing the empirical strategy adopted.
3.3.1 Data

Data Source

The firm-level data is extracted from the AMADEUS database. The version of this database we use provides standardised company accounts covering over 1.5 million European firms over a ten year period from 1996-2005. The raw data are collected from legal filings by companies in each country and as such the coverage of all firms is estimated to be above 95 percent, and likely even higher in the case of large firms. An important advantage of using the AMADEUS dataset for this study is that it allows us to identify the ownership patterns of firms and thus identify multinational companies.

Sample Selection

To maintain as complete coverage of firms as possible we set minimal criteria for the extraction of observations from the AMADEUS database. In the first instance, consistent with the motivation behind this thesis, we extract only those firms which are multinationals. To ensure we have the complete financial accounts for the multinational firm we use only consolidated accounts. Imposing this criteria we identify a total of 27,371 European multinational firms, providing 148,151 firm-year observations, over the period 1996 and 2005.

\(^1\)AMADEUS is an acronym for Analyse Major Databases from European Sources. For previous papers which have used the AMADEUS dataset see Huizinga and Laeven (2005), Huizinga and Nicolaï (2005).

\(^2\)Specifically, we identify multinationals as those firms with a shareholding in at least one foreign subsidiary which exceeds 50 percent. Whilst this condition is necessary it will not be sufficient to identify the top-level multinational firm which we want to examine and may instead identify subsidiaries that are themselves foreign owners but also owned by a parent elsewhere. To ensure we locate the ‘global ultimate owner’ we specify that AMADEUS must trace backwards through the ownership tree until it locates the ‘global ultimate owner’.
Cleaning the data

The raw data must be cleaned to recode or expunge observations which are non-meaningful. In addition, we must impose some restrictions on the data to facilitate dynamic panel analysis. The key variable in this analysis is the firm’s annual ETR. This can be measured from the available company accounts as the ratio of taxes paid to profits before tax\(^6\). For some values of the numerator and the denominator, the ETR will be undefined and/or meaningless. For all cases where profits before tax are zero there is no defined ETR and no obvious construct that would approximate it. In cases where tax payments are zero the ETR is also undefined, however, the ETR is very obviously zero in this case and therefore we recode these observations to reflect this. Negative ETRs are only meaningful when tax payments are negative and the firm records positive profits. When a firm records positive tax payments but is loss-making, the calculated ETR will be negative. Since this is misleading these observations are eliminated to avoid misinterpretation. Finally, when both the numerator and the denominator are negative, the ETR ratio returns a positive measure of the tax burden. Since this is also misleading, these observations are also eliminated. Table 3.1 summarises all possible permutations of the ETR which may be observed in the dataset and how they are dealt with in the ensuing empirical analysis.

Table 3.2 shows the attrition of the sample in response to the data transformations described above along with some other conditions required for the econometric analysis described later. A large decrease in sample size is attributable to missing ETRs which are those firms for which profits before tax and/or tax payments are not recorded for that particular year. Another large

\(^6\)Taxes paid is defined as current plus deferred taxes in the AMADEUS dataset and no disaggregation of these components is available. This does not, however, limit inference since tax planning is best captured by total tax expense - see Appendix A for a full explanation.
loss of data occurs due to the requirements of dynamic panel analysis, for which we require a minimum of at least 41 contiguous observations on each firm. Despite this, our final sample comprises 3,425 firms providing 16,487 firm-year observations. These firms are distributed across 14 European countries with the largest proportions of multinationals located in the UK and Sweden as shown in Table 3.3. Germany is under-represented in the sample and this is probably due to reporting standards which do not require full public disclosure in Germany.

In Table 3.4 we present some summary statistics for the dataset. The mean annual ETR reported by firms is approximately 20 percent. The variance of this average is however quite large. Figure 3.1 plots the distribution of annual ETRs for the sample of multinational firms. We can observe that whilst the majority of firms have an annual ETR between 20 and 40 percent, there is also a significant number of firms which experience unusually high or low ETRs. Figure 3.2 plots the coefficient of variation (or unmitigated risk) of each firms' annual ETRs over the period. The long tail in this histogram illustrates the marked variability in ETRs that a sizeable proportion of multinational firms experience. At the same time, it is clear that all firms experience some variability in their ETR. Over 50 percent of firms have a coefficient of variation of below 0.3, with a significant proportion recording a coefficient of variation of between 0.1 and 0.2. Thus, as we might expect, there appears some 'natural' level of variability in firm-level ETRs.

The objective of this chapter is to investigate whether there is any systematic relationship between the level of a firm's ETR and its variability. In Figure 3.3 we plot firms' average ETR over the period against the coefficient of variation of firms' ETRs. Consistent with the theory presented above, the fitted regression line suggests a positive risk premium increasing in the variability of firms' ETRs. This is evidenced in the negative relationship between the level and variability.
of firms' ETRs. The linear relationship however seems a poor approximation for this distribution, and it is certainly affected by some outliers. However, given that we have not controlled for the individual characteristics of the multinational firms in the sample, we cannot make any further inference.

3.3.2 Empirical strategy

In order to estimate the risk premium posited by the theory and suggested by the data we specify a model of multinational firms' ETRs which include as a determinant the coefficient of variation of their ETRs. In the design of our estimating equation we should be mindful of the data-generating process behind firm-level ETRs. First, the important strategic role of ETRs within the firm suggests that realizations of ETRs may exhibit dynamics such that current observations are influenced by past observations. Second, the differences between firms, countries, industries and over time may warrant the inclusion of fixed effects, arguing against cross-sectional regressions which cannot control for time-invariant unobservable effects. Third, as noted by Dyreng, Hanlon and Maydew (2005), ETRs and firm-level characteristics are likely to be jointly determined. Fourth, to the extent that instruments will have to be found for these endogenous variables, it is likely that instruments external to the dataset will be difficult to find. Finally, the number of ETR observations for each multinational firm is relatively short.

Given these considerations, realizations of the ETR \( y_{it} \) can be summarised in the following model:

\[
y_{it} = \alpha y_{i,t-n} + X'_{it} \beta + \epsilon_{it} \quad (3.7)
\]

\[
\epsilon_{it} = \mu_i + \nu_{it} \quad (3.8)
\]
\[ E[\mu_i] = E[\nu_{it}] = E[\mu_i \nu_{it}] = 0 \]  

(3.9)

In this model, the disturbance term has two orthogonal components: \( \mu_i \), which is the individual time-invariant fixed effect, and \( \nu_{it} \) representing the idiosyncratic shocks.

To estimate the size and significance of the risk premium identified in Equation (3.6) we include the coefficient of variation of the firm’s annual ETRs \( (\sigma_i) \) as an explanatory variable:

\[ y_{it} = \alpha y_{i,t-1} + X'_{it} \beta + \phi \sigma_i + \epsilon_{it} \]  

(3.10)

We expect \( \phi < 0 \), indicating that firms with more variable ETRs are compensated with lower average ETRs. We estimate Equation (3.10) using the dynamic panel methods pioneered by Arellano and Bond (1991). This allows us to recover unbiased estimates for the lagged dependent variable and the endogenous explanatory variables, whilst exploiting the panel nature of our data sample. Appendix B describes the estimation technique in detail.

3.4 Results

Table 3.5 presents the results from the baseline model described in Equation (3.7). In line with the extant literature on the determinants of firm-level ETRs we include as explanatory variables measures of firm profitability; size; leverage; intangible and fixed capital intensity\(^7\). In addition, we include the lagged value of the firm’s ETR as a potential determinant of the current period ETR. Columns 1 and 2 report estimates of Equation (3.7) using OLS and Within Group estimators respectively. The OLS estimates in Column 1 show that the

\(^7\)For definitions of these variables see the notes to Table 3.4.
ETR is decreasing in size, leverage, capital intensity and profitability; and increasing in the intensity of intangible assets. All of these effects are statistically significant at the 1 percent level with the exception of leverage. These results are, however, subject to the important qualification that since the dependent and independent variables are most likely jointly determined, the estimated coefficients are biased. Furthermore, whilst the inclusion of the lagged ETR variable proves highly significant, the coefficient estimate is also biased since the lagged dependent variable introduces correlation into the error term as shown by the tests of serial correlation at the bottom of column 1. In column 2, the Within-Groups estimate of the lagged dependent variable has a negative coefficient indicating the underestimation bias of this model. In terms of explanatory variables, only size and profitability emerge as significant. However, as previously noted, the inherent bias of these techniques means it is unwise to place much significance on these results.

In columns 3 through 6 we report estimates which account for both the endogeneity of the lagged dependent variable and the joint determinedness of the covariates using the techniques described in Appendix B. The first point to note is that all the estimates of the lagged dependent variable lie within the range indicated by the OLS levels and Within-Groups coefficients. Thus the estimates pass the rule-of-thumb check for unbiasedness suggested by Bond (2002). In addition, the lagged term is a statistically significant determinant of the firms' ETRs, validating its inclusion. In Column 3 we include only one lagged term and estimate the model using the difference estimator. The lagged ETR is statistically significant at the 1 percent level and the Sargan test does not reject the validity of the instrument set. Although statistically significant, the degree of persistence in ETRs, as captured by the coefficient on the lagged ETR, indicates a relatively low level of persistence. It is also noteworthy that among
the other explanatory variables only leverage and profitability are statistically significant, and only at the 10 percent level.

In column 4 we add a second lag of the dependent variable to the model, although it appears insignificant in this specification. Column 5 reports the estimates from the SYSTEM estimator which accommodates the inclusion of time-invariant fixed effects. We include country and 3 digit industry fixed effects to the model. The results reveal significant dynamics in ETRs with both the first and second lagged dependent variables proving highly significant and the degree of persistence is also larger. Of the other explanatory variables, only profitability remains statistically significant and the coefficient estimate indicates a quantitively significant result: firms with a 10 percent higher return on assets have a 6 percent lower ETRs. This may point to economies of scale or scope in tax planning, or the increased incentives for higher profitability firms to engage in tax planning. The use of the SYSTEM estimator is supported by the difference-Sargan test which suggests that the additional instruments for the time-invariant country and industry effects are sufficiently uncorrelated with the error term to validate their inclusion. In column 6 we report the SYSTEM estimator using the orthogonal deviations transform as proposed by Blundell and Bond (1998). It is noteworthy that the coefficient estimates are robust to this orthogonal deviations transform, and the significance of the second lag of the dependent variable is improved.

Table 3.6 provides estimates of the risk premium from estimation of Equation (3.10). We begin in Column 1 by presenting the benchmark model for comparison purposes (as per column 5 of Table 3.5)*. In Column 2 we include as a regressor the coefficient of variation of the firm’s ETR over the period. As expected, we find a negative relationship between the firm’s ETR and its vari-

*We do not pursue the Blundell-Bond (1998) orthogonal deviations transform as it is much less common in the literature, has no significant impact on our estimates, and has a poorer difference-Sargan statistic.
ability. This trade-off is statistically significant at the 1 percent level, however quantitatively the trade-off is relatively small. The coefficient estimate suggests that a 1 unit increase in the coefficient of variation results in a 0.05 percentage point reduction in ETRs.

One important factor which may be responsible for variability in the ETR is the variability of profits before tax, since this enters into the denominator of our ETR measure. Variability in pre-tax profits should not be interpreted as reflecting the increased risk of the tax strategy. For this reason, in Column 3 we control for the coefficient of variation of pre-tax profits. The results show that the trade-off estimated in Column 2 is robust, and actually increases in size, when we control for variability in pre-tax profits.

In Columns 4 and 5 we test a non-linear model of the trade-off between firms' ETR and their variability. In Column 4 we add the squared coefficient of variation to capture non-linearities. The results show that this term is highly significant, and its presence makes the linear trade-off redundant. This suggests that relatively small variability in ETRs attracts only small risk compensation, and the level of this compensation is increasing non-linearly in the amount of risk undertaken. As shown in column 5, the size and significance of this result is robust to the inclusion of the squared coefficient of variation in profits before tax.

Figure 3.4 plots the estimated trade-off using the estimated coefficients from Column 5. This shows that a unit increase risk at high levels of variability is compensated for in a much greater reduction in ETRs than a unit increase at lower levels of variability. For example, an increase in the coefficient of variation from 0.8 to 0.9 results in a reduction of almost 0.5 percentage points in the firm's ETR. This result is intuitively appealing since we would not expect significant risk compensation for the 'natural' variation in ETRs. Rather, only those firms
that have taken sizeable risks with their tax planning strategy and have thus been exposed to greater variability in their ETR, may be expected to receive risk compensation.

3.5 Conclusion

The decisions that multinational firms make with respect to tax planning can have a significant impact on economic welfare. Therefore, in this chapter, we have attempted to increase our understanding of the tax planning decision. We show that the risks of tax planning can be modelled in a choice under uncertainty framework. This allows us to derive an estimate for the risk premium which captures the compensation (in the form of lower ETRs) that tax director's expect for bearing the risks of tax planning. The risk premium interpretation of tax planning also helps explain why some firms may choose to pay more taxes they potentially have to. Our estimates suggest a non-linear trade-off between the level and variability of ETRs. Small variability in ETRs do not attract risk compensation, whilst a unit increase in risk at a high level of variability is associated with a statistically significant reduction in ETRs. These results suggest multinational firms are 'tax optimisers' rather than 'tax minimisers'.
Figure 3.1: Distribution of Firms' Annual ETRs
Figure 3.2: Variability in Firms’ Annual ETRs
Figure 3.3: Observed Risk-Return trade-off
Figure 3.4: Estimated Risk-Return trade-off
Table 3.1: Defining the Effective Tax Rate (ETR) measure

<table>
<thead>
<tr>
<th>TAX</th>
<th>PBT &lt; 0</th>
<th>PBT = 0</th>
<th>PBT &gt; 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAX &lt; 0</td>
<td>Misleading interpretation. Eliminated</td>
<td>ETR undefined. Eliminated</td>
<td>Negative ETR. Valid</td>
</tr>
<tr>
<td>TAX = 0</td>
<td>ETR undefined, recoded as ETR=0</td>
<td>ETR=0</td>
<td>ETR will be undefined, recoded as ETR = 0</td>
</tr>
<tr>
<td>TAX &gt; 0</td>
<td>Misleading interpretation. Eliminated.</td>
<td>ETR undefined. Eliminated.</td>
<td>Valid</td>
</tr>
</tbody>
</table>

Notes:

1. TAX is defined as "Taxation" and PBT refers to "Profits before Tax" both reported in the AMADEUS database (December 2006)

2. The Effective Tax Rate (ETR) is the ratio of Taxation (TAX)/Profits before Tax (PBT)
### Table 3.2: Sample Selection and Attrition

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Firms</th>
<th>Firm-Years</th>
<th>ΔFirm-Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>All multinational firms</td>
<td>27,371</td>
<td>148,151</td>
<td>(-)</td>
</tr>
<tr>
<td>2</td>
<td>Missing ETR</td>
<td>19,756</td>
<td>99,382</td>
<td>(48,769)</td>
</tr>
<tr>
<td>3</td>
<td>Recoding as per Table 3.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TAX&lt; 0 &amp; PBT&lt; 0</td>
<td>18,465</td>
<td>87,015</td>
<td>(12,367)</td>
</tr>
<tr>
<td></td>
<td>TAX&lt; 0 &amp; PBT= 0</td>
<td>18,465</td>
<td>87,013</td>
<td>(2)</td>
</tr>
<tr>
<td></td>
<td>TAX&gt; 0 &amp; PBT&lt; 0</td>
<td>15,257</td>
<td>74,171</td>
<td>(12,842)</td>
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<tr>
<td></td>
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<td>15,257</td>
<td>74,160</td>
<td>(11)</td>
</tr>
<tr>
<td></td>
<td>TAX= 0</td>
<td>15,257</td>
<td>74,183</td>
<td>23</td>
</tr>
<tr>
<td>4</td>
<td>Trim top and bottom ETR percentile</td>
<td>14,730</td>
<td>72,699</td>
<td>(1,484)</td>
</tr>
<tr>
<td>5</td>
<td>Require n≥4 spells of contiguous observations</td>
<td>3,425</td>
<td>16,487</td>
<td>(56,212)</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>3,425</td>
<td>16,487</td>
<td>(-)</td>
</tr>
</tbody>
</table>

**Notes:**

1. 'All multinational firms' refers to the total number of firms identified in the AMADEUS database with a majority interest in at least one foreign subsidiary. Firm-Years is the number of years for which data are available.

2. ETMS are recoded according to the procedure described in Table 3.1.

3. The top and bottom percentiles are trimmed to eliminate outliers caused by calculating the ETR ratio. This is not deemed necessary for the other financial ratios based on an inspection of their distribution.

4. In Step 5 we select the longest spell of contiguous data for each firm and then drop those spells which have a length of less than 4 years. This is a necessary condition for dynamic panel analysis.
Table 3.3: Decomposition of the dataset by Country

<table>
<thead>
<tr>
<th>Country</th>
<th>Firm-Years</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>13</td>
<td>0.38</td>
</tr>
<tr>
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Notes:

1. CVETR refers to the coefficient of variation of the firm’s ETR; CVETR2 is CVETR squared.
2. CVPBT refers to the coefficient of variation of the firm’s PBT; CVPBT2 is CVPBT squared.
3. SIZE defined as $\log(\text{Total Assets})$
   ROA defined as $\text{Pre-tax profits} / \text{Total Assets}$
   LEV defined as $\text{Long-term debt} + \text{Short-term debt} / \text{Total Assets}$
   INTANG defined as $\text{Intangible Fixed Assets} / \text{Total Assets}$
   CAPINT defined as $\text{Tangible Fixed Assets} / \text{Total Assets}$
Table 3.5: Baseline Specification

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Notes: (see overleaf)
Notes:

1. Asymptotic standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

2. m1, m2 and m3 are tests for first-order, second-order and third-order serial correlation in the residuals using the Arellano-Bond (1991) test for autocorrelation. The test is not appropriate for dynamic fixed effects models as the test assumes that the independent variables are not correlated with future errors, which is untrue for a dynamic fixed effects specification.

3. GMM results are two-step estimates with heteroskedasticity-consistent standard errors.

4. Sargan is a test of the overidentifying restrictions for the GMM estimators, and is asymptotically $\chi^2$. The p-values are reported.

5. Difference Sargan tests the additional instruments used by the SYS-GMM estimator.

6. Instruments used for DIFF-GMM are $y_{t-2}; y_{t-3}; y_{t-4}$.

7. Additional instruments used for levels equations in SYS-GMM are $\Delta y_{t-2}; \Delta y_{t-3}; \Delta y_{t-4}$.

8. Column 6 reports the GMM-SYS estimates using forward orthogonal deviations as in Blundell and Bond (1998).
Table 3.6: Estimating the Risk Premium

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Notes:

1. CVETR refers to the coefficient of variation of the firm’s ETR; CVETR2 is CVETR squared.
2. CVPBT refers to the coefficient of variation of the firm’s PBT; CVPBT2 is CVPBT squared.

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Chapter 4

Corporate Tax Competition between firms

4.1 Introduction

The perpetuating force of tax competition is based on the desire of multinational firms to reduce the burden of taxation on profits. This force is not only responsible for shifts of capital across borders, but also motivates the multitude of strategies that these firms adopt to lower their effective tax rate (ETR)\(^1\). Despite this, there is relatively little research investigating the motivating factors behind tax planning. Anecdotal evidence suggests that firms' tax planning decisions, similar to their other operational decisions, will be impacted by the behaviour of their competitors. This is neatly summed up on the corporate tax page of the international accountancy firm KPMG when it reminds firms of how they should think about their effective tax rate: 'A competitive, stable and sustainable effective tax rate ("ETR") is key for shareholders... Do you know the

\(^{1}\text{See Hines (1999).}^
potential reactions to this change from tax authorities? Is your current effective
tax rate competitive? How does your ETR compare to your industry peers? Is it sustainable?².

In this chapter, we propose and test a model of relative performance evaluation (RPE) among firms³. Our model captures the well-known agency problem between shareholders and managers of the firm. This has been explored in the recent literature on corporate taxation as discussed in Chapter 2. These papers have focused on the ability of managers to exploit the asymmetry of information and incomplete contracting environment to divert resources for his/her own private benefit (see Desai et al., 2005). In our model, we posit that RPE constitutes a response by shareholders to limit the agency costs. Specifically, shareholders compare the performance of similar firms by examining their reported ETRs. Managers, aware of RPE by shareholders and the threat of punishment for under-performance, seek to achieve an ETR that is comparable to their competitors. We show that, under RPE, the model predicts correlation across similar firms' ETRs.

This theoretical prediction is then tested on a large sample of multinational firms. The model suggests that shareholders use publicly observable measures of the firm’s ETR to assess management performance. Therefore, we use publicly available company reports data to generate the ETR variable. We use a dynamic spatial econometric model to test for interactions in the ETRs among similar firms. Our empirical model allows for an adjustment lag in firms’ responses when they learn of their performance relative to their competitors. Furthermore, we allow for asymmetric responses such that firms with relatively high ETRs may adjust at different speeds than those with an ETR already at, or below, the

²http://www.kpmg.co.uk/services/t/metr.cfm
³RPE is the terminology of the political economy models from which we borrow later in this chapter. It is, however, synonymous with benchmarking or comparative companies analysis, which are terms more familiar in the corporate sphere.
level of their competitors.

Our results suggest that firms compete with their similarly sized competitors, however, the reaction is asymmetric. Firms with relatively higher ETRs reduce their ETR in the next period whilst those firms with relatively favourable ETRs do not revert upwards towards their competitors. Whilst the interaction between firms reveals statistically significant evidence for RPE, the coefficients indicate that, quantitively, the effect is not very large.

The rest of this chapter is organised as follows: Part 4.2 describes the theoretical model. In Part 4.3, we briefly discuss the specific dataset (as the data have already been described in Chapter 3) and describe the empirical model. Part 4.4 presents the results and we draw some conclusions in Part 4.5.

4.2 Theoretical Motivation

At the heart of the model is an asymmetry of information between shareholders and managers. Shareholders want managers to maximise the present value of post-tax cash flows, an important part of which is ensuring a competitive ETR is achieved. However, when managers actions are unobserved by shareholders, managers may seek to maximise their private utility by choosing a level of costly effort which is suboptimal for shareholders. Therefore, in the presence of unobserved effort, managers may deliver a sub-optimally high ETR. As a response, shareholders may attempt to limit the agency costs by using the performance of similar firms to reveal the performance of managers. If shareholders detect under-performance they can punish managers using their voting rights at the firm’s annual general meeting. As a result, managers have an incentive

\[\text{This is a well-established phenomena in the corporate finance literature (see Tirole (2006).}\]

\[\text{Managers may also be more risk averse than is optimal for shareholders since managers cannot diversify their personal income risk.}\]

\[\text{In most countries, shareholders have the right to vote on managers’ re-election and remuneration.}\]
to deliver an ETR that is 'competitive' with respect to their peers. Thus the model predicts that, in the presence of RPE by shareholders, we should observe correlation across the ETRs of similar firms.

4.2.1 A Dynamic Model of ETRs

The above scenario is modelled as a dynamic game of incomplete information, and an appropriate equilibrium concept is therefore the Perfect Bayesian Equilibrium (PBE). Our model is a version of the yardstick competition model by Besley and Case (1995a), and the exposition borrows particularly from Bordignon, Cerniglia and Revelli (2003). These papers study RPE in a political economy context where there is an asymmetry of information between voters and politicians. We recast this model in the corporate finance setting as described above.

Setup of the Game

There are 3 players, the manager of firm 1, the manager of firm 2 and a shareholder. The game is played over 2 periods, and the manager chooses the tax strategy for the firm in each of the two periods. At the end of the first period there is a shareholder meeting where shareholders can choose to re-elect the current manager. This is an important strategy for shareholders as managers may be of 2 types: good or bad. Good managers will always deliver a competitive ETR, whilst bad managers may choose to opt for a higher ETR reflecting their desire to maximise private utility (minimise effort). Whilst managers know their type, shareholders cannot directly observe whether they are good or bad and must instead form a-priori beliefs on the type of manager they observe.

The ETRs that managers can deliver will be determined by a stochastic process of either positive or negative shocks which impact on the possible ETRs
that managers are able to deliver. These shocks reflect changes in the tax burden experienced by firms. These shocks are identical and arrive contemporaneously to the managers of both firms, but are unobserved by shareholders. They are negative with probability \( q \) and positive with probability \( 1 - q \). A negative shock raises the minimum possible ETR that managers can deliver to \( t + \Delta \) where \( \Delta > 0 \), while positive shocks allow managers to deliver a minimum ETR of \( t \). Shocks are persistent over the two periods. We also assume that all agents have the same discount rate \( \delta < 1 \).

**The Sequence of Play**

At the beginning of the first period, Nature chooses the type \( j \) of the manager from the set of feasible types \( j = (G, B) \) according to the probability distribution \( P(\theta, 1 - \theta) \). In addition, nature chooses the shock \( e \in (P, N) \) according to the probability distribution \( P(q, 1 - q) \). The manager then observes his type \( j \) and the shock \( e \), and decides on the ETR to deliver. His choice will be determined by the ETR which maximises the present value of his expected utility. Shareholders observe the ETR chosen by managers and, although they know the underlying stochastic structure of the shocks and the distribution of manager types, they do not directly observe the type of shock or type of manager chosen by Nature. Therefore, shareholders will use the observed ETR delivered by managers to update their beliefs, using Baye’s rule, on the type of the current manager. Their posterior beliefs on the type of manager will be \( \mu(\theta, t) \).

At the end of the first period the annual general meeting of shareholders will take place and shareholders vote for the manager that they expect to be good with higher probability at that time\(^7\). Therefore, the current manager will be retained if \( \mu(\theta, t) \geq \theta \). The manager in place in period 2 will again choose an

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\(^7\)To avoid mixed strategy equilibria, which provide no additional insights in this model, we assume that if shareholders are indifferent between retaining and firing the current manager they vote to retain the current manager.
ETR and since this is the final period, managers will act optimally according to their type.

We now proceed by solving for the equilibria of this game in the context of a single firm, and then proceed to the equilibria when there are two firms, thus facilitating relative performance evaluation. We solve the game by looking for the Perfect Bayesian Equilibria: those in which each manager is acting optimally given the behaviour of all other managers and beliefs are consistent. Our objective is to use this model to derive an empirically testable prediction concerning observed ETRs. In this respect, we show that there exist a set of conditions resulting in a Perfect Bayesian Equilibrium such that the ex ante probability of finding the managers of the two firms selecting similar ETRs is greater when RPE is possible. We can then empirically test whether we observe a correlation in the ETRs of similar firms and interpret this as evidence of RPE or ‘tax competition’ between firms.

4.2.2 Single Firm Equilibria

With only a single firm, RPE is impossible as there are no information externalities to help guide shareholders in an assessment of managers’ performance. We assume that good managers always act in the interest of shareholders by delivering the most competitive ETR given the shock. Therefore, they will deliver an ETR equal to $t$ if the shock is positive and $t + \Delta$ if the shock is negative. In contrast, bad managers do not always act in the best interests of shareholders. Let us assume that they can deliver a maximum ETR of $t + k\Delta$ where $k > 1$. The higher ETR which they potentially choose to deliver reflects the fact that they may exert a lower level of tax-minimising effort on behalf of shareholders. Therefore, the maximum utility the bad manager can earn is either $k\Delta$ if it is a positive shock, or $k\Delta - \Delta$ following a negative shock. Having assumed that
good managers always act in the best interests of shareholders we must now determine how the bad manager decides on the ETR to deliver in the event of each type of shock.

A Negative shock arrives
In the first period the bad manager will face a trade-off between selecting the maximum ETR they can and being discovered as a bad manager and thus not re-elected; against the alternative of mimicking the good managers and therefore having some positive probability of being re-elected. We assume that out-of-equilibrium beliefs of the shareholder are such that when shareholders observe an ETR that is higher than any of the two ETRs a good manager would deliver, they assume that the manager must be of the bad type. That is: \( \mu(\theta, t) = 0 \) for \( t \neq t + \Delta \) and \( t \neq t \).

When a negative shock arrives the bad manager will compare the present value of his expected utility from reporting \( t + \Delta \) against reporting \( t + k\Delta \). In the latter case, bad managers gain \( k\Delta - \Delta \) but will not get re-elected and therefore earn nothing in period 2. Alternatively, bad managers could deliver \( t + \Delta \) in period 1, earning no extra benefits but increasing their probability of re-election and thus their chance to earn \( k\Delta - \Delta \) in the second period (giving them utility: \( \delta(k\Delta - \Delta) \)). Even without considering the period 2 income as an uncertain payoff contingent on re-election, it is clear that delivering \( t + k\Delta \) in the first period and facing certain dismissal dominates since \( k\Delta - \Delta \geq \delta(k\Delta - \Delta) \).

A Positive shock arrives
Again, a good manager will always deliver an ETR commensurate with the observed shock, and therefore now delivers \( t \). Bad managers can choose between delivering \( t, t + \Delta, \) and \( t + k\Delta \) in the first period. The payoffs from choosing \( t = \delta(\Delta k); t + \Delta = \Delta + \delta\Delta k \) and \( t + k\Delta = \Delta k \). Clearly, \( t \) is a strictly dominated
strategy in the instance of a positive shock since \( \delta(\Delta k) < \Delta k < \Delta + \delta\Delta k \) for \( k < 1 \). Therefore, following a positive shock the bad manager will never choose \( t \). The interesting case is whether bad managers will play \( t + \Delta \) so as to lure shareholders into thinking they are actually good managers that have simply experienced a negative shock. In fact, we can show that there is a PBE in pure strategies in which bad managers deliver \( t + \Delta \) in the presence of positive shocks and succeed in getting re-elected.

To see this, first note that when shareholders observe \( t + \Delta \) they will update their beliefs on the probability that the incumbent manager is good. That is, their beliefs that the manager is good given they have observed \( t + \Delta \) will be:

\[
\mu(t, t + \Delta) = \frac{P(G) \cap P(t + \Delta)}{P(t + \Delta)} \tag{4.1}
\]

\[
\mu(\theta, t + \Delta) = \frac{\theta q}{\theta q + (1 - \theta)(1 - q)} \tag{4.2}
\]

Therefore, for shareholders to believe that the manager is good they must believe that they have experienced a negative shock. However, they will also be mindful that an observed ETR of \( t + \Delta \) is also consistent with bad managers experiencing a positive shock. The bad managers will get re-elected if shareholders’ posterior beliefs are greater than the probability of being good: \( \mu(\theta, t + \Delta) \geq \theta \) which occurs for \( q \geq 0.5 \). Intuitively, this says that when shareholders observe \( t + \Delta \) and the probability of a negative shock is most likely, they will give the benefit of the doubt to managers and attribute a strategy of \( t + \Delta \) to a good manager who has simply faced a negative shock. Assuming \( q \geq 0.5 \), bad managers imitate good managers by playing \( t + \Delta \) if this gives them a higher expected utility than simply playing \( t + k\Delta \). Since for \( q \geq 0.5 \), all managers choosing \( t + \Delta \) get re-elected the payoff to bad managers is \( \Delta + \delta E(\Delta k) \). This
payoff exceeds the alternative of choosing $\Delta k$ in the first period and facing certain dismissal for $\delta \geq (k - 1)/k$. Intuitively, the discount rate must be high enough such that the future matters enough to the bad manager for him to want to mimic the good type and get retained for the second period.

To summarise, there exists a Perfect Bayesian Equilibrium in pure strategies such that when a positive shock arrives and $\delta \geq (k - 1)/k$ and $q \geq 0.5$; the bad manager will choose $t + \Delta$ in the first period, and shareholders, after observing $t + \Delta$ will re-elect the bad manager. In contrast, when the shock is negative, the good type will always try to deliver the most competitive ETR which in this case is $t + \Delta$. Bad managers immediately separate choosing $t + k\Delta$ and are not retained by shareholders. Next, we examine how RPE changes the equilibria of this game, and show that RPE is more likely to lead to correlated ETRs across similar firms.

4.2.3 Relative Performance Evaluation

The model described above can be easily extended to a setting of RPE by replicating the setup of the game so we now have two identical firms, managers and sets of shareholders. In this setting, shareholders can potentially gain from benchmarking managers in the first period against the performance of the other firm. In doing so, they can better estimate the likelihood that their manager is good or bad. Shareholders' posterior beliefs are now a function of the ETR delivered by their manager and the ETR of the similar firm: $\mu(\theta, t_i, t_j)$. However, RPE is only useful if the firms are similar, and face similar shocks. Denoting $Prob(X, Y)$ as the joint probability that firm $i$ is impacted by a shock of type $X$ and firm $j$ by a shock of type $Y$ we have:

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8Whilst Besley and Case (1995a) assume perfect correlation between the entities, we adopt the more plausible approach taken by Bordignon, Cerniglia and Revelli (2003) and allow the correlation between firms to vary.
\[ \text{Prob}(N, N) = \sigma q \]  
\[ \text{Prob}(P, N) = (1 - \sigma)q \]  
\[ \text{Prob}(N, P) = (1 - \sigma)q \]  
\[ \text{Prob}(P, P) = 1 - q(2 - \sigma) \]

Where \( \sigma \) measures the degree of correlation between the shocks received by firm \( i \) and firm \( j \). For \( \sigma = q \) the shocks will be independent, \( \sigma = 1 \) we have perfectly correlated shocks and when \( q < \sigma < 1 \) we have positive but imperfectly correlated shocks across both firms.

With 2 firms we assume that the managers simultaneously choose their ETRs, and each manager only observes their own shocks and only knows the distribution of types of the competing firm's manager. The central question we must now answer is what effect RPE has on the equilibria of the game. To address this, we trace through the scenario of a negative shock and a positive shock as we did for determining the single firm equilibria.

**A Negative shock arrives**

Following a negative shock, bad managers always maximise their utility by delivering a high ETR and failing to be re-elected for the second period. That is, there is a separating equilibrium since the strategy \( t + k\Delta \) dominates any other strategy for the bad manager when the shock is negative. As before, the good manager is assumed to always act in shareholders' best interests choosing \( t + \Delta \) in the presence of a negative shock.
A Positive shock arrives

As shown earlier, following a positive shock, bad managers will never choose \( t \) as this is a strictly dominated strategy. Of most interest, therefore, is under what conditions will the bad manager choose \( t + \Delta \)? We start by noting that bad managers will base their reaction to a positive shock on the relative probabilities of re-election given their strategy set, the nature of the shock received by firm \( j \), and firm \( j \)'s response. When all agents expect the bad types to play \( t + \Delta \) and the shock is positive, the expected probability of being retained for the bad manager of firm \( i \) if he follows the strategy of \( t + \Delta \) is:

\[
G(t + \Delta) = \text{Prob}(\epsilon_j = N \mid \epsilon_i = P)[\theta R(t_i = t + \Delta, t_j = t + \Delta) \\
+ (1 - \theta)R(t_i = t + \Delta, t_j = t + k\Delta)] \\
+ \text{Prob}(\epsilon_j = P \mid \epsilon_i = P)[\theta R(t_i = t + \Delta, t_j = t) \\
+ (1 - \theta)R(t_i = t + \Delta, t_j = t + \Delta)]
\]  

(4.7)

That is, the probability that shareholders retain the bad manager will depend on the type of shock received by the other firm; how the manager of the other firm reacts to the shock it receives; and, how shareholders weigh the relative probability of each type of shock occurring. \( R(t_i = t + \Delta, t_j = t^*) \) is the probability of the bad manager being retained by the shareholders of firm \( i \) if he plays \( t + \Delta \) and firm \( j \) plays \( t^* = t, t + \Delta, t + k\Delta \). By our earlier assumption, \( R(t_i = t + \Delta, t_j = t^*) = 1 \) if \( \mu(\theta, t_i = t + \Delta, t_j = t^*) \geq \theta \) and \( \mu(\theta, t_i = t + \Delta, t_j = t^*) = 0 \) otherwise.

By applying Baye's rule at the proposed strategies for both types of managers, Bordignon, Cerniglia and Revelli (2003) compute the ex-post beliefs as follows:
\[ \mu(\theta, t_i = t + \Delta, t_j = t + \Delta) = \]
\[ \frac{\sigma \theta^2 + \theta(1 - \theta)(1 - \sigma)q}{(\sigma \theta^2 + 2\theta(1 - \theta)(1 - \sigma)q + (1 - \theta)^2(1 - q)(2 - \sigma)} \]  
(4.8)

\[ \mu(\theta, t_i = t + \Delta, t_j = t + k\Delta) = \]
\[ \frac{\sigma \theta}{\sigma \theta + (1 - \theta)(1 - \sigma)} \]  
(4.9)

\[ \mu(\theta, t_i = t + \Delta, t_j = t) = \]
\[ s \theta / \{s \theta + (1 - \theta)(1 - s)\} \]  
(4.10)

where \( s = (1 - \sigma)q/(1 - q) \)

Thus it follows that:

\[ R(t_i = t + \Delta, t_j = t + \Delta) = 1 \text{ if } \theta = 2(1 - 2\theta)(1 - \sigma)q \geq (1 - q) \]
\[ R(t_i = t + \Delta, t_j = t + \Delta) = 0 \text{ otherwise.} \]

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\( R(t_i = t + \Delta, t_j = t + k\Delta) = 1 \) if \( \sigma \geq 0.5 \)
\( R(t_i = t + \Delta, t_j = t + k\Delta) = 0 \) otherwise.

\( R(t_i = t + \Delta, t_j = t) = 1 \) if \( (1 - \sigma) \geq (1 - q)/2q \)
\( R(t_i = t + \Delta, t_j = t) = 0 \) otherwise.

Shareholders beliefs of the type of manager of firm \( i, i = 1, 2; j = 1, 2 \) for
\( i \neq j \) are such that the probability of retention \( R(t_i = t + \Delta, t_j = t + k\Delta) = 1 \)
if \( \theta \geq \theta^* \equiv ((1 - q)(3 - 2\sigma))/((1 - 4(1 - \sigma)q))) < 1 \) as \( \sigma > 0.5 \). Then, since
\( G(t+\Delta) = \{(1-\theta)(1-q)+\theta q(1-\sigma)\}/(1-q) \) we can use this to find the expected
utility of the bad manager when playing his equilibrium strategy: \( \Delta + \delta k\Delta \{(1-\theta)(1-q)+\theta q(1-\sigma)\}/(1-q) \}. The expected utility from this strategy dominates
his best deviation which is playing \( t + k\Delta \) and not being re-elected in the second
period if the discount rate \( \delta \geq \delta^* = \frac{(k-1)(1-q)}{k((1-\theta)(1-q)+\theta q(1-\sigma))}. \)
In turn, \( \delta^* < 1 \) if \( k < k^* \equiv \frac{(1-q)}{\theta(1-q)(2-\sigma)}. \) Thus, for \( q < 0.5, \sigma > 0.5 \)
and \( k < k^*; \) and \( \theta \in [\theta^*, 1], \) and \( \delta \in [\delta^*, 1] \) there exists a unique Perfect Bayesian
Equilibrium in pure strategies in which the bad types first period choices in
both firms upon observing a positive shock are \( t + \Delta^9. \)

Therefore, by comparing the single firm equilibrium with the relative perfor­
mance evaluation equilibrium it can be seen that it is possible to find values
of the parameters which support a pooling equilibrium under RPE when this
would not be possible otherwise. The intuition is that if the correlation between
the two firms is large enough and the reputation of the manager is also large
enough, observing \( t + \Delta \) at firm \( j \) reassures the shareholder that it must have
been a case of a bad shock and therefore observing an ETR of firm \( i \) equal to
\( t + \Delta \) indicates that the manager is actually good.

\(^9\)This proof is from Bordignon, Cerniglia and Revelli (2003).
For the purposes of empirically testing this model, we can show that under the above conditions, the \textit{ex ante} probability of finding two firms selecting similar ETRs is higher under RPE. To see this, note that the \textit{ex ante} probability of finding the first period difference equal to the maximum possible difference in the ETRs selected by the two firms is equal to $2\theta(1 - \theta)q$ if shareholders do not engage in RPE and is equal to $2\theta(1 - \theta)q(1 - \sigma)$ if they do engage in RPE. Furthermore, the \textit{ex ante} probability of finding two similar ETRs at the two firms is equal to $\theta^2(1 - 2q + 2q\sigma + (1 - \theta)^2)2$ if shareholders do not engage in RPE and is equal to $\theta^2(1 - 2q + 2q\sigma) + (1 - \theta)^2(1 - 2q + 2q\sigma) + 2\theta(1 - \theta)q(1 - \sigma)$ if they do engage in RPE. The latter is larger than the former if $\theta > 1/3$ (which is true since $\theta^* > 1/3$). Therefore, the observation in the data that certain firms’ ETRs are correlated could be interpreted as a signal of the presence of RPE by shareholders in ETRs.

4.3 Empirics

We now empirically test for correlation or spatial interaction among firms’ ETRs as predicted by the theoretical model described above. We begin by describing the data used in this study. We then outline the specification of the spatial econometric model which has four important features. First, it specifies a dynamic process for the firm’s ETR such that the current observed ETR is a function of lagged ETR values. Second, it includes a spatial lag term which captures the reaction of the firm to competitors’ ETR adjustments. Third, we use a spatial weighting matrix which selects competitors for each firm based on their inverse size differences across 3 potential groupings. Finally, we allow for asymmetric reactions allowing us to test whether firms only lower their ETR in response to lower competitor’s ETRs or follow competitor’s ETRs both upwards and downwards.
4.3.1 Data

The theoretical model relies on RPE by shareholders using publicly observable data on ETRs. This suggests that the correct dataset should be the published annual accounts, since it is these accounts that shareholders and analysts will use to benchmark the company’s performance, and in anticipating this, it is this ETR measure which the managers will seek to lower\(^\text{10}\). The company accounts data are sourced from the AMADEUS database is described in Chapter 3. In line with the objective of this thesis, our focus is on the activities of multinational firms. AMADEUS identifies 27,371 multinational firms operating during the period 1996-2005, of which 3,425 firms (equating to 16,487 firm-year observations) are suitable for analysis\(^\text{11}\).

4.3.2 Spatial Econometric Models

To test for the existence of RPE we specify a spatial autoregressive (SAR) model that can estimate the relationship between an individual firm’s ETR and that of its competitors. In Equation (4.11) (below) the individual firm’s ETR \((y_{it})\) is a function of its lagged value \((y_{it-n})\) up to \(n\) periods. Most importantly, we include as an explanatory variable, a set of the firm’s competitors’ ETRS.

\[
y_{it} = \alpha y_{i,t-n} + \kappa W_{i,c,t} y_{i-1,t} + X_{it}' \beta + \mu_i + \nu_{it} \tag{4.11}
\]

Competitors’ ETRS are contained in \(y_{i-1,t}\) and the matrix \(W_{i,c,t}\) selects the appropriate competitors for each firm \((i)\) in each period \((t)\) from the matrix of all firms’ ETRs \((y_{-i})\). The set of competitors \((c)\) varies by year and across firms (we discuss the selection of competitors later). This matrix is often referred

\(^{10}\)Interim reports are also published by many companies and may also be useful to test the model. Unfortunately, our dataset only includes annual reports.

\(^{11}\)The cleaning of these data, and the sample characteristics, has already been extensively discussed in Chapter 3. We replicate the appropriate tables at the end of this chapter for the reader’s convenience and refer the reader to the discussion of the data in Chapter 3.
to in the literature as the 'weighting' or 'connectivity' matrix. It will have a positive value if the current firm is related to another, and zero otherwise. The size of the positive value will reflect the strength of the relationship between the firms. This allows us to specify a relationship between the current firm's ETR and competitors' ETRs. The estimate of the parameter $\kappa$ will tell us the sign, size and significance of competitors' ETRs in determining the firm’s ETR. We also include a set of firm-level control variables $X_{it}$ consistent with the extant literature discussed in Chapter 3, along with a set of fixed effects $\mu_i$.

4.3.3 Specifying the weighting matrix

In this study, we would like to choose the competitor firms which represent the most likely benchmark set of firms that shareholders will use. This requires some judgement as there is no obvious best way to choose competitors. For this reason, we specify a number of alternative weighting matrices which we can trial.

The weights in the weighting matrix are calculated to select the most likely competitors for each firm. We do this by first sorting the firms by size (total assets) within the appropriate categories and then computing the weights of each competitor's ETR as the modulus of the inverse distance between the size of the current firm and all competitors\(^\text{12}\). The inverse distance measure ensures that similarly sized firms get greatest weight and the modulus allows firms to be similar in size if they are larger or smaller than the current firm. Formally, where $X$ is the measure of size, the weights are\(^\text{13}\):

$$W_{i,c,t} = \left|\left(X_{i,t} - X_{-.t} \right)\right|^{-1}$$ (4.12)

We use Equation (4.12) to construct three types of weighting matrix $W_{i,c,t}$

\(^{12}\)The construction of the weighting matrix was performed in MATLAB v7.0.

\(^{13}\)The weights are normalised to sum to 1
where \((c = 1, 2, 3)\). For the first weighting matrix, we select competitors for each firm along the size dimension only. The intuition for testing this weighting matrix is that shareholders may benchmark similarly sized companies regardless of country of domicile or industry. The second weighting matrix chooses competitors that operate in the same industry group and are of a similar size. This weighting matrix will capture relative performance evaluation of firms based on the industries in which they operate. Finally, we calculate a weighting matrix which takes into account the country within which each firm is domiciled. We choose competitors, again based on size, but only amongst those domiciled in the same country. Our rationale for this weighting matrix is that, RPE may take place among, for example, FTSE 100 companies irrespective of industry. Table 4.5 summarises the three weighting matrices used in the estimation

4.3.4 Reaction Times in the empirical model

Estimation of Equation (4.11) using OLS will yield biased and inconsistent estimates of \(\kappa\) because the weighted competitors’ ETRs will be correlated with each firm’s error term \((\nu_t)\). Correcting for this spatial endogeneity problem has been approached in a number of ways. A common method is to use 2 stage least squares where one first runs an initial regression using instruments for each firm’s ETR and generates predicted ETRs for each firm which are then used in the spatial weighting matrix. The key is that the instruments must not be spatially correlated.\(^{15}\)

The difficulty of this approach in the context of firm-level ETRs is that good instruments for a firm’s ETR are unavailable. Therefore, as an alternative

\(^{14}\)Unfortunately limitations of the data do not allow us to specify a weighting matrix which compares similar size firms domiciled in the same country and operating in the same industry. \(^{15}\)For example, a country’s tax rate may be spatially correlated with other countries, but one might argue that it can be instrumented for by unemployment rates and therefore a predicted tax rate can be generated which has no component which is spatially correlated because it has been generated from spatially uncorrelated, exogenous variables (see Feld and Rueller, 2001 for an example of this).
solution we use the lagged value of the matrix of competitors' ETRs. This breaks the link among firms' ETRs that resulted in spatial correlation. This specification is also perhaps more realistic, since competitors will only learn of their relative ETR when annual reports are published. Since annual reports are historic accounts of the year just passed, any response will necessarily be subject to some delay. Furthermore, given that the strategic decisions required to respond to competitors' ETRs may take time to implement, then even if firms were instantaneously aware of competitors' ETRs we would expect some lag in their response\(^{16}\). Therefore, we specify a revised model that is no longer subject to spatial endogeneity and which we argue better reflects the dynamic of competition between firms:

\[ y_{it} = \alpha y_{it-n} + \kappa W_{i,c,t-n}y_{i,t-n} + X'_{it}\beta + \mu_i + \nu_{it} \]  

(4.13)

4.3.5 Allowing for asymmetric reactions to competitors

It may be the case that managers do not follow competitors' ETRs upwards and downwards in the same measure. Therefore, we should incorporate the possibility of asymmetric responses to the benchmark ETR\(^{17}\). We do this by adding an indicator variable \(D_{it}\) to the empirical model:

\[ y_{it} = \alpha y_{it-n} + \kappa W_{i,c,t-n}y_{i,t-n} + D_{it} + D_{it} * \kappa W_{i,c,t-n}y_{i,t-n} + X'_{it}\beta + \mu_i + \nu_{it} \]  

(4.14)

where:

\(^{16}\)Therefore, even if interim accounts are available, it is likely that there will continue to be some response lag.

\(^{17}\)See Devereux et al. (2005) for an example of asymmetric adjustment in a tax competition model among countries.
\[ D_{it} = \begin{cases} 
1 & \text{if } y_{i,t-n} > \kappa W_{i,c,t-n} y_{i,t-n} \\
0 & \text{if } y_{i,t-n} \leq \kappa W_{i,c,t-n} y_{i,t-n} 
\end{cases} \]  

(4.15)

\( D_{it} \) takes the value 1 when the firm’s ETR is above the weighted average of competitors’ ETRs and zero otherwise. It enters the empirical model as both a level shift and interacted with the spatial weighting matrix, allowing for different speeds of adjustment across these firms. The model described in Equation (4.14) is estimated using the Arellano-Bond (1991) dynamic panel estimator (for a full description of this estimation method see Appendix B).

4.4 Results

We begin by presenting the results for each of the weighting matrices separately. We then run a horse-race between the competing specifications to discover the best performing and most robust specification.

In Table 4.6 we report the first results from the dynamic spatial econometric model specified in Equation (4.13). For comparison purposes, in the first column, we replicate the difference estimator results from Equation (3.7) in Chapter 3 which has no spatial interactions. Column 2 adds in the spatial weight matrix (\( W_1 \)) which comprises the weighted sum of similarly sized competitors’ ETRs for individual firm. This model meets the specification tests for serial correlation in the errors and the Sargan test statistic convincingly does not reject the instrument set. The estimated effect of the lagged weighting matrix of competitors’ ETRs suggests a positive and statistically significant impact on the firm’s current ETR. This is direct evidence for RPE among similarly sized firms. However, the magnitude of spatial interaction is relatively small. The coefficient estimate suggests that a one percentage point move upwards or downwards in the firm’s size competitors’ weighted ETR prompts a reaction of 0.07
percentage points. This relatively small coefficient estimate may be explained by different reactions between firms that have ETRs above the benchmark level versus those with ETRs below this level. To account for a potential asymmetric reaction, we include a dummy variable specified according to Equation (4.15). The results reported in column 3 show a negative coefficient on the dummy variable which is consistent with our expectation that firms with higher ETRs than competitors seek to reduce them in subsequent periods. However, this effect is not statistically significant at the 10 percent level. The interaction term, which captures whether firms with an ETR above their weighted competitors' ETR respond differently is both statistically and quantitatively significant. The estimated coefficient indicates that a 1 percentage point reduction in competitors' ETRs for a firm that has a higher ETR than its competitors, will prompt a response from that firm which will lower its ETR by 0.14 percentage points in the next period.

In columns 4 and 5 we re-estimate the model using the SYSTEM estimator, which allows for the inclusion of country and industry fixed effects. The results suggest that RPE only impacts on firms with ETRs above the benchmark of their size competitors. For these firms we find that they have a lower level effect in the next period of around 5 percentage points. In addition, the speed of adjustment is much faster with a coefficient estimate suggesting that for every 1 percentage point reduction in competitors' ETRs, the impact for firms above the benchmark level, is a reduction in their ETR of 0.2 percentage points in the next period. For each of these models the Sargan and difference-Sargan statistic does not reject the instruments. This evidence points to asymmetric RPE, such that firms only compete downwards towards the benchmark level with no evidence for adjustment towards an equilibrium ETR.

Table 4.7 repeats the procedure in Table 4.6 using the 2-digit industry level
set of competitors \((W_2)^{18}\). The most striking feature of the results reported in Table 4.7 is the lack of statistical evidence for industry-level RPE, even when allowing for asymmetric reactions. This cannot be attributed to a poorly specified model as the Sargan, difference-Sargan and correlation structure of the errors do not reject the model specification. These results are surprising as, intuitively, we may have expected RPE to be most pronounced among firms in the same industry. One caveat to the industry classification is that it may be too broad to capture industry interactions. This could perhaps be improved by using a more refined measure. In light of the results reported in Chapter 3, we must also be aware that aggressive tax planning may result in an increase in the variability of ETRs such that it may be difficult to discern interactions.

In Table 4.8 we look for evidence of RPE among the ETRs of firms and their domestic size competitors \((W_3)\). There is no evidence that domestic size competitors' ETRs impact on the firm's ETR, even allowing for asymmetric effects. Once again, these results cannot be attributed to poor model selection as the diagnostic tests do not locate any mis-specification error. From these separate tests of each set of potential competitors, we conclude that there is evidence of RPE only among multinational firms of similar size, irrespective of industry or country of domicile.

To test the robustness of these results, Table 4.9 reports estimates from a horse-race of all three models. Columns 1 and 2 replicate the results for the industry level competition using the difference and SYSTEM estimators. In Columns 3 and 4 we append to this estimating equation the three variables capturing pan-European size competition. The evidence for size competition discussed above remains robust, both quantitatively and statistically. In Columns

\(^{18}\) We select competitors at the 2-digit industry disaggregation since the data do not permit adequate analysis at a more detailed industry level due to small numbers of observations in some industry cells. The NAICS (2002) industry codes were used to classify firms into 67 different industries.
5 and 6 we report the difference and SYSTEM estimator results when domestic size competitors are added to the model. The impact of domestic competition is again insignificant. More importantly, pan-European asymmetric size competition remains significant. These results suggest that there is robust evidence for RPE among similarly sized multinational firms. Those firms with an ETR above that of their similarly size competitors report an ETR in the next period which is over 4 percentage points lower. In addition, a 1 percentage point reduction in the benchmark ETR prompts a further reduction of 0.15 percentage points in the firms' ETRs.

4.5 Conclusion

The objective of this chapter was to take a novel approach to examining tax competition. It is motivated by recognising that the force propelling tax competition is rooted in multinational firms' desire to reduce their corporate tax burden. This is, in turn, motivated by their desire to remain competitive. Competition among firms over their respective ETRs is captured in a modified yardstick competition model. We show that when shareholders engage in relative performance evaluation of firm managers' performance, this can lead to correlation across firms' ETRs. This theoretical prediction is tested using a spatial econometric model and variety of potential sets of competitors. The results provide robust evidence for RPE among similarly sized multinational firms. This manifests itself only in an asymmetric reaction to the benchmark ETR. There is no evidence that firms' ETRs revert towards an equilibrium level. The lack of evidence for symmetric reactions suggests that there may be a 'race to the bottom' dynamic in multinational firms' ETRs.
Table 4.1: Defining the Effective Tax Rate (ETR) measure

<table>
<thead>
<tr>
<th>TAX</th>
<th>PBT &lt; 0</th>
<th>PBT = 0</th>
<th>PBT &gt; 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAX &lt; 0</td>
<td>Misleading interpretation. Eliminated</td>
<td>ETR undefined. Eliminated</td>
<td>Negative ETR. Valid</td>
</tr>
<tr>
<td>TAX = 0</td>
<td>ETR undefined, recoded as ETR=0</td>
<td>ETR=0</td>
<td>ETR will be undefined, recoded as ETR = 0</td>
</tr>
<tr>
<td>TAX &gt; 0</td>
<td>Misleading interpretation. Eliminated</td>
<td>ETR undefined. Eliminated</td>
<td>Valid</td>
</tr>
</tbody>
</table>

Notes:

1. TAX is defined as "Taxation" and PBT refers to "Profits before Tax" both reported in the AMADEUS database (December 2006)

2. The Effective Tax Rate (ETR) is the ratio of Taxation (TAX)/Profits before Tax (PBT)
Table 4.2: Sample Selection and Attrition

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Firms</th>
<th>Firm-Years</th>
<th>ΔFirm-Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>All multinational firms</td>
<td>27,371</td>
<td>148,151</td>
<td>( - )</td>
</tr>
<tr>
<td>2</td>
<td>Missing ETR</td>
<td>19,756</td>
<td>99,382</td>
<td>(48,769)</td>
</tr>
<tr>
<td>3</td>
<td>Recoding as per Table 4.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TAX &lt; 0 &amp; PBT &lt; 0</td>
<td>18,465</td>
<td>87,015</td>
<td>(12,367)</td>
</tr>
<tr>
<td></td>
<td>TAX &lt; 0 &amp; PBT = 0</td>
<td>18,465</td>
<td>87,013</td>
<td>(2)</td>
</tr>
<tr>
<td></td>
<td>TAX &gt; 0 &amp; PBT &lt; 0</td>
<td>15,257</td>
<td>74,171</td>
<td>(12,842)</td>
</tr>
<tr>
<td></td>
<td>TAX &lt; 0 &amp; PBT = 0</td>
<td>15,257</td>
<td>74,160</td>
<td>(11)</td>
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<tr>
<td></td>
<td>TAX = 0</td>
<td>15,257</td>
<td>74,183</td>
<td>23</td>
</tr>
<tr>
<td>4</td>
<td>Trim top and bottom ETR percentile</td>
<td>14,730</td>
<td>72,699</td>
<td>(1,484)</td>
</tr>
<tr>
<td>5</td>
<td>Require n≥4 spells of contiguous observations</td>
<td>3,425</td>
<td>16,487</td>
<td>(56,212)</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>3,425</td>
<td>16,487</td>
<td>( - )</td>
</tr>
</tbody>
</table>

Notes:

1. 'All multinational firms' refers to the total number of firms identified in the AMADEUS database with a majority interest in at least one foreign subsidiary. Firm-Years is the number of years for which some data is available.

2. ETRs are recoded according to the procedure described in Table 4.1.

3. The top and bottom percentiles are trimmed to eliminate outliers caused by calculating the ETR ratio.

4. In Step 5 we select the longest spell of contiguous data for each firm and then drop those spells which have a length of less than 4 years. This is a necessary condition for dynamic panel analysis.
Table 4.3: Decomposition of the dataset by Country

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<th>Country</th>
<th>Firm-Years</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
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<td>Belgium</td>
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<tr>
<td>Finland</td>
<td>168</td>
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<tr>
<td>France</td>
<td>507</td>
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<tr>
<td>Germany</td>
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<td>6.95</td>
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<tr>
<td>Ireland</td>
<td>32</td>
<td>0.93</td>
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<tr>
<td>Italy</td>
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<tr>
<td>Luxembourg</td>
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<td>Netherlands</td>
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<tr>
<td>Portugal</td>
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<td>Spain</td>
<td>273</td>
<td>7.97</td>
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<tr>
<td>Sweden</td>
<td>759</td>
<td>22.16</td>
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<td>Switzerland</td>
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<td>3.36</td>
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<td>United Kingdom</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>3,425</strong></td>
<td><strong>100.00</strong></td>
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Notes:

1. Data downloaded from AMADEUS (December 2006)
Table 4.4: Summary Statistics

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<th>Mean</th>
<th>Std. Dev</th>
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<th>Max.</th>
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<tr>
<td>LEV</td>
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<td>.171306</td>
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<tr>
<td>INTANG</td>
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<td>.0969196</td>
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</table>

Notes:

1. SIZE defined as log(Total Assets)
   ROA defined as Pre-tax profits / Total Assets
   LEV defined as Long-term debt + Short-term debt / Total Assets
   INTANG defined as Intangible Fixed Assets / Total Assets
   CAPINT defined as Tangible Fixed Assets / Total Assets
Table 4.5: Choosing competitors using weighting matrices

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<tr>
<td>$W_2$</td>
<td>Cross-European Industry-Size Competitors</td>
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<tr>
<td>$W_3$</td>
<td>Domestic Size Competitors</td>
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</table>
Table 4.6: Competition between Size competitors

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<td>[0.01619]***</td>
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Fixed Effects:

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<th>m2</th>
<th>m3</th>
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90
Notes:

1. See notes to Table 3.5

2. \( L_x \) refers to the lagged value of variable \( x \)
   - \( W_n \) are as defined in Table 4.5
   - \( D_n^* W_n \) interacts the asymmetric dummy as described in Equation (4.15)
<table>
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<th>3</th>
<th>4</th>
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Notes:
1. See Notes to Table 3.5 and Table 4.6

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Chapter 5

Corporate Tax Competition and Bargaining

5.1 Introduction

Anecdotal evidence suggests that corporate tax competition is more sophisticated than the extant literature implies. Governments do not simply react to corporate tax changes in neighbouring countries by lowering the statutory tax rate or adjusting the tax base. Instead, there is some suggestive evidence that companies bargain with the government over their tax burden. This phenomenon is particularly important when the firm is a multinational and thus has the option to relocate investment (and with it employment and tax revenue) to another country. The resulting tax burden that is negotiated between the firm and the government may also be expected to depend on how favourable the government perceives the project to be for the host economy.

1See, for example, the discussion of tax enforcement in the Financial Times (1st May, 2007).
2See the case of Sandoz, a Swiss pharmaceutical company that asked 3 European governments to state what tax incentives they would offer for investment (FT, April 14th 2005).
There is a small number of studies in the tax competition literature which model the welfare consequences of preferential tax treatment (see Keen (2001); Janeba and Smart (2003); Haupt and Peters (2005)). Whilst these papers find that the impact of discriminatory taxation is sensitive to the models' assumptions, the most recent paper by Bucovetsky and Haufler (2006) shows a robust result that banning discriminatory tax regimes is most likely to reduce economic welfare. These studies have been partly motivated by the recent political decisions to eliminate preferential tax regimes in Europe (EC, 1998) and across OECD members (OECD, 1998). Cremer and Gahvari (2000) show that an additional effect of banning preferential tax treatment, may be to encourage governments to use the level of tax enforcement to provide incentives to preferred investors. In this vein, Peralta, Wauthy and Ypesele (2003) show that the optimal response of governments may be to not enforce transfer pricing rules as a way of providing tax incentives to multinational firms.

In this chapter, we follow Vandenbussche and Tan (2005) and model a bargaining game played between governments and multinational firms. The multinational firm is seeking a profit-maximizing location where the tax burden on the profits is minimized. The government's objective function is to maximize the welfare of the country, defined in terms of employment and tax revenues. However, the government will receive an additional boost to welfare if it attracts a firm in a target industry. This may reflect the fact that some industries are perceived to be strategically important in securing national competitive advantage, and politicians will be rewarded by voters for securing investment in these industries. Similarly, some investments may have positive spillovers or demonstration effects. Given these parameters, the government and firm bargain over the effective tax rate (ETR) on profits. The model predicts that foreign subsidiaries in industries targeted by governments have lower ETRs.
We empirically test this prediction using individual subsidiary-level data together with survey evidence on government preferences towards specific industries. We use a variety of estimators to ensure the results are robust to the various techniques. The results indicate that foreign subsidiaries in targeted industries have, on average, 1 percent lower effective tax rates (ETRs). The effect of targeting is, however, much greater in higher statutory tax rate countries. Our estimates suggest that countries with 10 percent higher statutory tax rates, offer foreign subsidiaries in target industries an additional 12.9 percentage point reduction in their ETR. This is evidence that countries mitigate the effects of a high statutory tax rate for specific FDI projects. Our evidence also suggests that low statutory tax rate countries can extract economic rents from FDI in target industries.

The remainder of this chapter is structured as follows: Part 5.2 presents the theoretical bargaining model which predicts that foreign subsidiaries in target industries bargain for lower ETRs. In Part 5.3 we discuss the dataset and estimation technique used in the empirical analysis. Part 5.4 presents the results, and we draw conclusions in Part 5.5.

5.2 Theoretical Motivation

5.2.1 A bargaining perspective

We use a bargaining model in which a multinational firm seeks profit-maximizing locations for its foreign subsidiaries and governments seek to attract FDI, and particularly FDI in target industries. We use the Nash Bargaining Solution to determine the subsidiary’s equilibrium ETR. In the model, the multinational firm seeks to maximise after-tax profits by locating in country A or B. The government wishes to maximise a welfare function that is increasing in tax
revenue and employment. A distinguishing feature of the model is that the government receives an additional payoff if it attracts a foreign subsidiary in a targeted industry\(^3\). Using backward induction to solve the model, we conduct a comparative static exercise to determine the foreign subsidiary's ETR.

The multinational firm is looking to locate a subsidiary in a country to serve a third market. This is a typical scenario where the multinational is seeking to enter the European market and set up an export platform that will serve all countries. The inverse demand function faced by the firm is given by:

\[
P = \alpha - \gamma Q
\]

We use a simple production function where one unit of output is produced by one unit of labour input:

\[
Q = L
\]

The firm makes total profits \(\pi\) equal to total revenue minus total costs:

\[
\pi = PQ - wL
\]

This profit will be subject to tax at a rate \(t_n\) (where \(n = a, b\)) giving an after-tax profit of:

\[
\pi = (1 - t_n)(PQ - wL) \quad (5.1)
\]

\(^3\)For a full discussion of why countries target particular industries see Charlton and Davies (2005)
We now turn to the objective function of the government. The government seeks to maximise a welfare function. We assume that the government benefits from both larger tax revenue and higher employment. In addition, the government also receives an additional payoff \( \psi > 0 \) if it successfully attracts a firm in a target industry:

\[
G = wL + t\pi + \psi
\]  

(5.2)

Using backward-induction we first solve the model for the case when the bargaining is between the government and a foreign subsidiary in a non-targeted industry \( (\psi = 0) \). The profit-maximizing level of output is found by:

\[
\pi = PQ - wL
\]

\[
\pi = (\alpha - \gamma Q)Q - wQ
\]

\[
\pi = \alpha Q - \gamma Q^2 - wQ
\]

\[
\frac{d\pi}{dQ} = \alpha - 2\gamma Q - w = 0
\]

\[
\alpha - w = 2\gamma Q
\]

\[
Q^* = \frac{\alpha - w}{2\gamma}
\]  

(5.3)
Using \( Q^* \) we calculate the equilibrium after-tax profits earned by the subsidiary in country A:

\[
\pi = (1 - t_a)(PQ - wL)
\]

\[
\pi = (1 - t_a)\alpha Q^* - \gamma Q^* - wQ^*
\]

\[
\pi = (1 - t_a)\alpha \left( \frac{\alpha - w}{2\gamma} \right) - \gamma \left( \frac{\alpha - w}{2\gamma} \right)^2 - w \left( \frac{\alpha - w}{2\gamma} \right)
\]

\[
\pi = (1 - t_a) \left( \frac{(\alpha - w)^2}{2\gamma} \right) - \gamma \left( \frac{(\alpha - w)^2}{4\gamma^2} \right)
\]

\[
\pi = (1 - t_a) \left( \frac{(\alpha - w)^2}{4\gamma} \right)
\]  \hspace{1cm} (5.4)

And it follows that the after-profit in the alternative country B will be:

\[
\pi = (1 - t_b) \left( \frac{(\alpha - w)^2}{4\gamma} \right)
\]  \hspace{1cm} (5.5)

The Nash Bargaining Solution (NBS) is given as:

\[
\Omega = (G^* - G_0)^\beta (\pi^* - \pi_0)^{1-\beta}
\]  \hspace{1cm} (5.6)

\( G^* \) is the government’s welfare function when it attracts a multinational firm.
to set up a subsidiary in the country, and $G_0$ is the payoff to the government if it is unsuccessful in attracting the firm. The after-tax profit of the firm is $\pi^*$ if it locates in the country it is currently bargaining with, and $\pi_0$ is the after-tax profit the firm would earn if it exercised its outside option and located in the alternative country. If the government is not successful in bargaining with the multinational firm its payoff will be zero, hence we set $G_0$ equal to zero:

$$\Omega = (G^*)^\beta (\pi^* - \pi_0)^{1-\beta}$$

We now substitute in the payoffs to the government:

$$\Omega = \left[ wQ^* + t_a \frac{(\alpha - w)^2}{4\gamma} \right]^\beta [\pi_a - \pi_b]^{1-\beta}$$

And similarly we substitute in the payoffs to the firm, noting that the multinational always has a outside option equal to the after-tax profits it would receive if it located its subsidiary in country B:

$$\Omega = \left[ wQ^* + t_a \frac{(\alpha - w)^2}{4\gamma} \right]^\beta \left[ (1 - t_a) \frac{(\alpha - w)^2}{4\gamma} - (1 - t_b) \frac{(\alpha - w)^2}{4\gamma} \right]^{1-\beta}$$

$$\Omega = \left[ wQ^* + t_a \frac{(\alpha - w)^2}{4\gamma} \right]^\beta \left[ t_b - t_a \frac{(\alpha - w)^2}{4\gamma} \right]^{1-\beta}$$

To solve for the bargaining outcome we take the first-order condition of the Nash Bargaining Solution with respect to $t_a$. To simplify we first take logs and then differentiate.
Solving for $t_a$:

$$
\ln \Omega = \beta \ln \left[ wQ^* + t_a \frac{(\alpha - w)^2}{4\gamma} \right] + (1 - \beta) \ln \left[ t_b - t_a \right] \frac{(\alpha - w)^2}{4\gamma}
$$

$$
\frac{d\Omega}{dt_a} = \left[ \frac{\beta}{2w} \frac{2w}{\alpha - w} + t_a \right] - \left[ \frac{1 - \beta}{t_b - t_a} \right] = 0
$$

Solving for $t_a$:

$$
t_a^0 = \beta t_b - (1 - \beta) \left[ \frac{2w}{\alpha - w} \right]
$$

Equation (5.7) shows that for the subsidiary in a non-target industry, the equilibrium ETR as a result of bargaining is positively related to the ETR achievable in the alternative location for the subsidiary ($t_b$). This result is intuitive since if the outside option of the firm was a very low tax country $B$, then this would result in a lower bargained ETR from the government of country $A$. Also intuitive is that the bargained ETR is increasing in the bargaining power of the government and decreasing in the bargaining power of the firm. However, the real insight from this model is only gained by examining the difference in the equilibrium ETR obtained from bargaining involving a multinational firm in a target industry and the government. In this case the welfare function of the government is appended with an additional payoff $\psi > 0$ and the outcome of bargaining is:

$$
t_a^1 = \beta t_b - (1 - \beta) \left[ \frac{2w(\alpha - w) + 4\gamma \psi}{(\alpha - w)^2} \right]
$$

\footnote{The superscript (0) in $t_a^0$ indicates that this is not a target firm.}
Comparing the outcome of bargaining for the foreign subsidiary in the targeted versus the non-targeted industry we obtain:

\[ t^0_n - t^1_n = (1 - \beta) \left[ \frac{4\gamma\psi}{(\alpha - w)^2} \right] > 0 \] (5.9)

This comparative statics exercise demonstrates that the firm in the targeted industry receives a lower ETR than the non-targeted firm. The reasoning is straightforward: the government receives a larger payoff if it attracts a foreign subsidiary in a target industry, hence in negotiations it stands to lose more if it fails to attract the targeted foreign subsidiary compared to the foreign subsidiary in the non-target industry. The multinational firm in the targeted industry is therefore able to exploit this to negotiate a lower ETR for its foreign subsidiary.

The model therefore generates a simple prediction that can be tested empirically: \textit{ceteris paribus}, foreign subsidiaries in industries targeted by a host country government should have lower ETRs than subsidiaries in non-target industries.

5.3 Empirics

We now test the prediction of the bargaining model presented above. Specifically, our aim is to estimate the size and significance of the difference in the ETRs of foreign subsidiaries in targeted versus non-targeted industries: \( (t^0_n - t^1_n) \).

We begin by discussing the dataset used to test this hypothesis before discussing the empirical techniques employed in the analysis.
5.3.1 The data

In this study we use data on the industries targeted by the investment promotion agencies (IPAs) of national governments matched with multinational firms' subsidiary-level data. The data on targeted industries has been collected in an international survey of IPAs undertaken by Charlton and Davies (2005) and kindly provided to us for use in this chapter. The survey asked IPAs to identify any industries they target and time period over which targeting has taken place. The responses were compared to historical reports on IPA activity and follow-up telephone conversations to verify their accuracy and minimise reporting bias.

The industries targeted by European IPAs are summarised in Table 5.1. We categorise these responses into NAICS (2002) 3 digit industry codes. For those industries which cannot be separately associated with a specific industry code, we eliminate them from the analysis. The final set of targeted industries is presented in Table 5.2. This table shows that, on average, each industry is targeted by 2 countries, and that targeting is a relatively recent phenomena with an average start date of 1998.

Our data on foreign subsidiaries is sourced from the AMADEUS database discussed in Chapter 3. From the AMADEUS database we identify foreign subsidiaries using the standard OECD definition\(^5\). Not all of the observations on foreign subsidiaries identified by the AMADEUS database are suitable for analysis. In particular, an important prerequisite for the analysis is that we have a meaningful measure of the ETR of the subsidiary. Therefore, it is necessary to apply a cleaning technique to the data on the ETR of the subsidiary to ensure we preserve the integrity of this variable. This process is outlined in Table 5.3 and the number of subsidiary observations affected by this cleaning is documented.

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\(^5\)A foreign direct investment subsidiary is an incorporated enterprise in which the foreign owner controls directly or indirectly (through another subsidiary) more than 50 per cent of the shareholders' voting power (OECD Benchmark Definition of Foreign Direct Investment, 3rd Edition).
in Table 5.4. In addition, Table 5.4 shows the number of subsidiaries for which the ETR measure was missing. In a final step, we clean the dataset by trimming the ETR to remove the top and bottom 1 percentile of observations to remove outliers caused by the construction of this variable.

In total, the final dataset comprises 138,272 subsidiary year observations over the period 1994-2001. These subsidiaries are distributed across 13 European countries as shown in Table 5.5. This table also shows the number and percentage of observations for each country which are in the target and control sample. The countries with the largest representation are France, the UK, Belgium, Spain and Sweden. Notably Germany is poorly represented in this sample, a direct result of the corporate reporting requirements in this country. For 5 countries we have no observations for target firms. In total, 18 percent of the total sample is comprised of targeted observations.

In Table 5.6 we present the sample means for a number of characteristics of the foreign subsidiaries in the target and control samples. As the theory predicts, targeted subsidiaries have a lower mean ETR by almost 3 percent. However, this is partly accounted for by target subsidiaries being located in countries with a lower mean statutory tax rate. The average age of both sets of subsidiaries is broadly similar, and they do not vary significantly in their respective sizes or levels of leverage. Interestingly, it appears that foreign subsidiaries in the control sample have a higher mean return on assets which is almost twice that of the target firms. This may be caused by recent investments by subsidiaries in target industries which are not yet highly profitable. Consistent with the notion that governments target industries which are R&D intensive is the much higher intensity of intangible assets reported by foreign subsidiaries in the target sample.
5.3.2 Estimation

The empirical task is to identify and measure the predicted difference between the ETR of foreign subsidiaries in targeted versus non-targeted industries. Following the theoretical model we can measure the effect of targeting for the individual subsidiary $i$ as: $(t^1_{it} - t^0_{it})$ where 1 and 0 refer to whether the subsidiary $i$ is in a target industry or not at time $t$. The quantity $(t^1_{it} - t^0_{it})$ will be a random variable which is individual-specific and we are interested in estimating the mean of this random variable. This will provide a measure of the impact of targeting on the subsidiaries's ETR.

We have a classic missing data problem since we never contemporaneously observe the same subsidiary in both states of nature (i.e. as a target and a non-target firm). To estimate the treatment effect in the presence of the missing data problem we must use some function of the missing data that can be estimated using data on the subsidiaries in non-target industries. In what follows we describe a number of potential counterfactuals which can be constructed to estimate the targeting impact.

Treatment-Control Estimator

A first step would be to assume that treatment is statistically independent of the outcomes on the ETRs of the subsidiaries. Under this assumption we can use the Treatment-Control (TC) estimator:

$$\text{TC} = E[(t^1 - t^0)] \quad (5.10)$$

In this case, estimation is straight-forward based on the difference between the sample means of the data available on the ETRs of subsidiaries in targeted and non-targeted industries. To implement this estimator we estimate the following linear regression model:
The significance of the difference in means can be interpreted from the standard error (or t-statistic) of the coefficient estimate on $D$, the target dummy. In the case of independence, this simple difference in means estimator is unbiased, consistent and asymptotically normal. However, the independence assumption means we must be willing to assume that targeting is randomised across subsidiaries and this is unlikely since targeting is likely to favour firms based on their characteristics. This suggests that there may be some self-selection into treatment which invalidates the independence assumption and therefore leads to a bias in the simple comparison of means analysis. This selection bias will mean that the targeting dummy variable will be, to some degree, correlated with the error in the estimating equation. This correlation is likely to stem from omitted variable bias in the sense that we have not included some variables in the equation which partly determine targeting and the outcome effect on the subsidiary’s ETR.

**Control Function Estimator**

In this case, it is possible to invoke the conditional independence assumption which states that selection into targeting is independent conditional on a set of covariates. This is also called 'selection on observables' (Heckman and Hotz, 1989) or 'ignorability of treatment' (Rosenbaum and Rubin, 1983). The idea is to introduce into the outcome equation all observable variables that could possibly be correlated with the error term and then estimate the resulting equation by ordinary least squares. The Control Function (CF) estimator is defined as:

$$CF = E[(t^1 - t^0)|X_{it}]$$ (5.12)
For estimation purposes the following model can be specified:

\[ t_i = \alpha + \beta D + X_{it} + \epsilon_{it} \quad (5.13) \]

**Before-After Estimator**

An alternative methodology is the Before-After (hereafter BA) comparison which estimates the mean difference between the pre-targeting ETR of subsidiaries in targeted industries and the ETR of the same subsidiaries during the target period. That is, we use only subsidiaries that eventually end up becoming targeted. The BA estimator, with covariate controls, is defined as:

\[ BA = E[(t_{1i} - t_{0i})X_{it}] \quad (5.14) \]

This estimate may however be misleading in that it reflects all changes that occur over the time period and not simply those impacting on the subsidiaries due to targeting. To ensure we have accurately captured the change in the ETR due solely to targeting and not other confounding variables we can calculate a similar quantity for changes in the control subsidiaries over the period, and subtract this from the mean change in the targeted subsidiaries’ ETRs. This is the essence of the difference-in-differences estimator.

**Difference-in-Differences**

The difference-in-differences (DD) estimator subtracts any unobservable changes from the impact of targeting on the subsidiaries in target industries. Examples of DD estimators with covariates and repeated cross-sections are Acemoglu and Angrist (2001), Card (1990, 1992), Finkelstein (2002) and Meyer, Viscusi and Durbin (1995). The DD estimator is defined as:
\[ DD = E[(t_{1}^{P} - t_{0}^{P})|X_{it}] - E[(t_{1}^{0} - t_{0}^{0})|X_{it}] \] (5.15)

The DD estimator identifies the mean effect of targeting on the ETR of target industry subsidiaries, under the condition that without the targeting the mean ETR would have changed by an equal amount across subsidiaries in targeted and non-targeted industries.

To implement the DD estimator with covariates we can specify the following linear regression:

\[ t_{i} = \alpha + \beta_{1}D_{PTP} + \beta_{2}D_{T} + \beta_{3}D_{PTP}*D_{T} + \beta_{4}X_{it} + \epsilon_{it} \] (5.16)

Where the indicator variable \( D_{PTP} \) equals one in the post-targeting period (PTP); the indicator variable \( D_{T} \) equals 1 if the subsidiary is in a targeted industry (T), and the interaction term \( D_{PTP}*D_{T} \) equals 1 if the subsidiary is in a targeted industry during the period of targeting. In this model \( \beta_{2} \) is the DD estimate.

As noted by Meyer (1995), introducing covariates in this linear fashion may not be suitable if the treatment effect has different impacts on different groups in the population. The effect of heterogeneity in the intensity of targeting can be estimated by including interactions between selected covariates \( (X_{it}) \) and the targeted industry subsidiaries during the target period.

\[ t_{i} = \alpha + \beta_{1}D_{PTP} + \beta_{2}D_{T} + \beta_{3}D_{PTP}*D_{T} + \beta_{4}D_{PTP}*D_{T}*X_{it} + \beta_{5}X_{it} + \epsilon_{it} \] (5.17)

In the above specification, \( \beta_{2} \) identifies the mean impact of targeting and \( \beta_{4} \) is an estimate of how targeting varies with the the covariates \( (X_{it}) \).
5.4 Results

A summary of the results is reported in Table 5.7, and the detail on the underlying regression analysis is reported in Table 5.8. In the following discussion we will refer to both as appropriate. Beginning with the treatment-control estimator we estimate a lower ETR for subsidiaries in targeted industries equal to approximately 2.5 percent, and this difference in means is statistically significant at the 1 percent level. As one would expect, this estimate is similar to the difference in the sample means since it does not control for any of the differences between subsidiaries in the target and control samples. Therefore, in the second row of Table 5.7 we provide the estimate for the Control Function estimator which uses the subsidiary level covariates reported in Column 2 of Table 5.8 along with Country, Industry and Year dummies. The estimate suggests that the ETRs of target industry subsidiaries are statistically lower than those in the non-targeted sample. The effect is quantitatively much smaller estimating a difference in ETRs of less than 1 percent.

Table 5.8 provides details of the estimated coefficients on the control variables used in the Control Function estimate. As expected, the statutory tax rate of the country in which the foreign subsidiary is located has an important effect on the ETR of the firm. The statutory tax rate can explain between 58 and 66 percent of differences in the ETRs and it is a statistically significant explanatory variable across all estimators. The dummy variable for subsidiaries that have been incorporated for 5 years or less has the expected negative sign and the coefficient estimate indicates that new subsidiaries have approximately 4 percent lower ETRs. The impact of age is also robust across the various specifications. The size, leverage and asset mix are also statistically significant determinants of the subsidiary's ETR. They all have a negative impact with the coefficient estimates on leverage and fixed capital intensity having the most robust and
quantitatively important impacts. Profitability, measured as the return on assets, does not appear to be an important determinant of subsidiary-level ETRs.

Returning to Table 5.7, the Before-After estimator, implemented with the same set of covariates, indicates a very small difference and this difference is not significant at the 10 percent level. This estimate is computed on a much smaller sample since it only compares the change in the ETR of subsidiaries which are the subject of targeting in at least one year with their ETR in non-target years.

The problem with the above estimates is that they assume that any change over the time period can be attributed to targeting. This is an unconvincing assumption since both subsidiaries in targeted and non-target industries are likely to have been subject to other influences over the period which are not captured in our specification. For this reason we employ the difference-in-differences estimator which allows us to control for changes in ETRs over the period not caused by targeting. This estimate reveals that subsidiaries in targeted industries have just over 1 percent lower ETRs compared to similar subsidiaries in non-targeted industries. This difference is statistically significant at the 1 percent level.

Finally, it may be the case that the intensity of targeting varies across countries. In particular, we might expect that countries with higher statutory tax rates will offer greater fiscal incentives to foreign subsidiaries in target industries since their outside option is considerably more attractive. To test for the heterogenous effects we adapt the difference-in-differences model to allow for the effect of targeting to vary with the statutory tax rate. The results suggest a much greater intensity of targeting for higher statutory tax rate countries. The estimated coefficient indicates that countries with 10 percent higher statutory tax rates provide incentives to subsidiaries in target industries that result in a reduction of over 12.9 percentage points in subsidiaries ETRs. This heterogenous targeting impact is statistically significant. Interestingly, when controlling
for the interaction between targeting and the statutory tax rate the mean effect of targeting turns positive and suggests that for low statutory tax rate countries targeted industries have ETRs that are almost 5 percentage points higher. This suggests that the strong bargaining position of low statutory tax rate countries may mean they are able to extract economic rents, through the corporate tax system, from target industries.

5.5 Conclusion

This chapter began with the observation that multinational firms often bargain with governments over the effective tax rate applied to their profits in the host economy. We also showed that governments have recently intensified investment promotion efforts that are directed at specific industries. These two observations formed the motivation for a theoretical bargaining model which predicted that subsidiaries in target industries would be able to bargain for lower ETRs. We then tested the prediction of the model using data on individual foreign subsidiaries in Europe over 8 years between 1994-2001. This data was combined with survey evidence on the preferences of governments towards specific industries. The results indicated that targeting is a quantitively and statistically significant form of tax competition. In particular, among high statutory tax rate countries, targeting results in significantly lower ETRs for foreign subsidiaries. In contrast, low tax countries appear able to use their favourable bargaining position to extract economic rent from foreign subsidiaries in specific industries. These results suggest that studies which analyse tax competition using aggregate measures of the effective tax rate may fail to account for the more sophisticated targeted tax competition that has been adopted by governments.
Table 5.1: Industries targeted by European IPAs, 1994-2001

<table>
<thead>
<tr>
<th>Country</th>
<th>Targeted Industries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>Aerospace, Automotive industry, Chemical Industry or Plastics, Electro or Electronics, Life Sciences, Logistics, ICT or Telecom or Software, Machinery, Private Equity or Real Estate, Wellness or Tourism</td>
</tr>
<tr>
<td>Belgium</td>
<td>None</td>
</tr>
<tr>
<td>Switzerland</td>
<td>Biotechnology, Pharmaceuticals, Chemicals, Medical Technology, ICT, General Machinery, Finance, Insurance, Shared Services, Microtechnology and Nanotechnology, Environmental Technologies</td>
</tr>
<tr>
<td>Germany</td>
<td>R&amp;D Intensive Industries, Automotive, Engineering, Aerospace, Services</td>
</tr>
<tr>
<td>Denmark</td>
<td>Life sciences, IT/Telecoms, Regional HQ/Distribution centres, Food</td>
</tr>
<tr>
<td>Spain</td>
<td>Biotech, Environment, Renewable Energies, Real Estate, New Technologies</td>
</tr>
<tr>
<td>Finland</td>
<td>Information and Communications Technology, Health Care, Environmental Technology, Forest</td>
</tr>
<tr>
<td>France</td>
<td>Aerospace, Automotive and Equipment Manufacturers; Health/Food/Agriculture: Pharmaceuticals, Biotech, Agribusiness; Electronics Semiconductors, Computers, Software, ICT, Machinery Mechanical equipment, Paper, Wood, Chemicals, New Materials, Ceramics, Energy; HQ shared Service Centers, R&amp;D, Call Centers, Logistics</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>Automotive, Chemicals, Electronics, Creative industries, Environmental industries, Financial services, Food and drink, Manufacturing advanced engineering, Pharmaceuticals and Biotech, Software computers, Telecoms call centres</td>
</tr>
<tr>
<td>Ireland</td>
<td>IT, Life Sciences (Pharmaceuticals and Biopharmaceuticals), Medical Technologies, Engineering, Software, Consumer products, Financial Services, Shared Services and Customer Support activities, Footwear</td>
</tr>
<tr>
<td>Italy</td>
<td>Pharmaceuticals, ICT, Electronics</td>
</tr>
<tr>
<td>Netherlands</td>
<td>IT/Telecoms, Life Sciences, Chemicals, Distribution centres/Logistics, European HQ, Customer care centres, Shared services centres, R&amp;D</td>
</tr>
<tr>
<td>Norway</td>
<td>None</td>
</tr>
<tr>
<td>Portugal</td>
<td>Automotive, Chemical, Electronic, ICT, Life sciences, Moulds, Shared services, Tourism</td>
</tr>
<tr>
<td>Sweden</td>
<td>Wood Processing, Automotive Technologies, Life Sciences, ICT, Business Services, Mineral Exploration, Food Tech, Venture Capital, Real Estate</td>
</tr>
</tbody>
</table>

Notes:
1. Data kindly provided by Andrew Charlton (LSE).
2. To preserve the security of the data the precise date that targeting started is not revealed in this table.
Table 5.2: Summary Statistics of Target Industries

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Countries Targeting</th>
<th>Total Years</th>
<th>Start Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Agriculture and Fishing</td>
<td>1</td>
<td>3</td>
<td>1999</td>
</tr>
<tr>
<td>2</td>
<td>Mining of Metals</td>
<td>1</td>
<td>6</td>
<td>1996</td>
</tr>
<tr>
<td>3</td>
<td>Extraction of Petrochemicals</td>
<td>0</td>
<td>0</td>
<td>n.a</td>
</tr>
<tr>
<td>4</td>
<td>Food Products</td>
<td>4</td>
<td>18</td>
<td>1998</td>
</tr>
<tr>
<td>5</td>
<td>Textile and Wood Activities</td>
<td>3</td>
<td>14</td>
<td>1997</td>
</tr>
<tr>
<td>6</td>
<td>Petroleum, Chemical, Rubber, Plastic Products</td>
<td>7</td>
<td>34</td>
<td>1997</td>
</tr>
<tr>
<td>7</td>
<td>Metal and Mechanical Products</td>
<td>0</td>
<td>0</td>
<td>n.a</td>
</tr>
<tr>
<td>8</td>
<td>Machinery, Computers, RTV, Communication</td>
<td>5</td>
<td>17</td>
<td>1999</td>
</tr>
<tr>
<td>9</td>
<td>Vehicles and Other Transport Equipments</td>
<td>6</td>
<td>16</td>
<td>1998</td>
</tr>
<tr>
<td>10</td>
<td>Electricity, Gas and Water</td>
<td>1</td>
<td>3</td>
<td>1999</td>
</tr>
<tr>
<td>11</td>
<td>Construction</td>
<td>0</td>
<td>0</td>
<td>n.a</td>
</tr>
<tr>
<td>12</td>
<td>Trade and Repairs</td>
<td>0</td>
<td>0</td>
<td>n.a</td>
</tr>
<tr>
<td>13</td>
<td>Hotels and Restaurants</td>
<td>3</td>
<td>12</td>
<td>1999</td>
</tr>
<tr>
<td>14</td>
<td>Land, Sea and Air Transport</td>
<td>1</td>
<td>10</td>
<td>1999</td>
</tr>
<tr>
<td>15</td>
<td>Telecommunications</td>
<td>7</td>
<td>26</td>
<td>1998</td>
</tr>
<tr>
<td>16</td>
<td>Monetary Intermediation</td>
<td>1</td>
<td>3</td>
<td>1999</td>
</tr>
<tr>
<td>17</td>
<td>Other Financial Intermediation</td>
<td>0</td>
<td>0</td>
<td>n.a</td>
</tr>
<tr>
<td>18</td>
<td>Insurance</td>
<td>0</td>
<td>0</td>
<td>n.a</td>
</tr>
<tr>
<td>19</td>
<td>Real Estate and Business Activities</td>
<td>1</td>
<td>35</td>
<td>1997</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td></td>
<td>2.2</td>
<td>10.4</td>
</tr>
</tbody>
</table>

Notes:

2. 'Countries targeting' is the total number of countries targeting that industry.
3. 'Total years' is the cumulative total years the industry has been a target.
4. 'Start Year' is the average year targeting began.
Table 5.3: Defining the Effective Tax Rate (ETR) measure

<table>
<thead>
<tr>
<th>TAX</th>
<th>PBT &lt; 0</th>
<th>PBT = 0</th>
<th>PBT &gt; 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 0</td>
<td>Misleading interpretation. Eliminated</td>
<td>ETR undefined. Eliminated</td>
<td>Negative ETR. Valid</td>
</tr>
<tr>
<td>≥ 0</td>
<td>ETR undefined, recoded as ETR = 0</td>
<td>ETR = 0</td>
<td>ETR will be undefined, recoded as ETR = 0</td>
</tr>
<tr>
<td>&gt; 0</td>
<td>Misleading interpretation. Eliminated.</td>
<td>ETR undefined. Eliminated.</td>
<td>Valid</td>
</tr>
</tbody>
</table>

Notes:

1. TAX is defined as "Taxation" and PBT refers to "Profits before Tax" both reported in the AMADEUS database (December 2006).

2. The Effective Tax Rate (ETR) is the ratio of Taxation (TAX)/Profits before Tax (PBT)
Table 5.4: Sample Selection and Attrition

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Change</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>All Foreign Subsidiaries</td>
<td>(-)</td>
<td>352,050</td>
</tr>
<tr>
<td>2</td>
<td>Missing ETR</td>
<td>(148,342)</td>
<td>203,708</td>
</tr>
<tr>
<td>3</td>
<td>Recoding as per Table 5.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TAX&lt; 0 &amp; PBT&lt; 0</td>
<td>(32,263)</td>
<td>171,445</td>
</tr>
<tr>
<td></td>
<td>TAX&lt; 0 &amp; PBT= 0</td>
<td>(9,854)</td>
<td>161,591</td>
</tr>
<tr>
<td></td>
<td>TAX&gt; 0 &amp; PBT&lt; 0</td>
<td>(20,299)</td>
<td>141,292</td>
</tr>
<tr>
<td></td>
<td>TAX&lt; 0 &amp; PBT= 0</td>
<td>(199)</td>
<td>141,093</td>
</tr>
<tr>
<td></td>
<td>TAX= 0</td>
<td>746</td>
<td>141,093</td>
</tr>
<tr>
<td>4</td>
<td>Trim top and bottom ETR percentile</td>
<td>(2,821)</td>
<td>138,272</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>(213,778)</td>
<td>138,272</td>
</tr>
</tbody>
</table>

Notes:

1. 'All foreign Subsidiaries' refers to the total number of firms identified in the AMADEUS database with a foreign parent who has a majority shareholding. Firm-Years is the number of years for which some data are available.

2. ETRs are recoded according to the procedure described in Table 5.3.

3. The top and bottom ETR percentiles are trimmed to eliminate outliers caused by calculating this ratio.
Table 5.5: Decomposition of the dataset by country and target or non-target

<table>
<thead>
<tr>
<th>Country</th>
<th>Targets</th>
<th>Non-Targets</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Belgium</td>
<td>0</td>
<td>16,653</td>
<td>16,653</td>
</tr>
<tr>
<td>Finland</td>
<td>541</td>
<td>2,744</td>
<td>3,285</td>
</tr>
<tr>
<td>France</td>
<td>11,672</td>
<td>27,602</td>
<td>39,274</td>
</tr>
<tr>
<td>Germany</td>
<td>0</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Ireland</td>
<td>65</td>
<td>366</td>
<td>431</td>
</tr>
<tr>
<td>Netherlands</td>
<td>0</td>
<td>1,853</td>
<td>1,853</td>
</tr>
<tr>
<td>Norway</td>
<td>0</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Portugal</td>
<td>417</td>
<td>1,782</td>
<td>2,199</td>
</tr>
<tr>
<td>Spain</td>
<td>2,715</td>
<td>27,771</td>
<td>30,486</td>
</tr>
<tr>
<td>Sweden</td>
<td>1,150</td>
<td>2,694</td>
<td>3,844</td>
</tr>
<tr>
<td>Switzerland</td>
<td>14</td>
<td>46</td>
<td>60</td>
</tr>
<tr>
<td>UK</td>
<td>8,575</td>
<td>31,590</td>
<td>40,165</td>
</tr>
</tbody>
</table>

Total 25,149 113,123 138,272

Notes:

1. Data downloaded from AMADEUS (December 2006)
Table 5.6: Sample Means in Target and Non-Target Firms

<table>
<thead>
<tr>
<th>Variable</th>
<th>Targeted</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETR</td>
<td>0.203197</td>
<td>0.2284374</td>
</tr>
<tr>
<td>Statutory Tax Rate</td>
<td>0.3364641</td>
<td>0.3496489</td>
</tr>
<tr>
<td>Age</td>
<td>19.79903</td>
<td>19.4146</td>
</tr>
<tr>
<td>SIZE</td>
<td>9.631197</td>
<td>9.26739</td>
</tr>
<tr>
<td>ROA</td>
<td>0.0249237</td>
<td>0.0589661</td>
</tr>
<tr>
<td>LEV</td>
<td>0.2598733</td>
<td>0.248487</td>
</tr>
<tr>
<td>INTANG</td>
<td>0.0324479</td>
<td>0.023414</td>
</tr>
<tr>
<td>CAPINT</td>
<td>0.2185692</td>
<td>0.2087253</td>
</tr>
</tbody>
</table>

Notes:

1. ETR defined as per Table 5.3
   Statutory Tax Rate is each country’s annual statutory tax rate sourced from Devereux, Griffith and Klemm (2002) and available at www.ifs.org.uk/data/internationaltaxdata.zip
   Age is the number of years between the Date of Incorporation and the current date of the observation in the dataset
   SIZE defined as log(Total Assets)
   ROA defined as Pre-tax profits / Total Assets
   LEV defined as Long-term debt + Short-term debt / Total Assets
   INTANG defined as Intangible Fixed Assets / Total Assets
   CAPINT defined as Tangible Fixed Assets / Total Assets
### Table 5.7: The Impact of Targeting on Firm-Level ETRs

<table>
<thead>
<tr>
<th>Method</th>
<th>Definition</th>
<th>Estimate</th>
<th>Robust Standard Error</th>
<th>t Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment-Control sample mean comparison</td>
<td>$\beta$ from Eq. (5.11)</td>
<td>-0.0252404</td>
<td>0.0022938</td>
<td>-11.00</td>
</tr>
<tr>
<td>Control function estimator</td>
<td>$\beta$ from Eq. (5.13)</td>
<td>-0.0070243</td>
<td>0.0027907</td>
<td>-2.52</td>
</tr>
<tr>
<td>Before-After Comparison</td>
<td>$\beta$ from Eq. (5.13)</td>
<td>-0.0048695</td>
<td>0.0055902</td>
<td>-0.87</td>
</tr>
<tr>
<td>(target firms only)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difference-in-Differences</td>
<td>$\beta_2$ from Eq. (5.16)</td>
<td>-0.0130836</td>
<td>0.0035529</td>
<td>-3.68</td>
</tr>
<tr>
<td>(Heterogenous Effects)</td>
<td>$\beta_1$ from Eq. (5.17)</td>
<td>0.0458943</td>
<td>0.0205408</td>
<td>2.23</td>
</tr>
<tr>
<td></td>
<td>$\beta_4$ from Eq. (5.17)</td>
<td>-0.1751277</td>
<td>0.0593746</td>
<td>-2.95</td>
</tr>
</tbody>
</table>

Notes:

1. Standard errors for each estimate are computed using heteroscedastic-consistent standard errors from the appropriate OLS regression.
Table 5.8: Detailed results: The Impact of Targeting on Firm-Level ETRs

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>$D_T$</td>
<td>-0.02524</td>
<td>-0.00702</td>
<td>-0.00487</td>
<td>-0.01308</td>
<td>0.04589</td>
</tr>
<tr>
<td>[0.00229]**</td>
<td>[0.00279]**</td>
<td>[0.00550]**</td>
<td>[0.00355]**</td>
<td>[0.02054]**</td>
<td></td>
</tr>
<tr>
<td>$D_{PTP}$</td>
<td>0.00999</td>
<td>0.01014</td>
<td>[0.00469]**</td>
<td>[0.00469]**</td>
<td></td>
</tr>
<tr>
<td>$D_{PTP} * D_T$</td>
<td>0.01088</td>
<td>0.01030</td>
<td>[0.00415]**</td>
<td>[0.00417]**</td>
<td></td>
</tr>
<tr>
<td>$D_{PTP} * D_T * X_{it}$</td>
<td>[0.05937]**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Statutory tax rate | 0.65462 | 0.58794 | 0.65472 | 0.66653 |
|                   | [0.04987]** | [0.09373]** | [0.04988]** | [0.05007]** |
| AGE5             | -0.04293 | -0.04907 | -0.04288 | -0.04286 |
|                  | [0.00244]** | [0.00437]** | [0.00244]** | [0.00244]** |
| SIZE             | -0.00247 | -0.00441 | -0.00248 | -0.00245 |
|                  | [0.00072]** | [0.00128]** | [0.00072]** | [0.00072]** |
| LEV              | -0.05484 | -0.04227 | -0.05477 | -0.05479 |
|                  | [0.00677]** | [0.00911]** | [0.00676]** | [0.00676]** |
| INTANG           | -0.02118 | 0.00063 | -0.02133 | -0.02172 |
|                  | [0.01506] | [0.02508] | [0.01507] | [0.01505] |
| CAPINT           | -0.041 | -0.04934 | -0.04069 | -0.04065 |
|                  | [0.00572]** | [0.00967]** | [0.00572]** | [0.00572]** |
| ROA              | 0.00409 | 0.000125 | 0.00041 | 0.000409 |
|                  | [0.00373] | [0.00113] | [0.00373] | [0.00373] |
| Constant         | 0.22844 | 0.01377 | 0.09643 | 0.09974 | 0.00868 |
| [0.00125]** | [0.16566] | [0.08675] | [0.16563] | [0.16573] |

| Industry Dummy   | N.A. | Yes | N.A. | Yes | Yes     |
| Country Dummy?   | N.A. | Yes | N.A. | Yes | Yes     |
| Year Dummy?      | N.A. | Yes | N.A. | Yes | Yes     |
| Observations     | 138272 | 134565 | 41060 | 134565 | 134565 |

Notes:
1. Standard errors are computed using heteroscedastic-consistent standard errors from the appropriate OLS regression.
2. AGE5 is a dummy variable equal to 1 if the subsidiary has been incorporated within the previous five years of the current observation, and equal to zero otherwise.
Chapter 6

Conclusion

This thesis was motivated by the remarkable effect that low corporate tax rates and capital mobility has had on Ireland's economic growth. Against this background, our perspective has been to examine the importance of corporate taxation for multinational firms. From our review of the literature, it is clear that the role of taxation within multinational firms is central to understanding the likely scale and scope of tax competition. Therefore, our approach has been to frame our models in terms of firm-level behaviour and how this might interact with government objectives. For our empirical analysis we have used large firm-level datasets that span over 10 years and 14 European countries. In particular, we have advocated the usefulness of the ETR measured from company accounts data to test the particular hypotheses derived from our theoretical models.

We believe our innovative approach, and the accompanying empirical results, have made a number of contributions. We have shown that the objective function of multinational firms with respect to taxation cannot be assumed as one of minimising total tax liabilities. Instead, their seems good reason to think of these firms as 'tax-optimisers', evaluating the risks and rewards of tax planning.
This view is corroborated by anecdotal and survey evidence which indicates that simply minimising taxes may not be in the best long-term interests of managers or shareholders. We showed that the classic model of choice under uncertainty provides a useful way to think about the tax planning decision made by firms. This model identifies the trade-off that firms face between a lower ETR and greater ex-ante uncertainty in their ETR. We used the coefficient of variation (otherwise known as unitized risk) as a proxy for the riskiness of the firm's tax strategy. This allowed us to investigate the existence of the trade-off predicted by the model, and estimate its size. Our results, which show a non-linear trade-off, are intuitively appealing. They suggest little risk compensation for the 'natural' variation in ETRs, but a quantitatively significant trade-off at higher levels of risk.

The model proposed above allows each multinational firm to individually choose a tax planning strategy. That is, the management can pick any point along the risk compensation frontier. Shareholders, however, may be wary of the decisions of management. In particular, the asymmetry of information between management and shareholders leaves room for managerial opportunism. Managers may engage in too little effort to achieve the desired ETR, or they may be overly risk averse. In the presence of asymmetric information, shareholders have a number of responses, however, one observed response is the benchmarking of firm performance against a set of peers. We used a modified yardstick competition model to capture the effect of benchmarking on firms' ETRs. The model predicts that benchmarking (or relative performance evaluation) by shareholders should lead to similar firms choosing similar ETRs. This provided us with an empirically tractable hypothesis which we could test. The results found statistically significant evidence for benchmarking across similarly sized firms. We think that this identified an interesting dynamic of tax competition as game
played between firms, as opposed to countries. In our opinion, it is the dynamic of tax competition that exists between firms that is of first-order importance for tax competition models.

Finally, we examined a feature of tax competition which we believe could become more important in future years. This type of tax competition is one in which governments bargain with firms over the tax burden on profits. Whilst the EU and OECD have both attempted to eliminate any preferential treatment of firms in tax legislation, the scope to vary the level of enforcement or interpretation of the tax code, leaves sufficient room to effect preferential treatment. Our model of the bargaining game, predicted that foreign subsidiaries in industries which governments favoured should be able to bargain for lower ETRs. Using a large sample of subsidiary level data along with survey evidence on the preferences of governments towards specific industries, we were able to estimate the size and significance of preferential treatment. Our results suggested that high statutory tax rate countries provided significantly lower tax burdens to foreign subsidiaries in favoured industries. In contrast, low statutory tax rate countries appeared able to extract rents from foreign subsidiaries in their preferred industries. These results suggest that analysing tax competition using aggregate measures of the effective tax rate may fail to capture the more sophisticated forms of tax competition that has been adopted by governments.

We hope that this thesis will add to the emerging research agenda which focuses on the role of corporate taxation within multinational firms. It is our belief that these issues are fundamental to understanding the likely speed, scale and scope of corporate tax competition.
Appendices
Appendix A:

Using Effective Tax Rates from Financial Statement Data

In this appendix we discuss the measure of the effective tax rate (ETR) used in the empirical parts of this thesis. We focus on the process which generates the ETR measure calculated from financial statements. Our objective is to show how the definition of the ETR that we use in our empirical analysis accurately captures the phenomena we wish to investigate. Several papers have discussed the limitations of using an ETR measure calculated from financial statements\(^1\). However, it is important to recognise that the objective of these papers has been distinctly different from the issues explored in this thesis\(^2\). In particular, the phenomena we study in this thesis are closely aligned with the objectives of financial accounting under which the tax expenses are reported in financial statements. Therefore, we argue that the ETR is an appropriate measure for our purposes, whilst not disagreeing that it is wholly inappropriate for other purposes.

We begin by discussing the rules which govern how taxes and profits are recorded in the income statement. This distinction revolves around the differences between book income and taxable income. We then show that the difference between tax and book income can be decomposed into permanent and temporary components. This is important as it means that the total tax expense recorded on the income statement is rarely equivalent to cash taxes paid to the government authorities. The reason why companies do not report

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\(^1\)See, for example, Hanlon (2003), Plesko (2003).

\(^2\)Specifically, previous studies have argued that using financial statement data to estimate actual taxes paid or taxable income leads to erroneous results. We do not disagree with this conclusion. We simply point out that there are other circumstances in which the financial statement data accurately serve the purpose they are intended to.
actual taxes paid is because cash taxes do not provide an accurate assessment of the tax burden on the firm's profits. In contrast, the total tax expense is the best estimate of the firm's current tax burden. Finally, we provide a detailed discussion of the ETR measure for a company in our data sample. This provides a direct example of the data generating process. Furthermore, it demonstrates how our our theoretical and empirical models reflect the underlying data generating process. This ensures we have accurately captured the phenomena we investigate in this thesis.

Financial Reporting of Tax Expenses

The tax expense observed in company financial statements is measured according to the principles of financial accounting. The objective of financial reporting is to provide shareholders and other stakeholders with accurate information. In particular, financial statements are prepared in order to provide a signal of managers' private information about firms' performance (Dechow, 1994). To meet this objective, the items in financial statements are prepared using the accrual method of accounting. Accrual accounting methods recognize revenue, expenses, assets, liabilities and equity when the economic transaction occurs, irrespective of the timing of the related cash flow. In contrast, under a cash based accounting method, items are recognized when the cash is actually received or when expenses are paid out. The accrual method provides a more accurate reflection of the performance of the firm since it is not affected by timing issues which may provide a misleading picture of the financial position of the firm. In the context of reporting tax expenses, firms which face potential tax expenses in the future related to the profit they have reported for the current period, will include these in their total recorded tax expense\(^3\). At the time of reporting,

\(^3\)See the $995m accrual for tax contingencies recorded in AstraZeneca's Annual Report, discussed later.
they may not have paid any taxes, however, reporting zero tax expenses would give a misleading picture of the firm's performance since it expects to have to pay taxes in the future on the profits it has reported. In this way, the accrual method of accounting provides a more accurate measure of the tax position of the firm.

**Tax Return Data**

The tax return data of a firm will typically be substantially different from the tax expenses reported in the accounts. Tax rules are much closer to a cash accounting system and are thus based on realized transactions. The reasoning is that the tax system has a different objective from financial reporting. Whilst financial reporting is designed to relate information on the firm's performance, the tax code is designed to collect revenue, redistribute wealth, and to encourage (or discourage) certain behaviour (Scholes et al., 2003). For this reason, the calculation of income for tax purposes (taxable income) is different from the income reported in the financial statements (book income). For example, some expenses may not be tax-deductible, resulting in taxable income being higher than book income. Alternatively, some income may not be subject to taxation and therefore taxable income can be less than book income. This book-tax income gap, and its determinants, has been the subject of much recent research (see Desai, 2003). Efforts to estimate taxable income from financial statements have proved difficult and inaccurate when compared to actual tax returns (see, Plesko, 2003). This is partially because the total tax expense includes both a current and a deferred element. To the extent that the deferred element is an estimate of future liabilities it is not expected to be correlated with actual taxes paid.
Temporary and Permanent Differences

The differences between tax and book income can be partitioned into temporary and permanent differences. Temporary differences are included in calculating both taxable and book income, except in different time periods. An example is accelerated depreciation for tax purposes which expenses the asset more rapidly in calculating taxable income than in the calculation of book income. Taxable income will therefore be lower in the current period, and book income higher (as the tax charge is reduced). However, in future periods, taxable income will be higher than book income since the asset will have been fully depreciated for tax purposes whilst book income will still show a depreciation charge reflecting the slower rate of depreciation for book income. Thus, temporary differences reverse over time. For this reason, the total tax charge includes a measure of deferred tax due to temporary differences. This allows shareholders to determine whether a low current tax expense reflects a permanently lower tax position for the firm, or simply a temporary difference which will be reversed in the future.

In contrast, permanent differences do not reverse over time and result in a sustained difference in the calculation of book and tax income. The difference is usually accounted for by income which is never taxable or expenses which are not tax deductible. For example, during the late 1950s and 1960s, export earnings in Ireland were not subject to any corporate tax. This created a permanent difference between book income and tax income such that export earnings would have been included in book income but excluded from taxable income calculations. The total tax expense (TTE) can be written as a function of taxable income and the statutory tax rate (STR):

\[
TTE = (\text{taxable income}) \times \text{STR}
\]
Taxable income is pre-tax book income less only permanent differences. These are due to the rules on income subject to taxation and expenses allowable against taxable income. Thus, we can rewrite TTE as:

\[
TTE = (\text{pre-tax book income} - \text{permanent differences}) \times \text{STR}
\]

The reason why only permanent differences matter is because the total tax expense includes a component called deferred tax expense which ensures that the net effect of any temporary differences which reduce taxable income today but will necessarily increase it in a future period are fully accounted for. We can write the total tax expense as the sum of the current and deferred tax expense components:

\[
TTE = \text{current tax expense} + \text{deferred tax expense}
\]

The current tax expense is an estimate of current taxes due on the firm’s taxable income in the current period. The deferred tax expense is an estimate of the tax effects arising from items included in the current period but liable for taxation in a future period. Deferred tax expense arises from temporary differences. For example, if the firm is currently depreciating an asset at a faster rate for tax purposes than for book income reporting, then the current tax expense will be lower, but a deferred tax liability will be recorded such that the total tax expense in the income statement will be unaffected by this temporary difference. Therefore, using total tax expense means that only permanent differences will be responsible for differences in the total tax expense between otherwise similar firms.

The deferred component of total tax expense ensures that any temporary
differences which will reverse over time will be accounted for by using either a deferred tax asset or liability. Permanent differences which cause book income to exceed taxable income result in an ETR lower than the STR. Similarly, permanent differences which result in lower book income relative to tax income mean an ETR higher than the STR. The ideal tax shelter is one which results in a permanent difference between book and tax income, such that it reduces taxable income with no effect on book income. It is also important to note that the total tax expense relates only to income from 'ordinary activities' and thus exceptional items will not affect this measure or the ETR. These exceptional items are recorded below the tax expense line and their individual tax effects are also usually noted separately.

**An Example: AstraZeneca Plc**

We now illustrate the above discussion with an example of a firm from the AMADEUS dataset, supplemented with the information from the firm's Annual Report. Table 1 (overleaf) shows the calculation of the ETR for AstraZeneca from the company accounts data:
Table 1: AstraZeneca Annual Report (2006)

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2005</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profit before tax</td>
<td>8,543</td>
<td>6,667</td>
<td>4,844</td>
</tr>
<tr>
<td>Total tax expense</td>
<td>2,480</td>
<td>1,943</td>
<td>1,161</td>
</tr>
<tr>
<td>ETR</td>
<td>29.0%</td>
<td>29.1%</td>
<td>24.0%</td>
</tr>
</tbody>
</table>

AstraZeneca’s ETR is below the 30 percent statutory tax rate that applied in the UK during this period. The notes to the 2006 accounts include an explanation for why AstraZeneca’s total tax expenses are below that which would be due if the UK STR where to be applied to pre-tax profits. This reconciliation to the UK statutory tax rate is reproduced overleaf, and we add a column which shows the impact of each item on the firm’s ETR.

In the case of AstraZeneca, the main reason given for the difference is the geographic distribution of profits. This explains why taxes are $156 million below what they would be if all profits were subject to the UK statutory tax rate. This results in a reduction of the firm’s ETR of 1.8% below the STR, and it clearly illustrates how the location of subsidiaries and/or profits in low-tax countries can reduce the tax burden on the multinational firms’ profits.

Another significant factor explaining the difference between the firm’s ETR and the UK STR is items not chargeable for tax purposes. This is an example of a permanent difference between book and tax income, which in this case, reduces taxable income. There is no detail on exactly how $109 million was shielded from taxation, however we know that a variety of tax shields can be used by firms (see Graham and Tucker, 2005), particularly multinational firms.
like AstraZeneca which have greater opportunities for tax planning.

The final significant component is prior period adjustments, which increase the tax charge by $130 million. This amounts to an increase in the firm’s ETR this year of 1.5%. The notes to the accounts explain that this item relates mainly to an increase in provisions in respect of a number of transfer pricing audits and double tax relief. Therefore, the firm has had to report a provision for potentially higher tax charges, and thus a higher ETR, based on its evaluation of future taxes that may become payable as a result of tax planning activities.

The notes to the accounts show that the current tax expenses also includes a charge of $995 million to cover worldwide exposure to transfer pricing audits. This has increased by $452 million in the last year alone due to a number of
new audits and revisions of estimates relating to existing audits. In addition, the company also makes a provision for interest that may be chargeable on any taxes which have to be paid in light of these audits. The interest charge amounts to $265 million of tax expenses. This illustrates the significant impact that tax planning can have on firms’ tax expenses and consequently on the level and variability of ETRs. In the context of Chapter 3, it illustrates how annual variability in ETRs is driven by revisions to the benefits or costs of tax planning strategies. All of these provisions are estimates and may fall above or below the actual amounts that will be paid. However, to the extent that management must give shareholders an accurate representation of the financial position of the firm at the time of reporting, these adequately capture the firm’s tax liabilities.

In conclusion, the ETR calculated from company accounts is recorded with the objective of providing a measure of the firm’s performance to shareholders and other stakeholders. In this respect, it necessarily includes judgments by management in order to report an accurate estimate of the proportion of profits which will be paid in taxation (and thus the residual amount of profits available to shareholders). Using total tax expense means that temporary differences, which reverse over time, will not impact on the measure of the ETR. Only permanent differences, which affect taxable income, will lead to changes in firms’ ETRs. The example has illustrated the impact of multinational activity in substantially reducing the firm’s ETR below the STR. It also showed how tax planning efforts can result in substantial changes to the level and variability of firms’ ETRs.

4Revisions to the value of deferred assets and liabilities over time will affect ETRs, however the valuation effect is expected to be relatively small
Appendix B:

Estimating a Dynamic Model of Firm-Level ETRs

In this appendix we describe the dynamic panel estimation method used in Chapters 3 and 4. This allows us to specify a dynamic model and, for the first time, correctly estimate the determinants of firm-level ETRs when they are jointly determined. The estimators are particularly suited to panel data which has a large number of firms observed over a relatively short time period.

Estimation of regressions with lagged dependent variables by OLS will lead to 'dynamic panel bias' since the $y_{i,t-1}$ term is endogenous to the fixed effect $\mu_i$ in the error term. Dynamic panel bias will inflate the coefficient on the lagged dependent variable since it will attribute predictive power to this regressor that properly belongs to the fixed effect. The most obvious approach to dealing with dynamic panel bias may appear to be the explicit inclusion of an individual fixed effect to draw out the fixed effect from the error term. This technique is the Least Squares Dummy Variable (LSDV) estimator or the Within-Groups estimator. However, this will not eliminate dynamic panel bias (Nickell, 1981; Bond, 2002). Under Within-Groups, and in contrast to the OLS estimates, dynamic panel bias will reduce the coefficient on the lagged dependent variable. However, the OLS and Within-Groups estimators provide a useful check on any improved estimation technique we use as the coefficient estimate should lie in the range between the Within Groups and OLS coefficient estimates (Bond, 2002).

Solutions to Dynamic Panel Bias

Dynamic panel bias can be eliminated by transformations to the regressors which purge the fixed effect from the data whilst avoiding mechanically introducing endogeneity as in the Within Groups technique. Two commonly used transfor-
mations are first-differencing and taking forward orthogonal deviations. First differencing transforms regressors by subtracting each consecutive observation from its previous value. For example:

\[ y_{it} = \alpha y_{i,t-n} + X'_{it}\beta + \mu_i + \nu_{it} \]  

becomes:

\[ \Delta y_{it} = \alpha \Delta y_{i,t-n} + \Delta X'_{it}\beta + \Delta \nu_{it} \] 

The time-invariant unobservable term in the error \( \mu_i \) has now been purged. However, the lagged dependent variable remains endogenous since the \( y_{i,t-n} \) term in \( \Delta y_{it} \) correlates with the \( \nu_{i,t-n} \) in \( \Delta \nu_{it} \). Despite this, unlike with the Within-Groups transform, deeper lags of the regressors remain orthogonal to the error and are therefore valid as instruments.

Using lags as Instruments

One feature of ETRs is that there are no natural instruments for the endogenous determinants that are external to the dataset. In this scenario, we can use internal instruments to estimate the model. Candidate instruments for \( y_{i,t-1} \) (the transformed lagged dependent variable) are the lagged levels of the variable \( y_{i,t-2} \) and, additionally, the lagged differenced variable (e.g. \( \Delta y_{i,t-2} \)) can also be used. In fact, in the differenced case we have a mechanical relationship between \( \Delta y_{i,t-1} \) and both the lagged level term and the lagged difference term, and this provides the basis of their use as instruments⁵.

The most obvious way to proceed with estimation, now that we have established potential instruments, is to use Two Stage Least Squares (2SLS) in the

\[ \Delta y_{it} = \alpha \Delta y_{i,t-n} + \Delta X'_{it}\beta + \Delta \nu_{it} \]

⁵This can be seen as \( \Delta y_{i,t-1} = y_{i,t-1} - y_{i,t-2} \) but neither are related to the error term \( \Delta \nu_{i,t-2} = \nu_{it} - \nu_{i,t-1} \). Provided the \( \nu_{it} \) are not serially correlated.
manner of the Anderson-Hsiao (1981) difference and level estimators. Generally, however, the Anderson-Hsiao estimates perform poorly, giving estimates outside the range provided by the Within-Groups and OLS coefficient estimates. As a result, Holtz-Eakin, Newey and Rosen (1988) propose using GMM to reduce the trade-off between sample size and efficiency. This has been developed by Arellano and Bond (1991), and is commonly referred to as the difference GMM estimator. They compare their one and two step difference GMM estimates to OLS, Within Groups, and Anderson-Hsiao level and difference estimates using Monte Carlo simulations. They find that the difference GMM estimator exhibits the least bias and variance when estimating the parameter of interest.

However, Blundell and Bond (1998) demonstrate that if the dependent variable is close to a random walk, then difference GMM can perform poorly as lagged levels tell us relatively little about future changes in $y_{it}$. This makes lagged levels poor instruments in differenced GMM. Blundell and Bond propose an enhanced technique outlined in Arellano and Bover (1995). This uses additional instruments in the form of lagged differences or subtracting the forward orthogonal means from the endogenous variable. This is only valid if we assume that changes in the instrumenting variable are uncorrelated with the fixed effects$^5$. This has been named the SYSTEM estimator.

In short, Arellano-Bond (difference estimator) instruments differences with lagged levels, whilst Arellano-Bover (SYSTEM estimator) use additional instruments for the levels equation by including differenced lags or forward-orthogonal deviations in the instrument set. One advantage of the SYSTEM estimator is that we may think that past changes may have greater predictive power for future levels than past lagged levels have of future changes. In this sense, the Arellano-Bover instruments may contain more relevant information. A further advantage of this technique is that it is possible to include time-invariant re-

$^5E[\Delta w_{it}\mu_{it}] = 0$ for all $i$ and $t$. 

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gressors which are eliminated in the Arellano-Bond first-differencing of the regressors.

The Sargan and difference-Sargan tests

A crucial assumption for the validity of the estimates, from either the difference or SYSTEM estimator, is that the instruments are exogenous. To test this we use the Sargan (1958) test for over-identifying restrictions. We also use the Sargan statistic to test the validity of the additional instruments used in the SYSTEM estimator, this is called the difference in Sargan test.

These tests are only reliable when the number of instruments is relatively small. This is because the error in the Sargan test is proportional to the number of instrumental variables. For example, in one simulation of difference GMM on an $8 \times 100$ panel, Windmeijer (2005) reports that cutting the instrument count from 28 to 13 reduced the average bias in the two-step estimate of the parameter of interest by 40%. For this reason we use a maximum of 2 lagged variables in the instrument set, which gives us a comfortable margin for error in such a large dataset. This choice is also validated by the serial correlation tests suggested by Arellano and Bond (1991) and reported to the third order in our results. Finally, we use robust two-step standard errors for estimation following the procedure of Windmeijer (2005).
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