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The Corporate Income Tax in the Open Economy: Incidence and Profit Shifting

by

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A thesis submitted in partial fulfilment of the requirements for the degree of

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Contents

List of Tables

List of Figures

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Finally, this work could have not been possible without the support of my husband Antonio to whom I would like to dedicate this thesis.

Declaration

This thesis represents my own work.

Chapter 1 is joint with Professor Wiji Arulampalam (University of Warwick) and Professor Michael Devereux (University of Oxford). For the first chapter, I have reviewed the literature, constructed the theoretical model, prepared the dataset, and carried out the empirical analysis including the regression analysis and the calculation of the incidence values.

Chapter 2 is joint with Socrates Mokkas (UK Office of Gas and Electricity Markets). For the second chapter, I have reviewed the literature, constructed the empirical model, prepared the dataset, and carried out the empirical analysis including the regression analysis.

The thesis has not been submitted for a degree at another university.

Summary

This thesis investigates empirically the effects of the corporate income tax in an open economy. The analysis is carried out using linear panel-data regression methods.

The first chapter studies the incidence of the corporate income tax. It introduces a model with location-specific rents which distinguishes between a direct effect and an indirect effect of the corporate income tax on labour. The former occurs when an increase in the corporate tax reduces the rent over which the employees and the company bargain. This reduces the bargained wage. The latter effect is the result highlighted in previous literature wherein an increase in the corporate tax reduces the stock of capital and consequently wages. Chapter 1 estimates the direct effect using accounting data from over 55,000 companies located in nine OECD countries (1996–2003) and finds that the tax is largely shifted to the labour force.

Chapter 2 shows that measured productivity of multinational firms is overestimated in low-tax countries (and vice versa), because multinationals manipulate the value of sales upwards and the costs of intermediate inputs downwards. The analysis is carried out using accounts from about 16,000 firms located in 10 OECD countries (1998–2004). The results show that a 10 percentage points cut in the statutory corporate tax rate induces multinationals to increase their measured to-

tal factor productivity by about 10 per cent.

Chapter 3 investigates the effect of tax haven operations in a corporate group. Using accounting data for about 3,400 corporate groups in 15 OECD countries (2003–2007), the study finds that tax haven operations reduce the tax liabilities of multinational companies by 7.4 per cent in the long run (at the mean). Also, the ETR of a corporate group with tax haven subsidiaries is one percentage point lower than the ETR of entities without such operations. Chapter 3 also finds that the marginal ETR of companies headquartered in a jurisdiction with a territorial system is lower than the marginal ETR of companies headquartered in jurisdictions adopting a worldwide taxation system.

List of abbreviations

AB: Arellano and Bond (1991)

AFA: Activities of Foreign Affiliates

AFDI: Annual Inquiry into Foreign Direct Investment

ARD: Annual Respondent Database

AR(1): Autoregressive of First Order

AR(2): Autoregressive of Second Order

ATR: Average Tax Rate

BEA: Bureau of Economic Analysis

BB: Blundell and Bond (1998)

CFC: Controlled Foreign Corporation

CGE: Computable General Equilibrium

CRS: Constant Returns to Scales

DO: Direct Owner

EATR: Effective Average Tax Rate

EBIT: Earnings Before Interest and Tax

EMTR: Effective Marginal Tax Rate

ETR: Effective Tax Rate

FDI: Foreign Direct Investment

FPI: Foreign Portfolio Investment

GDP: Gross Domestic Product

GMM: Generalised Method of Moments

GMM-diff: Difference Generalised Method of Moments

GMM-sys: System Generalised Method of Moments

GUO: Global Ultimate Owner

G8: Group of Eight

IMF: International Monetary Fund

ISIC: International Standard Industrial Classification

ITR: Implicit Tax Rate

MA(1): First-Order Moving Average

MiDi: Microdatabase on Direct Investment

M&A: Mergers and Acquisitions

MNC: multinational company

MOFA: Majority-owned Foreign Affiliate

NACE Rev. 1.1: Nomenclature Générale des Activités Economiques dans les Communautés Européennes, Revision 1.

NIBT: Net Income Before Taxes

OECD: Organisation for Economic Co-operation and Development

OLS: Ordinary Least Squares

P&L: Profit and Loss

R&D: Research and Development

STAN: Structural Analysis

TFP: Total Factor Productivity

TNC: Transnational Corporation

UNCTAD: United Nations Conference on Trade and Development

UD: Union Density

WG: Within-group

2-SLS: Two Stage Least Squares

Introduction

The growing mobility of capital has been one of the most distinct trends in the global economy over the last 40 years. Foreign direct investment (FDI) and foreign portfolio investment have surged, especially since the early 1990s, creating renewed interest in international tax policy and tax design issues. Figure 1 and Figure 2 point to a worldwide expansion of FDI flows (as a percentage of gross domestic product (GDP)), in particular during the last decade of the twentieth century.

The increased integration of capital markets has forced economists and policy makers to re-think the effects of taxing capital in the open economy. Most developed and developing countries aim to tax profits inside the borders of the jurisdiction within which they are produced. That is, the corporate income tax is levied on a source basis. By mid-2009 the United States remained the sole large country still adopting some elements of a residence-based taxation system. However, the funds collected from the taxation of foreign earnings are small and this means that, broadly, the international taxation of profit is levied on a source basis (Devereux (2008)).

This thesis offers an empirical investigation of some of the most prominent issues raised by the corporate income tax levied on a source basis, and in an open economy. The first chapter addresses the fundamental question of the real incidence

of the corporate income tax, while the following two chapters focus on some important effects of the profit-shifting activities of multinationals (MNCs). More specifically, Chapter 2 tests whether manipulation of transfer-prices affects the well-documented productivity advantage of MNCs with respect to domestic entities. Chapter 3 investigates the impact of tax haven operations on the tax burden of multinational corporate groups. The empirical analysis of the effects of the corporation income tax is carried out using linear panel-data regression models and the firm-level dataset ORBIS which records companies' accounting information.

The literature provides different motivations for the presence of a source-based corporate income tax in the open economy. Political considerations are perhaps the most powerful reason why governments still apply such an inefficient tax on returns to capital. There seems to be a popular view that rich corporations should pay their fair share of tax, and consequently that the corporate income tax has a redistributive purpose. This idea cannot be supported on economic grounds: as entities and not individuals, corporations cannot bear the tax, which instead will be passed on to the labour force, the owners of capital, and (or) consumers. The literature analysing the incidence of the corporate income tax in a closed economy states that the effective incidence of the tax is on capital owners (Harberger (1962)). However when considering the more realistic case of an open economy, results change considerably. A central theorem in the theory of optimal taxation states that in a small open economy without location-specific rents, source-based taxes on capital income are borne by the immobile factors of production: labour and land. In a small open economy, which cannot influence the world rate of return, a tax on capital increases the required pre-tax rate of return. An outflow of capital achieves this. In other words, capital can avoid a source-based tax by investing elsewhere. This distorts the capital-labour ratio and therefore leads to production

inefficiency. With less capital in the economy, the demand for the immobile factors of production such as labour and land will shrink. With less capital, both labour and land will be less productive; therefore they are rewarded with lower wages and lower rents. In summary, the burden of the corporate income tax is shifted onto the immobile factors: the labour force and land (Gordon (1986)). The theoretical literature provides clear-cut predictions on the incidence of corporate income tax. Nonetheless, how much of the corporate income tax is passed on to the immobile factors is an empirical question. The first chapter of this thesis aims to re-examine the extent to which taxes on corporate income are passed on to workers in the form of lower wages.

The research makes two novel contributions to the understanding of the effective incidence of the corporate income tax levied on a source basis. First, we model a new mechanism by which corporate taxes may be passed on in lower wages: the wage bargain. This implies that it is possible to differentiate two aspects of the effective incidence of the tax: a *direct* and an *indirect* effect. Previous contributions such as Gordon (1986) and the more recent Randolph (2006) and Gravelle and Smetters (2006) derive results on the incidence of the corporate tax using Computable General Equilibrium (CGE) models in which there are no location-specific rents. Chapter 1 proposes a more realistic set-up, where quasi-rents arise from the economic activity of firms. In a partial equilibrium setting, the firm and the workforce bargain over after-tax profits.

This model is the first to identify the *direct* incidence of the tax: given the pre-tax profit of the firm, a higher tax bill will directly reduce the quasi-rent over which the workers and the company can bargain. This generates a previously unexplored channel through which corporate taxes can affect wages. The *indirect* incidence

instead has an effect on wages through determining the level of pre-tax profit via two routes. There may be an effect of a change in the tax liability on the output price, conditional on capital and labour. Additionally, a change in tax policy may affect the incentive to invest and hence the capital stock, and thus indirectly the labour force. Both of these effects may affect the pre-tax level of value added. The effect on the capital stock determines the size of the deadweight cost arising from distortions in the behaviour of the company because of the tax.

The second novel contribution of this research is that the size of the *direct* effect is tested empirically. We use unconsolidated firm-level accounting data for over 55,000 companies in nine European countries. The results suggest that this *direct* effect is both large and significant. Hassett and Mathur (2006) also attempt to estimate the incidence of the corporate income tax in the open economy. However, they do not distinguish between a *direct* and an *indirect* effect and this leads to an identification problem in their estimations. On the one hand, it is important to control for value added, that is for productivity, as the more productive firms are likely to have higher wages and higher tax charges. Nonetheless, controlling for value added wipes out the effect of the corporate income tax that materialises through the *indirect* effect of a change in the capital stock, and subsequently of productivity. In fact this effect would be captured entirely by value added. Chapter 1 recounts the first attempt to resolve this deadlock by deriving and estimating the *indirect* effect in isolation. Controlling for labour productivity (and hence for the effects of the corporate tax through capital) and other relevant company characteristics, the chapter examines whether firms with a higher tax liability pay lower wages, *ceteris paribus*. Analysing this variation enables us to identify the *direct* effect of the tax on wages, while controlling for other effects through the pre-tax level of profit. It does not allow the identification of the scale of *indirect*

effects. The empirical analyses carried out in the first chapter show that in this bargaining framework, a substantial part of the corporate income tax is passed on to the labour force in the form of lower wages.

The literature proposes a justification for taxing profits on a source basis when there are location-specific rents, such that $r > r^*$, where r and r^* are the domestic and worldwide returns to capital respectively. In this case, the standard argument is that there will not be an outflow of capital and therefore no distortion to production. This would be an efficient way of raising revenues (Zodrow (2006)). Without capital outflows, the tax would then be entirely borne by capital owners. In fact, according to the bargaining model set out in Chapter 1, when the tax rises the employees will bargain over a smaller rent and this will negatively affect their wages. In the presence of location-specific rents, the labour force might bear some of the corporate income tax if there is bargaining on location-specific rents between the company and the employees. The empirical analysis of Chapter 1 suggests that this effect is large. Only in the absence of bargaining is the corporate income tax borne entirely by capital. There is an argument that the corporate income tax is levied at source to capture rents accruing to non-residents who use public goods (for example infrastructure and law enforcement) in their production process (Sørensen (2007)) In the light of the results on incidence outlined in the first chapter, it is unlikely that foreign owners bear the tax levied in the source country.

In a world of integrated capital markets, a source-based tax is not only distorting but it is also difficult to implement. When multinational companies conduct different activities in different jurisdictions, the administration and collection of revenues from the corporate income tax become very challenging for tax authorities. By definition, a source-based tax attempts to tax profits in the country in

which they are generated. In the interconnected business environment we face now, it might be extremely complex to assign profits to a specific jurisdiction. For example, multinational companies can shift their earnings to the part of their operations located in lower-tax jurisdictions. In recent years, researchers have found evidence that multinationals shift profits by manipulating the value of intragroup debt and transfer-prices, and hence the value of their sales and the costs of inputs to minimise their overall tax burden (for a survey, see Devereux (2007)).

Labour and total factor productivity (TFP) play crucial roles in GDP growth and therefore their dispersion across firms has been at the centre of extensive research. A broad literature reports the heterogeneity in productivity levels between multinationals and domestic firms. The general finding is that MNCs are more productive than domestic entities in terms of both labour and total factor productivity (for a survey see Lipsey (2002)).

The second chapter of this thesis assesses whether the measurement of productivity is impaired when companies engage in manipulation of transfer-prices and those manipulated prices are employed in the measurement of productivity. Insofar as there is intragroup trade and transfer-price manipulation is not prohibitively costly, MNCs have an incentive to overstate the true value of sales and to understate the costs of their intermediate inputs in a low-tax country (and vice versa). As book values of sales and costs of materials are generally used in the calculation of productivity levels, measured productivity for international companies will be over-reported in low-tax countries, just as sales will be over-recorded and the costs of intermediate inputs will be under-recorded. Hence the well-documented productivity advantage of multinationals is overestimated in low-tax jurisdictions, and vice-versa. Chapter 2 shows that profit shifting is not only relevant for the

public finance literature, but it also has important implications for studies on cross-company and cross-country productivity differences if the researcher employs manipulated prices. This is another novel contribution from the research. Using a sample of about 16,000 companies located in 10 European countries, we find that the statutory corporate tax rate has a negative impact on the measured TFP of multinationals relative to domestic companies.

A specific aspect of the difficulty of implementing a source-based tax in the open economy is the shifting of earnings to tax havens. Tax havens and low-tax countries are very active in terms of international flows of capital. Small tax havens such as the small Caribbean islands[1] and low-tax larger jurisdictions such as Hong Kong, Ireland, Singapore, and Switzerland display higher ratios of inward and outward FDI to GDP than any other group of countries. In particular, smaller tax havens are characterised by spectacular inflows and outflows of capital with respect to their GDP (see figures 3 to 6).

Jurisdictions with very low taxes cast further doubt on the feasibility of imposing a source-based tax on capital income. Tax havens normally attract profits without attracting real economic activity. By separating real capital from profits, their presence symbolises the difficulty of implementing the core principle of a source-based tax on capital, which is to tax profits in the country in which they originate.

Governments' interventions during the recent financial crisis and the resulting worldwide recession have placed a lot of strain on public finances. At the same time, the need for better regulation and more transparency in financial markets has become apparent. In this environment, the role of tax havens in the global

[1]Small Caribbean islands include Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, British Virgin Islands, Cayman Islands, Dominica, Grenada, Montserrat, Netherlands Antilles, St. Kitts and Nevis, St Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, and Turks and Caicos Islands.

economy has recently regained attention in many political circles and in the media. It is thought that offshore fiscal centres erode (unjustly) the tax base of larger, higher-tax countries and provide an unfair competitive advantage to corporations organising some of their operations through them.

The third chapter of this thesis investigates the effect of tax haven operations on the tax liabilities of corporate groups, holding other firm characteristics such as profitability constant. By analysing the tax bill of the whole group, the research reported in this chapter is able to assess whether the corporation income tax is (in fact) substantially avoided, thus creating the conditions for an erosion of the worldwide tax base. Previous studies such as Desai et al. (2006b) have investigated the effect of offshore low-tax jurisdictions using unconsolidated accounts. Unfortunately, an analysis based on unconsolidated accounts is unable to test appropriately whether the corporate income tax is in fact avoided, as tax savings in one subsidiary could be compensated for by higher tax charges in other subsidiaries of the group. Using consolidated accounting data for 15 OECD countries, Chapter 3 finds that the presence of tax haven subsidiaries reduces group tax liabilities over total assets. Additionally, corporate groups with offshore low-tax operations display a lower marginal effective tax rate (ETR) with respect to entities without such operations.

The United Kingdom recently substituted a worldwide system for a territorial system for the taxation of corporate profits. The reform has spurred a debate on whether the new system substantially reduces the tax burden of MNCs. The third chapter of this thesis also reports the results of an investigation of whether the marginal ETR of the corporate groups headquartered in countries with a worldwide system is larger than the marginal ETR of the companies whose parent is

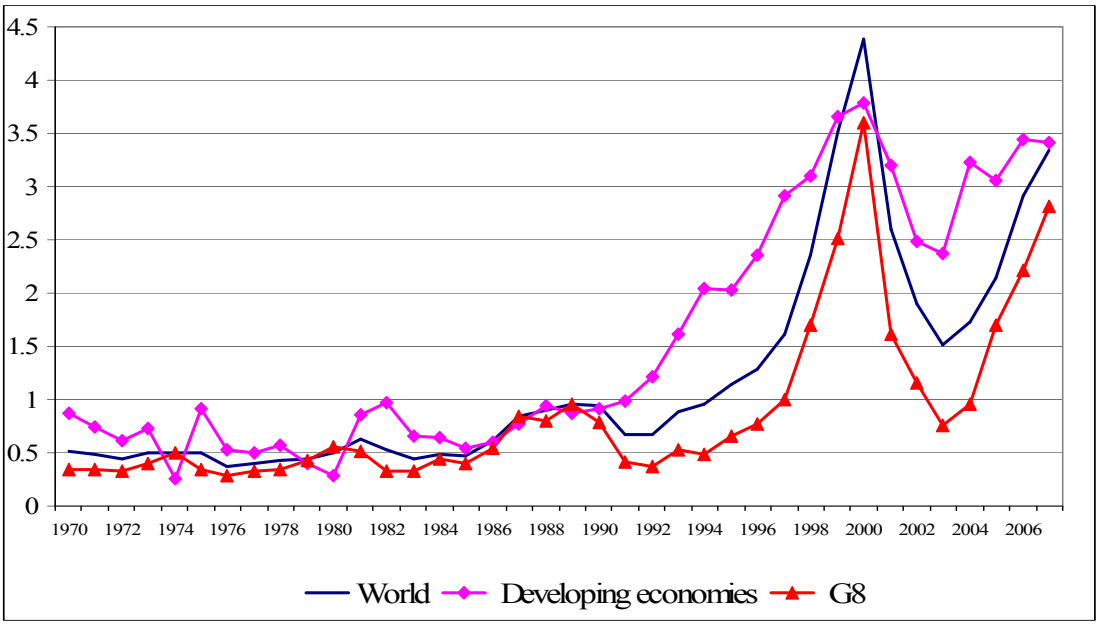
resident in jurisdictions with an exemption system.

The existence of profit-shifting activities undermines a key principle underlying a source-based tax: that is, to tax profits in the jurisdiction in which they are produced. This casts further doubt on the idea that a source-based tax is efficient in a setting where there are location-specific rents. When profits arising from location-specific rents can be shifted through debt and (or) transfer-prices, capital owners will in part be able to avoid the tax burden.

The same critique applies to the argument that the corporate income tax is a backstop for the personal income tax. According to the standard claim, the tax would prevent entrepreneurs from fully escaping the personal income tax. Without a tax levied on corporate profits, there would be an incentive to transform both labour and capital incomes into corporate earnings, and to finance consumption with loans taken out by the company (Zodrow (2006)). The idea of the corporate income tax as a backstop to personal income tax is certainly appealing, but the evidence on profit shifting provided in Chapter 2 and Chapter 3 weakens its rationale. In this context, it is easy to imagine that the entrepreneur can avoid, at least partially, the taxation of their income.

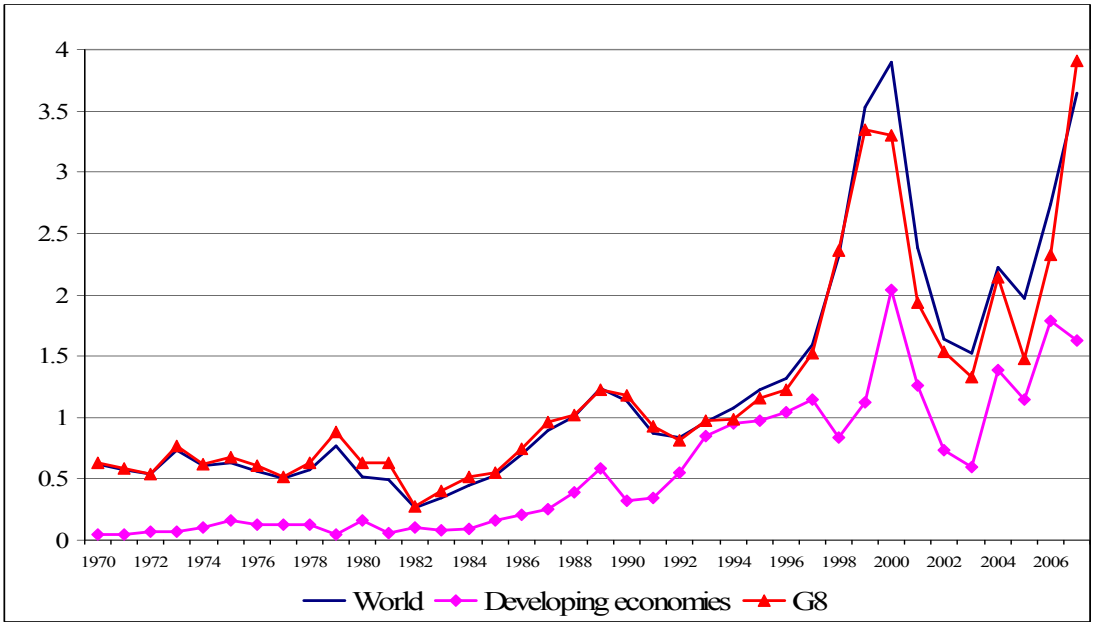
The findings of this thesis identify the adverse effects of the incidence of the corporate income tax (Chapter 1) and the consequences of its difficult implementation in a world of integrated capital markets (Chapter 2 and Chapter 3). Overall, this work suggests that in an open economy with the corporate income tax levied on a source basis, the distortions are many and important in size. This has significant implications for a world where the source-based corporate income tax is still widely used and is still generating revenues (Devereux et al. (2004)).

Figure 1: FDI Inflows (% GDP)



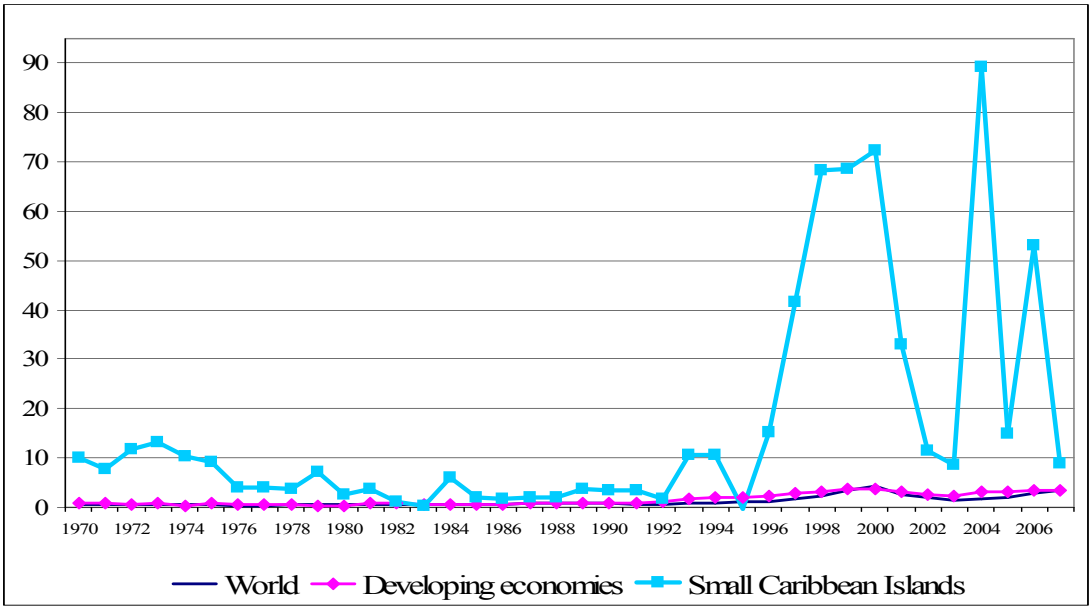
Source: UNCTAD (2008)

Figure 2: FDI Outflows (% GDP)



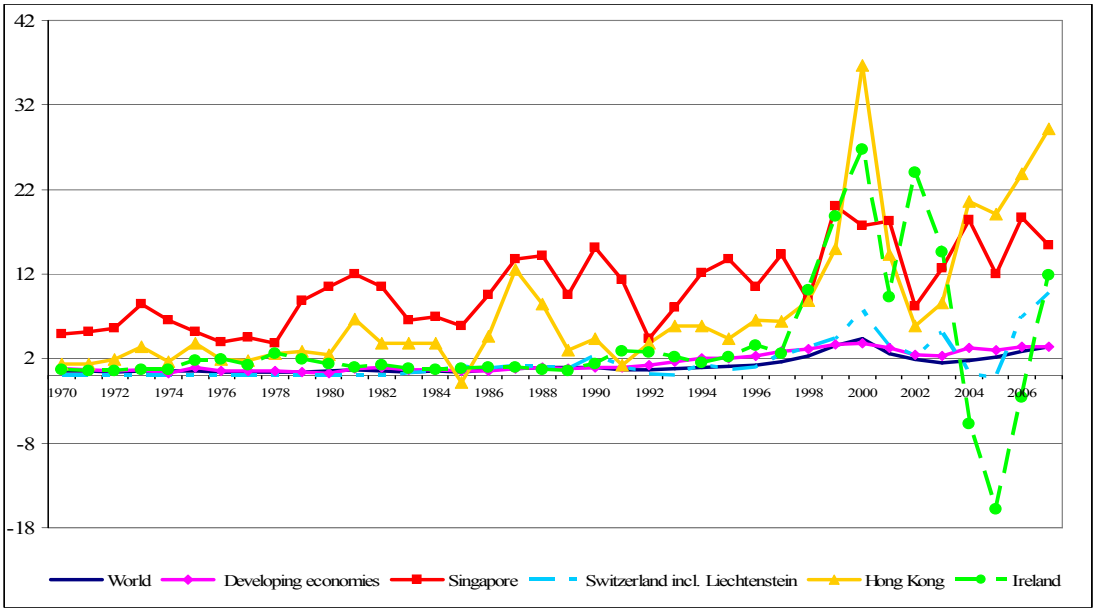
Source: UNCTAD (2008)

Figure 3: FDI Inflows (% GDP) in Small Tax Havens



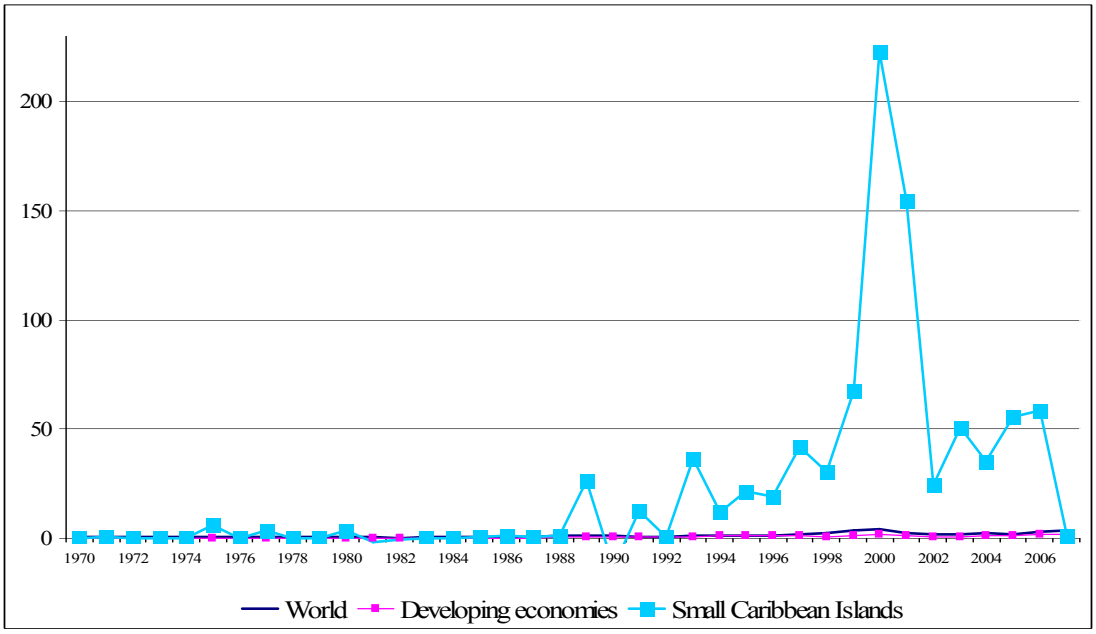
Source: UNCTAD (2008)

Figure 4: FDI Inflows (% GDP) in Large Tax Havens



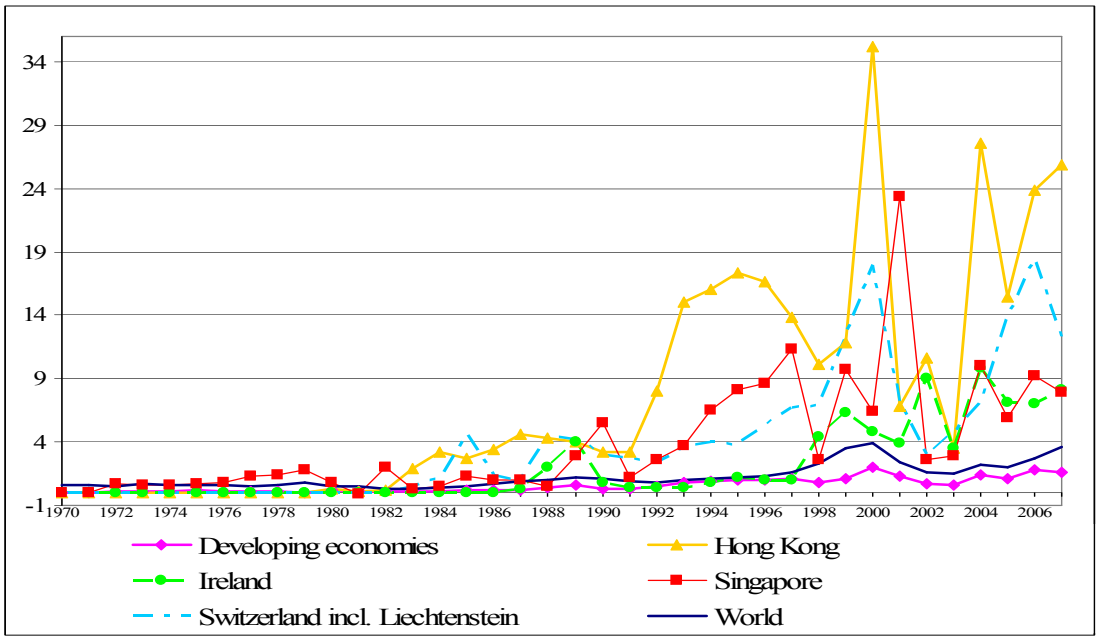
Source: UNCTAD (2008)

Figure 5: FDI Outflows (% GDP) in Small Tax Havens



Source: UNCTAD (2008)

Figure 6: FDI Outflows (% GDP) in Large Tax Havens



Source: UNCTAD (2008)

Chapter 1

The Direct Incidence of Corporate Income Tax on Wages

"On corporation tax, the Chancellor got his priorities wrong today.
The public will simply not understand why, when businesses are enjoying record profits,
the Chancellor found money to cut their tax payments".
"The TUC is not in favour of companies paying excessive taxes,
but we do expect them to pay fair taxes".
Brendan Barber,
General Secretary, UK Trades Union Congress
on the 2007 UK corporation tax cut (FT.com (2007))

1.1 Introduction

A central issue in the distribution of tax burdens is the effective incidence of the corporation tax. This has been the subject of study for nearly 50 years in theoretical, and in CGE models.[1] Nonetheless, despite its policy relevance, until very recently it received virtually no econometric investigation.

This chapter re-examines the extent to which taxes on corporate income are passed on to workers in the form of lower wages. We make two main novel contributions. First, we model a new mechanism by which corporate taxes may be passed on in lower wages: the wage bargain. We differentiate two aspects of the effective incidence of the tax. Differently from previous contributions, we identify the *direct* incidence of the tax: given the pre-tax profit of the firm, a higher tax bill will directly reduce the quasi-rent over which the workers and the company can bargain. The *indirect* incidence instead has an effect on wages through determining the level of pre-tax profit, by affecting either investment or output prices. Second, we test the size of this effect using unconsolidated firm-level accounting data for over 55,000 companies in nine major European countries over the period 1996 to 2003. Variations in tax payments and effective tax rates arise due to both differences

[1] In a 1994 survey of North American tax professionals undertaken by Slemrod (1995), 75 per cent of respondents believed that corporate income taxes are largely passed on to workers and consumers.

across countries and over time in the legal tax system, and due to firm-specific factors. We identify the effects of taxation using all of these sources of variation.

The literature on the incidence of taxes on corporate income dates back to Harberger (1962), who developed a model of a closed economy with a corporate sector and a non-corporate sector, and analysed the introduction of a tax only in the corporate segment of the economy. Harberger (1962) showed that the incidence of the tax depended on a number of factors, including the elasticities of substitution between labour and capital used in each sector, and between the goods produced in each sector. His main conclusion was that under reasonable assumptions, the tax is borne by all owners of capital, across both segments of the economy, as it drives down the post-tax return to capital. A number of more complex CGE models with a larger number of sectors generate similar results (see for example Shoven (1976)).

However these results depend crucially, on among other things, the assumption of a closed economy, which restricts the supply of capital to the economy. If capital is perfectly mobile between countries, but labour is not, then the results can be very different. Bradford (1978) and Kotikloff and Summers (1987) showed that the introduction of a tax on corporate income in a home country tends to reduce the home rate of return to capital, and tends to shift capital from the home country to the rest of the world. This shift in capital reduces the return to labour in the home country, and increases the return to labour abroad. As the home country becomes small relative to the rest of the world, the effect on the world rate of return diminishes towards zero. There remains an exodus of capital, and the domestic labour force effectively bears the entire burden of the tax. Indeed given a deadweight loss induced by the outward shift of capital, the cost to the home country labour force can exceed the tax revenue generated. This suggests that a small open economy

would be better off taxing immobile labour directly, compared to imposing a tax which distorts the allocation of capital (Gordon (1986)).

A number of recent contributions have developed more sophisticated general equilibrium models of the long-run incidence of taxes on corporate income in an open economy (Randolph (2006); Gravelle and Smetters (2006); Harberger (1995) and Harberger (2006)). Randolph (2006) considered a model with two countries and five sectors, with three of the sectors being taxed only in the domestic country. Of critical importance in the model are the assumptions about factor mobility, supply elasticities, and the relative capital intensities of the different sectors. Under reasonable assumptions, Randolph (2006) found that the domestic labour force and owners of domestic capital bear the tax burden roughly in proportion to their factor income shares: labour bears 73 per cent of the tax burden. Where the domestic economy is large (as for the United States), the tax also increases wages and reduces the return to capital in the foreign country. Gravelle and Smetters (2006) allowed for a form of imperfect competition with the possibility that tradable goods are not perfect substitutes across countries. This effectively reduces the mobility of capital, and increases the extent to which owners of capital bear the tax burden.

Of course these models exclude several factors that may be important. In a recent survey, Auerbach (2006) noted a number of such factors including dynamics, investment incentives, corporate financial policy, choice of organisational form and alternative forms of imperfect competition. In this chapter, we extend the literature by drawing on many studies of wage determination to investigate how taxes on corporate income can play a role in the wage bargain. Instead of making the simple assumptions that the aggregate stock of labour is fixed, and that labour is paid its marginal product, we investigate the wage bargain at the firm level. To

do so, we introduce a tax on corporate income into the basic efficient bargaining framework of McDonald and Solow (1981), in which the firm and the labour force bargain over both wages and employment.

This generates a previously unexplored channel through which corporate taxes can affect wages. Companies operating in imperfect competition may bargain over the proportion of quasi-rents paid out in wages. We introduce into the bargain a standard tax on domestic corporate income, which is levied on profit net of wages and an allowance for capital expenditure. We refer to the impact of the tax through the wage bargain itself –conditional on value added –as a *direct* effect, which reduces the size of the quasi-rent available to bargain over. Our model specification enables us to identify this effect empirically at the level of an individual firm. We present evidence below suggesting that this *direct* effect is both large and significant.

We distinguish this from *indirect* effects of the tax, which can arise through two channels. First, there may be an effect of a change in the tax liability on the output price, conditional on capital and labour. Second, a change in tax may affect the incentive to invest and hence the capital stock, and indirectly the labour force. Both of these may affect the pre-tax level of value added.[2] The second effect determines the size of the deadweight cost arising from distortions to the behaviour of the company as a result of the tax.

This chapter builds on an empirical literature investigating the extent to which wages are partly determined by sharing in quasi-rents.[3] Part of this literature ex-

[2]In an international context, wage bargaining may give a firm an incentive to generate outside options in the form of foreign investment. See, for example, the model by Eckel and Egger (2009).

[3]In a recent contribution, using similar data to this chapter, Budd et al. (2005) investigated whether wages are determined as a share of parent-firm profit as well as subsidiary profit.

amined the extent to which rents generated by technological innovation are passed on in higher wages; for example, Van Reenen (1996) followed both a reduced form and a structural approach to examine this question. Like Abowd and Lemieux (1993), Van Reenen (1996) emphasised the importance of dealing with the endogeneity of quasi-rents. Dealing with endogeneity appropriately can significantly raise the estimated proportion of quasi-rents passed on to the workforce. Our estimates of the elasticity of wage payments with respect to value added are higher than those in the literature. However, we find these elasticities plausible, in that they imply that the effect of a marginal increase in quasi-rents on wage payments is very similar to the ratio of wage payments to quasi-rents. Our model indicates that a marginal increase in the tax liability has a larger effect, since unlike the pre-tax quasi-rent it is not subject to tax itself. The empirical results support this.

Four other recent papers aim to provide empirical evidence of the incidence of taxes on corporate income.[4] Hassett and Mathur (2006) used aggregate wage and tax data from 72 countries over the period 1981–2002. They experimented with different measures of the tax rate. They found that wages are highly responsive to the corporate tax rate, and more so in small countries. One element of this approach is surprising however. In most of its empirical formulations, the paper adds controls, including a measure of value added per worker in the manufacturing sector. This control is unlikely to be independent of the effects of the tax on corporate income, which the authors are seeking to identify: a higher tax rate should generate a net outflow of capital, which is likely to depress value added per worker. To the extent that their paper identifies a large effect of the tax on wages, conditional on value added per worker, then the effect they identify would also seem to abstract from effects arising indirectly through changes in value added.

[4] A survey of this literature is provided in Gentry (2007).

Felix (2007) employed aggregate data on wages differentiated by skill level from 19 developed countries over the period 1979–2000. Controlling for the openness of the economy, and using alternative measures of the tax rate, Felix (2007) also found very large and significant effects of the corporate income tax on wages. The effect tends to be uniform across skill levels. Desai et al. (2007) used aggregate data on the activities of US companies in around 50 countries in four years to estimate jointly the impact of the corporate income tax on the wage rate and the rate of profit. Fixing the sum of these effects to be unity, they found results of a similar magnitude to Randolph (2006): between 45 and 75 per cent of the corporate tax borne is borne by labour with the remainder falling on capital. Again, fixing the sum of the effects to be unity abstracts from the indirect effects of the deadweight cost, which if included would generate a total effect in excess of unity.

Riedel (2008) also presented a wage-bargaining model in the presence of a simplified corporate tax. Partly based on the empirical results of Budd et al. (2005), she modelled the bargain as being over the sum of the parent firm's profit and the subsidiary's profit. Abstracting from capital, this model predicts that a higher domestic tax rate would tend to increase domestic wages, because it would reduce the cost to the domestic subsidiary of paying wages (since taxable income is net of wages), while not reducing the size of the parent company's profit.[5] Symmetrically, a rise in the tax rate applied to the parent company would tend to reduce wages in the domestic subsidiary, since the total profit to be bargained over would fall, while the cost of paying domestic wages would be unchanged. Riedel (2008) found

[5]Note that this is the exact opposite of the result that would be found if the domestic subsidiary bargained over domestic profit only, but there was an outside option. In this case the higher tax rate would leave the value of the outside option unaffected, leading to a lower domestic wage rate. This effect was showed, for example, by Goerke (1996).

empirical support for the latter proposition, but not for the former.

Our empirical analysis differs from these papers in several important respects. We exploit within-firm and cross-firm variation in taxation using firm-level data. We use a panel of unconsolidated firm-level accounting data for around 55,000 companies in Belgium, Finland, France, Germany, Italy, the Netherlands, Spain, Sweden and the United Kingdom over the period 1996–2003. Controlling for labour productivity (and hence for the effects of the corporate tax through capital) and other relevant company characteristics, we examine whether firms with a higher tax liability pay lower wages, *ceteris paribus*. Analysing this variation enables us to identify the *direct* effect of the tax on wages, while controlling for other effects through the pre-tax level of profit. It does not allow us to identify the scale of *indirect* effects.

We are able to identify the effects of taxation by exploiting firm- and time-specific variation in the tax liability. We therefore do not have to rely solely on changes in the statutory tax system. Tax liabilities can vary across firms with similar levels of profit because of diversity in the form of their economic activity, such as the assets invested in and the sources of finance used, the extent to which profits are shifted between subsidiaries, the extent of losses brought forward from earlier periods, and a number of other reasons. We use lagged values of firm-specific variables based on these factors as instruments for the endogenous tax liability.

Using micro data also allows us to exploit the heterogeneity of companies' behaviour, displaying more cross-sectional variation, which is useful for identifying parameters. We are able to exploit companies' heterogeneity to analyse whether the incidence of the corporate income tax differs according to the type of firm. For

example, multinational corporations may differ from domestic companies because they have the option to relocate part or all of their productive activity abroad. Moreover, firms in multinational groups are more likely to shift profit to lower tax jurisdictions. This may increase their bargaining power, as well as reducing the location-specific profit over which they would be prepared to bargain.

We provide rigorous empirical evidence that, in this bargaining framework, a substantial part of the corporation income tax is passed on to the labour force in the form of lower wages. Our central estimates show that, conditional on value added per employee, in the long run an exogenous $1 increase in the tax bill tends to reduce real wages at the median by 75 cents.[6] Note that since wage payments are deductible from the tax base, this induced reduction in wages will generally generate a further increase in the tax bill. At the mean statutory tax rate (τ), in our sample 35 per cent, this would imply a further increase in tax of just over 26 cents. Relative to this overall tax increase of $1.26, the effective incidence on labour is therefore approximately 59 per cent.

Our bargaining model indicates that the effective incidence of an exogenous $1 rise in pre-tax value added should be lower than this. The model is based on the assumption that the two parties bargain over the share of the post-tax quasi-rent. A rise in pre-tax value added is partly shared by the government in higher taxes. The model predicts that the effective incidence on labour of an exogenous $1 rise in pre-tax value added should be a fraction $(1 - \tau)$ of the effective incidence of an exogenous fall of $1 in the tax liability. Evaluated at the mean tax rate of 35 per cent, the above result implies that wages would rise by 49 cents (0.75*0.65=0.49)

[6]Calculations are based on the estimated long-run elasticity of -0.093 and are detailed in Section 1.4.4.

in response to an exogenous $1 rise in pre-tax value added. In fact, our empirical results indicate that, at the median, the effective incidence of an exogenous $1 rise in pre-tax value added is 57 cents. The similarity of these two estimates provides support for the hypothesis that firms and workers do indeed bargain over the post-tax quasi-rent.

The chapter is organised as follows. Section 1.2 develops the conceptual framework, which allows us to consider the impact of corporate income taxes on the determination of wages, and to differentiate their direct and indirect effects. Section 1.3 presents the data used in the empirical section. Section 1.4 discusses various econometric issues, and presents the results. Section 1.5 concludes.

1.2 Conceptual Framework

We employ a simple model to inform the empirical work reported below. We consider the case of a single firm. The wage rate, w, and the labour force, N, are set through efficient bargaining between the firm and a single union representing all the workers in the company. Simultaneously, the firm chooses its capital, K. The model is similar to many used in the literature (see references in Booth (1995); Blanchflower et al. (1996); Addison and Schnabel (2003)).

Employees have an outside wage available, $\bar{w}$. This may reflect the wage rate in an alternative job, or an unemployment benefit; it is unaffected by the bargain. The union aims to maximise $(u(w) - u(\bar{w}))N$, where $u(.)$ represents the utility of a single worker and N is the number of workers employed by the firm. The firm may have the option of shifting its activities to another location, or another activity where, net of the costs of shifting, it can earn an outside post-tax profit.

The firm is prepared to bargain over location-specific profit (before wages), that is, the additional profit available by producing locally. Domestic post-tax profit is

$$\pi = F(K, N) - wN - rK - T. \tag{1.1}$$

is a standard revenue function, depending on capital, labour, and the output price. We interpret F as value added. The cost of capital is rK. Corporation tax, levied at rate τ is denoted T and is defined as

$$T = \tau \left\{ F(K, N) - wN - \alpha rK + \phi \right\}. \tag{1.2}$$

Thus, the tax is levied on revenue net of wage payments and an allowance for the cost of capital, where α is a measure of the generosity of depreciation allowances. In addition however, many other factors can affect the firm's tax position. These include for example, the size of interest payments, the allocation across types of investment which receive different capital allowances, the existence of losses brought forward from an earlier period, the extent to which taxable profit can be shifted abroad to a lower-tax country through manipulating transfer-prices, stock relief, or the contribution to an investment reserve or pension fund. We do not explicitly model these factors; rather we include them all in the term ϕ. The existence of this term implies that tax liabilities may vary across firms that have the same revenue, wage payments, and investment. In the empirical work, it is the existence of the factors incorporated in ϕ which allows us to identify the effects of tax independently of F.

We assume that the additional factors determining the tax liability in the outside option are not captured exactly by ϕ. If they were, then this term would drop out of the wage bargain. This assumption is clearly reasonable if the outside option is

to shift production abroad to where there is a different tax system. The outside option could also be undertaken by the same domestic firm by stopping production in period t and resuming it in the following period *t+1*. In this case for example, losses could be carried forward to period *t+1*. Their net present value will depend on the interest rate and on the probability of producing enough income in *t+1* to be able to claim them. Unless the interest rate is zero and it is certain that the losses will be claimed in the following period, the value of loss carry forwards will be smaller in the outside option. The same holds for the deductions for interest payments and for capital allowances. Without production, they will generate a loss in period t and the loss will be carried forward to the following period. The net present value of the loss will be lower than in the situation without strike. Additionally, the strike and the subsequent lack of production are likely to change the financing and investment patterns of the firm with respect to the situation in which there are no labour disputes. For example, the firm might need to borrow more to face the consequences of lower o zero profits or it might decide to invest less. This implies that interest payments and capital allowances accrued in a situation without the strike will be somehow different from those that would accrue when there is no production and probably little revenues.

The bargaining power of the firm, μ may depend on the cost of a temporary dispute with the workforce. The bargaining power of the union is $(1-\mu)$; this may depend on the availability of alternative income to the workers in the event of a dispute. We assume that wages and employment are determined by a Nash bargain, which maximises:

$$B = \{[u(w) - u(\bar{w})]\, N\}^{(1-\mu)} \{\pi - \pi^*\}^{\mu} \tag{1.3}$$

where π is defined by (1.1) and (1.2). The first order conditions for maximisation are:

$$(1-\mu)\frac{u'(w)}{u(w)-u(\bar{w})} - \mu\left\{\frac{N(1-\tau)}{\pi-\pi*}\right\} = 0 \tag{1.4}$$

and

$$F_N(K,N) = w - \frac{(1-\mu)}{\mu}\left\{\frac{\pi-\pi^*}{N(1-\tau)}\right\} \tag{1.5}$$

Finally, the firm chooses its capital stock by maximising its net of tax profit π. This yields the familiar expression:

$$F_K(K,N) = (1+m)r \tag{1.6}$$

where m is the effective marginal tax rate (EMTR), $m = \frac{\tau(1-\alpha)}{(1-\tau)}$. The three expressions (1.4), (1.5), and (1.6) jointly determine the values of the wage rate, w, the capital stock, K, and the number of workers employed, N.

To investigate the role of tax in affecting these three variables, we can begin by expanding $u(w)$ around the observed wage w. This yields $u(\bar{w}) \cong u(w)+u'(w)(\bar{w}-w)$. Making this approximation and substituting into (1.4) generates an expression similar to (1.5), but with the marginal product F_N replaced by the outside wage $\bar{w}$:[7]

$$w \cong \mu\bar{w} + (1-\mu)\left\{\frac{F(K,N)-(1+m)rK}{N} - \frac{\tau\phi}{(1-\tau)N} - \frac{\pi^*}{(1-\tau)N}\right\} \tag{1.7}$$

[7]Since it is based on equation (1.4), this specification could also be generated from a right to manage model.

Here the wage is approximately equal to a weighted average of the outside wage and a share of the per-employee location-specific profit, gross of wages. The deductibility of labour costs from taxable income implies that there are only three elements of the home country tax in the expression.

The first is the effect of less than full deductibility of capital expenditure. For a cash flow tax $\alpha = 1$, implying that $m = 0$. However, in the more common case of $\alpha < 1$, the additional tax liability reduces the profit over which the firm is prepared to bargain, thereby reducing the wage rate. This effect is independent of any effect via the capital stock K, as discussed below. Note that α typically varies across firms, depending on the mix of assets in which the firm invested.

Second, the other factors determining the tax liability, captured in ϕ, also remain as elements affecting the size of the post-tax profit over which the firm is prepared to bargain. Conditional on other factors, a rise in ϕ induces a rise in tax, and this will tend to reduce the wage rate:

$$\frac{\partial w}{\partial \phi} = -\frac{(1-\mu)}{N}\frac{\tau}{(1-\tau)} < 0 \tag{1.8}$$

We describe this effect as the *direct* impact of taxation through the wage bargain: a rise in ϕ reduces the wage conditional on the levels of capital, employment, and pre-tax profit. This is the effect identified in the empirical estimation when the wage rate is regressed on the tax liability per employee conditional on F/N, proxied by the variable value added per employee. The tax liability itself is likely to be endogenous, as we discuss below.

There may also be an indirect effect of a change in ϕ via a change in value added,

F. This may be reflected in a change in investment, and hence in the capital stock, K. Nonetheless, the more obvious route for such an effect would be through the effective marginal tax rate m discussed below. A change in ϕ may also reflect a modification in the output price, conditional on a given level of capital and labour. The extent to which the company can pass on in its prices its tax liability incorporated in ϕ is constrained by competition in the output market. It is most probable that any change in a company's tax liability that is not reflected in its competitors' tax bill will not be passed on in higher prices.

A third effect of taxation in equation (1.7) is that the home country tax rate also affects the value of the outside option in the bargain.[8] The value of the firm's outside option itself may be unaffected by the tax rate (depending on what the outside option is), but the deductibility of wages from the home country tax implies that in the bargain the outside option is effectively grossed up by (1 - τ). This effect of the tax rate mirrors its effect through the firm's discrete location choice. The latter can be affected by the tax rate, even under a cash flow tax (see Devereux and Griffith (1998)).

There may be another *indirect* effect on wages through the impact of the effective marginal tax rate m on the cost of capital in equation (1.6). This is straightforward to analyse when labour is fixed. In this case, a rise in m induces a fall in K, from (1.6). In turn, the fall in K induces a reduction in the marginal productivity of labour F_N, which in the absence of bargaining implies a reduction in the wage rate.

The analysis of a rise in m is more complex though when considering an individual

[8]Goerke (1996) presented a theoretical model identifying the effect of the home country tax rate.

firm, or indeed in any case where the labour force is not fixed. To explore the effect of m on the wage rate, we totally differentiate the three first order conditions, allowing w, K, and N to vary in response to a change in m, but holding all outside options constant. This yields:

$$N\left\{\frac{1}{\mu}-(w-F_N)\frac{u''(w)}{u'(w)}\right\}dw+\frac{w-F_N}{\mu}dN+\frac{(1-\mu)}{\mu}rKdm=0 \tag{1.9}$$

$$\left\{\frac{F_N-w}{\mu}+NF_{NN}\right\}dN+NF_{NK}dK=\frac{N}{\mu}dw+\frac{(1-\mu)}{\mu}rKdm \tag{1.10}$$

and

$$F_{KK}dK+F_{KN}dN=rdm \tag{1.11}$$

Combining (1.9), (1.10), and (1.11) implies that a sufficient condition for a negative effect of m on w, $\frac{dw}{dm}<0$ is that

$$w<F_N+\mu N\left[\frac{F_{NK}F_{KN}-F_{NN}F_{KK}}{F_{KK}}\right] \tag{1.12}$$

Given concavity of the production function, the term in square brackets is positive. Thus a rise in m can reduce the wage rate, even when the wage exceeds the marginal product of labour. We describe the effect of m on w as another *indirect* effect of tax on the wage rate, since it allows for an effect through K and N, and hence through value added.[9] This indirect effect determines the deadweight cost of the tax-induced distortions to capital and labour decisions.

In the empirical work below, we attempt to identify only the *direct* effect of corporation tax on wages. We estimate a log-linear version of expression (1.7), where

[9]Note though that part of the effect is direct, since even conditional on K and N, a rise in m reduces the post-tax location-specific profit that is bargained over.

the post-tax quasi-rent per employee is captured by two terms: value added per employee and tax per employee. Identification of the *direct* effect of taxation is straightforward: conditional on the other factors, the 'tax per employee' term identifies the effect of ϕ on the wage rate. Because of the potential endogeneity of the tax liability, we instrument this term using two sets of instruments. One measures the legal parameters of the tax system, and so is common to all companies in the same country and year. The other depends on the firm-specific tax liability. These measures include the use of debt finance, the markup of capital expenditure, and the extent to which losses from previous periods may be used to reduce current liabilities.

Note that the size of the tax effect is predicted to be larger than that of value added. Interpreting the tax term in the empirical equation as $T^* = \tau\phi/N$, the expected coefficient would be $\partial w/\partial T^* = -(1-\mu)/(1-\tau)$. By contrast, the expected coefficient on the value added per employee term is $\partial w/\partial(F/N) = (1-\mu)$. This difference arises because value added is pre-tax: a marginal addition to value added is shared between the firm, the workforce, and the government. By contrast, a reduction in tax is shared only by the firm and the workforce. This accounts for the fact that the marginal impact of tax is grossed up by $(1-\tau)$.

In the empirical estimation, we also consider heterogeneity across firms. In particular, we compare firms that are part of multinational groups with purely domestic companies. In the model there are two reasons why these may behave differently. First, the outside option of the multinational π^* may be higher, implying that the size of the profit over which the firm is prepared to bargain is lower. This is difficult to test; we cannot observe the outside option since the firm does not in practice choose it. In the empirical estimation, we therefore cannot include the outside option. This means that we may over-estimate the size of the profit over

which the firm is willing to bargain, and that the degree of overestimation is higher for multinational firms. This may induce greater negative bias in the estimated coefficients for firms that are part of multinational groups.

As a possible proxy for the outside option, we experiment by including the value added and the tax of the rest of the multinational group. As a proxy for the outside option, these variables would tend to have a negative impact on the wage. However, as Budd et al. (2005) and Riedel (2008) argued, it is also possible that domestic workers bargain over the firm's entire profit, rather than only on the part earned domestically. In this case, these group variables would have a positive impact on the domestic wage.

A second element of heterogeneity between firms is that a multinational may also find it cheaper to transfer production to another plant temporarily while it is engaged in a dispute with a union. This would tend to increase the firm's bargaining power μ, as it can be more patient in waiting to achieve a deal, compared with a firm which does not have this opportunity. We can examine this effect by testing whether the coefficients from the bargaining equation (which reflects bargaining strength) differ between these two groups of firms.

Note that the model predicts that a higher bargaining power of the firm would result in the firm paying a smaller share of any additional profit to the workforce through higher wages. Given the symmetry in the model across all cash flows within the firm, this also implies that a firm with greater bargaining strength would respond to an increase in tax by passing on a *smaller* proportion of the increase to the workforce. From equation (1.7), we have:

$$\frac{\partial \left(\partial w/\partial \phi\right)}{\partial \mu} = \frac{\tau}{(1-\tau)N} > 0 \tag{1.13}$$

That is, as the bargaining power of the firm increases, the coefficient on the tax per

employee term should rise. That is, a multinational which has greater bargaining power should have a smaller coefficient in absolute terms.

Finally, note that in the empirical work below we do not attempt to identify the *indirect* effect of taxes through the effective marginal tax rate and the capital stock, or through an effect of ϕ on prices, conditional on capital and labour. To evaluate the former would mean that we could not include other firm-level variables as controls in the equation, since all of them would be affected by the size of the capital stock. Another possible approach would be to identify separately the impact of the effective marginal tax rate on investment and the capital stock, and the impact of the capital stock on value added. These effects would need to be combined with the effects of value added on the wage rate that we do estimate. We leave evaluation of these effects for future research.

1.3 Data

The empirical analysis is carried out using a commercially available firm-level worldwide data set called ORBIS, compiled by the Bureau van Dijk (2007). It consists of accounting data from the balance sheet and profit and loss account of companies all around the world from 1996 to 2003. In addition ORBIS contains information on the ownership structure of the firms in 2004, including the number of shareholders, their names, their country of residence and their percentage interest in the company, and the number of subsidiaries, their names, and the percentage participation of the parent company.

Initially, we selected only the companies not defined as 'micro' in European Com-

mission (2003).[10] This sample was further restricted as follows. First, it was limited to companies for which unconsolidated data and ownership information were available; our interest is in the determination of wages at the level of an individual company, rather than at the level of a group of companies. Second, observations which showed clear errors and missing values were dropped, along with observations in the first and one hundredth percentiles of the distribution for the main variables.[11] Finally, the dynamic model specification and the method of estimation we used required companies with at least four continuous years of data. The final sample consists of 55,082 companies located in Belgium, Finland, France, Germany, Italy, the Netherlands, Spain, Sweden, and the United Kingdom.

We used ownership information from the original full set of data to identify companies in the same group in our sample. Companies were classified as: (i) belonging to a multinational group if they were connected to at least one other company in a different country by an ownership link of at least 50 per cent of the capital; (ii) belonging to a domestic group if the company was connected to other companies by an ownership link of at least 50 per cent but with none of those companies located in a different country; or (iii) as a stand-alone company if it did not have any ownership links with other companies.

Table 1.1 illustrates the distribution of companies across the nine countries. It also shows the number of companies that are stand-alone (overall around 35 per cent), part of a domestic group (30 per cent), or part of a multinational group (35 per cent). Table 1.2 indicates the number of observations used in the estimation

[10]Selecting non-micro companies involved selecting only companies with at least two subsequent years of recorded total assets greater than 2,000 EUR and at least one employee.

[11]The main variables are wage rate, number of employees, fixed assets per employee, tax bill per employee, and value added per employee.

for each company. Over 15,000 companies (over one quarter of the sample of companies used) have data for eight years; a similar number of companies have either six or seven observations. Table 1.3 shows the number of observations per year used in the regressions; each year is well represented.

1.4 Empirical Analysis

Based on the conceptual framework in Section 1.2, and in particular on equation (1.7), we consider the following log-linearised dynamic specification for wage rate w:

$$w_{it} = \sum_{j=1}^{2} \gamma_j w_{i,t-j} + \sum_{j=0}^{2} \left[\beta_j v_{i,t-j} + \delta_j T_{i,t-j} + \underline{\lambda}_j' \underline{Z}_{i,t-j} \right] + \alpha_i + \alpha_t + \varepsilon_{it} \qquad (1.14)$$

where i and t index companies and years respectively, w is log wage rate, v is log value added per employee, T is log tax bill per employee, α_i is a company-specific fixed effect, α_t is a year effect, and ε_{it} is the error term. The vector $\underline{Z}$ contains other variables associated with wage bargaining such as the outside wage and union density. About 15 per cent of our sample observations contain either a negative or a zero value for the tax liability. We assume that the effect of the actual magnitude of the tax burden on the wage rate is only present when there are positive taxes, so we include T only when it is positive. To account for the observations with non-positive taxes, we include in $\underline{Z}$ a dummy variable indicating a non-positive tax liability. We allow for a general dynamic specification, which can also be derived from a static model with an AR(2) process for the disturbance.

Several econometric issues need to be considered before a choice of an appropriate

technique is made for the estimation of a dynamic equation of this form. Due to the presence of permanent company-specific unobserved heterogeneity (α_i) which is correlated with the lagged dependent variables and endogenous regressors (v, T and the outside wage), the pooled OLS and within-group (WG) estimators are inconsistent. It is well recognised in the literature that the most appropriate technique to use in this case is the Generalised Method of Moments (GMM) applied to the first-differenced equation that does not contain α_i. The precise set of moment conditions that should be used to generate the appropriate instruments depends on the assumptions about the correlation between the regressors and the composite error term $u_{it} = \alpha_i + \varepsilon_{it}$.[12] Much of the recent literature has focused on finding appropriate instruments for the application of GMM. Arellano and Bond (1991) (AB) proposed the use of lagged levels of the variables as instruments for the endogenous differences in the first-differenced model [GMM-diff]. However, later research (for example, Blundell and Bond (1998)) has shown that when the series are highly persistent, the levels instruments are weak predictors of the differenced endogenous variables. Therefore, the AB estimator can have very poor finite sample properties in terms of bias and precision. Blundell and Bond (1998) (BB) proposed the use of additional moment conditions that correspond to the use of lagged differences of endogenous variables as instruments for the model in levels. This GMM estimator is known as system GMM [GMM-sys]. It combines moment conditions for the model in first differences with the moment conditions for the model in levels. BB and Blundell et al. (2000) showed that the system GMM estimator had better finite sample properties than AB's original differenced GMM estimator. They advocated the use of this technique when the series were highly persistent. However, this relied on certain stationarity conditions of the initial observation. Bun and Windmeijer (2007) showed that when the variance of

[12] We accommodate the time effects using year dummies.

the unobserved heterogeneity α_i is high relative to the variance of the idiosyncratic error ε_{it}, the performance of the system GMM deteriorates. In summary, whether one uses GMM-diff, or GMM-sys, or even some other method of estimation will depend on the statistical properties of the variables used in the model. Our choice of instruments for our GMM estimation has been based on this discussion. We shall return to the issue of appropriate instruments later when we discuss the results.

We have used two tests to investigate the validity of our chosen instruments. The first is the Sargan-Hansen test for over-identification (Sargan (1958); Hansen (1982)) which requires a non-rejection of the null hypothesis being tested. The second is a serial correlation test (Arellano and Bond (1991)) that tests for the presence of serial correlation in the first differenced errors ε_{it}. White noise errors ε_{it} would imply an MA(1) process for the $\Delta\varepsilon_{it}$, thus rejecting the null of no first order serial correlation but not rejecting the null of second order serial correlation. We use xtabond2 (Roodman (2009b)) in StataCorp (2005) to estimate our models using the GMM technique.

1.4.1 Variables

The wage rate is calculated as the annual average company wage (that is, costs of employees (**435**) divided by the total number of employees (**425**)).[13] We also calculate an outside wage. We assume that a worker could move to take up a job in the worst paid company in the same broad industrial sector[14], the same country, and the same year; we take this to be the outside wage in that sector, country, and

[13]This is the only measure of wage available in the dataset. The variable codes in ORBIS are given in parenthesis in bold.

[14]The broad industrial sector is defined using the Nomenclature Générale des Activités Economiques dans les Communautés Européennes (NACE) core codes, revision 1.1 (Rev 1.1) at the 2-digit level.

year. We use the ORBIS measure of value added (**439**).

The tax variable recorded in the profit and loss statement (**430**) is our measure of the tax liability of the firm in each period.[15] As discussed above, this measure is company and time-specific, in that the tax liability depends on many factors specific to the firm's performance in any particular period. We treat the tax liability as endogenous. We use two different sets of instruments. The first set includes the country and year-specific measures of the effective marginal tax rate (EMTR), the effective average tax rate (EATR)[16] and the statutory corporate tax rate. These measures are based on the legal tax system, and so are unlikely to be affected by the shocks to the individual firm's profit and wages. The second set of instruments is a collection of lagged time-varying firm-specific variables. We use the ratio of tangible fixed assets (**406**) to total fixed assets (**404**) as an indicator of the likely value of depreciation allowances for tax purposes. Non-current liabilities (**416**) as a proportion of total assets (**412**) are employed as an indicator for the extent to which taxable income is likely to be reduced by interest payments. We also use a binary indicator of whether profit before taxes (**429**) in previous periods was negative, which may indicate that the company has brought forward taxable losses to set against current profit to reduce current tax liabilities.

All monetary variables are deflated to 2000 prices using OECD country- and year-specific consumer price indexes, and converted to a common currency (US dollars) using the year 2000 OECD national average exchange rates.[17] We also investigate

[15] This is an approximation, since firms may record a value for the tax liability which differs from their obligation to the tax authorities; however, there is no reason to believe that there should be a systematic bias in using this measure.

[16] These are calculated according to the methodology proposed by Devereux and Griffith (2003), and are computed from a number of sources.

[17] OECD consumer price indexes and exchange rates are taken from www.OECDStat.org

the impact of union density (UD) using a country- and year-specific index from the OECD (2004).[18] Table 1.4 displays some basic descriptive statistics for the main variables and instruments.

1.4.2 Basic Specification

Table 1.5 presents results for our basic specification using different estimators. This specification includes only value-added per employee (v) and the tax bill per employee (T). All specifications include time dummies and two lags of each variable. Since the preferred specification required two lags of each variable, we have estimated the same model using different methods to illustrate the effect of choice of technique on the estimated coefficients. Column 1 presents the results from a pooled OLS regression. There is no allowance for company-specific unobservables in this specification, although the standard errors are clustered to account for this. Columns 2 and 3 present results from the WG estimation (OLS on variables entered in mean deviations) and OLS on the first-differenced data respectively. These are two alternative ways of dealing with company-specific unobservables in the estimation. Generally, in the absence of endogenous regressors, the pooled OLS estimator of the coefficient of the lagged dependent variable is upward-biased, while the WG and the OLS on the first-differenced estimators are downward-biased estimates (Blundell et al. (2000)). The coefficient estimates on the lagged dependent variables are very different in the three model estimations and are consistent with these biases. Both the pooled OLS and the WG estimates of the coefficient on w_{it-1} are positive, though of very different magnitudes. The first-differenced OLS model estimate of this coefficient is negative. Surprisingly, all other coefficient estimates are very similar.

[18] For a review of the effect of union density on labour market performance, see OECD (2006).

GMM estimation results are provided in columns 4 to 8 of Table 1.5. The sets of instruments used in these specifications are different. As noted above, all sets of instruments include country- and time-specific measures of the EMTR, the EATR, and the statutory corporate tax rate. Also included are the following time-varying firm-specific variables in logs: tangible fixed assets as a proportion of total fixed assets, non-current liabilities as a proportion of total assets, and an indicator variable for non-positive profit before tax. Indicator variables to pick up zero values of the logged variables were also included in the set of instruments. Columns 4 and 5 are based on the AB GMM-diff estimation of the first-differenced equation using levels of the endogenous variables as additional instruments. Columns 6 and 7 are based on the BB GMM-sys estimation, which uses levels (first-differences) of the endogenous variables as instruments for the first-differenced (levels) endogenous variables.

One practical problem with both approaches is that the number of instruments can be numerous. Unlike in two-stage-least-squares (2-SLS) where the estimation sample is restricted according to the choice of lag for the instrument, in standard applications of GMM-diff and GMM-sys, a separate instrument is included for each time period. To illustrate this problem, consider our application where $T = 8$. If we were to apply 2-SLS to estimate (1.14) in first-differences, w_{it-3} can be used as an instrument for Δw_{it-1} under standard assumptions. This would imply that the estimation sample would be $t = 4,...,8$. However, every additional lag of our dependent variable that is included in the set of instruments would result in the loss of one extra time observation. In our sample where the number of companies is large, every loss of a time observation results in a loss of around 55,000 observations per period. In contrast, the standard GMM-diff and GMM-sys approaches include separate instruments for each time period. This results in a sparse instrument set but a larger estimation sample. Three practical problems can result from the use

of a sparse instrument set (Roodman (2009a)).[19] First, the instruments can be too weak to identify the relevant effects. Second, the precision of the weighting matrix that is used in the GMM estimation is affected. Third, the Sargan-Hansen test has low power. Given these problems, we also investigate the approach in a strand of the literature where the standard GMM-diff instruments are combined through addition to create a smaller instrument set (Roodman (2009b)).[20] Columns 4 and 6 present results from the GMM estimation that used the full set of unrestricted instruments, while columns 5 and 7 present results from estimation that used the smaller restricted instrument set.

However, in all cases, the Sargan-Hansen test for over-identification is rejected and the tests for first and second order serial correlations are rejected, implying a problem with the estimators.[21] The table reports that the degrees of freedom for the over-identifying tests in the case of the restricted instrument matrix are much smaller. However, the tests still reject the null of instrument validity.[22]

[19] Taking a simple example to illustrate this issue, consider an AR(1) specification in first-difference as follows: $\Delta y_{it} = \gamma \Delta y_{it-1} + \Delta \varepsilon_{it}$, and the model would be estimated using $t = 3,..T$. The instrument matrix for the ith company in the case of AB-diff would be: $Z_i = \begin{bmatrix} y_{i1} & 0 & 0 & 0 & 0 & 0 & 0... \\ 0 & y_{i1} & y_{i2} & 0 & 0 & 0 & 0... \\ 0 & 0 & 0 & y_{i1} & y_{i2} & y_{i3} & 0... \\ . & . & . & . & . & . & . \\ . & . & . & . & . & . & . \end{bmatrix}$. For example, the instruments for the observation $y_{i3} - y_{i2}$ would be y_{i2} and y_{i1}.

[20] This is achieved in STATA using the 'collapse' option in estimation command xtabond2. Taking the example given in footnote 19, the new instrument matrix would be $Z_i = \begin{bmatrix} y_{i1} & 0 & 0 & . \\ y_{i2} & y_{i1} & 0 & . \\ y_{i3} & y_{i2} & y_{i1} & . \\ . & . & . & . \end{bmatrix}$.

[21] In Table 1.9, we have provided the results from OLS and WG estimations of simple univariate AR(1) and AR(2) models. The results are not suggestive of a near unit root in the two main variables w and v. Hence, the need for the estimation of the model using GMM-sys is not present. When we used the GMM-diff estimator, we were only able to find a reasonable specification which passed all the model diagnostics when we used lags 5 or more as instruments. This resulted in a drastic loss of observations and we therefore did not pursue this strategy.

[22] Bun and Windmeijer (2007) showed that when the variance of the unobserved company-specific heterogeneity (α_i) relative to the variance of ε_{it} increases, the bias in the GMM-sys can

We next turn to our preferred estimates, which are provided in column 8 of Table 1.5. These results refer to the GMM estimation of the first differenced equation using a set of first differenced instruments. Using a general notation, in the example of footnote 19, the instrument matrix for this GMM estimation is as follows:

$$Z_i = \begin{bmatrix} 0 & 0 & 0 & 0 \\ y_{i2} - y_{i1} & 0 & 0 & 0 \\ y_{i3} - y_{i2} & y_{i2} - y_{i1} & 0 & 0 \\ y_{i4} - y_{i3} & y_{i3} - y_{i2} & y_{i2} - y_{i1} & 0 \\ . & . & . & . \end{bmatrix}.$$

We treat all lags from two upwards of all our variables as being predetermined. The columns of the above matrix refer to the different instruments used.

Unlike the results in columns 4 to 7 of Table 1.5, for the specification shown in column 8, the tests for over-identification and the tests for first and second order serial correlations are all satisfactory. The Sargan-Hansen test for over-identification is not rejected. The test for first order serial correlation is rejected, while the test for second order serial correlation is not. This is what we would expect if the errors in the levels equation were not serially correlated.

Turning to the coefficient estimates, the estimated effects are broadly consistent with the theoretical model presented in Section 1.2, even though we have added dynamics in the empirical specification. Both the first period and second period lagged wage rate terms have a significant effect on the current wage rate, after

become quite high compared to the GMM-diff estimator and they advocate the use of GMM-diff in this case.

controlling for company-specific unobservables and accounting for endogeneity of the regressors. There is some persistence but it is not very high; the coefficients are smaller than the GMM-diff and GMM-sys estimates but are larger than the WG estimates in column 2. The short-run elasticity of the wage rate with respect to the tax per employee is quite large compared to other columns; it is estimated to be -0.095 in column 8, about six times those reported in columns 1 to 3. The long-run elasticity is a little lower at -0.066. The short-run elasticity with respect to value added per employee is estimated to be 0.773, and the longer run is again slightly lower at 0.723. We explore below the implications of these results for the incidence of the tax.

1.4.3 Basic Specification with Bargaining Variables

In Table 1.6, we use the same estimator as in column 8 of Table 1.5, but add variables associated with union bargaining. The new variables include a measure of country- and year-specific aggregate union density, and a measure of the outside option available to the workers.[23] As a proxy for the latter, we use the minimum of the log wage per employee in that sector and country in a particular year. We also include a dummy for those companies that pay the minimum wage.

For ease of exposition, column 8 of Table 1.5 is reproduced in column 1 of Table 1.6. We add the extra variables one at a time: column 2 of Table 1.6 includes the aggregate union density variable and column 3 includes additionally the outside-option variables. Since these variables do not vary by company, they are unlikely to have a very strong effect. This is what we find, although the variables have the correct sign. Including these additional controls has little impact on the other

[23]Although union coverage would be a better measure of union strength, we were unable to obtain consistent data series for our sample of countries for the years we have used. Hence, we include union density as a proxy for the strength of the union in these countries.

coefficients and standard errors. The diagnostic tests change a little: in particular the Sargan-Hansen statistic no longer rejects the null at 10%. The estimated short-run elasticity of T is now slightly higher; for example, in column 3 if Table 1.6 it is -0.120. The union density variable is correctly signed and is positive and significant at 5%.

In summary, the basic specification results displayed in column 8 of Table 1.5 do not change much with the addition of variables associated with the bargaining strength. Below, we use column 3 of Table 1.6 as our preferred model for further investigations. We next examine the behaviour of multinationals compared to domestic companies.

1.4.4 Evaluating the Direct Incidence

As already noted, the elasticity of the wage rate with respect to the tax liability per employee, T, is a little higher with the additional bargaining variables. In column 1 of Table 1.6, the short-run elasticity is estimated at -0.095 and the long-run elasticity at about -0.066. In column 3, the short-run elasticity is -0.120 and the long-run elasticity is -0.093. Standard errors of both the short- and long-run estimates for column 3 of Table 1.6 are given in Table 1.7.

Since the wage rate is calculated as total compensation per employee, these estimates are equivalent to the elasticity of total compensation with respect to the tax liability. To use these results to identify the direct incidence of tax, it is useful to calculate the impact of an exogenous $1 change in the tax liability on total compensation. Calculations are presented in Table 1.7. We calculate the incidence for each observation in the sample by multiplying the estimated elasticity by the

ratio of the wage rate to tax per employee. Based on the estimates of column 3 of Table 1.6, at the median of the resulting distribution, a \$1 increase in the tax liability leads to a 97 cents reduction in total compensation in the short run, and a 75 cents reduction in the long run. These are very large effects: the majority of any additional \$1 of tax is passed on in lower wages, and this effect happens within one period. Note though that the reduction in wages results in a further increase in the tax liability because of the deductibility of wages from the tax base. At the mean tax rate in the sample, a reduction in wages of 75 cents would generate a rise in tax of around 26 cents ($\tau\Delta w = 0.35 * (-0.75) = -0.26$). The change in wages is just under 60 per cent ($0.75/1.26 = 0.59$) of the overall change in tax of \$1.26.

Recall that these are estimates only of the *direct* effects of an increased tax liability. They do not include any *indirect* effect through prices or the capital stock, since we are controlling for pre-tax value added per employee. Note also that we would not expect over-shifting in the *direct* effect, which simply measures the distribution of a given location-specific profit between the firm and the workers.

It is also interesting to compare the effects of taxation and value added. Following the same procedure as above, we find the effective incidence of a \$1 change in value added by multiplying the estimated elasticity by the ratio of the wage rate to value added per employee. Table 1.7 indicates that the median of the resulting distribution in the short run is 0.67. A fall of \$1 in value added reduces wage payments by 67 cents. The long-run reduction is 57 cents. These figures are close to the median share of labour compensation in value added in the sample, which is 0.67.

From the theory above, we would expect the incidence of the tax to be higher than the incidence of a change in the pre-tax value added; the theory would suggest that the impact of an exogenous \$1 increase in value added would need to be grossed up by a factor $(1 - \tau)$ to find the expected impact of an exogenous \$1 reduction in tax. Our estimate of 75 cents in the long run is only slightly smaller than this, evaluated at the median.

There are a number of estimates of the elasticity of the wage rate to value added per employee in the literature. These vary widely and depend on the specification and econometric techniques used. For example, estimates from Nickell and Wadhwani (1990), Abowd and Lemieux (1993), and Van Reenen (1996) vary between 0.2 and 0.4. One possible explanation of the higher elasticities found here is that we use unconsolidated accounting data, which link wage payments of each subsidiary within a group to the value added of that subsidiary.[24] Other studies that use consolidated data may combine separate wage negotiations in different parts of the group; this may reduce the estimated elasticity. We test for the effects of other parts of the group below. In any case, as pointed out already, our estimates of the marginal effect of changes in value added seem plausible in that they are consistent with the average share of value added captured by the labour force.

1.4.5 Behaviour of Multinationals

Finally, we consider two forms of heterogeneity across firms, both of which involve multinational companies. Both are based on the specification of Table 1.6 column 3 (which is reproduced in column 1 of Table 1.8 for ease of reference).

[24]Budd et al. (2005) employed the same data source as used here, and found much lower elasticities. We attribute this primarily to the fact that they use a level, rather than a log, specification. By contrast, Riedel (2008) also used the same data, but with a log specification found a similar range of estimates of the effect of value added to those presented here.

First, we investigate whether the estimated parameters differ according to whether a firm is part of a multinational group or not. The conceptual framework in Section 1.2 indicated that the stronger the bargaining power of a firm, the lower the proportion of profit before wages that would be passed on to the labour force, and symmetrically, the lower the proportion of any increase in tax that would be passed on to the labour force. To consider differences in bargaining power, we investigate two sub-samples of the data: in column 2 of Table 1.8, we consider only stand-alone firms and in columns 3 and 4, we consider only firms, which are part of multinational groups.

The short-run elasticities of the wage rate with respect to tax per employee are very similar for the two groups of companies, whilst the long-run elasticity is bigger for international groups (-0.108 for multinationals versus -0.075 for stand-alones). The long-run incidence of an exogenous $1 rise in tax is very similar. At the median of the stand-alone sub-sample, compensation would fall by 73 cents. For companies that are part of multinational groups, the comparative figure is around 70 cents. For value added, the short-run elasticities for the two groups are very close. However, the long-run elasticity, and the long-run incidence of an extra $1 of value added, evaluated at the median, are both slightly higher for companies that are part of multinational groups[25]. Both of these results are consistent with multinational companies having greater bargaining power, although the evidence is not strong.

A second effect for multinationals could occur through the outside option. In col-

[25]The long-run elasticity is 0.816 for stand-alones and 0.900 for multinational companies. The long-run incidence of value added is 0.542 for stand-alones and 0.611 for multinationals.

umn 5 we investigate this for multinational companies by including the tax and value added variables for the rest of the multinational group. The group variables are calculated aggregating values over all of the other subsidiaries of the group for which we have data. We express these aggregates as a proportion of the number of the original company's employees. If these terms proxy the outside option of the group, then a higher value added (or lower tax) in the rest of the group may indicate a more valuable outside option and hence a lower domestic wage.

In fact, we do not find any significant effects of these variables. This may of course simply indicate that they are not good proxies for the firm's outside options. Such lack of significance also differs from the results of Budd et al. (2005) and Riedel (2008). They find the opposite effect for the value added of the parent firm. The value added of the parent has a positive effect on the wage in the subsidiary. They attribute this to the domestic labour force bargaining over profits in the parent as well as in the subsidiary. However, neither paper includes the tax or value added of the rest of the multinational group, but only the parent. The lack of significance in our results may be due to this difference in our approach. More generally, it may reflect the possibility that the workers may bargain over worldwide profits, a factor that offsets the use of worldwide profit as a proxy for the outside option in the bargain.

1.5 Conclusion

The standard model of a small open economy yields strong results for the effective incidence of a tax on capital located in that country. Given a fixed world rate of return, a tax will raise the pre-tax rate of return, but leave the post-tax rate of return unaffected. The rise in the pre-tax rate of return is achieved by an outflow

of capital, which reduces labour productivity and hence the compensation received by the immobile domestic labour force. There is therefore a presumption that the burden of the tax will be shifted away from the owners of capital to the labour force.

In this chapter, we investigate empirically part of this effect. Specifically, in our estimation we analyse the impact of a change in taxation conditional on value added. We interpret this in the context of a wage bargaining model: for a given pre-tax quasi-rent, a higher tax reduces the post-tax quasi-rent available to be bargained over by the firm and the employees. This wage bargain introduces a direct channel by which taxation affects the wage rate, a channel which can be estimated conditional on the value added of the firm. We estimate the size of this direct effect using a large database of over 55,000 companies in nine countries over the period 1996 to 2003.

We do not estimate the *indirect* effect of a change in tax, which affects the wage rate through changing the size of the pre-tax quasi-rent available to be bargained over. More specifically, although by controlling for value added (as an estimate of the pre-tax quasi-rent) we estimate the impact of changes in value added on the wage rate, we do not estimate the impact of the tax on the size of value added. By excluding this effect, our estimate of the direct effect can be interpreted as excluding the effects associated with the deadweight cost of the tax, and any changes in output price.

The results strongly support the hypothesis of a direct effect of corporate income tax through wage bargaining. We find that source-based taxes on corporate income are largely passed on in the form of lower wages. At the median, our results suggest that 75 per cent of an exogenous increase in tax is passed on in lower wages in the long run. These estimates are for the *direct* effect of the tax only,

conditional on value added (and hence indirectly conditional on investment); they are additional to possible *indirect* effects through value added.

We also investigate whether the incidence of the corporate income tax on the wage rate differs between stand-alone companies and companies that are part of multinational groups. We find only weak evidence that the companies that are part of multinational groups shift a smaller proportion of any additional tax onto the workforce (or keep a larger proportion of any reduction in tax). This is consistent with such companies having greater bargaining power. We find no effect on the wage rate of the profit or tax liability elsewhere in the multinational group.

Table 1.1: Number and Type of Company, by Country

Country	*Number of companies*				*Number of observations*
	Total	*Stand-alone*	*Part of domestic groups*	*Part of multinationals*	
Belgium	1,954	224	453	1,277	3,408
Finland	1,023	91	467	465	2,833
France	17,505	4,894	5,645	6,966	54,511
Germany	168	24	19	125	319
Italy	8,483	3,212	2,775	2,496	29,021
Netherlands	303	10	32	261	911
Spain	13,704	6,873	3,906	2,925	42,367
Sweden	2,713	99	1,053	1,561	5,964
United Kingdom	9,229	3,972	1,985	3,272	27,415
Total	55,082	19,399	16,335	19,348	166,749

Table 1.2: Number of Observations per Company

Years available per firm	Number of companies	
	Frequency	Per cent
4	12,261	22.3
5	12,217	22.2
6	7,667	13.9
7	7,632	13.8
8	15,305	27.8
Total	55,082	100

Table 1.3: Observations per Year

Years	*Frequency*	*Per cent*
1999	24,087	14.5
2000	30,614	18.4
2001	32,848	19.7
2002	38,527	23.1
2003	40,673	24.4
Total	166,749	100

Table 1.4: Descriptive Statistics for Main Variables and Instruments (in levels)

		Wage rate	*Value added per employee*	*Tax bill per employee*	*Negative tax bill (dummy)*	*Union density*	*Outside wage rate*	*Tangible fixed assets/ fixed assets*	*Non current liabilities/ total assets*	*Negative profit before tax (dummy)*	*EMTR*	*EATR*	*Statutory tax rate*
Belgium	*Mean*	52.6	215.56	13.22	0.14	55.37	17.57	0.68	0.16	0.15	0.06	0.30	0.40
	Median	48.45	78.05	4.54	0	55.6	17.69	0.86	0.10	0	0.06	0.30	0.40
	S.D.	17.11	1,300.09	56.03	0.35	0.25	7.97	0.35	0.17	0.36	0	0	0
Finland	*Mean*	41.97	110.42	14.34	0.14	74.71	7.57	0.65	0.17	0.18	0.15	0.24	0.29
	Median	39.75	60.76	3.32	0	74.8	5.82	0.78	0.10	0	0.15	0.25	0.29
	S.D.	13.41	233.6	52.58	0.35	0.6	6.01	0.33	0.20	0.39	0.01	0.01	0
France	*Mean*	42.94	81.58	7.16	0.18	8.22	2.48	0.65	0.11	0.20	0.14	0.30	0.37
	Median	39.01	53.52	2.49	0	8.2	0.42	0.75	0.06	0	0.14	0.29	0.35
	S.D.	17.15	359.98	46.71	0.39	0.09	3.49	1.75	0.16	0.40	0.01	0.02	0.03
Germany	*Mean*	57.51	137.17	14.92	0.08	23.42	13.41	0.69	0.29	0.21	0.19	0.32	0.39
	Median	54.79	90.25	5.46	0	23.2	8.91	0.84	0.24	0	0.19	0.31	0.38
	S.D.	18.73	168.19	33.33	0.27	0.99	12.14	0.33	0.20	0.41	0.03	0.04	0.05
Italy	*Mean*	32.58	76.13	10	0.03	34.68	11.82	0.69	0.13	0.18	0.19	0.35	0.43
	Median	31.59	56.15	4.68	0	34.8	11.7	0.80	0.09	0	0.18	0.33	0.41
	S.D.	9.3	205.54	30.05	0.16	0.82	9.84	0.30	0.13	0.39	0.04	0.04	0.05
The Netherlands	*Mean*	53.95	209.43	64.1	0.23	22.82	14.56	0.81	0.15	0.21	0.15	0.28	0.35
	Median	51.49	83.93	7.28	0	22.5	11.6	1.00	0.06	0	0.15	0.29	0.35
	S.D.	16.6	817.05	521.39	0.42	0.76	8.79	0.31	0.20	0.40	0	0	0
Spain	*Mean*	31.77	78.02	9.44	0.18	16.19	1.25	0.70	0.14	0.17	0.18	0.29	0.35
	Median	29.21	48.77	2.95	0	16.2	1.12	0.82	0.07	0	0.18	0.29	0.35
	S.D.	13.66	225.86	38.56	0.38	0.08	1.47	0.31	0.33	0.37	0	0	0
Sweden	*Mean*	36.51	96.08	10	0.26	78.12	4.27	0.72	0.25	0.23	0.11	0.23	0.28
	Median	34.34	54.18	3.07	0	78	3.14	0.90	0.18	0	0.11	0.23	0.28
	S.D.	11.02	500.9	53.41	0.44	0.34	4.99	0.34	0.25	0.42	0	0	0
United Kingdom	*Mean*	35.92	77.26	6.4	0.18	29.43	1.62	0.91	0.14	0.15	0.17	0.26	0.30
	Median	33.55	48.26	2.22	0	29.3	1.1	1.00	0.07	0	0.16	0.26	0.30
	S.D.	15.36	347.05	28.83	0.38	0.23	2.24	0.23	0.19	0.36	0.01	0.01	0.01

All values are in thousands of US$ at 2000 prices.

Table 1.5: Wage Equation Model Estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable: Log(wage rate)	OLS levels	Within Group (FE)	OLS first difference	GMM-diff AB –full instrument matrix	GMM-diff AB –restricted instrument matrix	GMM-sys BB–full instrument matrix	GMM-sys BB–restricted instrument matrix	GMM –restricted first difference instruments
Log(wage rate) *t-1*	0.665***	0.044***	-0.302***	0.146***	0.236***	0.419***	0.449***	0.121***
	(0.006)	(0.008)	(0.006)	(0.009)	(0.012)	(0.009)	(0.010)	(0.022)
t-2	0.200***	-0.020***	-0.111***	0.052***	0.076***	0.157***	0.152***	0.029***
	(0.005)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.006)	(0.010)
Log (tax per employee)	-0.016***	-0.014***	-0.013***	-0.014	0.011	-0.169***	-0.191***	-0.095***
	(0.001)	(0.001)	(0.001)	(0.011)	(0.020)	(0.009)	(0.012)	(0.034)
t-1	0.005***	-0.001*	-0.005***	-0.002	-0.008	0.039***	0.048***	0.033***
	(0.001)	(0.001)	(0.001)	(0.004)	(0.007)	(0.004)	(0.005)	(0.010)
t-2	0.000	-0.004***	-0.002***	-0.001	-0.003*	0.010***	0.012***	0.006***
	(0.001)	(0.001)	(0.000)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Dummy: negative or zero tax bill	0.064***	0.067***	0.059***	0.249***	0.313***	0.190***	0.121**	0.386***
	(0.002)	(0.002)	(0.002)	(0.042)	(0.069)	(0.040)	(0.050)	(0.078)
t-1	-0.032***	0.007***	0.021***	-0.063***	-0.071***	-0.121***	-0.110***	-0.096***
	(0.002)	(0.002)	(0.002)	(0.011)	(0.016)	(0.011)	(0.013)	(0.019)
t-2	-0.008***	0.012***	0.009***	-0.017***	-0.016***	-0.044***	-0.040***	-0.012**
	(0.002)	(0.002)	(0.001)	(0.003)	(0.004)	(0.004)	(0.005)	(0.005)
Log (value added per employee)	0.265***	0.281***	0.264***	0.756***	0.621***	1.121***	1.082***	0.773***
	(0.005)	(0.007)	(0.005)	(0.025)	(0.044)	(0.013)	(0.016)	(0.069)
t-1	-0.161***	0.013***	0.092***	-0.149***	-0.163***	-0.432***	-0.418***	-0.136***
	(0.005)	(0.004)	(0.003)	(0.012)	(0.014)	(0.010)	(0.012)	(0.021)
t-2	-0.049***	0.023***	0.041***	-0.034***	-0.034***	-0.131***	-0.122***	-0.022***
	(0.003)	(0.003)	(0.002)	(0.005)	(0.005)	(0.006)	(0.007)	(0.008)
AR(1)	-13.17		-11.08	-22.40	-17.93	-29.94	-28.92	-13.99
p-value	[0.000]		[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
AR(2)	-10.97		-5.42	-3.21	-2.95	-3.14	-2.90	-1.23
p-value	[0.000]		[0.000]	[0.001]	[0.003]	[0.002]	[0.004]	[0.219]
Hansen over-identification test				526.24	166.64	1191.31	653.68	45.64
(Degrees of freedom)				(172)	(46)	(227)	(56)	(37)
p-value				[0.000]	[0.000]	[0.000]	[0.000]	[0.156]

(i) Number of firms in the estimation sample is 55,082 and the total number of observations used is 166,749. (ii) Standard errors (in parenthesis) allow for clustering at the company level. (iii) Additional excluded instruments used in columns 4 to 8 were first differences of EMTR, EATR, statutory corporate tax rate, second and higher order lags of log (tangible fixed assets as a proportion of total fixed assets if positive), log (non-current liabilities as a proportion of total assets if positive) and binary indicators for: non-positive profits excluding taxes, zero tangible fixed assets and non-current liabilities.
(iv) *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

Table 1.6: Extensions to the Basic Specification (Column 8 from Table 1.5)

Dependent variable: Log(wage rate)	(1) Basic specification	(2) Basic specification & Union density	(3) Basic specification & All bargaining variables
Log(wage rate)			
t-1	0.121***	0.116***	0.135***
	(0.022)	(0.024)	(0.024)
t-2	0.029***	0.024**	0.031***
	(0.010)	(0.011)	(0.011)
Log (tax per employee)	-0.095***	-0.118***	-0.120***
	(0.034)	(0.035)	(0.037)
t-1	0.033***	0.036***	0.036***
	(0.010)	(0.010)	(0.010)
t-2	0.006***	0.007***	0.007***
	(0.002)	(0.003)	(0.003)
Dummy: negative or zero tax bill	0.386***	0.376***	0.361***
	(0.078)	(0.091)	(0.088)
t-1	-0.096***	-0.094***	-0.089***
	(0.019)	(0.021)	(0.021)
t-2	-0.012**	-0.012**	-0.011*
	(0.005)	(0.006)	(0.006)
Log (value added per employee)	0.773***	0.849***	0.889***
	(0.069)	(0.069)	(0.067)
t-1	-0.136***	-0.145***	-0.155***
	(0.021)	(0.023)	(0.023)
t-2	-0.022***	-0.023**	-0.025***
	(0.008)	(0.009)	(0.009)
Union Density		0.012**	0.013**
		(0.006)	(0.006)
t-1		-0.005	0.003
		(0.004)	(0.006)
t-2		-0.010	-0.005
		(0.009)	(0.008)
Log(industry minimum wage)			0.002
			(0.002)
t-1			0.003*
			(0.002)
t-2			0.004***
			(0.001)
Dummy: Company is min wage company			-0.731
			(0.571)
t-1			0.124
			(0.207)
t-2			0.037
			(0.067)
AR(1)	-13.99	-13.19	-13.30
p-value	[0.000]	[0.000]	[0.000]
AR(2)	-1.23	-1.12	-1.24
p-value	[0.219]	[0.263]	[0.214]
Hansen over-identification test	45.64	43.71	48.28
Degrees of freedom	(37)	(35)	(39)
p-value	[0.156]	[0.148]	[0.147]

(i) See notes to Table 1.5. (ii) All regressions use difference GMM estimates. (iii) Excluded instruments used are the same as in the model of column 8 of Table 1.5.

Table 1.7: Estimated Incidence from Table 1.6, Column 3 Results

	Elasticity	Incidence
Short run		
Tax bill	-0.120	-0.970
	(0.037)	
Value added	0.889	0.670
	(0.067)	
Long run		
Tax bill	-0.093	-0.751
	(0.031)	
Value added	0.851	0.569
	(0.0670	

(i) Standard errors in parenthesis.
(ii) The reported incidence is the median value.

Table 1.8: Difference GMM Estimates

Dependent Variable Log(wage rate)	(1) All companies	(2) Stand-alone companies	(3) Multinational companies	(4) Multinational companies
Lagged log(wage rate)	0.135***	0.079	0.166***	0.093**
	(0.024)	(0.066)	(0.028)	(0.040)
t-2	0.031***	-0.013	0.055***	0.014
	(0.011)	(0.023)	(0.013)	(0.016)
Log (tax bill per employee)	-0.120***	-0.118***	-0.117**	-0.101***
	(0.037)	(0.041)	(0.047)	(0.033)
t-1	0.036***	0.042***	0.029**	0.028**
	(0.010)	(0.013)	(0.014)	(0.014)
t-2	0.007***	0.006	0.004	-0.005
	(0.003)	(0.004)	(0.003)	(0.004)
Dummy: negative or zero tax bill	0.361***	0.549***	0.391***	0.316
	(0.088)	(0.136)	(0.142)	(0.311)
t-1	-0.089***	-0.149***	-0.045	0.185
	(0.021)	(0.033)	(0.034)	(0.207)
t-2	-0.011*	-0.025***	0.004	0.080
	(0.006)	(0.009)	(0.010)	(0.083)
Log (value added per employee)	0.889***	0.863***	0.837***	0.640***
	(0.067)	(0.068)	(0.133)	(0.105)
t-1	-0.155***	-0.101**	-0.122***	-0.111***
	(0.023)	(0.045)	(0.037)	(0.051)
t-2	-0.025***	-0.001	-0.014	-0.004
	(0.009)	(0.018)	(0.013)	(0.019)
Union density	0.013**	-0.007	0.020**	0.023***
	(0.006)	(0.008)	(0.009)	(0.009)
t-1	0.003	-0.012	0.002	-0.004
	(0.006)	(0.007)	(0.010)	(0.010)
t-2	-0.005	0.017*	-0.017	-0.031**
	(0.008)	(0.009)	(0.014)	(0.015)
Log(industry minimum wage)	0.002	-0.002	-0.001	-0.001
	(0.002)	(0.002)	(0.004)	(0.005)
t-1	0.003*	-0.000	0.005*	-0.000
	(0.002)	(0.002)	(0.003)	(0.003)
t-2	0.004***	-0.000	0.005***	0.001
	(0.001)	(0.002)	(0.002)	(0.002)
Dummy: min wage company	-0.731	-1.091	-0.751	-0.037
	(0.571)	(1.222)	(1.090)	(0.759)
t-1	0.124	-0.041	-0.213	-0.249
	(0.207)	(0.358)	(0.523)	(0.287)
t-2	0.037	-0.033	-0.074	-0.091
	(0.067)	(0.137)	(0.169)	(0.100)
Log (group tax bill per employee)				0.010
				(0.018)
t-1				-0.011
				(0.010)
t-2				-0.003
				(0.003)

continued

Table 1.8 (*continued*)

	(1) All companies	(2) Stand-alone companies	(3) Multinational companies	(4) Multinational companies
Dummy: negative or zero group tax bill				-0.062
				(0.093)
t-1				-0.014
				(0.047)
t-2				-0.006
				(0.020)
Log (group value added per employee)				0.074
				(0.063)
t-1				0.015
				(0.049)
t-2				0.003
				(0.006)
AR(1)	-13.30	-9.61	-5.55	-5.13
p-value	[0.000]	[0.000]	[0.000]	[0.000]
AR(2)	-1.24	-1.97	-1.11	-1.74
p-value	[0.214]	[0.048]	[0.265]	[0.081]
Hansen over-identification test	48.28	23.37	23.24	40.00
Degrees of freedom	(39)	(19)	(19)	(30)
p-value	[0.147]	[0.221]	[0.227]	[0.105]
Observations	166,749	62,955	56,883	35,820
Number of companies	55,082	19,399	19,348	13,717

(i) See notes to Table 1.6; (ii) Additional excluded instruments used in columns 2 and 3 were first-differences of EMTR, EATR, statutory corporate tax rate, third order lags of log (tangible fixed assets as a proportion of total fixed assets if positive), log (non-current liabilities as a proportion of total assets if positive) and binary indicators for: non-positive profits excluding taxes, zero tangible fixed assets and non-current liabilities. Additionally, third order lags of the group level variables of the additional instruments used in columns 2 and 3 were also used in column 4. (iii) The group variables are calculated by adding up the values for the subsidiaries present in the dataset, excluding the company concerned. The group tax bill and value added are divided by the employment of the subsidiary.

Table 1.9: Persistence of Wage Rate and Value Added per Worker. Simple Univariate AR Models.

	Dependent variable: Log(wage rate)				Dependent variable: Log(value added per worker)			
	Pooled OLS	Within-Group	Pooled OLS	Within-Group	Pooled OLS	Within-Group	Pooled OLS	Within-Group
Lagged log(wage rate)	0.863***	0.080***	0.682***	0.080***				
	(0.003)	(0.008)	(0.006)	(0.008)				
2nd Lag log(wage rate)			0.206***	-0.011**				
			(0.005)	(0.004)				
Log (Value added per employee)								
Lag. log (value added per employee)					0.844***	0.014*	0.616***	0.014*
					(0.003)	(0.008)	(0.006)	(0.008)
2nd Lag. log (value added per employee)							0.274***	-0.075***
							(0.005)	(0.006)
AR(1)	-23.11		-33.82		-26.55		-24.77	
p-value	[0.000]		[0.000]		[0.000]		[0.000]	
AR(2)	5.79		-18.22		4.15		-30.83	
p-value	[0.000]		[0.000]		[0.000]		[0.000]	

(i) Time dummies are included in all of the above. (ii) The equations were estimated on the same sample as the one used in the main tables using 55,082 companies giving a total of 166,749 observations. (iii) Standard errors in parenthesis unless otherwise stated. (iv) *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

Chapter 2

Profit Shifting and Measured Productivity of Multinational Firms

"The global integration of production cuts costs
and taps new sources of skills and knowledge"
Samuel Palmisano,
IBM Chairman, President and CEO
on the evolution of multinationals (Palmisano (2006))

2.1 Introduction

The divergence in productivity between multinationals and other companies is now well-documented in both developed and developing economies (Lipsey (2002)). Multinational enterprises are not only more productive than purely domestic firms are, they also seem to be the major forces driving the international performance of European countries (Mayer and Ottaviano (2008)). But is the performance of these stars measured correctly?

In recent years, researchers have provided evidence that multinationals (MNCs) manipulate transfer-prices and hence the value of sales and the costs of inputs to minimise their overall tax burden (Devereux (2007)). We argue that manipulation of transfer-prices affects the measured productivity of MNCs. As there is intra-group trade and transfer-pricing manipulation is not prohibitively costly, measured productivity for international companies will be over-reported in low-tax countries, as sales will be over-recorded and the costs of intermediate inputs will be under-recorded. Hence, the productivity advantage of multinationals with respect to domestic entities will be overestimated in low-tax jurisdictions, and vice versa. We find that a 10 percentage points cut in the statutory corporate tax rate would induce affiliates of multinationals to increase their measured total factor productivity (TFP) by about 10 per cent relative to domestic firms. At the sample mean, the TFP advantage of international companies would increase by about 44 per cent.

There is increasing evidence that international companies engage in either over-or under-pricing of components shipped among various affiliates (Clausing (2003) and Bernard et al. (2006)). Despite a variety of contributions on the performance of MNCs, the effect of transfer-pricing manipulation on their reported productivity has not been studied so far. Our study fills this gap. It bridges two streams of literature, the research on productivity heterogeneity across firms and the investigation of profit shifting. The novel aspect of our analysis is that we investigate changes in the measured TFP advantage of multinationals with respect to domestic firms following changes in the corporate tax rate. After a tax cut, multinationals have less incentive to shift profits abroad, while domestic enterprises should not change their behaviour, *ceteris paribus*. A direct comparison between multinational and domestic companies has not been used previously in the profit-shifting literature. We complement it with the use of company fixed effects to control for unobserved firm-level characteristics which might affect the productivity premium of international firms. The literature on the performance of MNCs rarely controls for unobserved firm effects as this would wipe out the multinational indicator which is mostly time-invariant in short panels.

Using ORBIS unconsolidated accounting data from 1998 to 2004, we find that the statutory corporate tax rate has a negative impact on the measured TFP of multinationals relative to domestic companies. The advantage of ORBIS is twofold. Companies can be classified as either multinational or domestic. Additionally, ORBIS allows us to compare entities and hence corporate tax rates across countries. This is unusual in the productivity literature where most of the contributions are country studies and the effects of taxes have been neglected.[1] Our sample con-

[1]In a single country short panel, there might not be enough time-series variation in the tax

sists of about 16,000 companies located in the European countries: Belgium, the Czech Republic, Finland, France, Italy, Norway, Poland, Spain, Sweden, and the United Kingdom.

The rest of this chapter is structured as follows. Section 2.2 briefly describes the most relevant literature on productivity of multinational companies and on profit shifting. Section 2.3 describes the data. Section 2.4 presents the results and a number of extensions designed to show the robustness of our results. Section 2.5 concludes. A detailed description of the dataset construction is presented in Appendix B.

2.2 Related Literature

2.2.1 Productivity of Multinational Companies

Heterogeneity in firms' productivity has been the subject of many studies encompassing developed, developing, and transitional economies.[2] Affiliates of multinationals are usually found to be superior to domestic companies in terms of both labour and total factor productivity. Estimates of the TFP advantage of MNCs with respect to domestic firms range from 2.3 per cent to 15.5 per cent.[3]

Doms and Jensen (1998) is one of the earliest studies addressing productivity heterogeneity using longitudinal micro-level data. They focus on the US manufacturing sector and show that foreign-owned establishments have between 2.3 per

rate to identify any effect.

[2]For reviews of the earlier literature, see Lipsey (2002) and Bartelsman and Doms (2000).

[3]Castellani and Zanfei (2007) find that subsidiaries of multinationals located in Italy are 15.5 per cent more productive in terms of TFP than are domestic Italian companies. Their data correspond to the 1996 Italian subset of ORBIS. For more information on ORBIS and its subsets, see Table A.10 in Appendix A.

cent and 3.7 per cent higher TFP than their purely domestic counterparts, even after controlling for observable characteristics such as size, age, state and industry. For the United Kingdom, Criscuolo and Martin (2009) analyse the TFP of 19,000 British manufacturing establishments between 1996 and 2000 using the Annual Respondent Database (ARD). They estimate that the establishments owned by MNCs are around 4.7 per cent more productive than purely domestic ones. Additionally, US-owned entities display the highest performance (4.4 per cent higher TFP than non-US MNCs). For Germany, Arnold and Hussinger (2005) find that the TFP distribution of multinationals stochastically dominates that of domestic companies.[4]

An important concern with these studies is the potential endogeneity of multinational status, if company-specific unobservable characteristics affect the probability of a particular unit of observation being owned by a multinational company. The literature has discussed many reasons why this could occur. For example, Criscuolo and Martin (2009) find that MNCs systematically take over more productive entities in the United Kingdom. In this chapter, we focus on changes in the TFP advantage of multinationals following changes in the corporate tax rate. Unlike previous studies concerned with the level of TFP advantage, we can simply use subsidiary fixed effects to address the endogeneity of multinational status.[5]

[4]The authors use the Mannheim Innovation Panel and the Bundesbank's Microdatabase on Direct Investment (MiDi). For more information on the MiDi dataset, see Table A.13 in Appendix A.

[5]While investigating productivity spillovers from MNCs to domestic companies in Venezuela, Aitken and Harrison (1999) are able to control for company fixed effects. Their ownership indicator changes over time. The same is true for Fukao et al. (2006) and Girma and Görg (2007), who investigate TFP growth in establishments acquired by foreign companies in Japan and in the United Kingdom, respectively.

2.2.2 Evidence on Profit Shifting

Multinational groups can shift income among affiliates resident in different countries in two main ways. First, they can alter the financing structure of the affiliates. Multinational groups have an incentive to finance affiliates in high-tax countries with debt, which may be provided by other affiliates in lower-taxed countries, because debt interest payments are deductible from the tax base. The second channel, which is the main focus of this chapter, is through transfer-pricing. If subsidiaries within the same group trade with each other, then there is an incentive for the subsidiary in the higher-taxed country to underprice the goods that it sells to the subsidiary in the lower-taxed country, and to overprice the goods that it purchases from the subsidiary in the lower taxed country. Goods may include material inputs, intermediate products, or intangible goods such as royalties. The reverse is true for the subsidiary in the low-tax country.

Bartelsman and Beetsma (2003) analyse the effect of profit-shifting activities on reported value added using the sector-level OECD Structural Analysis (STAN) database.[6] The dataset does not allow the authors to distinguish between MNCs and domestic companies. The authors disentangle the effects of profit shifting from the effects of changes in real economic activity by employing the ratio of total value added to wage payments. Assuming a technology with constant elasticity of substitution, they estimate the following econometric model:

$$V_{ijt} = \left[1 + (c^{csy})^{(1/(\rho+1))}\left(\frac{\widetilde{r}_{it}}{w_{ijt}}\right)^{\rho/(\rho-1)}\right]\left[1 + \gamma^{cs}(\tau_{it} - \overline{\tau}_{jt}^{-i})\right] + \epsilon_{ijt} \tag{2.1}$$

where V_{ijt} is the reciprocal of the observed labour share in country i, sector j and time t; τ_{it} is the headline corporate tax rate in country i at time t and $\overline{\tau}_{jt}^{-i}$ is the

[6] For more information on the STAN database, see Table A.8 in Appendix A.

weighted average corporate tax rate for the foreign countries (excluding country i) in period t for sector j. The coefficient c^{csy} is allowed to vary across country, sector and time, whereas the coefficient γ^{cs} is allowed to vary across country and sector only. The authors' estimates of the CES function parameter c range from 2.7 to 3.57, whereas their estimate of the tax-shifting parameter γ range from -0.0033 to -0.0042, depending on whether γ is fixed or if it varies across countries or sectors. These estimates suggest that the size of profit shifting can be significant. The authors report a back of the envelope calculation according to which 68 per cent of the additional revenue created by a one per cent tax rate increase is lost due to profit shifting.

The literature has found both direct and indirect evidence of manipulation of transfer-prices at the firm level. Clausing (2003) uses the Bureau of Labour Statistics data on US international trade export and import prices. The data allow one to distinguish between intrafirm trade and 'arm's length' trade. She finds that a one per cent lower statutory tax rate in the foreign country is associated with 0.8 per cent lower intrafirm export prices to, and 0.8 per cent higher intrafirm import prices from, the foreign country. In addition, Bernard et al. (2006) use the Linked/Longitudinal Firm Trade Transactions Database which links individual trade transactions to firms in the United States between 1993–2000. The data record whether the transactions take place at 'arm's length' or between 'related parties'. The authors create for each related party price, the price wedge which is equal to the difference between the log of a representative 'arm's-length' trade price minus the log of the 'related party price'. They find that a one percentage point decrease in the host country (average effective) tax rate is associated with an increase of 0.55 to 0.66 points in the price wedge. Other literature that finds evidence of transfer-pricing includes Swenson (2001) and Overesch (2006).

Two recent contributions find indirect evidence of transfer-pricing manipulation using European data. Weichenrieder (2009) finds indirect evidence of transfer-price manipulation analysing German inbound FDI. He finds that an increase in the home country's tax rate of 10 percentage points increases the return on assets for the German subsidiary by half a percentage point, which is roughly a 10 per cent increase. Huizinga and Laeven (2008) use the AMADEUS dataset,[7] the European sub-sample of the ORBIS dataset. Their sample consists of subsidiaries located in Europe that belong to multinational groups whose parents are also located in Europe, and their parent companies. They find that European multinationals' semi-elasticity of reported profits with respect to the top statutory corporate tax rate is -1.3, while profit-shifting costs are estimated to be 0.6 per cent of the tax base.[8]

2.3 Data

The sample is drawn from ORBIS, a database recording balance sheet and profit and loss account items for companies all over the world. The dataset is created by Bureau van Dijk (2007) and is based on the mandatory information from filed and publicly available accounts. The ORBIS unit of observation is an individual company, which may be a subsidiary of a larger group.[9]

The comparison between the behaviour of MNCs and domestic firms when the

[7]Fore more details on AMADEUS, see Table A.10 in Appendix A.

[8]The sample used in this chapter is different from the sample used in Huizinga and Laeven (2008). As detailed in Table B.1, we start from a sample of about 900,000 companies as we drop small and very small firms (with assets smaller than 2,000 EUR or less than one employee) from the general sample. Additionally, we only consider companies with at least three years of consecutive data for EBIT and costs of employees. We also drop very big MNCs and very small domestic companies so that the group of domestic entities acts as a control group.

[9]For more information on ORBIS, see Table A.10 in Appendix A.

corporate tax rate changes will be the source of our identification strategy: the total factor productivity advantage of multinationals relative to domestic firms is expected to increase after a tax cut.

To implement this comparison, firms must be classified as either multinational or domestic. This can be done in ORBIS, as it provides information on the shareholders and subsidiaries of the company, on shareholders' type (that is, individual or corporate) and country of residence. We classify firms as multinationals if they are owned by a corporate shareholder (with more than 50 per cent of their capital) either resident abroad or owning subsidiaries in at least one other foreign country. The rest of the companies for which adequate ownership information is provided are classified as domestic. For a more detailed description of how we derive the ownership structure of each firm, see Appendix B.

We restrict our analysis to companies that are classified to the manufacturing sector to reduce conceptual and empirical problems in measuring productivity in the non-manufacturing sectors.[10] We eliminate very large multinationals and very small domestic companies in terms of total assets to obtain a sample of more comparable entities in both groups. We keep only companies with at least three consecutive years of observations between 1998 and 2004.[11]

The sample consists of 16,022 firms (85,606 observations) over the period 1998–2004. The geographical distribution of these companies is given in Table 2.1, where firms

[10]Each country uses a specific industrial classification system for cataloguing the industries of the companies filing accounts with the official registries. All company accounts filed in a given country, therefore, indicate the company's sector of activity with this national code. ORBIS matches this code with the NACE code (Rev 1.1) for each firm. For the manufacturing sector, the NACE code ranges between 15.00 and 40.00. For more information, see Appendix B.

[11]See Appendix B for a more in depth analysis of how we created the sample.

are divided between multinational and domestic entities. In Belgium, Finland, France, and United Kingdom the proportion of MNCs is not far from that of domestic firms. In Italy, Norway, Poland, Spain, and Sweden domestic companies represent nearly, or more than, two-thirds of all companies, depending on the country. The Czech Republic is an exception: about 67 per cent of the sample belongs to a multinational group.[12]

The country coverage of our sample can be explained as follows. As shown in Table B.1 and as explained in detail in Appendix B,[13] after a thorough cleaning and after selecting firms with a known ownership structure, we are left with about 120,000 companies. We then select only manufacturing firms[14] and we drop host countries with a small sample size (less than 15 domestic or multinational companies).[15] Finally, we make the sample of the MNCs and of the domestics more comparable so that the domestics can be used as a control group. We drop very small domestic companies and very big multinationals.[16]

The literature suggests that companies owned by MNCs are systematically bigger than their domestic counterparts (Flanagan (2006)). Our sample is no exception. In every country, firms affiliated to an international group display on average a larger size in terms of value added, fixed assets, and number of employees (see Table 2.2).[17]

[12]The results remain robust to the exclusion of the Czech Republic from the sample (see Section 2.4.3).

[13]See the section on Financial data.

[14]This is a difference with Chapter 1.

[15]These two last requirements eliminate countries such as Germany which have a small coverage in ORBIS.

[16]For more details, see the section on Financial data in Appendix B.

[17]The Czech Republic and Poland are exceptions when size is measured by the number of employees. Domestic companies in these transitional economies might still have a large labour force which is relatively unproductive, as suggested in Table 2.4. For robustness checks excluding the Czech Republic and Poland, see Section 2.4.3.

In this analysis, changes in the statutory corporate tax rate identify the effect of profit shifting by MNCs on their measured total factor productivity. As depicted in Table 2.3, the variations are mainly cuts. Belgium reduced its rate from 40 per cent to 34 per cent in 2003. More gradual cuts happened in the Czech Republic where the rate was decreased from 35 per cent in 1998 to 28 per cent in 2004, in France where the tax rate was reduced from 42 per cent to 34 per cent between 1998 and 2002, in Poland were the rate was lowered gradually by 17 percentage points and in Italy where the tax rate dropped in stages from 41.2 per cent to 37 per cent within the period 2000–2004. Smaller changes happened in Finland, United Kingdom, and Spain.

2.4 Empirical Model and Main Results

The purpose of this study is to look at how the measured TFP of multinational companies is affected by transfer-pricing manipulation and hence by the host country's corporate tax rate. Total factor productivity can be affected by other country-specific factors for which one can control only partially. We consider a change in the statutory corporate tax rate. Multinationals can react to a change in the statutory corporate tax rate by increasing or decreasing the extent to which they shift profits abroad. Domestic firms do not have this opportunity. They cannot engage in the manipulation of transfer-prices but, at the same time, they are affected by all the other host-country- specific factors (for example, infrastructure, regulations), which also affect the resident multinationals.

In our sample, tax rate changes occur at different points in time and in different countries. Additionally, some of the tax cuts did not happen in one year, but rather

gradually over a longer period. In this study, we identify the effect of transfer-pricing manipulation on multinationals' TFP using a dummy variable indicating multinational status interacted with the corporate tax rate of the host country. This approach has not been implemented previously in the profit-shifting literature. It is a robust method as, through the inclusion of domestic firms, it controls for unobserved factors affecting multinational and domestic companies at the same time. We further control for firm-level fixed effects which are likely to be correlated with MNC status.

2.4.1 TFP Measurement

We consider a conventional Cobb-Douglas production function of the form:

$$Y_{i,t} = A_{i,t} K_{i,t}^{\alpha_K} L_{i,t}^{\alpha_L} \tag{2.2}$$

where i indexes a firm, and t a year. $Y_{i,t}$ is value added. Our main measure of value added is constructed as reported earnings before interest and taxes (EBIT) plus reported costs of employees. In our robustness checks we also consider sales minus costs of materials as an alternative measure of value added.[18] $K_{i,t}$ is capital stock. In our main specification, we measure capital as the book value of fixed assets, but we also consider the book value of tangible fixed assets as an alternative measure. $L_{i,t}$ is the number of employees.

Taking logarithms of equation (2.2) and rearranging,

$$ln(A_{i,t}) = ln(Y_{i,t}) - \alpha_K ln(K_{i,t}) - \alpha_L ln(L_{i,t}) \tag{2.3}$$

[18]The UK companies do not report costs of materials. Hence, we drop them when using this second measure of value added.

Measurement of log TFP (that is, $ln(A_{i,t})$) requires estimates of the parameters α_K and α_L. The literature reports two main ways of obtaining these estimates.[19] The factor share approach calculates the parameters from cost share data for each firm.[20] Assuming that the firm maximises profits, the first order conditions for optimal input choices imply that $\alpha_K = \frac{rK}{Y}$ and $\alpha_L = \frac{wL}{Y}$, where r is the cost of capital and w is the wage. Under the assumption of constant returns to scale, we also have $\alpha_K = 1 - \alpha_L = 1 - \frac{wL}{Y}$, so that this approach only requires data on wage bills and value added, both of which are available in ORBIS.

The production function approach estimates these parameters from a regression of log value added on log capital and log labour, and hence estimates log TFP as the residual of this estimated production function.[21]

The main results that we present in Section 2.4.2 are based on a version of the cost share approach, but we also present results for estimated production functions in Section 2.4.3 as a robustness check.

Imposing constant returns to scale in (2.3), we then obtain our main measure of log TFP as:

$$ln(A_{i,t}) = ln(\frac{Y_{i,t}}{L_{i,t}}) - \alpha_K ln(\frac{K_{i,t}}{L_{i,t}}) \tag{2.4}$$

The parameter α_K is measured separately for each country-industry pair, as the mean value of one minus the share of labour costs in value added for firms in that country and industry.[22]

[19] See Van Biesebroeck (2008) for a review of the advantages and disadvantages of each method.
[20] See Caves et al. (1982).
[21] See for example Griliches and Mairesse (1998) and Klette (1999).
[22] Industry here is defined as a sub-sector of manufacturing industry. We have defined three

Table 2.4 shows that the unconditional mean TFP and labour productivity of multinationals are significantly higher than those of domestic firms in all countries.[23] A mean-comparison t-test reveals that the MNCs' advantage relative to domestic companies in both total factor and labour productivity is significant at the one per cent level for all countries, except for Sweden where the difference in labour productivity is significant at the 5 per cent level.

2.4.2 Main Results

We estimate a regression model to assess how changes in the statutory corporate tax rate affect the measured TFP of companies owned by multinational groups relative to those of domestic companies:

$$ln(A_{i,t}) = \beta_1(multi_i * \tau_{c,t}) + \beta_2(C_c * T_t) + f_i + \varepsilon_{i,t} \tag{2.5}$$

where c indexes a country, $multi_i$ is a time-invariant dummy variable indicating that a firm belongs to a multinational group, and $\tau_{c,t}$ is the statutory corporate tax rate in the home country in year t; $(C_c * T_t)$ are country-year dummy variables which control *inter alia* for different inflation rates in different countries;[24] f_i is an unobserved time-invariant company-specific effect which might be correlated with multinational status; $\varepsilon_{i,t}$ is an idiosyncratic shock.

sub-sectors on the basis of the NACE code (Rev 1.1). For more details, see Appendix B. The values of α_K range from 0.13 to 0.37 with an overall mean of 0.21. In column 4 of Table 2.7, we also run the regression with α_K which is calculated at the country-industry level but differs between multinational and domestic companies. The resulting estimates do not change.

[23] As we would expect, the difference between TFP of multinational and domestic companies is higher in Table 2.4 than reported in the previous literature (see Section 2.2.1). This is because the literature conditions on other factors which we believe are not correlated with the tax factor (for example, R&D).

[24] This is a simpler alternative to deflating nominal values country by country. Country-year dummies also control for country-specific macro effects.

We allow the extent to which the productivity of MNCs differs from that of domestic enterprises to vary with the host country corporate income tax rate. As discussed earlier, we expect the productivity advantage of multinationals to increase following a reduction in the host country tax rate. This would be consistent with a negative value of the parameter β_1.

This assumes that other relevant countries do not cut their corporate tax rate at the same time. The incentive for MNCs to transfer profits out of a country also depends on tax rates in the countries where the MNCs of our sample own subsidiaries and more specifically on the difference in the tax rates between country C and country G. If many of the relevant countries cut their rates simultaneously and we do not control for it, we would have an omitted variable problem and the bias in our estimate of β_1 could be large.[25] Table 2.3 shows that many countries of our sample cut their corporate tax rates; however it confirms that corporate tax rate changes were not synchronised during our sample period. Huizinga and Laeven (2008) construct a weighted average of tax rates for all countries where an individual multinational has affiliates. We do not follow this approach here because our sample only has partial coverage of multinational groups (see Appendix B). The weighted average constructed in Huizinga and Laeven (2008) displays the same problem: their sample only includes European subsidiaries of European multinationals.

[25]This is likely to be an upward bias. Consequently, our estimate of β_1 will be an upper bound for the true population parameter. If we admit there are adjustment costs and (or) expectations, past and future values of other countries' tax rate could be relevant and considered as omitted variables in equation (2.5). We estimated a dynamic version of equation (2.5) but the statistical tests used did not provide any evidence that a dynamic specification would fit the data better. Results are available with the authors.

We estimate equation (2.5) with a standard within-group estimator.[26] This allows us to control for unobserved firm-level fixed effects. The results are presented in column 1 of Table 2.5. The coefficient on the interaction term between the MNC dummy and the corporate tax rate is negative and highly significant. It implies that a 10 percentage points increase in the host country tax rate decreases the measured TFP of multinationals by about 10 per cent relative to domestic firms. This is approximately the difference between the corporate tax rate in Italy (37.4 per cent) and Sweden (28 per cent) in 2004. At the sample mean,[27] the result implies that the TFP advantage of multinationals would increase by about 44 per cent.[28]

2.4.3 Sensitivity Analysis

The results presented so far are based on a TFP measure where value added is calculated as EBIT plus cost of employees, and the capital stock is measured by the book value of fixed assets. We first test whether our findings hold when we employ other measures of value added and capital. Column 2 of Table 2.5 reports results using value added calculated as sales minus costs of materials. Here the sample drops to 52,692 observations because UK firms do not report costs of materials. Column 3 shows results where the capital stock is measured as the book value of tangible fixed assets. In both columns, the coefficient on the interaction term between the MNC dummy variable and the corporate tax rate remains negative,

[26]Standard errors are clustered at the company level to allow for serial correlation within the firm. We also clustered at the country, country-sector, and country-global owner levels to allow for common country, country-sector, and country-global owner shocks. Coefficients remain significant at 1%.

[27]See the last row of Table 2.4.

[28]At the sample mean, the initial TFP gap between multinational and domestic companies is seven (see last row of Table 2.4). After a 10 percentage points cut in the corporate tax rate, the total factor productivity of MNCs will increase by 10 per cent (see the coefficient estimate of column 1 of Table 2.5) to 34.1. The gap between the TFP of multinationals and domestic firms will increase to 10.1. This is an increase of about 44 per cent with respect to the initial gap.

significant, and very close in magnitude to the main specification of column 1. So far we have presented results for an unbalanced panel of firms. Column 4 of Table 2.5 shows that the coefficient on the interaction of the MNC dummy variable and the tax rate remains negative and significant in a balanced panel where all firms have all seven years of data.[29]

As a further robustness check, we restrict the analysis to a sub-sample of countries which have implemented substantial cuts in their corporate tax rate (that is, France, Italy, Belgium, the Czech Republic and Poland). Column 1 of Table 2.6 shows that in this sub-sample, the coefficient on the variable of interest stays negative, significant, and very close in magnitude to the main specification of Table 2.5. A 10 percentage points increase in the corporate tax rate would reduce the TFP of multinationals relative to domestic firms by about 11 per cent. Columns 2 to 6 estimate equation (2.5) on separate sub-samples for these individual countries. The estimated coefficients remain negative and significant (except for Belgium), although with differing magnitudes. This is not particularly surprising as many other country-specific tax provisions (for example, controlled foreign corporation (CFC) rules) and firm-specific factors (for example, location of affiliates) may affect the degree to which MNCs can engage in profit shifting.

One feature we notice is that the estimated coefficient is consistently larger for the two transitional economies. Column 7 of Table 2.6 tests the robustness of our results to the exclusion of the Czech Republic and Poland. The key coefficient remains negative and significant although smaller in magnitude: a 10 percentage points cut in the corporate tax rate would here reduce the TFP of multinational

[29] In this sample all firms from the Czech Republic are necessarily dropped, as we do not have Czech data for all seven years.

companies by about 6 per cent.

Subsidiaries of multinational companies are known to be larger than the average domestic firm (Lipsey (2002)). In column 1 of Table 2.7, we rule out that the effect picked up by the multinational dummy is in fact a size effect. Whilst the negative impact of the tax rate for multinational companies remains strong and highly significant, it shows that the size effect is insignificant.[30] In the same table, we allow for domestic and multinational companies to be different across the economic cycle. Column 2 shows that the tax rate does not proxy the economic cycle.[31] Also, real productivity of multinational companies could respond differently to tax rate cuts. For example, multinationals might be quicker in increasing their productivity because they can adjust their investment decisions faster. Devereux and Griffith (2003) explain that conditional on the discrete investment choice (that is, where to locate), marginal investment decisions (that is, the size of investment) depend on the EMTR. The latter is a measure of the effect of taxes on the cost of capital. It accounts not only for the statutory corporate tax rate, but also for capital depreciation allowances and different forms of financing. In column 3 of Table 2.7 we allow for the effect of the EMTR[32] to be different between multinational and domestic entities. The coefficient on the variable of interest stays negative and not statistically different from one, but it increases in magnitude with respect to the benchmark specification of Table 2.5 where we do not control for the EMTR. Column 4 allows for a different α_K between multinational and domestic companies. The key coefficient remains negative and even if lower, its magnitude is not

[30]The size dummy takes value one when the log(total assets) is bigger than the sample median log(total assets) for at least four years. It is a time-invariant variable. The model in column 1 is also tested with a time-variant size dummy. The estimates do not change.

[31]To control for the economic cycle, we employ the World Bank Development Indicators on inflation, GDP growth, and unemployment rates.

[32]For more details on how the EMTR is built, see Devereux and Griffith (2003). Effective marginal tax rates are taken from Devereux et al. (2008).

significantly different from the estimate of the benchmark specification of Table 2.5.

If after a tax cut multinational companies systematically buy highly productive domestic entities, our estimates will be upward biased. To control for this effect, we identify companies involved in operations of mergers and acquisitions (M&A) during the sample period using a dataset called ZEPHYR.[33] Unfortunately, because of a lack of information, we are not always able to identify whether a company has changed its ownership status after an M&A deal. Therefore, in column 5 of Table 2.7 we drop all companies involved in some sort of M&A operations between 1998 and 2004. Our results remain strongly robust to the exclusion of firms which have potentially changed their ownership status in response to a change in the corporate tax rate.

In Table 2.8, we show that our results are not sensitive to the use of the factor share approach to measure TFP. As an alternative, we combine equations (2.4) and (2.5) and estimate an extended production function of the form

$$ln(\frac{Y_{i,t}}{L_{i,t}}) = \alpha_K ln(\frac{K_{i,t}}{L_{i,t}}) + \tag{2.6}$$
$$+\beta_1(multi_i * \tau_{c,t}) + \beta_2(C_c * T_t) + f_i + \varepsilon_{i,t}$$

In column 1 of Table 2.8, we report within-group estimates of equation (2.6). The coefficient of the key interaction term remains negative, highly significant, and very close in magnitude to the results of Table 2.5. The estimated value of α_K is somewhat lower than suggested by the cost share data (see Footnote 22). The production function approach allows us to relax the constant returns to scale (CRS)

[33]ZEPHYR is also compiled by Bureau van Dijk as ORBIS. It is therefore possible to merge the two datasets and identify some but not all ownership changes occurred during the sample period. For a description of ZEPHYR, see Table A.11 in Appendix A. For a description of how we employed and merged ZEPHYR with ORBIS, see Appendix B.

assumption easily by adding the term $\alpha_1 ln(K_{i,t})$ on the right-hand side of equation (2.6). The results shown in column 2 of Table 2.8 confirm that our main findings hold when we do not impose CRS: a 10 percentage points cut in the tax rate would induce MNCs to increase their measured TFP by about 9 per cent.

In summary, tables 2.6 to 2.8 indicate that the effect of changes in the tax rate on the TFP gap between multinational and domestic companies is robust to various sensitivity checks.

2.5 Conclusions

We find evidence consistent with multinational companies shifting revenues into low-tax countries and shifting input costs into high-tax jurisdictions. This has implications for measured TFP. In particular, if MNCs engage in transfer-price manipulation, the difference in TFP between multinationals and domestic companies will tend to be underestimated in high-tax countries and overestimated in low-tax countries.

We estimate that a 10 percentage points increase in the host country tax rate decreases the measured TFP of multinationals by about 10 per cent relative to domestic firms. At the sample mean, this implies a 44 per cent increase in the TFP advantage of multinationals. This has potentially important implications when comparing measured TFP differences across countries with high and low corporate tax rates. If a high-tax country such as Italy were to reduce its statutory corporate tax rate (37.4 per cent) to the level of Sweden (28 per cent), multinational companies located in Italy would increase their measured TFP relative to domestic companies by about 10 per cent.

Table 2.1: Ownership Structure

Country	Domestic	MNCs	Total
Belgium	485	382	867
	56	*44*	
Czech Republic	40	81	121
	33	*67*	
Finland	112	117	229
	49	*51*	
France	1,434	1,381	2,815
	51	*49*	
Italy	1,575	514	2,089
	75	*25*	
Norway	361	131	492
	73	*27*	
Poland	209	141	350
	60	*40*	
Spain	2,272	558	2,830
	80	*20*	
Sweden	1,015	534	1,549
	66	*34*	
United Kingdom	2,666	2,014	4,680
	57	*43*	
Total	10,169	5,853	16,022
	63	*37*	

(i) Number of firms. (ii) Percentages in italics.

Table 2.2: Descriptive Statistics –Unconditional Means

Country	Value added		Fixed assets		Number of employees	
	MNCs	Domestics	MNCs	Domestics	MNCs	Domestics
Belgium	4,672	2,487	4,450	2,608	81	49
Czech Republic	3,636	3,009	6,388	4,417	197	270
Finland	6,374	4,205	4,734	4,227	107	86
France	5,029	3,413	3,430	2,041	95	72
Italy	3,857	2,862	3,064	3,426	78	61
Norway	4,686	3,188	3,790	2,643	70	55
Poland	3,353	2,823	5,663	4,060	205	227
Spain	4,206	2,156	4,597	3,017	80	50
Sweden	3,994	2,421	3,994	2,741	84	57
United Kingdom	4,642	3,904	3,770	2,944	98	99
Total	4,562	3,013	3,870	2,905	94	73

(i) Values for value added and fixed assets are in thousands of US$ 2000 prices. (ii)Values for the number of employees are headcounts. Value added is calculated as EBIT plus costs of employees.

Table 2.3: Statutory Corporate Tax Rates

Country	Rates (per cent)	Years
Belgium	40	1998–2002
	34	2003–2004
Czech Republic	35	1998–1999
	31	2000–2003
	28	2004
Finland	28	1998–1999
	29	2000–2004
France	41.7	1998
	40	1999
	36.7	2000
	35.3	2001
	34.3	2002–2004
Italy	41.2	1998–2000
	40.3	2001–2002
	38.2	2003
	37.3	2004
Norway	28	1998-2004
Poland	36	1998
	34	1999
	30	2000
	28	2001–2002
	27	2003
	19	2004
Spain	35	1998–2003
	35.3	2004
Sweden	28	1998–2004
United Kingdom	31	1998
	30	1999–2004
Sample Mean	34.3	

Table 2.4: TFP and Labour Productivity –Unconditional Means

Country	TFP		% Difference	Labour productivity		% Difference
	MNCs	Domestics		MNCs	Domestics	
Belgium	38	32	18***	65	56	16***
Czech Republic	8	6	33***	36	18	100***
Finland	30	24	25***	68	53	28***
France	37	34	9***	63	56	12***
Italy	26	20	30***	63	56	12***
Norway	45	35	29***	83	65	28***
Poland	10	7	43***	44	28	57***
Spain	25	18	39***	64	50	28***
Sweden	21	18	17***	54	49	10**
United Kingdom	33	26	27***	56	44	27***
Total	31	24	29***	60	50	20***

(i)Values are in thousands of US$ 2000 prices. Labour productivity is calculated as (EBIT plus costs of employees) / number of employees. (ii) % difference is calculated as follows: (MNCs' productivity - domestics' productivity)/domestics' productivity. (iii)*** 1% significance level and ** 5% significance level for a mean-comparison t-test where H_0: mean(MNCs)-mean(domestics)= 0 and H_a: mean(MNCs)-mean(domestics)> 0.

Table 2.5: Main Results

	(1)	(2)	(3)	(4)
MNC dummy * corporate tax rate	-1.034***	-1.088***	-1.023***	-0.798***
	(0.210)	(0.232)	(0.208)	(0.240)
Company fixed effects	✓	✓	✓	✓
(Country*year) fixed effects	✓	✓	✓	✓
Observations	85,606	52,692	84,306	39,991
Number of companies	16,022	10,041	15,824	5,713
R-squared	0.10	0.03	0.10	0.00

(i) Standard errors in parentheses and clustered at the company level. Model estimated using within-groups estimator.
(ii) Dependent variable: TFP as defined in equation (2.4). In all columns, except for column 2, value added is defined as EBIT plus costs of employees. In column 2, value added is defined as sales minus costs of materials. In all columns, except for column 3, capital is measured as fixed assets. In column 3, capital is measured as tangible fixed assets. (iii) Column 4 reports results for a balanced panel where each firm has seven years of data. The Czech Republic drops out of this sample. (iv) $***$ significant at 1%. $**$ significant at 5%. $*$ significant at 10%.

Table 2.6: Results by Country

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	FR, IT, BE, CZ, PL	France	Italy	Belgium	Czech Rep	Poland	All except CZ & PL
MNC dummy *	-1.075***	-0.684***	-1.698***	-0.228	-4.873***	-2.866***	-0.622***
corporate tax rate	(0.213)	(0.243)	(0.754)	(0.346)	(2.406)	(0.821)	(0.193)
Company fixed effects	✓	✓	✓	✓	✓	✓	✓
(Country*year) fixed effects	✓						✓
Year fixed effects		✓	✓	✓	✓	✓	
Observations	33,185	14,483	11,442	5,006	596	1,658	83,352
Number of companies	6,242	2,815	2,089	867	121	350	15,551
R-squared	0.10	0.01	0.06	0.03	0.04	0.38	0.00

(i)Standard errors in parentheses and clustered at company level. Model estimated using a within-groups estimator. (ii) Dependent variable: TFP as defined in equation (2.4). Value added is defined as EBIT plus costs of employees. Capital is measured as the book value of fixed assets. (iii) In column 1, the sample contains five countries which have substantially reduced their corporate tax rate: Belgium, the Czech Republic, France, Italy and Poland. (iv) In column 7, the sample includes all countries of column 1 of Table 2.5 except the Czech Republic and Poland. (v) $***$ significant at 1%. $**$ significant at 5%. $*$ significant at 10%.

Table 2.7: Variations of the Main Model

	(1)	(2)	(3)	(4)	(5)
MNC dummy * corporate tax rate	-1.094***	-1.067***	-1.203***	-0.730***	-1.031***
	(0.217)	(0.228)	(0.252)	(0.199)	(0.212)
Size dummy * corporate tax rate	0.242				
	(0.210)				
MNC dummy * Inflation		-0.012***			
		(0.004)			
MNC dummy * GDP growth		0.001			
		(0.003)			
MNC dummy * Unemployment rate		-0.002			
		(0.004)			
MNC dummy * EMTR			0.297		
			(0.328)		
Company fixed effects	✓	✓	✓	✓	✓
(Country*year) fixed effects	✓	✓	✓	✓	✓
Observations	85,606	85,606	85,606	85,606	84,119
Number of companies	16,022	16,022	16,022	16,068	15,753
R-squared	0.097	0.097	0.096	0.078	0.097

(i)Standard errors in parentheses and clustered at company level. Model estimated using a within-groups estimator. (ii) Dependent variable: TFP as defined in equation (2.4). Value added is defined as EBIT plus costs of employees. Capital is measured as the book value of fixed assets. (iii) The size dummy takes value 1 when the log(total assets) > median log(total assets). It is time invariant. (iv) In column 4, α_K is different for multinational and domestic firms. (v) In column 5, the sample excludes companies which have undergone an M&A operation during the sample period. (vi) $***$ significant at 1%. $**$ significant at 5%. $*$ significant at 10%.

Table 2.8: Production Function Estimation

	(1)	(2)
MNC dummy * corporate tax rate	-1.009***	-0.879***
	(0.217)	(0.201)
Log(fixed assets / employees)	0.139***	0.435***
	(0.007)	(0.013)
Log(fixed assets)		-0.380***
		(0.012)
(Country*year) dummies	✓	✓
Company fixed effects	✓	✓
Observations	85,606	85,606
Number of companies	16,022	16,022
R-squared	0.04	0.10

(i) Dep. variable: $\frac{EBIT+wage\ bill}{no.employees}$. (ii) Columns 1 and 2 estimated using a within-groups estimator. (iii) Standard errors in parentheses and clustered at company level.

Chapter 3

Tax Haven Activities and Tax Liabilities of Multinational Groups

3.1 Introduction

The debate on the role of tax havens has lately gained great momentum, beyond any expectations one might have entertained at the beginning of 2008. In the wake of the credit crunch and the following severe economic downturn, with heavy government intervention, declining tax revenues, and pleas for new market regulation, pressure on tax havens has mounted to unprecedented levels. Under the threat of being placed on an OECD blacklist of "jurisdictions that have not committed to internationally agreed tax standard" on transparency, low-tax countries agreed just before the Group of Twenty (G20) meeting of April 2009 to curtail bank secrecy rules. The affected countries include Switzerland, Monaco, and Liechtenstein; traditionally they have been very reluctant to amend their rules on bank secrecy and the exchange of information. In May 2009, Andorra, Liechtenstein, and Monaco were removed from the OECD list of uncooperative tax havens, after agreeing on a timetable to implement the standards of transparency and effective exchanges of information set out by the organisation. Now more and more low-tax jurisdictions are signing treaties in accordance with the OECD principles on tax matters. In June 2009, Bermuda signed its twelfth treaty (with the Netherlands) crossing the OECD threshold between being a tax haven or not. The OECD moved Bermuda to a list of jurisdictions that have substantially implemented the internationally agreed tax standard. This is the list which includes Group of Eight (G8) countries. A month later, Luxembourg signed its twelfth treaty with Norway. These are the first tax treaties satisfying OECD guidelines ever signed by Luxembourg with another OECD member (OECD (2009)). In August 2009, the Cayman Islands and the British Virgin Islands signed their twelfth bilateral agreements with New Zealand and they now also appear in the OECD list of jurisdictions that have substantially implemented the internationally agreed tax standard. At 28 August

2009, the OECD list of jurisdictions that have not committed to internationally agreed tax standard was empty. These developments concern mainly evasion of personal taxation; therefore they are not likely to affect tax avoidance by multinational corporate groups. They are nonetheless a sign that in recent months tax havens have come under unprecedented pressure.

More relevant for corporations, in May 2009 the US Presidency announced measures which could reduce the incentives for corporations to shift profits to tax havens. The measures aim at preventing the use of the check-the-box rules to avoid Sub-part F regulations for intra-group debt[1]. Additionally, they would disallow expenses deductions associated with deferred foreign profits and they would introduce a pooling system of foreign tax credits which should reduce tax planning of multinationals (Shaviro (2009)).[2]

Critics of these proposals argue that the measures will reinforce the deviation of the US tax system from those of most other countries. After Japan and the United Kingdom adopted a territorial (exemption) system in 2009, the United States remained the only major country with a worldwide taxation system on corporate income (credit system). Under a territorial system which exempts foreign profits, companies have an incentive to maximise overall the group profit by locating their real activities and by shifting some of their earnings into low-tax jurisdictions. Under a worldwide system of taxation, this incentive is smaller as foreign profits are

[1]Sub-part F of the US Internal Revenue Code was introduced in 1962 and it prescribes that certain income earned by a controlled foreign corporation has to be taxed, even if it is not repatriated (for example, income from intra-group loans). The check-the-box rules introduced in 1996 allow for choosing whether certain entities are to be treated as separate corporations for US tax purposes. The rules have unintentionally weakened Sub-part F (Shaviro (2009)).

[2]The measures are likely to be included in the 2009 US budget document. They have to be approved by the Congress. For more details on the US legislation and the proposed changes, see Shaviro (2009).

taxed at the same rate as domestic profits when they are repatriated (Dharmapala (2008)). This could imply a higher tax burden for companies headquartered in credit countries.

Critics of tax havens argue that offshore tax centres erode tax revenues, undermine fair competition, and dangerously reduce transparency. Other analysts suggest that even though tax haven activity might reduce the tax burden of MNCs, it enhances economic activity in nearby non-haven countries by lowering the cost of capital (Desai et al. (2006a); Dharmapala (2008)). But are offshore low-tax jurisdictions really important in reducing the tax burden of multinational groups and hence in eroding the tax base of higher-tax countries?

This chapter studies whether in the aggregate MNCs are successful in reducing their tax liabilities by shifting profits in tax havens. More specifically, it identifies the effect of tax haven operations on the group tax bill, and it investigates whether the presence of group operations in offshore low-tax jurisdictions reduce the tax burden of the corporate group.

Despite a variety of contributions on the extent to which multinational companies shift profits to low-tax jurisdictions through manipulation of transfer-prices and (or) debt financing,[3] direct evidence of the effect of tax haven operations on tax liabilities is minimal. The emerging small body of literature focuses mainly on

[3]For contributions that report findings of direct evidence of transfer-pricing activities among US multinationals, see Swenson (2001); Clausing (2003); Bernard et al. (2006). Altshuler and Grubert (2002) and Desai et al. (2004), among others, find direct evidence of debt shifting with US data. Huizinga et al. (2008) report evidence of debt shifting using European data from AMADEUS. For more information on the dataset, see Table A.10 in Appendix A. Several researchers find direct evidence of debt shifting using the German Bundesbank MiDi dataset (see Mintz and Weichenrieder (2005); Buettner et al. (2006); Buettner and Wamser (2009)). For more information on the dataset, see Table A.13 in Appendix A.

US-owned companies (with the exception of Markle and Shackelford (2009)).

This chapter compares the marginal ETR of corporate groups headquartered in credit countries with that of groups headquartered in exemption countries, where the marginal ETR measures the increase in the tax liabilities when accounting profits increase by one US dollar. Corporate groups whose ultimate owner is resident in jurisdictions with a worldwide system are characterized by a higher ETR. In particular, companies headquartered in the United States display the highest ETR.

The analysis is carried out by merging two datasets: ORBIS and ZEPHYR. ORBIS contains accounting data derived from profit and loss (P&L) accounts and balance sheet items. In the online version of ORBIS used here, for each global ultimate owner, the country of residence of its first-level subsidiaries is available.[4] ZEPHYR contains information on M&A deals which may have changed the ownership structure of the group. Information includes acquisition and (or) sell-off of affiliates in tax havens. Therefore, a time-varying ownership structure can be created by merging ORBIS with ZEPHYR. Our sample consists of about 3,400 ultimate owners between 2003 and 2007 located in 15 countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, the Netherlands, Norway, Spain, Sweden, Switzerland, the United Kingdom, and the United States. A common problem of the previous literature is that the effect of tax haven operations on tax liabilities is not identified properly because of endogeneity issues which are not tackled. The decision to boost or to reduce tax haven activity is likely to be influenced by both unobserved group fixed effects such as the ability of the tax department, and by unobservable time-varying shocks likely to affect the tax

[4]The online version of ORBIS contains information on second- and further-level subsidiaries but it is not possible to download it in a format which can be processed with standard econometric softwares.

liabilities simultaneously. Desai et al. (2006b) control for group fixed effects but none of the studies in the literature controls for the simultaneous determination of the tax bill and of tax haven activities. By merging two datasets and creating a time-varying ownership structure, this cross-country research is able to investigate tax payments of corporate groups with tax haven operations, whilst dealing with the identification issues underlying the relationship between offshore low-tax operations and tax liabilities.

Differently to Desai et al. (2006b), this chapter employs consolidated accounts and therefore it identifies the determinants of the tax liabilities of the group instead of the single affiliate. Unconsolidated accounts could lead to an overestimation of the ETR. Suppose company A owns a subsidiary B located in a tax haven. Suppose that A borrows US$ 100 from B and pays 10 per cent interest. The parent company can deduct interest payments from its tax base. If in the home country the statutory corporate tax rate is 30 per cent and A reports a pre-tax profit of US$ 100, then its ETR is 30 per cent.[5] Suppose additionally that B reports profits only from interest payments received, and that its relevant statutory corporate tax rate is zero. If consolidated data are used, the profit of the tax haven subsidiary will be added to the profit of the parent and the ETR will drop to 27 per cent.[6] Additionally, unconsolidated data only give a partial picture of how offshore low-tax jurisdictions affect tax liabilities. In fact, a reduction in the tax bill of one affiliate could be compensated for by an increased tax bill somewhere else in the group. By failing to provide information on the tax liabilities of the whole group, unconsolidated accounts are not suitable for comparing the tax burdens of corporate groups resident in exemption countries with the tax burdens of companies headquartered

[5] $\lfloor \frac{0.3*(100-10)}{(100-10)} \rceil = 0.30$.
[6] $\lfloor \frac{0.3*(100-10)}{(100-10)+10} \rceil = 0.27$.

in credit countries.

The chapter is organised as follows. Section 3.2 reviews the literature. Section 3.3 presents the data used in the empirical section. Section 3.4 develops the empirical model and discusses various econometric issues. Section 3.5 presents the results. Section 3.6 concludes.

3.2 Literature

The emerging literature can be partitioned into the accounting literature describing country- or group-level ETRs (Markle and Shackelford (2009); Dyreng and Lindsey (2009)) and the studies trying to establish a causal relationship between affiliate-level tax payments and the tax haven operations of multinational firms (Desai et al. (2006b)). The accounting literature is descriptive because it does not control for observable characteristics of the firm such as profitability, which clearly affects tax liabilities.

The accounting literature employs consolidated data whilst Desai et al. (2006b) employ unconsolidated confidential affiliate-level data. Unfortunately, as discussed in Section 3.1, unconsolidated data fail to provide a complete picture of the real tax burden faced by a corporate group.

The literature differs across various dimensions but it has a common, important problem. The common actor is that it does not deal with identification issues arising from the simultaneous determination of tax liabilities and offshore low-tax operations. This implies that the effect of tax haven operations is not correctly identified.

Markle and Shackelford (2009) describe country-level ETRs between 1988 and 2007 for 85 different countries. They employ consolidated accounting data from OSIRIS.[7] The authors distinguish aggregate country-level ETRs between domestic and multinational firms using time-invariant ownership information for 2008. OSIRIS contains information on tax haven subsidiaries. Given the time-invariant nature of the ownership information, the research employs a pooled OLS. Markle and Shackelford (2009) calculate the ETR as the ratio of book total tax expenses divided by net income before taxes (NIBT). They employ only companies with positive NIBT and positive tax charges.[8] Regressing the ETR on a set of country dummies identifying the location of the ultimate owner and of its subsidiaries, the authors find that the ETR of corporate groups with tax haven affiliates is 0.5 percentage points lower than the ETR of the ultimate owners without low-tax offshore operations.[9] More specifically, the ETR of US firms with offshore low-tax operations is between 0.1 per cent and 0.7 per cent lower than that of US companies without tax haven operations. For UK multinationals, the ETR of those with tax haven operations is between 0.1 per cent and 0.2 per cent lower than the ETR of companies without offshore low-tax jurisdictions. For countries with a territorial system such as France and Germany, the ETR of the multinationals with tax haven operations is 2.4 per cent and 0.1 per cent lower, respectively, than the ETR of companies without tax haven operations. Also, within the same country multinationals overall do not seem to enjoy a lower ETR than do domestic companies, but multinationals domiciled in tax havens have a slightly lower worldwide ETR,

[7] OSIRIS is also produced by Bureau van Dijk. It contains financial information for listed companies, banks, and insurance companies around the world. For more information on the dataset, see Table A.10 in Appendix A.

[8] As explained in Section 3.4, this might lead to sample selection bias.

[9] The only exception is Japan.

as explained above.[10] Markle and Shackelford (2009) also investigate whether companies headquartered in credit countries have a higher ETR with respect to companies headquartered in exemption countries. They do not report results for this analysis. They simply say that the additive dummy recording whether the ultimate owner is resident in a credit country is not statistically significant.

Dyreng and Lindsey (2009) estimate the worldwide, federal, and foreign tax burdens on the corresponding worldwide, domestic, and foreign incomes of US-owned multinationals. They use a panel of consolidated accounting data from Compustat for the period 1995 to 2007.[11] The time-varying presence of a corporate group in low-tax jurisdictions is derived from Exhibit 21 of form 10-K submitted to the US Security and Exchange Commission. Form 10-K is an annual report that publicly traded companies incorporated in the United States are required to submit according to the US federal securities laws. The form contains business and financial information, including audited financial statements. In particular, Exhibit 21 gathers information on the subsidiaries of the registrant, including their name and location. Using an OLS estimator, the authors find that the effect of tax haven operations on the worldwide tax charges of US multinationals is small. The worldwide ETR (inclusive of US state taxes) for US multinationals is about 36 per cent. For groups with at least one subsidiary in a low-tax jurisdiction, the ETR is one and a half percentage points lower than the ETR of other MNCs. Foreign taxes on the foreign income of US multinationals are on average 26 per cent, but for groups with tax haven operations the foreign ETR is about 3.2 percentage points lower than the ETR of companies without those low-tax operations. The paper also finds that the federal tax on foreign profits is on average 4.4 per cent with no

[10] Markle and Shackelford (2009).

[11] For more information on Compustat, see Table A.9 in Appendix A.

significant difference between companies with and without tax haven operations. This measures the US federal taxes on repatriated profits. Operations in low-tax jurisdictions do not seem to influence the federal ETR on domestic profits which is 36 per cent at the mean.

The aforementioned studies are descriptive. They do not establish a causal relationship between tax haven operations and the tax burden. The presence in tax havens could be proxying some other characteristics such as the unobserved ability of the tax department to reduce the fiscal burden of the group effectively,[12] or the observable size and profitability of the company over which they do not have controlled. Also, the presence in tax havens could be determined at the same time as the tax burden. In this context, to prove a causal relationship between the fiscal burden of a multinational group and its low-tax subsidiaries, one has to control for the heterogeneity of observable characteristics such as profitability, intangibles intensity, and size and for unobservable characteristics such as the aggressiveness of the tax department. To this aim, a time-varying ownership structure is useful as this allows the researcher to control for the unobservable group-level fixed effects.

Desai et al. (2006b) provide a quantification of the extent to which tax haven operations reduce the tax burden of affiliates of US multinationals. Using group dummies and affiliate dummies, they control for unobserved fixed effects. Unfortunately, they do not control for the endogeneity of the decision to set up operations in an offshore low-tax jurisdiction even if the data contain a time-varying ownership structure. They employ a panel of unconsolidated confidential accounts of US-owned affiliates for the period from 1982 to 1999. The data are drawn from

[12]In this case, one would attribute a lower tax bill to the presence in tax havens when in fact, the ability of the tax department determines both the tax bill and the decision to locate some operations offshore.

the affiliate-level confidential data of the US Bureau of Economic Analysis.[13] The authors find that US firms use tax haven operations to reduce their domestic and foreign tax bills. In general, affiliates whose parent company owns operations in offshore regional tax centres reduce their ratio of taxes to sales by about 2 per cent with respect to companies without operations in regional tax havens. More specifically, the authors distinguish operations between small tax havens such as the Cayman Islands and large tax havens such as Ireland and Switzerland. The presence only in regional small tax havens reduces the tax bill by less than the broader ownership of tax havens. At the same time, companies with many low-tax affiliates are more likely to have operations in small tax havens, whilst groups with many subsidiaries located in high-tax countries are more likely to have operations in large tax havens also. The authors argue that these findings are consistent with affiliates in large low-tax countries such as Ireland and Switzerland being used to shift profits away from high-tax locations, and with affiliates in small tax havens being employed to defer US taxation. Desai et al. (2006b) also show that companies with operations in offshore territories (or belonging to a group which owns subsidiaries in tax havens) are larger, more international, and have extensive intra-firm trade and higher R&D intensity.

3.3 Data

This chapter investigates the effect of tax haven operations on group tax payments using ORBIS, a database recording balance sheet and profit and loss account items for companies all over the world. The dataset is created by Bureau van Dijk and is based on the mandatory information from filed and publicly available accounts.[14]

[13]For more information on the dataset, see Table A.12 in Appendix A.
[14]For more information on the dataset, see Table A.10 in Appendix A.

The online version of ORBIS used here[15] includes only large and very large companies.[16] The unit of observation is a group of companies which file consolidated accounts together and under the name of a parent company, called the global ultimate owner (GUO). The GUO is a company that ultimately owns at least one subsidiary (with at least a share of more than 50 per cent of capital). For the definition used by Bureau van Dijk, at least one of the shareholders of the GUO must be known and this shareholder cannot own more than 50 per cent.

The sample consists of 3,389 industrial corporate groups[17] over five years (2003–2007) for a total of 12,876 observations distributed across 15 OECD countries.[18] The distribution of the observations across years is shown in Table 3.3. There are large differences in the number of companies reported for each country (see Table 3.4). Differences are due to different reporting requirements and different industrial structures. For example, France, the United Kingdom, and the United States have large multinationals, whilst countries such as Spain are characterised by smaller and less internationalised groups. US and UK global ultimate owners represent about 55 per cent and 19 per cent of the sample respectively, together forming a total of almost 75 per cent. More than half of the remaining quarter are German, French, and Swedish groups.[19]

Following Desai et al. (2006b), 38 countries are classified as tax havens and di-

[15]The version of ORBIS used in this chapter has been accessed on 16 October 2008.

[16]Bureau van Dijk defines large and very large companies as those having operating revenue greater than 13 million $US (10 million EUR) or total assets greater than 26 million $US (20 million EUR) or a number of employees greater then 150 headcounts.

[17]This excludes GUOs which are insurance companies, financial companies, banks, hedge funds, private equity firms, venture capital firms, mutual and pension funds, and public authorities. The different sectors represented in the sample are showed in Table 3.1.

[18]For more details on the sample construction, see Table 3.2.

[19]The observations are less than 27,120 (see last rows of Table 3.2) because companies with only one year of data are dropped in a dynamic model with one lagged dependent variable. Also, the use of the instrumental variables and their lags reduces the sample.

vided between large and small low-tax jurisdictions (see Table 3.5). Among others, the former group includes two OECD countries (Ireland and Switzerland) and two Asian tigers (Hong Kong and Singapore). Small tax havens include differing jurisdictions ranging from Caribbean islands such as the Bahamas and the Cayman Islands to archipelagos in the Indian Ocean such as Mauritius and the Seychelles, through to European small countries such as Liechtenstein, Luxembourg, and Malta.[20]

In the sample, the most popular low-tax jurisdictions are large countries such as Switzerland, Singapore, Ireland, and Hong Kong reflecting the wider opportunities of their larger and more developed economies (see Table 3.6). Ultimate owners of all 15 countries are present in the four large low-tax jurisdictions. More specifically, Switzerland has a prominent role among continental European countries. It is the most popular low-tax location for Austrian, German, Danish, Finnish, French, Dutch, and Swedish companies. Ireland is the favourite destination of UK companies whilst Singapore is the prevailing choice for US multinationals, followed by Hong Kong and Ireland. Among small tax havens, the most popular is Luxembourg. It is the first destination for Belgian GUOs whilst remaining important for Spanish, Greek (second destination), French, and Swiss companies (third destination). Bermuda, the Cayman Islands, the British Virgin Islands, and Barbados are also prominent small tax havens. Bermuda, the Cayman Islands, and Barbados are strongly dominated by US companies whilst about one fourth of the subsidiaries in the British Virgin Islands are UK-owned.

[20]Table 3.5 does not provide an exhaustive list of low-tax jurisdictions. Some tax havens such as the Maldives, the Isle of Man, and the Channel Islands are not included. Table 3.5 includes only the offshore fiscal centres in which the ultimate owners in the sample own a subsidiary. Interestingly, for US global ultimate owners, the pattern of tax haven operations is similar to the one in Dyreng and Lindsey (2009) who find that US companies locate their low-tax subsidiaries mainly in Singapore, Switzerland, Ireland, Barbados, Bermuda, and the Cayman Islands (see Table 3.6).

The identification strategy of this chapter relies on measuring the change in the consolidated tax bill after tax haven operations have been expanded or reduced: groups with more extensive offshore operations are expected to have a lower tax bill. To implement this strategy, the extent of tax haven operations of each group must be identified. This can be done in ORBIS as it provides information on the country of residence of the immediate subsidiaries of the ultimate owner filing the consolidated accounts. Unfortunately, ORBIS contains only time-invariant information on the ownership structure.[21] To create a time-varying variable recording the number of subsidiaries in offshore low-tax centres, the dataset is merged with ZEPHYR.[22] The latter contains M&A deals that occurred between 1999 and 2007. By merging the two datasets, it is possible to create a time-varying ownership structure using ORBIS ownership information as a starting point. In other words, if a company in ORBIS appears in ZEPHYR as an acquirer and (or) as a vendor of a subsidiary located in a tax haven, a time-varying variable recording the number of subsidiaries in offshore centres can be built. For an example of how such a variable as been constructed see Table 3.8.

The datasets used have some limitations. First, the variable recording the number of tax haven subsidiaries is built starting from the static information recorded in ORBIS. This includes only first-level subsidiaries. The empirical analysis of this chapter is carried out using a difference-GMM and therefore the effect of tax haven subsidiaries is identified only using the corporate groups which have increased or decreased the number of their first level low-tax subsidiaries during the sample period. It is important, however, to recognise that if a company has only second and

[21] The information refers to the last available year, mainly 2007.

[22] ZEPHYR is also produced by Bureau Van Dijk. For a summary of the final dataset downloading and construction, see tables 3.2 and 3.7. For more information on the dataset, see Table A.11 in Appendix A.

further level tax haven subsidiaries, it will not be used to produce the estimates. It is difficult to understand in which direction the bias would be. Companies with first level tax haven subsidiaries could be very special with respect to the average company with low-tax offshore operations. They could also be thought of being more aggressive tax planners. In this case, the results would overestimate the effect of tax haven subsidiaries for the whole population of companies in the economy. On the contrary, it could be possible that corporate groups without first-level tax haven subsidiaries but with less apparent and more complicated structures[23] have greater opportunities to shift profits to low-tax offshore jurisdictions. In this case, the results would underestimate the real effect. Second, the time-varying changes in the variable are built using ZEPHYR. The latter only records M&A deals. It does not record whether a new subsidiary has been created. More generally, there might be an underestimation of their presence in tax havens. Despite the drawbacks of the sample used here, this is one of the first cross-country datasets constructed with time-varying information on tax haven operations.

Descriptive statistics for the entire sample are shown in Table 3.9. Ultimate owners are classified as multinationals if they own foreign subsidiaries (with more than 50 per cent of their capital). The rest of the companies are classified as domestic. For descriptive purposes, multinationals are then classified further into two groups: those with at least one subsidiary in tax havens and those without any operations in offshore centres[24] (see Table 3.10). In the sample, multinationals are evenly split between those with and those without first-level tax haven subsidiaries. Each of the two groups represents about 40 per cent of the total GUOs. Most of the individual countries are characterised by a higher proportion of multinational ulti-

[23] A typical structure would see a first level subsidiary in a non tax haven country such as the United Kingdom or the Netherlands and then a second level subsidiary in a tax haven.

[24] See Table 3.5 for a classification of tax havens.

mate owners without offshore first-level subsidiaries, with the exception of Austria, Belgium, France, Germany, the Netherlands, and Switzerland.

Multinationals with operations in tax havens are on average not only the most profitable but also the least likely to run losses (see tables 3.10 and 3.11). Additionally, their losses are the smallest on average. These factors explain their higher tax bill (divided by total assets): higher profits lead to higher tax charges, *ceteris paribus*. Ultimate owners with subsidiaries in low-tax jurisdictions are also the largest in terms of number of employees and the number of total subsidiaries, including non-tax havens subsidiaries.

3.4 Empirical Model and Main Empirical Challenges

The purpose of this chapter is to assess how tax haven operations impact on the tax bill of a corporate group. Tax payments can be affected by various characteristics of the tax base such as deductions for labour costs and interest payments. Given these characteristics, a group with tax haven operations has the ability to reduce its tax bill to a relatively greater extent than can groups without operations in low-tax jurisdictions. To motivate the empirical analysis illustrated later in this chapter, the consolidated profit of a corporate group with operations in a tax haven can be described with a stylised model where a MNC headquartered in country H owns a subsidiary in a low-tax country F and $t^H > t^F$:

$$\Pi^* = \pi^A - t^H[\pi^A(1-\xi-s_1) - s_2K - s_3I] + \\ -t^F[s_1\pi^A + s_2K + s_3I] + \\ -\frac{\gamma_1}{2}s_1^2 - \frac{\gamma_2}{2}s_2^2 - \frac{\gamma_3}{2}s_3^2 \tag{3.1}$$

π^A is accounting profit which is generated only in the home country H; t^H is the statutory corporate tax rate in the home country and t^F is the statutory corporate tax rate in a foreign country F. ξ represents the proportion of accounting profit which does not form part of the taxable profit; K represents consolidated total assets. The amount of profit shifted to low-tax jurisdictions can either be proportional to accounting profit (s_1) and (or) be associated with other characteristics of the firm such as size K (s_2) or the amount of intangible assets I (s_3). Two corporate groups with the same profitability may be able to shift different amounts of profits around the world. In particular, larger firms may have more opportunities to relocate earnings in one of their many subsidiaries. The same can be said for intangible assets whose role in profit-shifting activities has been widely recognised in the literature. For US-owned MNCs, Grubert (2003) argues that half of the difference between their profitability in low-tax and high-tax subsidiaries can be explained by transfer of intellectual property. The terms $\frac{\gamma_1}{2}s_1^2$, $\frac{\gamma_2}{2}s_2^2$, and $\frac{\gamma_3}{2}s_3^2$ represent the cost of profit shifting entailed by the resources needed to set up tax avoidance schemes and by the legal expenses arising if such schemes are contested by the tax authorities or by the minority shareholders. Such costs are assumed not to be tax deductible.

Suppose the only decision variables are the amounts of profit shifted from H to F. The firm maximises its overall profit by choosing to shift optimal amounts of profits s_1^*, s_2^*, and s_3^* such that:

$$s_1^* = \frac{(t^H - t^F)\pi^A}{\gamma_1} \tag{3.2}$$

$$s_2^* = \frac{(t^H - t^F)K}{\gamma_2} \tag{3.3}$$

$$s_3^* = \frac{(t^H - t^F)I}{\gamma_3} \tag{3.4}$$

Equations (3.2), (3.3), and (3.4) indicate that the corporate group shifts profits to the low-tax jurisdiction F insofar as $t^H > t^F$.

The data described in Section 3.3 do not contain information on the flows of profits between the low-tax subsidiaries and the ultimate owner. Only the number of tax havens subsidiaries is available. Given the restrictions placed on this analysis by the data, there are two ways in which the profit-shifting functions s_1, s_2, and s_3 can be modeled. First, profit shifting to tax havens can be represented as a function of a dummy recording whether the corporate group has at least one subsidiary in tax havens.[25] Second, profit shifting can be thought of as a general quadratic function of the number of tax havens subsidiaries such that:

$$s_1 = \delta_1 n + \delta_2 n^2 \tag{3.5}$$

$$s_2 = \phi_1 n + \phi_2 n^2 \tag{3.6}$$

$$s_1 = \lambda_1 n + \lambda_2 n^2 \tag{3.7}$$

[25]Robustness checks on this specification are presented in Section 3.5 and in Table 3.13.

To empirically investigate the effects of profit shifting into tax havens on the tax liabilities, it is useful to represent the group tax bill as

$$\begin{aligned} T = t^H[\pi^A(1-\xi-s_1^*) - s_2^*K - s_3^*I] + \\ +t^F[s_1^*\pi^A + s_2^*K + s_3^*I] \end{aligned} \tag{3.8}$$

Substituting (3.5), (3.6), and (3.7) in equation (3.8) and dividing through by K:

$$\begin{aligned} \frac{T}{K} = \phi_1(t^F - t^H)n + \phi_2(t^F - t^H)n^2 + \\ +[t^H(1-\xi)]\frac{\pi^A}{K} + \\ +\delta_1(t^F - t^H)\frac{\pi^A}{K}n + \delta_2(t^F - t^H)\frac{\pi^A}{K}n^2 + \\ +\lambda_1(t^F - t^H)\frac{I}{K}n + \lambda_2(t^F - t^H)\frac{I}{K}n^2 \end{aligned} \tag{3.9}$$

Equation (3.9) is estimated as:

$$\begin{aligned} Y_{i,t} = \alpha_0 + \alpha_1 n_{i,t} + \alpha_2 n_{i,t}^2 + \\ +\alpha_3(\frac{\pi^A}{K})_{i,t} + \alpha_4(\frac{\pi^A}{K}n)_{i,t} + \alpha_5(\frac{\pi^A}{K}n^2)_{i,t} + \\ +\alpha_6(\frac{I}{K}n) + \alpha_7(\frac{I}{K}n^2) + f_i + \epsilon_{i,t} \end{aligned} \tag{3.10}$$

where

$$\begin{aligned} \alpha_1 = \phi_1(t^F - t^H);\ \alpha_2 = \phi_2(t^F - t^H); \\ \alpha_3 = t^H(1-\xi); \\ \alpha_4 = \delta_1(t^F - t^H);\ \alpha_5 = \delta_2(t^F - t^H); \\ \alpha_6 = \lambda_1(t^F - t^H);\ \alpha_7 = \lambda_2(t^F - t^H) \end{aligned} \tag{3.11}$$

and i indexes a group filing consolidated accounts, and t denotes a year. $Y_{i,t}$ is the tax (**430**)[26] charged to the consolidated P&L account divided by total assets (**412**). The tax variable used here reflects book taxes. There might be discrepan-

[26]The variables codes in ORBIS are given in parenthesis and in bold.

cies between the tax charges reported in the financial accounts and the real taxes paid. In particular, in countries with a worldwide system of taxation of corporate profits, tax charges can be reported in the financial accounts because profits will be repatriated and taxes paid on them sometimes in the future. If the tax liabilities charged to the P&L account reflect only accounting adjustments and not real taxes paid, this research would not estimate a real effect but only an accounting effect. This is a problem common to the rest of the literature.[27]

The literature traditionally employs the ETR (that is, tax bill divided by profitability) as the dependent variable (for example, Markle and Shackelford (2009)) where both the numerator and the denominator are positive. The sample used here contains positive and negative values for both the tax bill and profitability. Selecting only profitable companies and companies paying positive taxes might lead to biased results as explained below.[28]

The extent of tax haven operations is represented by n and it is measured by the number of subsidiaries located in the low-tax jurisdictions listed in Table 3.5. π^A symbolises accounting profitability which is measured as P&L before taxation (**429**); K represents the capital stock and it is measured by the book value of total assets (**412**). I represents intangibles measured by the book value of intangible fixed assets (**405**); f_i is an unobserved time-invariant group-specific effect; and $\varepsilon_{i,t}$ is an idiosyncratic shock likely to be correlated with the right-hand side variables.

This model allows the group tax payments to change when the extent of opera-

[27]For more details on the debate about the advantages and disadvantages of using accounting tax charges, see Markle and Shackelford (2009), footnote 14 and references therein.

[28]Using sales instead of profitability as in Desai et al. (2006b) also mitigates the problem. Unfortunately, the variable net sales is scarcely available in the working sample.

tions in tax havens changes. The coefficient α_1 captures the effect of tax haven operations independently of profitability (direct effect); α_1 is expected to be negative. α_2 captures any non-linear relationship between tax haven operations and the corresponding conditional expectation of $Y_{i,t}$. In this model, it is possible to estimate the extent to which the group ETR drops when more offshore operations become available within a corporate group. In equation (3.10), α_3 measures the marginal ETR[29] for a group without tax haven operations. α_4 and α_5 measure the additional effect on the marginal ETR for a group which switches from zero to one subsidiary in tax havens; α_4 is expected to be negative, as the marginal ETR should decline when tax haven operations are available; α_5 captures the non-linear effects of tax haven operations on the marginal ETR.

For companies with tax haven operations, the marginal ETR is given by $(\alpha_3 + \alpha_4 n + \alpha_5 n^2)$. Thus, as shown in (3.11), the marginal ETR depends on the corporate statutory tax rates t^F of the countries where profits have been shifted. Empirically, the marginal ETR will be determined not only by the corporate statutory tax rates of tax havens but also by the statutory tax rates of other countries where real profits are located or where profits have been shifted. The data used here do not contain information on the location of all subsidiaries of a corporate group. This implies there is no information on all the relevant foreign corporate tax rates. When comparing marginal ETR across different companies, it is therefore not possible to control for the different foreign tax rates relevant for calculating the overall group tax burden.

Intangible assets such as patents are often used to transfer profits from high- to

[29]In fact, $\alpha_3 = \frac{\partial(\frac{tax\ bill}{tot.\ assets})}{\partial(\frac{P\&L}{tot.assets})} = \frac{\partial(tax\ bill)}{\partial(P\&L)}$ for a group without tax haven operations. A similar approach is used in Dyreng and Lindsey (2009).

low-tax jurisdictions: they can be moved easily and arm's length prices are difficult to establish for them. Since a higher concentration of intangibles creates more opportunities for transfer-pricing, α_6 is expected to be negative. α_7, like α_5 captures non-linear effects of low-tax operations.

In the setting analysed here, there are three econometric issues that need to be addressed. The first one is related to the possible endogeneity of tax haven operations. The choice of setting up operations in low-tax jurisdictions might be determined by the profit and hence by the tax bill itself. Table 3.11 shows that groups without tax haven operations are more likely to report losses, and their losses are larger than those of groups present in tax havens. Unprofitable companies have less profits to shift and therefore they will gain less from tax haven operations, as they are already able to reduce their tax bill through the loss carryforward provisions. This result is important. It shows that the selection of only profitable companies can bias the estimations towards finding a negative effect of tax haven subsidiaries on tax liabilities as profitable firms have a greater incentive to locate part of their operations in offshore low-tax jurisdictions. Two key implications can be drawn from Table 3.11. First, unprofitable entities and unprofitable years have to be included in the sample. Second, the presence in tax havens is likely to be determined endogenously by previous tax positions. This is connected with the second econometric issue. This second issue stems from the likely presence of unobservable group fixed effects and unobservable time-variant shocks which simultaneously affect the tax bill and the decision to locate activities in tax havens. The third issue concerns regressors other than the number of tax haven subsidiaries. Important determinants of the tax bill such as profitability and intangibles intensity could be determined simultaneously with the tax bill. This chapter tackles the first issue by including unprofitable entities and years in

which a group reports an aggregate loss. It deals with the last two issues by first constructing a time-variant indicator for tax haven operations and then by using the difference generalised method of moments (GMM-diff) estimator described in Arellano and Bond (1991).

3.5 Main results

Table 3.12 presents results for the basic specification of equation (3.10) where the dependent variable is the ratio of consolidated tax charges to the consolidated book value of total assets. Presence in low-tax jurisdictions is measured by the number of first-level subsidiaries in tax havens. All specifications include a lagged dependent variable which controls for slow adjustments in the tax bill. Tax liabilities might depend on previous tax payments for many reasons. For example, a company might arise the suspicion of tax authorities if it shifts an amount of ernings that is too high with respect to previous years. All specifications also include country-year dummies which control for factors in the country of the GUO likely to affect tax liabilities. Examples of such factors are the statutory corporate income tax rate, the extent of deductions from the tax base, the effectiveness of the anti-avoidance legislation, the effectiveness of tax authorities in detecting tax avoidance and tax evasion, and the economic cycle.

Column 1 of Table 3.12 shows the results from a pooled OLS regression. In this context, the estimator does not control for group-specific effects, nor does it deal with the likely correlation of the regressors with the error term. The within-group estimator in column 2 controls for group fixed effects, but it does not deal with the bias arising from the correlation between the regressors and the error term.

Blundell et al. (2000) showed that the pooled OLS estimator of the coefficient of the lagged dependent variable is upward-biased, whilst the within-group estimator is downward-biased. Hence, columns 1 and 2 are useful for setting an upper and a lower bound to the estimates of the lagged dependent variable shown in columns 3 to 5 and obtained using a GMM-diff estimator.

As explained above, the GMM-diff controls for unobservable group fixed effects, and at the same time it deals with the likely correlation of unobservable shocks with the first-difference of the lagged dependent variable and of other regressors. The set of instruments used in the GMM-diff of columns 3 to 5 includes the first and second lag of the previous two periods' average tax bill divided by total assets.[30] The average tax bill in the two previous periods is a suitable instrument for the number of subsidiaries in tax havens. In fact, it is likely to be a good predictor of whether the company decides to expand its tax haven operations or not. A group with a low-tax bill will be less willing to incur the costs of expanding its operations in low-tax jurisdictions, *ceteris paribus*. As standard in Arellano and Bond (1991), other instruments employed are the second and further lags of the number of subsidiaries in tax havens, of profitability, intangible intensity, size, and of their interactions with the number of subsidiaries in tax havens. The appropriate lags of these variables[31] can be good instruments for the number of subsidiaries in tax havens as well. For example, groups with higher profitability in the past have higher incentives to expand their tax haven operations. Country-year dummies are also included in the instrument set. Instruments are collapsed as described in

[30]The average value of the tax bill divided by total assets for the previous two periods is calculated as follows: $\frac{(\frac{tax\ bill_{t-1}}{tot.assets_{t-1}})+(\frac{tax\ bill_{t-2}}{tot.assets_{t-2}})}{2}$. The instruments used are therefore $\frac{(\frac{tax\ bill_{t-2}}{tot.assets_{t-2}})+(\frac{tax\ bill_{t-3}}{tot.assets_{t-3}})}{2}$ and $\frac{(\frac{tax\ bill_{t-3}}{tot.assets_{t-3}})+(\frac{tax\ bill_{t-4}}{tot.assets_{t-4}})}{2}$.

[31]As explained below, the appropriateness of the lagged values as instruments is tested using the Hansen test for the orthogonality of the instruments to the errors and the Arellano and Bond test to check whether there is serial correlation in the error structure in the original equation.

Roodman (2009a) to contain their proliferation. In the specifications of columns 3 to 5, the test for over-identification and the tests for first and second order serial correlation are satisfactory. The null hypothesis of first order serial correlation is rejected and the null hypothesis of second order serial correlation is not rejected. Under the Sargan-Hansen test, the joint null hypothesis that the instruments are uncorrelated with the error term, and that they are correctly excluded from the estimated equation is not rejected.

The estimates of Table 3.12 are consistent with the model presented in Section 3.4. In columns 3 to 5, the estimated coefficient of the lagged dependent variable lies between the pooled OLS value of column 1 and its within-group equivalent displayed in column 2. More specifically, the estimated coefficient of the lagged dependent variable varies between 0.068 and 0.071.

Column 3 reports results for the model displayed in equation (3.10). The direct effect of the number of tax haven subsidiaries on the tax bill over total assets is not significant; it remains so across all specifications in Table 3.12. The marginal ETR estimated by the coefficient of profitability α_3 is highly statistically significant. It remains so across all specifications in Table 3.12. Its magnitude is estimated to be around 34 per cent. This means that for companies without tax haven operations, a one US dollar increase in the consolidated accounting profit leads to about a 34 cents increase in the consolidated tax liabilities. As expected, the coefficient on the interaction term between profitability and the number of tax haven subsidiaries α_4 is negative but not significant.

As discussed in Section 3.4, it is important to control for losses, as companies with negative earnings might have less incentive to expand in tax havens. The coefficient of the dummy indicating an aggregate loss is positive and significant.

This might seem counter-intuitive. However it is possible that an ultimate owner has a positive tax bill even when it reports losses in the consolidated accounts. In fact some of its subsidiaries might be profitable and therefore might be paying taxes, even if total group losses are larger than the profits of those subsidiaries. The presence of a consolidated loss interacted with tax haven subsidiaries reduces the tax bill, as shown by the negative and statistically significant coefficient on the interaction between the dummy for losses and the number of subsidiaries in tax havens.

It is known that larger firms tend to have more intangibles. It is therefore useful to control for both intangibles and size[32] in the same regression, as shown in column 4. The coefficient of intangible intensity is not statistically significant at conventional levels. However, the coefficient of the interaction between intangible intensity and the number of subsidiaries in tax havens is negative and significant. This indicates that intangibles *per se* might not influence the tax bill, but it is their role in conjunction with tax havens that really reduces tax charges. The effect of size on the tax bill seems more complex to analyse. The significant and positive coefficient of the interaction between the logarithm of employment and the presence in tax havens points to a slightly higher tax over total assets for larger entities with operations in tax havens.

Column 4 of Table 3.12 shows that the marginal ETR is around 33 per cent and highly significant across different specifications. It also indicates that there is a negative and statistically significant effect of low-tax operations on the marginal ETR as α_4 is negative and statistically significant. The coefficient α_5 is instead

[32]Size is measured by the logarithm of the number of employees (**425**).

not significant. Considering a corporate group with two tax haven subsidiaries,[33] the coefficient estimates imply that its marginal ETR will be 0.4 percentage points lower than the marginal ETR of companies without tax haven subsidiaries, *ceteris paribus*. Considering the mean number of subsidiaries in tax havens for the group of companies with at least one offshore subsidiary (five), the marginal ETR will be about one percentage points lower (that is, at about 32 per cent) than the marginal ETR of companies without tax haven operations. As explained above, the coefficient of the dummy recording whether the corporate group reports a consolidated loss is positive and statistically significant. This positive effect is however reduced by the use of tax haven operations as indicated by the negative and statistically significant value of the coefficient on the interaction term between the indicator for losses and the number of subsidiaries in tax havens. This provides evidence that the combined presence of aggregate losses and operations in low-tax jurisdictions reduces the tax burden of the corporate group.

The specification in column 5 controls for the size of losses. The coefficient of the value of losses is not significant. The same can be said for the coefficients of the interaction between the value of losses and the number of tax haven subsidiaries and its squared value. The other coefficients confirm the results in column 4. α_4 is negative and statistically significant pointing to a reduction of the marginal ETR through tax haven operations. Low-tax offshore operations also reduce the tax liabilities through the use of intangibles (see the negative and significant coefficient of the interaction between tax haven subsidiaries and intangible assets) and losses. The number of operations in tax havens do not seem to have a non-linear relationship with the tax bill and with the marginal ETR. The coefficient of the

[33]The sample mean value of the variable number of subsidiaries in tax havens is 2. For more details see Table 3.9.

variables interacted with the squared value of the number of tax haven subsidiaries is never significant, except than in the case of size proxied by the logarithm of the number of employees.

In a polynomial model with interaction terms, coefficients are not directly interpretable as the effect of their associated covariates depends on the value of the covariate itself and on the value of the other regressors. To quantify the overall effect of an additional tax haven subsidiary, it is useful to write:

$$\begin{aligned}\frac{\partial y}{\partial n} = \alpha_1 + 2\alpha_2 n + \alpha_4 \frac{\pi^A}{K} + 2\alpha_5 \frac{\pi^A}{K} n + \\ + \alpha_6 \frac{I}{K} + 2\alpha_7 \frac{I}{K} n + \\ + \alpha_8 d_{loss} + 2\alpha_9 d_{loss} n + \\ + \alpha_{10} log(employees) + 2\alpha_{11} log(employees) n\end{aligned} \tag{3.12}$$

It is possible to calculate the value of equation (3.12) for each observation of the sample by multiplying the value of the estimated coefficients by the relevant variables. In this way, it is possible to obtain a sample mean value for the derivative in equation (3.12). The sample mean value for the derivative is -0.0013, which applied to the sample mean value of the dependent variable (0.019) indicates that an additional tax haven subsidiary reduces the tax liabilities over total assets by about 7 per cent. The long-run effect is very similar, at about 7.4 per cent.[34]

Table 3.13 introduces a slightly different model by employing dummy indicators for tax haven activity. Each specification of Table 3.13 includes a dummy *d1* which records whether the corporate group owns at least one low-tax offshore subsidiary.

[34]The calculations of the long-run effect are as follows: $\frac{-0.0013}{(1-0.0703)} = -0.0014$ and $\frac{-0.0014}{0.019} = -0.074$

To capture additional effects of a large number of tax haven subsidiaries, dummies registering whether the group has two or more, three or more, four or more, and 30 or more[35] offshore subsidiaries are employed in columns 1, 2, 3, and 4, respectively. Dummies vary very little in the sample. Table 3.14 shows that only a few companies switch from owning zero to owning some tax haven subsidiaries. The variation is even smaller for the dummies recording whether the corporate group has more than 2, 3, 4, or 30 low-tax offshore subsidiaries. With so little variation the dummies are unlikely to pick up the effects being studied here. Contrary to the number of subsidiaries in Table 3.12, in columns 1 to 3 of Table 3.13 the dummy *d1* identifies a negative and statistically significant direct effect on total tax liabilities divided by total assets. Column 4 instead identifies only the effect of tax havens on the marginal ETR. The estimated coefficient of the dummies recording more than two, three, four, or 30 tax haven subsidiaries are never statistically significant. The same can be said for the estimated coefficients of the variables interacted with those dummies. This is probably a consequence of the little within-group variation of the dummies. Most of the ultimate owners enter and exit the sample with either some or no tax haven subsidiaries whilst many groups frequently vary the number of offshore operations. Therefore, dummies may not be able to pick up adequately the effect this chapter attempts to analyse. The number of subsidiaries in tax havens employed in Table 3.12 seems therefore a more suitable measure for corporate groups' activity in low-tax jurisdictions.

The findings of the model measuring offshore activities with the number of subsidiaries in tax havens are robust to various changes in the sample, as shown in Table 3.15. For ease of comparison, column 1 of Table 3.15 reports the preferred specification initially introduced in column 4 of Table 3.12. About 3 per cent of the

[35]The top percentile for the variable 'number of subsidiaries in tax havens' is 30.

ultimate owners in the sample are resident in Ireland or Switzerland, two countries considered as tax havens for the purpose of this research. Groups headquartered in low-tax jurisdictions may profit less from tax haven operations, as they already enjoy mild taxation in the home country. The results of the preferred specification are robust to the exclusion of GUOs located in Ireland or Switzerland, as displayed in column 2 of Table 3.15. Column 3 shows that when excluding companies classified as domestic entities at least once between 2003 and 2007, the results remain very close in magnitude to those of column 1. As for corporations headquartered in low-tax jurisdictions, companies reporting losses are likely to profit less from tax haven operations. However, results are also robust to the exclusion of companies always reporting aggregate losses between 2003 and 2007, as shown in column 4. The same can be said of a set of companies with a total number of tax haven subsidiaries smaller than 30 (column 5 of Table 3.15).[36]

All countries in the sample exempt foreign profits with the exception of Ireland, the United Kingdom, and the United States. The United Kingdom shifted to a territorial system in 2009 and the new rules will apply from the fiscal year 2009–2010. The change in the taxation of foreign profits has spurred a debate on whether the new system will be more vulnerable to tax avoidance. In a territorial system, there is an incentive for a corporate group to both locate the real activities and shift profits to low-tax jurisdictions as foreign profits from low-tax jurisdictions bear no taxation at home even if they are repatriated. In a worldwide taxation system, foreign profits enjoy mild or zero taxation only insofar as they are not repatriated. In theory, tax haven operations are more effective in reducing the overall tax burden for multinationals headquartered in countries with a territorial system, although this does not hold in practice if multinationals rarely repatriate their

[36]The top percentile for the variable 'number of subsidiaries in tax havens' is 30.

profits to a home jurisdiction with a worldwide system. The question becomes an empirical one. Table 3.16 investigates this issue in two ways. First, it investigates whether tax haven operations are more effective at reducing the tax burden of corporate groups headquartered in exemption countries, rather than of groups resident in jurisdictions with a worldwide taxation system. Second, it evaluates whether the marginal ETR of the former set of countries is statistically different from the marginal ETR of the latter group, at conventional significance levels.

The specification in column 1 of Table 3.16 is obtained by interacting the variables of the preferred specification (column 4 of Table 3.12) with a dummy *dCR* which takes the value one when the GUO is resident in a jurisdiction which applies a worldwide system for the taxation of corporate profits. Some interacted variables are then dropped if their estimated coefficient is not statistically significant at conventional levels in all specifications presented in Table 3.16. This should reduce multicollinearity problems and shrink the number of instruments. For all companies, the specification is able to identify both a negative and statistically significant direct effect of tax haven operations on the tax bill (α_1) and a negative statistically significant effect of low-tax activities on the marginal ETR (α_4). In column 1 the effect of offshore operations on tax liabilities does not differ statistically between territorial and worldwide systems of corporate income taxation. None of the coefficients of the variables recording the number of tax haven subsidiaries interacted with the credit dummy *dCR* is significant, except for those interacted with the dummy recording an aggregate loss.

Column 2 excludes companies classified at least once as domestic. When only MNCs are considered, the effect of tax haven subsidiaries on the marginal ETR is larger for companies headquartered in countries with an exemption system than for companies headquartered in a credit country. The effect for the former group

of companies is given by the coefficient of the variable interacting profitability with the number of tax haven subsidiaries (0.8 percentage points). The effect for the latter set of firms is 0.1 percentage points (0.008 - 0.007). The differential effect of tax haven operations between territorial and credit countries is also robust to the specifications of the last two columns of Table 3.16. Column 4 excludes GUOs headquartered in Ireland and Switzerland whilst column 5 drops GUOs reporting only losses between 2003 and 2007. The direct effect of low-tax offshore operations on the tax bill (α_1) and the effect on the marginal ETR (α_4) are robust to the specifications of columns 3 to 6.

A crucial result for the comparison of territorial and worldwide systems of taxation is that the marginal ETR is substantially lower for corporate groups headquartered in jurisdictions which exempt foreign profits. Depending on the sample considered, the group marginal ETR of companies with a GUO resident in an exemption country is between 13 and 14 percentage points lower than the marginal ETR of groups headquartered in credit countries. This is shown by the coefficient of the profitability variable multiplied by the dummy for credit countries. The difference is statistically significant at 1 per cent. Corporate groups headquartered in countries which exempt foreign profits may be able to reduce their overall tax liabilities by locating their real activities and by shifting profits into jurisdictions that can guarantee a lower fiscal burden without being tax havens. The difference between the marginal ETR of the two groups cannot be entirely attributed to the different ways in which the territorial and the worldwide systems tax foreign profits and therefore to the amount of tax avoidance activity in the two systems. The marginal ETR of each company is influenced by many characteristics of the tax system of each country where the corporate group has some operations. These characteristics include the statutory corporate tax rates and the deductions al-

lowed on the tax base. Also, for credit countries, the taxes reported in the P&L accounts could be higher than those really paid. In fact, taxes could be reported in the financial accounts in anticipation of profits repatriation in future accounting periods. Because of constraints in the data, this study is unable to control for these characteristics.

Columns 5 and 6 investigate the difference in marginal ETRs further. By interacting country dummies with the profitability for the three credit countries (Ireland, the United Kingdom, and the United States), the last two columns of Table 3.16 explain in more details the determinants of such difference. The corporate groups headquartered in the United States are characterised by the highest marginal ETR which is between 13 and 15 percentage points higher than the mean marginal ETR of groups headquartered in exemption countries. Companies headquartered in the United Kingdom have a marginal ETR of about 29 per cent, 7.7 percentage points higher than companies headquartered in exemption countries. The difference in marginal ETRs between US- and UK-owned groups might reflect a tougher stance taken by the United States on profit shifting for example through the implementation of passive income rules and interest allocation rules. Irish companies display an overall marginal ETR lower than that of groups headquartered in exemption countries. This is expected as Ireland has the lowest corporate tax rate among OECD countries (12.5 per cent). These results do not describe the tax revenues of an individual country or of a group of countries. They instead describe the overall tax burden of corporate groups headquartered in a specific jurisdiction or in a specific set of jurisdictions. They are consistent with the idea that the territorial system is more flexible in allowing corporations to minimise their tax burden by choosing where to locate real activities and profits.

3.6 Conclusions

This chapter investigates the effect of tax haven operations on tax liabilities of multinational groups headquartered in 15 OECD countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, the Netherlands, Norway, Spain, Sweden, Switzerland, the United Kingdom, and the United States. Using consolidated accounting data from ORBIS (2003–2007) and ownership changes constructed by merging ZEPHYR with ORBIS, this chapter finds that, at the mean, an additional tax haven subsidiary reduces tax liabilities over total assets by about 7 per cent in the short run and 7.4 per cent in the long run. More specifically, at the mean, the marginal ETR of a corporate group with tax haven subsidiaries is about one percentage point lower than groups without low-tax offshore operations. The results are likely to underestimate the effect of offshore low-tax operations on the tax bill, as the number of subsidiaries in tax havens may not pick up the entire extent of profit shifting into low-tax jurisdictions.

This chapter also investigates whether a territorial system for the taxation of corporate profits entails a lower consolidated tax burden than a worldwide taxation system. The results show some evidence consistent with tax haven operations reducing tax liabilities more in territorial systems. Multinational companies headquartered in exemption countries reduce their marginal ETR more from low-tax offshore operations than do corporate groups headquartered in a credit country. The results also indicate that the marginal ETR of the first set of companies is lower than the marginal ETR of corporate groups headquartered in jurisdictions which do not exempt foreign profits. More specifically, companies headquartered in the United States are characterised by the highest marginal ETR. Cross-country variations in statutory corporate tax rates, in the way the tax base is calculated,

and in the way future tax liabilities are recorded into the accounts can only partially explain such a divergence.

The results on the marginal ETRs presented in this chapter do not describe the tax revenues of countries with a territorial or a worldwide system. They instead describe the overall tax burden of corporate groups headquartered in countries with either one or the other system of taxation of corporate profits. The findings are consistent with the territorial system being more flexible in allowing corporations to minimise their tax burden by choosing where to locate real activities and profits.

Table 3.1: Corporate Groups by Sector

Sector	No. of corporate groups	Per cent
Mining and quarrying	110	3.25
Manufacturing of food products and beverages	92	2.71
Manufacturing of tobacco products	5	0.15
Manufacturing of textiles	22	0.65
Manufacturing of wearing apparel	28	0.83
Manufacturing of leather products	11	0.32
Manufacturing of wood	10	0.30
Manufacturing of paper	36	1.06
Publishing and printing	54	1.59
Manufacturing of coke, petroleum, and nuclear fuel	14	0.41
Manufacturing of chemicals	220	6.49
Manufacturing of rubber and plastic products	46	1.36
Manufacturing of other non-metallic products	31	0.91
Manufacturing of basic metals	51	1.50
Manufacturing of fabricated metal products	46	1.36
Manufacturing of machinery and equipment	172	5.08
Manufacturing of office machinery and computers	65	1.92
Manufacturing of electrical machinery	61	1.80
Manufacturing of radio, TVs, and communication equipment	280	8.26
Manufacturing of medical, precision, and optical instruments	192	5.67
Manufacturing of transport equipment	99	2.92
Manufacturing (various)	68	2.01
Electricity, gas, and water supply	83	2.45
Construction	76	2.24
Wholesale and retail trade	307	9.06
Hotels and restaurants	73	2.15
Transport	97	2.86
Post and telecommunication	130	3.84
Financial intermediation	102	3.01
Real estate activities	43	1.27
Renting of machinery and equipment	22	0.65
Computer and related activities	348	10.27
Research and development	35	1.03
Other business activities	244	7.20
Recreational, cultural, and sport activities	116	3.42
Total	3,389	100.00

[(i)] Sectors correspond to the two-digit NACE codes (Rev. 1.1).

Table 3.2: Construction of the Dataset used in the Empirical Analysis

	No. of companies	No. observations
ORBIS (online version 16/10/2008)		
Selecting on large and very large companies	1,093,428	
Exclude companies with no financial information	739,989	
Region: Western Europe (26), Canada, and the United States	427,331	
Industrial companies only	401,944	
Number of employees available non missing	293,906	
Only Global Ultimate Owners	26,193	
Active companies only	25,201	
Firms with consolidated accounts only	17,876	
Total assets available for last year	17,863	
Companies with majority owned subsidiaries[(i)]	17,816	
Real download from online version[(ii)]	15,207	136,863
Drop if accounting period different from 12 months	15,207	134,360
Drop if total assets negative or zero	15,207	134,257
Drop non-suitable sectors	14,592	128,833
Drop countries with less than 300 observations	14,555	128,503
Drop if incorporation year is missing	13,918	122,842
Drop outliers[(iii)]	13,710	117,495
Drop if total assets, P&L before tax, or tax bill missing	13,089	76,445
Drop if information on ownership structure missing	12,959	75,930
MERGE WITH ZEPHYR ACQUIRERS	12,959	75,930
- of which present in ZEPHYR (acquirers)	*295*	*348*
MERGE WITH ZEPHYR VENDORS	12,959	75,930
- of which present in ZEPHYR (vendors)	*190*	*271*
- of which present in ZEPHYR (acquirers and (or) vendors)	*437*	*606*
Drop if number of subs in tax havens is negative	12,908	75,532
- of which present in ZEPHYR (acquirers and (or) vendors) also	*386*	*541*
Drop if number of employees missing	5,161	35,288
Drop if (intangibles/total assets) missing	4,618	28,882
Drop if (debt/total assets) missing	4,618	28,882
- of which present in ZEPHYR (acquirers and (or) vendors) also	*335*	*471*
Drop if observations not contiguous in the time for same company	4,618	27,120
- of which present in ZEPHYR (acquirers and (or) vendors) also	*323*	*452*

[(i)] Subsidiaries are of the following type: industrial, insurance, banks, or financial institutions.
[(ii)] The number of companies obtainable through the real download is slightly smaller than the number of companies potentially available from the online version of ORBIS. This happens because the some observations are dropped during the download as they miss all the variables, including the company name and identification number. [(iii)] Outliers are defined as the observations with a value of $\frac{P\&L\ before\ taxation}{total\ assets}$, $\frac{Tax\ bill}{P\&L\ before\ taxation}$, $\frac{Fixed\ assets}{no.\ employees}$, or age within the top or bottom 1 per cent. The observations dropped are 4.35 per cent of the sample.

Table 3.3: Distribution of Observations Across Years

Year	Frequency	Percent
2003	2,115	16.43
2004	2,387	18.54
2005	2,610	20.27
2006	2,813	21.85
2007	2,951	22.92
Total	12,876	100.00

Table 3.4: Country Distribution by Type of Group

	MNCs with TH subs	MNCs without TH subs	Domestic groups	Total (%)
Austria	15 [63]	9 [37]	0	24 (0.71)
Belgium	15 [68]	6 [27]	1 [5]	22 (0.65)
Denmark	15 [44]	18 [53]	1 [3]	34 (1.00)
Finland	21 [34]	36 [59]	4 [7]	61 (1.80)
France	112 [56]	68 [34]	20 [10]	200 (5.89)
Germany	105 [50]	83 [40]	22 [10]	210 (6.18)
Greece	8 [32]	16 [64]	1 [4]	25 (0.74)
Ireland	9 [29]	20 [65]	2 [6]	31 (0.91)
Netherlands	34 [69]	12 [24]	3 [6]	49 (1.44)
Norway	10 [26]	28 [72]	1 [3]	39 (1.15)
Spain	20 [44]	24 [53]	1 [2]	45 (1.33)
Sweden	36 [42]	45 [53]	4 [5]	85 (2.51)
Switzerland	42 [70]	16 [27]	2 [3]	60 (1.77)
United Kingdom	242 [38]	255 [40]	142 [22]	639 (18.86)
United States	635 [34]	710 [38]	520 [28]	1,865 (55.03)
Total	1,319 (38.92)	1,346 (39.72)	724 (21.36)	3,389 (100)

(i) Figures indicate the number of ultimate owners. (ii) In parenthesis, percentage of ultimate owners over the total sample. (iii) In brackets, percentage over the total number of ultimate owners within a single country.

Table 3.5: Classification of Tax Havens in the Sample

Small tax havens	Large tax havens
Andorra (AD)	Hong Kong (HK)
Anguilla (AI)	Ireland (IE)
Antigua and Barbuda (AG)	Lebanon (LB)
Aruba (AW)	Liberia (LR)
Bahamas (BS)	Panama (PA)
Bahrain (BH)	Singapore (SG)
Barbados (BB)	Switzerland (CH)
Belize (BZ)	
Bermuda (BM)	
Cayman Islands (KY)	
Cyprus (CY)	
Dominica (DM)	
Gibraltar (GI)	
Grenada (GD)	
Iceland (IS)	
Jordan (JO)	
Liechtenstein (LI)	
Luxembourg (LU)	
Macau (MO)	
Mauritius (MU)	
Malta (MT)	
Marshall Islands (MH)	
Monaco (MC)	
Netherlands Antilles (AN)	
Saint Kitts and Nevis (KN)	
Saint Lucia (LC)	
Saint Vincent and the Grenadines (VC)	
Samoa (WS)	
Seychelles (SC)	
Vanuatu (VU)	
Virgin Islands (British) (VG)	

(i) Table 3.5 does not provide an exhaustive list of low-tax jurisdictions. Some tax havens such as the Maldives, the Isle of Man, and the Channel Islands are not included. Table 3.5 includes only the offshore fiscal centres in which the ultimate owners in the working sample own a subsidiary.

Table 3.6: Subsidiaries in Each Tax Haven, by Country of GUO

	Country of Ultimate Owners															
Tax havens	AT	BE	CH	DE	DK	ES	FI	FR	GR	IE	NL	NO	SE	UK	US	Total
AD						2 (67)		1 (33)								3 [0.10]
AG				1 (33)										1 (33)	1 (33)	3 [0.13]
AI														2 (100)		2 [0.07]
AN		2 (5)	5 (11)	1 (2)				2 (5)			6 (14)		1 (2)	2 (5)	25 (57)	44 [1.56]
AW				1 (17)							2 (33)			1 (17)	2 (33)	6 [0.20]
BB			1 (1)	1 (1)				1 (1)			2 (3)			5 (6)	68 (87)	78 [2.69]
BH			1 (6)	2 (12)		1 (6)		2 (12)						6 (35)	5 (29)	17 [0.63]
BM			7 (4)	1 (0.6)				3 (2)		1 (0.6)	2 (1)	1 (0.6)	2 (1)	15 (9)	128 (80)	160 [5.64]
BS			1 (3)	1 (3)				2 (6)			3 (9)		1 (3)	3 (9)	22 (67)	33 [1.19]
BZ															1 (100)	1 [0.07]
CH	11 (2)	3 (0.5)	58 (11)	79 (15)	11 (2)	3 (0.5)	11 (2)	57 (11)	1 (0.2)	1 (0.2)	17 (3)	1 (0.2)	20 (4)	56 (10)	211 (39)	540 [12.74]
CY	3 (5)	1 (2)	4 (7)	1 (2)				4 (7)	8 (13)	2 (3)	3 (5)	1 (2)		7 (12)	26 (43)	60 [2.36]
DM			1 (33)					2 (67)								3 [0.10]
GD															1 (100)	1 [0.03]
GI	1 (4)		1 (4)										1 (4)	4 (17)	16 (70)	23 [0.83]
HK	1 (0.2)	3 (1)	21 (6)	21 (6)	4 (1)	1 (0.2)	5 (1)	31 (8)	1 (0.2)	1 (0.2)	2 (0.5)	1 (0.2)	9 (2)	69 (19)	198 (54)	368 [13.47]
IE	1 (0.2)	4 (1)	10 (2)	13 (3)	1 (0.2)	7 (2)	5 (1)	21 (5)	1 (0.2)	28 (7)	15 (4)	1 (0.2)	11 (3)	113 (27)	181 (44)	412 [15.13]
IS				1 (9)	2 (18)			2 (18)					1 (9)		5 (45)	11 [0.36]
JO	1 (6)		3 (19)	2 (12)				2 (12)						3 (19)	5 (31)	16 [0.53]
KN															1 (100)	1 [0.03]
KY			1 (1)	5 (3)			1 (1)	1 (1)	1 (1)		5 (3)		1 (1)	17 (11)	117 (79)	149 [1.76]
LB			3 (15)	1 (5)		1 (5)		8 (45)							6 (30)	20 [0.76]
LC				2 (33)										2 (33)	2 (33)	6 [0.20]
LI	1 (6)		4 (25)	2 (12)				1 (6)			1 (6)			3 (19)	4 (25)	16 [0.56]
LR				1 (9)										1 (9)	9 (81)	11 [0.50]
LU	1 (0.3)	9 (3)	11 (4)	19 (7)	1 (0.3)	6 (2)	3 (1)	38 (15)	2 (0.8)	1 (0.3)	8 (3)		7 (3)	47 (18)	108 (41)	261 [9.59]
MC						1 (10)		5 (50)						2 (20)	2 (20)	10 [0.40]
MH														1 (20)	4 (80)	5 [0.23]
MO				1 (10)	1 (10)									2 (20)	6 (60)	10 [0.33]
MT	3 (10)		2 (6)	8 (28)				2 (7)	1 (3)		1 (3)			7 (24)	5 (17)	29 [1.19]
MU	1 (1)		3 (4)	4 (5)	1 (1)			10 (13)						3 (4)	54 (71)	76 [2.75]
PA			7 (11)	4 (7)		4 (7)		5 (8)			3 (5)		1 (2)	6 (10)	31 (51)	61 [2.32]
SC					1 (33)			1 (33)							1 (33)	3 [0.13]
SG	2 (0.4)	3 (0.6)	27 (5)	31 (6)	6 (1)	1 (0.2)	4 (1)	46 (9)	1 (0.2)	2 (0.4)	12 (2)	6 (1)	10 (2)	69 (14)	276 (56)	496 [17.55]
VC					1 (50)									1 (50)		2 [0.07]
VG	1 (1)		2 (2)	1 (1)		1 (1)	2 (2)	1 (1)	1 (1)	2 (2)	2 (2)	1 (1)	1 (1)	19 (23)	48 (59)	82 [3.52]
VU															4 (100)	4 [0.13]
WS														1 (50)	1 (50)	2 [0.10]
Total	27 (1)	25 (1)	173 (6)	204 (7)	29 (1)	28 (1)	31 (1)	248 (8)	17 (0.5)	38 (1.2)	84 (3)	12 (0.4)	66 (2)	468 (15)	1,577 (52)	3,026 [100]

(i) Figures are taken from the 2007 ORBIS static ownership structure. (ii) In parentheses per cent of country of ultimate owner (columns) for each specific tax haven (rows). (iii) In brackets per cent of subsidiaries in each tax haven over total number of tax haven subsidiaries.

Table 3.7: Download of ZEPHYR

ZEPHYR ACQUIRERS (online version 06/01/2009)	No. firms (acquirers)	No. obs	No. deals
Acquirer located in OECD country			379,323
Target located in tax haven			11,348
Deal type: merger or acquisition			6,634
Deal completed from 1999 onwards			4,295
Real download[i]	3,963	4,762	4,256
Drop if acquirer's ID missing	2,405	3,204	3,142
Drop if country of target missing	2,362	3,143	3,138
Keep if final stake is majority	1,792	2,248	2,244
Drop if year of deal 2008 or missing	1,579	1,957	1,957
Drop if acquirer's country not relevant	1,523	1,886	1,957
Drop if country of target not tax haven	1,491	1,841	1,886
Create a panel with only one observation for each year and each company	1,491	1,701	
ZEPHYR VENDORS (online version 06/01/2009)	**No. firms (vendors)**	**No. obs**	**No. deals**
Vendor located in OECD country			140,425
Target located in tax haven			5,166
Deal completed from 1999 onwards			3,252
Real download[i]	3,224	4,097	3,223
Drop if aquirer's ID missing	1,528	2,401	2,086
Drop if country of target missing	1,392	2,189	2,084
Drop if year of deal 2008 or missing	1,257	1,822	1,822
Drop if country of target not tax haven	1,220	1,773	1,773
Create a panel with only one observation for each year and each company	1,220	1,528	

[(i)] The number of deals obtainable through the real download is slightly smaller than the number of deals potentially available from the online version of ZEPHYR. This happens because some observations are dropped during the download as they miss all the variables, including the company name and identification number.

Table 3.8: Construction of 'Number of Tax Havens Subsidiaries' –Example

Year	Static ownership structure from ORBIS											ZEPHYR (vendors)				ZEPHYR (acquirers)	No. subsidiaries in tax havens
	BB	BM	CH	HK	IE	KY	LC	LU	MO	PA	VC	BH	HK	SG	CH	MC	
1999	1	2	1	2	2	1	1	1	1	1	1	0	1	0	0	0	18
2000	1	2	1	2	2	1	1	1	1	1	1	0	1	0	0	0	17
2001	1	2	1	2	2	1	1	1	1	1	1	0	0	1	1	0	15
2002	1	2	1	2	2	1	1	1	1	1	1	0	0	0	0	0	15
2003	1	2	1	2	2	1	1	1	1	1	1	0	1	0	0	0	14
2004	1	2	1	2	2	1	1	1	1	1	1	0	0	0	0	1	15
2005	1	2	1	2	2	1	1	1	1	1	1	0	0	0	0	0	15
2006	1	2	1	2	2	1	1	1	1	1	1	0	0	0	0	0	15
2007	1	2	1	2	2	1	1	1	1	1	1	1	0	0	0	0	14

[(i)] Barbados (BB), Bermuda (BM), Switzerland (CH), Hong Kong (HK), Ireland(IE), Cayman Islands (KY), Saint Lucia (LC), Luxembourg (LU), Macau (MO), Panama (PA), Saint Vincent (VC), Singapore (SG), Monaco (MC). [(ii)] Figures represent the number of subsidiaries located in each tax haven. In the section 'ZEPHYR (vendors)' the figures represent the number of subsidiaries sold by the ultimate owner in that specific year. In the section 'ZEPHYR (acquirers)' the figures represent the number of subsidiaries acquired by the ultimate owner in that specific year. [(iii)] The value of the variable recording the number of subsidiaries located in tax havens for 2007 is created by adding up the static information from ORBIS (column 2 to 12). The value of such a variable for the previous year (2006) is created by adding up the information from ZEPHYR vendors (column 13 to 16, row 2007) and by subtracting the information from ZEPHYR acquirers (column 17, row 2007). The process continues backwards until the last year (here 1999).

Table 3.9: Descriptive Statistics of the Main Variables

Variable	Mean	Std. Dev.	Min	Max
Tax bill/total assets	.019	.026	-.190	.222
Number of subsidiaries in tax havens	2	6.134	0	192
Dummy - at least one tax haven subsidiary	.409	.492	0	1
Dummy - more than two tax haven subsidiaries	.261	.439	0	1
Dummy - more than three tax haven subsidiaries	.184	.388	0	1
Dummy - more than four tax haven subsidiaries	.139	.346	0	1
Dummy - more than 30 tax haven subsidiaries	.011	.103	0	1
P&L before tax/total assets (if gain)	.070	.070	0	.521
P&L before tax/total assets (if loss)	-.056	.227	-6.964	0
Dummy - aggregate loss	.243	.429	0	1
Intangibles/total assets	.203	.190	0	.975
Log(employees)	7.390	2.175	0	14.557

(i) Intangibles include goodwill (ii) The total number of ultimate owners is 3,389 and total number of observations is 12,876.

Table 3.10: Descriptive Statistics by Type of Group

	Obs.	Mean	Std. Dev.	Min	Max
MNCs with Subsidiaries in Tax Havens					
Tax bill/total assets	5,407	.022	.025	-.190	.222
Number of total subsidiaries		76	137.29	1	2,288
Number of subs in tax havens		5	8.684	0	192
Dummy - any subs in tax havens		.974	.161	0	1
Dummy - less than 2 subs in tax havens		.534	.490	0	1
Dummy - more than 2 subs in tax havens		.439	.496	0	1
P&L before tax/total assets (if gain)		.077	.070	0	.421
P&L before tax/total assets (if loss)		-.021	.102	-2.434	0
Dummy - aggregate loss		.165	.371	0	1
Intangibles/total assets		.207	.174	0	.934
Log(number of employees)		8.406	1.987	0	14.557
MNCs without Subsidiaries in Tax Havens					
Tax bill/total assets	5,045	.019	.027	-.113	.159
Number total subsidiaries		23	59.13	1	1,398
P&L before tax/total assets (if gain)		.069	.071	0	.521
P&L before tax/total assets (if loss)		-.059	.21	-4.252	0
Dummy - aggregate loss		.256	.437	0	1
Intangibles/total assets		.192	.189	0	.924
Log(number of employees)		6.929	1.905	0	12.806
Domestic Groups					
Tax bill/tot. assets	2,424	.013	.027	-.115	.143
Number total subsidiaries		8	17.71	1	249
P&L before tax/total assets (if gain)		.053	.066	0	.483
P&L before tax/total assets (if loss)		-.128	.338	-6.964	0
Dummy - making a loss		.390	.488	0	1
Debt ratio		.536	.353	.012	4.935
Intangibles/total assets		.213	.224	0	.975
Log(number of employees)		6.023	2.040	0	11.695

(i) GUOs are grouped according to the situation in 2007. (ii) The variable 'Number of subsidiaries in tax havens' and the dummy variables indicating the presence of those subsidiaries are equal to zero for all MNCs without tax haven subsidiaries and for domestic groups.

Table 3.11: ETRs, Losses, and Tax Charges Across Types of Companies

	MNCs with TH subs	MNCs without TH subs	Domestic groups	MNCs with TH subs	MNCs without TH subs	Domestic groups
	ETR - only positive values (per cent)			ETR - all observations (per cent)		
2003	32	34	34	23	21	18
2004	30	31	33	24	20	17
2005	30	30	32	24	21	17
2006	29	30	33	24	21	17
2007	28	30	31	23	20	17
Mean	30	31	33	23	21	17
	Per cent of groups reporting losses			Per cent of groups reporting negative tax charges		
2003	23	31	40	17	24	40
2004	17	27	37	13	23	38
2005	15	24	38	12	21	36
2006	14	23	39	11	20	37
2007	15	23	39	11	21	34
Mean	17	25	40	12	22	37
	Mean gain size (over total assets)			Mean loss size (over total assets)		
2003	.062	.058	.048	.032	.069	.165
2004	.074	.067	.051	.021	.061	.105
2005	.079	.071	.052	.020	.055	.126
2006	.083	.074	.057	.017	.062	.129
2007	.084	.074	.053	.019	.053	.124
Mean	.077	.069	.053	.021	.059	.128

(i) Mean ETR calculated using only observations with both positive pre-tax profit and positive tax charges
(ii) Mean ETR calculated setting to zero observations with either losses or negative tax charge.
(iii) All values are consolidated.

Table 3.12: Main Results

Dependent variable: Tax bill/total assets	(1) OLS	(2) WG	(3)	(4) GMM-diff	(5)
Lag(tax bill/total assets)	0.292***	-0.023*	0.071***	0.070***	0.068***
	(0.015)	(0.014)	(0.022)	(0.023)	(0.023)
Number of tax havens subsidiaries (α_1)	-0.00003	0.001	0.004	-0.006	-0.007
	(0.000)	(0.001)	(0.006)	(0.006)	(0.007)
Number of tax havens subsidiaries squared (α_2)	0.000	-0.000	-0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P&L/total assets (if gain) (α_3)	0.228***	0.226***	0.341***	0.332***	0.336***
	(0.007)	(0.010)	(0.026)	(0.026)	(0.025)
X Number of tax havens subsidiaries (α_4)	0.0004	0.004***	-0.0005	-0.002*	-0.002**
	(0.001)	(0.003)	(0.000)	(0.001)	(0.001)
X Number of tax havens subsidiaries squared (α_5)	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Dummy - aggregate loss	-0.001	0.001	0.024***	0.025***	0.024***
	(0.001)	(0.001)	(0.004)	(0.004)	(0.004)
X Number of tax havens subsidiaries	0.000	0.000	-0.001*	-0.002***	-0.001*
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
X No. tax havens subsidiaries squared	0.000	0.000	0.000	0.00003**	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intangibles/total assets				0.007	0.008
				(0.010)	(0.010)
X Number of tax havens subsidiaries	0.000	0.000	0.008	-0.001**	-0.003*
	(0.000)	(0.000)	(0.002)	(0.000)	(0.002)
X Number of tax havens subsidiaries squared	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log(number of employees)				-0.004	-0.003
				(0.003)	(0.003)
X Number of tax havens subsidiaries				0.001**	0.001**
				(0.000)	(0.000)
X Number of tax havens subsidiaries squared				-0.00001**	-0.00001**
				(0.000)	(0.000)
P&L/total assets (if loss)					-0.007
					(0.007)
X Number of tax havens subsidiaries					0.002
					(0.003)
X Number of tax havens subsidiaries squared					0.000
					(0.000)
Country-year dummies	✓	✓	✓	✓	✓
AR(1)			-13.00	-12.62	-12.62
p-value			[0.000]	[0.000]	[0.000]
AR(2)			-1.080	-0.995	-1.030
p-value			[0.278]	[0.320]	[0.305]
Hansen over-identification test			64.48	86.64	96.63
Degrees of freedom			(68)	(92)	(110)
p-value			[0.462]	[0.638]	[0.815]
Observations	12,876	12,876	12,876	12,876	12,876
Number of groups	3,389	3,389	3,389	3,389	3,389

(i) Regressions run using pooled OLS (column 1), within-group estimator (column 2) and GMM-diff estimator (Arellano and Bond (1991)) in columns 3 to 5. (ii) Standard errors in parentheses. (iii) Instruments used are 2nd and further lags of firm-level variables, 1st and 2nd lag of mean tax bill, and country-year dummies. Instruments are collapsed as described in Roodman (2009a). (iv) ***, **, * significant at 1%, 5% and 10% respectively.

Table 3.13: Presence in Tax Havens Measured by Dummy Variables

Dependent variable: Tax bill/total assets	(1)	(2)	(3)	(4)
Lag(tax bill/total assets)	0.062***	0.063***	0.064***	0.083***
	(0.019)	(0.019)	(0.019)	(0.012)
Dummy - at least 1 tax haven subsidiary (*d1*)	-0.048*	-0.048*	-0.050*	-0.043
	(0.029)	(0.029)	(0.029)	(0.026)
Dummy - 2 or more tax haven subsidiaries (*d2*)	0.025			
	(0.028)			
Dummy - 3 or more tax haven subsidiaries (*d3*)		0.031		
		(0.039)		
Dummy - 4 or more tax haven subsidiaries (*d4*)			0.010	
			(0.042)	
Dummy - 30 or more tax haven subsidiaries (*d5*)				-0.290
				(0.475)
P&L/total assets (if gain)	0.351***	0.349***	0.354***	0.348***
	(0.028)	(0.028)	(0.028)	(0.026)
X *d1*	-0.028	-0.035	-0.029	-0.077*
	(0.044)	(0.040)	(0.039)	(0.039)
X (*d2*)	-0.016			
	(0.042)			
X (*d3*)		-0.027		
		(0.040)		
X (*d4*)			-0.044	
			(0.039)	
X (*d30*)				0.064**
				(0.028)
Making loss dummy	0.022***	0.024***	0.023***	0.024***
	(0.005)	(0.005)	(0.005)	(0.005)
X (*d30*)				-0.016***
				(0.006)
Intangibles/total assets	0.014	0.008	0.011	0.011
	(0.013)	(0.013)	(0.013)	(0.013)
Log(number of employees)	-0.002	-0.003	-0.002	-0.002
	(0.003)	(0.003)	(0.003)	(0.003)
X (*d1*)	0.005	0.006*	0.006**	0.004
	(0.003)	(0.003)	(0.003)	(0.003)
X (*d2*)	-0.002			
	(0.003)			
X (*d3*)		-0.003		
		(0.003)		
X (*d4*)			-0.003	
			(0.003)	
X (*d30*)				-0.005**
				(0.003)
AR(1)	-13.58	-13.64	-13.68	-13.75
p-value	[0.000]	[0.000]	[0.000]	[0.000]
AR(2)	-1.386	-1.318	-1.402	-1.030
p-value	[0.166]	[0.188]	[0.161]	[0.303]
Hansen over-identification test	98.44	114.6	106.8	88.21
Degrees of freedom	(92)	(92)	(92)	(92)
p-value	[0.304]	[0.0552]	[0.138]	[0.592]

(i) Number of observations is 12,876 and number of corporate groups is 3,389.
(ii) Coefficient estimates of the variable intangible intensity multiplied by different dummies are not reported. They are insignificant. The same is true for the dummy recording an aggregate loss multiplied by the dummies for at least one, 2 or more, 3 or more, and 4 or more tax haven subsidiaries.
(iii) Regressions run using GMM-diff estimator (Arellano and Bond (1991)).
(iv) Standard errors in parentheses. (v) Country-year dummies used in all specifications.
(vi) Instruments used are 2nd and further lags of firm-level variables, 1st and 2nd lag of mean tax bill, and country-year dummies. Instruments are collapsed as described in Roodman (2009a).
(vii) ***, **, * significant at 1%, 5% and 10% respectively.

Table 3.14: Within-group Changes in Tax Haven Dummies

	No. of groups	Per cent of total corporate groups
Dummy - at least one tax haven subsidiary	47	1.3
Dummy - two or more tax haven subsidiaries	37	1.1
Dummy - three or more tax haven subsidiaries	29	0.9
Dummy - four or more tax haven subsidiaries	19	0.6
Dummy - more than 30 tax haven subsidiaries	10	0.3
Total	3,389	

(i) Number of corporate groups recording at least one change in the dummy.

Table 3.15: Different Samples

Tax bill/total assets	(1)	(2)	(3)	(4)	(5)
Lag(tax bill/total assets)	0.070***	0.068***	0.085***	0.070***	0.069***
	(0.023)	(0.012)	(0.013)	(0.012)	(0.018)
Number of tax haven subsidiaries (α_1)	-0.006	-0.006	-0.002	-0.006	-0.002
	(0.006)	(0.004)	(0.004)	(0.004)	(0.016)
Number of tax haven subsidiaries squared (α_2)	0.0001	0.0001**	0.00003	0.0001**	0.0002
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
P&L/total assets (if gain) (α_3)	0.332***	0.332***	0.318***	0.330***	0.361***
	(0.026)	(0.020)	(0.021)	(0.020)	(0.024)
X Number of tax haven subsidiaries (α_4)	-0.002*	-0.002**	-0.002*	-0.002***	-0.014**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.006)
X Number of tax haven subsidiaries squared (α_5)	0.00002	0.00002**	0.00002*	0.00002***	0.0003
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Dummy - aggregate loss	0.025***	0.025***	0.025***	0.024***	0.028***
	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)
X Number of tax haven subsidiaries	-0.002***	-0.002***	-0.002***	-0.002***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)
X Number of tax haven subsidiaries squared	0.00003**	0.00003***	0.00003***	0.00003***	0.0001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intangibles/total assets	0.007	0.009	0.008	0.006	0.010
	(0.011)	(0.009)	(0.009)	(0.010)	(0.011)
X Number of tax haven subsidiaries	-0.003*	-0.003***	-0.004***	-0.003***	-0.002
	(0.002)	(0.001)	(0.001)	(0.001)	(0.003)
X Number of tax haven subsidiaries squared	0.00004	0.00004***	0.00005***	0.00004***	0.0001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log(number of employees)	-0.004	-0.004*	-0.003	-0.005**	-0.003
	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)
X Number of tax haven subsidiaries	0.001**	0.001***	0.001**	0.001***	0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
X Number of tax haven subsidiaries squared	-0.00001**	-0.0001***	-0.00001**	-0.00002***	-0.00003
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Country-year dummies	✓	✓	✓	✓	✓
AR(1)	-12.62	-13.87	-12.89	-13.88	-13.71
p-value	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
AR(2)	-0.995	-1.136	-0.981	-1.092	-1.060
p-value	[0.320]	[0.256]	[0.327]	[0.275]	[0.289]
Hansen over-identification test	86.64	84.28	87.02	83.97	91.22
Degrees of freedom	(92)	(92)	(92)	(92)	(92)
p-value	[0.638]	[0.704]	[0.627]	[0.712]	[0.503]
Observations	12,876	12,522	10,452	11,951	12,749
Number of groups	3,389	3,298	2,665	3,060	3,359

(i) Regressions run using GMM-diff estimator (Arellano and Bond (1991)). (ii) Standard errors in parentheses. (iii) Instruments used are 2nd and further lags of firm-level variables, 1st and 2nd lag of mean tax bill, and country-year dummies. Instruments are collapsed as described in Roodman (2009a). (iv) Column 1 contains results for the entire sample. In column column 2, GUOs resident in Ireland and Switzerland are dropped. In column 3 domestic entities are dropped. In column 4 groups always reporting a consolidated loss are dropped. In column 5 companies with number of tax haven subsidiaries larger than the 99th percentile (30) are dropped. (v) ***, **, * significant at 1%, 5% and 10% respectively.

Table 3.16: Worldwide versus Territorial Systems of Taxation

Dependent variable: Tax bill/total assets	(1)	(2)	(3)	(4)	(5)	(6)
Lag(tax/total assets)	0.074***	0.083***	0.071***	0.078***	0.071***	0.082***
	(0.010)	(0.011)	(0.010)	(0.010)	(0.010)	(0.010)
Number of tax havens subs. (n) (α_1)	-0.008**	-0.004	-0.007*	-0.009**	-0.010***	-0.007*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Number of tax havens subs. squared ($n2$) (α_2)	0.0002***	0.0001*	0.0002***	0.0002***	0.0002***	0.0001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P&L/total assets (if gain) (α_3)	0.214***	0.217***	0.229***	0.215***	0.215***	0.219***
	(0.035)	(0.034)	(0.036)	(0.034)	(0.035)	(0.034)
X n (α_4)	-0.007**	-0.008***	-0.006*	-0.005*	-0.008***	-0.009***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
X $n2$ (α_5)	0.0003***	0.0002***	0.0003***	0.0002***	0.0003***	0.0002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
X dCR	0.148***	0.131***	0.133***	0.140***		
	(0.041)	(0.041)	(0.041)	(0.040)		
X dUS					0.152***	0.133***
					(0.041)	(0.041)
X dUK					0.077*	0.075*
					(0.042)	(0.042)
X dIE					-0.046	-0.027
					(0.111)	(0.113)
X dCR X n	0.004	0.007**	0.003	0.002	0.006*	0.007**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
X dCR X $n2$	-0.0002***	-0.0001***	-0.0002***	-0.0002***	-0.0002***	-0.0003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Dummy - aggregate loss	0.024***	0.018***	0.025***	0.022***	0.024***	0.018***
	(0.006)	(0.005)	(0.006)	(0.005)	(0.006)	(0.005)
X n	-0.006***	-0.004**	-0.008***	-0.005***	-0.006***	-0.004**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
X $n2$	0.0002***	0.0001*	0.0003***	0.0002**	0.0002***	0.0001*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
X dCR	-0.000	0.006	-0.002	0.002	-0.002	0.005
	(0.007)	(0.006)	(0.007)	(0.006)	(0.007)	(0.006)
X dCR X n	0.004**	0.003	0.006***	0.003*	0.004**	0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
X dCR X $n2$	-0.0002**	-0.000	-0.0003***	-0.0001*	-0.0002**	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intangibles/total assets	0.008	0.007	0.011	0.006	0.007	0.007
	(0.008)	(0.008)	(0.009)	(0.009)	(0.008)	(0.008)
X n	-0.004***	-0.003***	-0.004***	-0.004***	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
X $n2$	0.0001***	0.0001***	0.00005***	0.00006***	0.00005***	0.00006***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log(number of employees)	-0.013***	-0.012***	-0.011***	-0.012***	-0.013***	-0.013***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
X n	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
X $n2$	-0.00002***	-0.00003***	-0.00002***	-0.00003***	-0.00003***	-0.00003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
X dCR	0.014***	0.016***	0.013***	0.012***	0.014***	0.016***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
X dCR X n	-0.000	-0.000	-0.000	0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
X dCR X $n2$	0.000	0.00001*	0.000	0.000	0.000	0.00001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
AR(1)	-13.90	-12.59	-13.76	-13.75	-13.82	-12.52
p-value	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
AR(2)	-0.888	-1.066	-1.039	-0.869	-1.183	-1.251
p-value	[0.357]	[0.274]	[0.364]	[0.282]	[0.206]	[0.211]
Hansen over-identification test	140.0	147.2	133.6	137.4	151.2	156.1
Degrees of freedom	(146)	(146)	(146)	(146)	(158)	(158)
p-value	[0.624]	[0.457]	[0.761]	[0.682]	[0.636]	[0.527]
Observations	12,876	10,452	12,522	11,951	12,876	10,452
Number of groups	3,389	2,665	3,298	3,060	3,389	2,665

(i) Regressions run using GMM-diff estimator (Arellano and Bond (1991)).
(ii) Standard errors in parentheses. (iii) Instruments used are 2nd and further lags of firm-level variables, 1st and 2nd lag of mean tax bill, and country-year dummies. Instruments are collapsed as described in Roodman (2009a).
(iv) The dummy dCR takes value one if the group is headquartered in a country with a credit system. The dummies dUS, dUK, and dIE take value one if the group is headquartered in the United States, the United Kingdom, and Ireland, respectively.
(v) Column 1 and 5 show results for the entire sample. In column 2 and 6 domestic entities are dropped. In column 3, GUOs resident in Ireland and Switzerland are dropped. In column 4 groups always reporting a consolidated loss are dropped.
(vi) Country-year dummies are used in all specifications. (vii) The variables n*dCR, $n2$*dCR, intangibles/tot. assets*dCR, intangibles/tot. assets*n*dCR, and intangibles/tot. assets*$n2$*dCR not reported as insignificant in all specifications.
(viii) ***, **, * significant at 1%, 5% and 10% respectively.

Conclusion

This thesis reports an empirical investigation of some of the fundamental issues raised by a source-based corporate income tax in an open economy.

The first chapter addressed the essential question of the true incidence of the corporate income tax. Differently from the previous literature, it introduced a model with location-specific rents. This allowed us to distinguish between two effects: a direct effect and an indirect effect of the corporate income tax on labour. The former occurs when an increase in the corporate income tax reduces the size of the rent over which the employees and the company can bargain. This reduces the bargained wage, ceteris paribus. The latter effect is the result highlighted in previous literature wherein an increase in the corporate income tax leads to a lower stock of capital, lower labour productivity, and consequently to lower wages (Gordon (1986)).

Chapter 1 estimated the direct effect using unconsolidated accounting data from a panel of over 55,000 companies in Belgium, Finland, France, Germany, Italy, the Netherlands, Spain, Sweden, and the United Kingdom over the period 1996 to 2003. The results showed that the tax is largely shifted to the labour force. The central estimates illustrated that, conditional on value added per employee, in the long run an exogenous $1 increase in the tax bill tends to reduce real wages at the

median by 75 cents. Since wage payments are deductible from the tax base, this induced reduction in wages will usually generate a further increase in the tax bill. At the mean statutory tax rate in our sample (35 per cent), this would imply a further increase in tax of just over 26 cents. Relative to this overall tax increase of $1.26, the effective incidence on labour is therefore approximately 59 per cent.

The second and the third chapters cast doubts on the feasibility of taxing profits on a source basis. When profit-shifting opportunities are available, the principle underlying the current system of taxing corporate income might fail in practice, as earnings are transferred away from the jurisdiction in which they have been generated.

Chapter 2 showed that the profit-shifting activities of MNCs have important implications for the productivity literature. More specifically, measured productivity of international firms is overestimated in low-tax countries (and vice versa), because multinationals have an incentive to manipulate the value of sales upwards and the costs of intermediate inputs downwards. The well-documented productivity advantage of multinationals with respect to domestic entities is also a function of the tax system. This has important implications for cross-company and cross-country productivity comparisons. The analysis is carried out using unconsolidated accounts from a panel of about 16,000 firms located in Belgium, the Czech Republic, Finland, France, Italy, Norway, Poland, Spain, Sweden, and the United Kingdom between 1998 and 2004. The results showed that a 10 percentage points cut in the statutory corporate tax rate would induce affiliates of multinationals to increase their measured total factor productivity by about 10 per cent relative to domestic firms. At the sample mean, the TFP advantage of international companies would increase by about 44 per cent.

Chapter 3 investigated whether tax haven operations reduce the tax burden of a corporate group. Using consolidated accounting data for a panel of about 3,400 corporate groups in 15 OECD countries from 2003 to 2007, the study found that tax haven operations reduce the tax liabilities of multinational companies. More specifically, at the mean, an additional tax haven subsidiary reduces the tax liabilities over total assets by 7 per cent in the short run and by 7.4 per cent in the long run. Offshore low-tax operations also have an effect on the ETR. At the mean, the ETR of a corporate group with tax haven subsidiaries is 0.2 percentage points lower than the ETR of entities without such operations. Chapter 3 also found that the marginal ETR of companies headquartered in a jurisdiction with a territorial system is lower than the marginal ETR of companies headquartered in jurisdictions adopting a worldwide taxation system.

This thesis has produced evidence consistent with the corporate income tax being largely passed on to the labour force (Chapter 1). Chapter 2 and Chapter 3 analysed different aspects of profit shifting. Results from both chapters highlight the consequences of the difficult implementation of a source-based corporate income tax in a world of integrated capital markets. Overall, the empirical analysis carried out in this work suggests that in an open economy, a corporate income tax levied on a source basis creates large distortions. In a world where the source-based corporate income tax is still widely used, and is still generating revenues (Devereux et al. (2004)), the policy implications of the research findings of this thesis are important. They point to the need for a reform of the corporate income tax as applied in most countries.

Appendix A

Data Appendix

This Appendix provides a brief summary of some of the data employed in the empirical research carried out in this thesis and (or) used in the cited literature. It describes datasets suitable for the study of the effects of taxes on companies' behaviour in the open economy. The first type of data described here is aggregate data on FDI, available through national balance of payments statistics. These are published for most countries by either national statistics offices or central banks. EUROSTAT, the Organisation for Economic Cooperation and Development (OECD), and the United Nations Conference on Trade and Development (UNCTAD) collect data from individual countries and make them available in a broadly comparable format across countries.

According to the definition used by EUROSTAT (2007a), page 143, the balance of payments is:

> "*... a statistical statement that systematically summarises, for a specific time period, the economic transactions of a country with the rest of the world. The two main categories of the balance of payments are: the current account (goods, services, and income and current transfers) and the capital and financial account (capital transfers, direct investment, portfolio investment, other investment, and reserve assets). Foreign direct investment (FDI) flows appear in the financial account of the balance of payments, FDI income flows in the current account. Foreign direct investment (FDI) is cross-border investment made by a direct investor with the intent of obtaining a lasting interest in an enterprise resident in another country (direct investment enterprise). International investment is classed as FDI when an investor owns 10 per cent or more of ordinary shares or voting rights in an incorporated or unincorporated enterprise abroad respectively. FDI flows are*

direct investment transactions from the reporting to the partner country (outward FDI) and from the partner to the reporting country (inward FDI). They include the net purchase by the investor of the investment company's equity capital, plus the direct investor's share in the company's reinvested earnings, plus other capital, which is the net increase in trade and other credit, including the net purchase of debt and other financial instruments. Also referred to as FDI positions, foreign direct investment stocks are a measure, at a specific point in time, of the value and composition of a country's FDI assets (outward stocks, or claims on the rest of the world) and of its FDI liabilities (inward stocks from the rest of the world)".

FDI flows therefore differ from measures of capital expenditure in two main ways. The first is that a multinational corporation resident in country i which undertakes capital expenditure though an affiliate in country j, may finance the investment in several ways. The parent in j can issue a loan or new equity. This would represent a flow of FDI from i to j. The affiliate can also raise funds locally, in which case there is no flow of FDI. In fact roughly equivalent options are available to any company in j: any company can raise funds for capital expenditure domestically, or on the international market. In the latter case, there would be a flow of foreign portfolio investment (FPI) to j. The second way is that FDI can fund activities other than capital expenditure. In particular, a large proportion of FDI flows tend to finance mergers and acquisitions. For example, the multinational in i may simply purchase another existing company in j. If they finance the purchase by a flow of funds from the multinational, it would count as FDI from i to j. Such FDI will have no effect on the aggregate capital stock in j. It merely reflects a change in ownership.

Every country collects data on the national balance of payments and on FDI. Table A.1 below summarises the data collected by a number of major countries, while Table A.2 describes in more detail the case of the United States as an example of widely used data on FDI. Tables A.3 to A.5 summarise cross-country collections of data on FDI gathered by international organisations such as EUROSTAT, the OECD, and UNCTAD. The analysis of the companies' behaviour in the open economy can also be carried out using aggregate data on activities of affiliates of multinational companies, such as the US Operations of Multinational Companies database (see Table A.6) and the OECD Activities of Foreign Affiliates (AFA) database (see Table A.7). Aggregate cross-country analyses can also be carried out using the sector-level Structural Analysis (STAN) database produced by the OECD (Table A.8).

Aggregate data have some important drawbacks. When employing them, it is difficult to control for heterogeneous responses of firms to changes in the tax system. For example, it is likely that larger companies with more involvement in the international economy react faster to changes in the tax system. Micro data with firm-level information on foreign direct investment are more suitable for this purpose. Firm-level data are identifiable in different directions. Compustat (Table A.9) and ORBIS (Table A.10), contain information for companies resident in different countries. In Compustat it is not possible to link parent data with information on its subsidiaries. ORBIS contains ownership information and potentially financial data for both parent companies and their affiliates. Originally the information on the ownership structure was time-invariant but the latest versions of ORBIS contain historical ownership changes from 2002 onwards. Variations in the old versions and for the years before 2002 can be created by merging ORBIS with ZEPHYR, a dataset gathering information on mergers and acquisitions (see Table A.11).

Firm-level data can also be country-specific like the US BEA firm-level dataset (Table A.12), the German Micro database on Direct Investment (Table A.13), and the UK Annual Inquiry into Foreign Direct Investment (Table A.14). The three datasets are constructed through surveys of the business sector. They are confidential in that they can only be accessed on site through special programs. The literature has also used the US firm-level tax return data (Table A.15) which are not available to researchers outside the US government bodies. Table A.16 summarises other country-specific firm-level datasets which contain information on the foreign activities of domestic companies and of the domestic activities of foreign companies.

This Appendix also includes information on the tax system which can be employed in the empirical analysis of the effects of the tax system on companies' behaviour. Measures of tax rates can be divided into forward-looking and backward-looking measures. The former include the EMTR and the EATR. Calculations are carried out by applying the rules of a particular tax regime (such as tax incentives, depreciation allowances, valuation method for inventories) to a hypothetical investment (for example in plant and machinery), with a given financing method (for example retained earnings), and the specific tax status of the investor (see Table A.17). Backward-looking measures are generally calculated by dividing a tax liability or payment by a measure of profit. They can be calculated either at the aggregate level as implicit tax rates (Table A.18) using data on aggregate tax payments, and aggregate measures of profit or capital income. They can also be calculated at the micro level as average tax rates (Table A.19) using company-level data on tax liabilities and profits.

The final part of this Appendix contains a brief description of some datasets containing useful and relevant information on tax legislation and tax systems (Table A.20) and on tax revenues (Table A.21 and Table A.22).

Table A.1: National Statistics

Country	Collected by	Collection method	Coverage
France	Banque de France and the Ministère de l'Économie des Finances et de la Privatisation	Data on flows and end-of-year positions of FDI in France and French investment overseas are collected through surveys sent to the enterprises and bank settlements.	Operations with foreign capital participation greater than 10 per cent, increases of capital, purchases of shares in a firm, loans of affiliates from parent companies (short and long-term), unguaranteed loans and subsidies, purchases of property.
Germany	Deutsche Bundesbank	Enterprises report transactions and investment stocks to the Deutsche Bundesbank. Additionally, data are also collected from an annual survey on direct investment.	Data are available on a monthly basis.
Ireland	Central Statistics Office	Data are collected through an annual survey of domestic branches and subsidiaries of foreign parent companies.	
Italy	The Ufficio Italiano Cambi and the Bank of Italy	The Ufficio Italiano Cambi collects information on settlements. The Bank of Italy then compiles the balance of payments based on the transactions.	Transactions above a certain value have to be declared to the Ufficio Italiano Cambi which registers them. Any participation of over 20 per cent in the capital of a firm is treated as direct investment. Direct investment flows contain equity capital and debt securities but they exclude reinvested earnings.
Japan	Balance of payment data are collected by the Bank of Japan. Data on FDI are published by the Ministry of Finance	Data for the balance of payments are based on total net transactions and include reinvested earnings only for incorporated enterprises. The position at the end of the fiscal year is derived from the cumulative value of FDI.	FDI data include all foreign projects which lead to an intended participation in the management of a business enterprise. FDI stock data are derived from the cumulated approved values of specific projects presented to the Japanese Ministry of Finance.
Spain	Banco de España	Any transaction above a certain threshold has to be reported to the Banco de España according to the International Transaction Reporting System.	Data include information on shares and other equity representing more than 10 per cent of a company's capital, real estate investment, and long and short-term net claims (claims less liabilities) on parent and (or) affiliate companies. Data on reinvested earnings and data on positions are not available.
Sweden	Sveriges Riksbank	Companies report information on FDI flows directly to the Sveriges Riksbank. An annual sample survey gathers data on stocks and reinvested earnings. The survey is submitted to Swedish companies with subsidiaries abroad and to Swedish enterprises wholly or partially owned by non-residents.	FDI flow data include equity capital, inter-company long-term loans, and reinvested earnings.
United Kingdom	Office of National Statistics	FDI data are collected with compulsory annual and quarterly surveys.	Key data series by area and main country include net UK FDI investment flows abroad; net UK FDI international investment positions abroad at year end; net earnings from UK FDI investments abroad; net foreign FDI investment flows into the UK; net foreign FDI international investment positions in the United Kingdom at year end, and net Earnings from foreign FDI investments in the United Kingdom.

Table A.2: US FDI Data from the Bureau of Economic Analysis

Coverage	*Type of data:* Balance of payments and direct investment position data cover US affiliates of foreign companies when an affiliate's assets, annual sales, or annual net income exceeds $20 million (inward investment). Regarding outward investment, the data cover all foreign business enterprises owned at the level of 10 per cent or more, directly or indirectly, by a US investor. *Frequency* quarterly *Unit of observation*: country (United States)
Variables	*Inward*(i) • Direct investment capital flows • Direct investment income • Royalties and licence fees • Other transactions with affiliated foreigners *Outward* • Direct investment income (current account flows item) • Royalties and licence fees (current account flows item) • Charges for other services (current account flows item) • Equity capital (capital account flows item) • Inter-company debt (capital account flows item) • Reinvested earnings (capital account flows item) • Direct investment position abroad (stock item)
Sources of data and methods of collection	Balance of payments and direct investment position data are collected through a quarterly mandatory survey.
Drawbacks of the data	The FDI data are based on a benchmark survey carried out every four years. For non-benchmark years, all the series are estimated by extrapolating the benchmark data based on sample data from the quarterly survey. When new benchmark data are available, the previous estimates are not revised and this could lead to an incorrect estimate of true FDI. The bias would become worse the further the year is away from the benchmark year.
Availability	Available on the Bureau of Economic Analysis (BEA) website: http://www.bea.gov/international/
Information on the dataset	http://www.bea.gov/international/ Barefoot and Mataloni (2009); Mataloni (1995); Quijano (1990)

(i) Inward data are all presented by country of foreign parent and by industry of affiliate.

Table A.3: EUROSTAT Data

Coverage	*Type of data*: Balance of payments data (with FDI flows and positions) for European Union countries, Japan, Norway, Turkey, and the United States. *Frequency*: Balance of payments data are available monthly (only for the Euro-zone), quarterly, and annual. FDI annual data are available. *Unit of observation*: country
Variables	*Current account transactions* • Exports, imports and balance of account for goods, services, income and current transfers • Balance of the current account *Balance of payments* • Trade integration of goods and services • Balance of international trade in goods and services • Direct investment flows (as percentage of GDP) • Direct investment stocks (as percentage of GDP) • FDI intensity *European Union direct investment* • Current account transactions • Extra-EU outward FDI (by sector (i), country, and economic activity) • Extra-EU inward FDI (by sector, country, and economic activity) • Income from FDI from outside the EU (ii) • Intra-EU outward and inward direct investments (breakdown by sector and country) • EU FDI in emerging markets (iii)
Sources of data and collection methods	Data are collected from questionnaires sent out to member states, from national balance of payments publications, and additional information provided by national compilers. EUROSTAT collects FDI data via common EUROSTAT and (or) OECD questionnaires from member states.
Drawbacks of the data	Definitions of FDI vary across countries. Consequently, data may not be completely comparable across countries.(iv)
Availability	www.europa.eu/eurostat
Information on the dataset	EUROSTAT (2007a)

(i) International Standard Industrial Classification (ISIC) and NACE codes are used. (ii) FDI income consists of income on FDI equity and of interest payable on inter-company debt. Income on equity consists of dividends due for payment in the period to the direct investor, gross of withholding taxes, plus the direct investor's share of the company's reinvested earnings. Interest payable on inter-company debt is interest accrued during the period by the enterprise on the direct investment; it includes interest on the borrowing and the lending of funds including debt securities and suppliers' credits. (iii) Data are also divided in European FDI towards candidate countries, placeLatin America, Far East Asia, and Mediterranean Partner Countries. (iv) Some countries have different collection methods, concepts, and classifications for gathering FDI data. To overcome such problems, EUROSTAT harmonises national data. EUROSTAT also estimates missing data for each member state to create complete European Union FDI flows and positions.

Table A.4: OECD International Direct Investment Database

Coverage	*Type of data:* The OECD International Direct Investment Database gathers data on FDI to and from the OECD member countries.(i) *Frequency*: annual *Unit of observation*: country
Variables	• Direct investment inflows (by sector and country) • Direct investment outflows (by sector and country) • Direct investment inward positions (by sector and country) • Direct investment outward positions (by sector and country)
Sources of data and collection methods	FDI data are collected through common EUROSTAT/OECD questionnaires from member states.(ii) Balance of payments and international investment position statistics compiled by central banks or statistical offices are used together with other sources (for example FDI notifications or approvals).
Drawbacks of the data	Definitions of FDI vary across countries. For example some countries do not include retained earnings. Consequently, data may not be completely comparable across countries. Comparability is also affected by differences in industrial classifications and geographic breakdowns.
Availability	Available online at OECD.Stat under the section International Trade and Balance of Payments.
Information on the dataset	IMF and OECD (2004)

(i) The 30 OECD member countries are Australia, Austria, Belgium, Luxembourg, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States. (ii) Some countries have different collection methods, concepts and classifications for gathering FDI data and this might make the comparison difficult.

Table A.5: UNCTAD Databases

Coverage	*Type of data:* The UNCTAD FDI/TNC (Transnational Corporations) database contains information on inward and outward flows and stock of FDI classified by type of investment, by region, and by industry for almost 200 countries and economies worldwide. The cross-border mergers and acquisitions database covers data on cross-border mergers and acquisitions, documenting all transactions with more than 10 per cent equity capital since 1987. It also includes information on over 73,000 deals involving more than 150 countries. The largest TNCs database ranks the world's largest non-financial TNCs by the size of their foreign assets. The database has been published since 1993 and it has been complemented by a list of the 50 largest TNCs with headquarters in developing countries since 1995 and by a list of the 25 largest TNCs from the countries in Central and Eastern Europe since 1999. *Frequency*: annual *Unit of observation*: country
Variables	*FDI/Transnational corporations database*: • Inward and outward FDI flows and stocks • TNCs number of employees, wages, and salaries • TNCs sales, profits, and value added • TNCs exports and imports • TNCs R&D expenditures and employment *Mergers and acquisitions database:* • Value and nature of the deal • Name of acquiring company, its home economy, and industry • Acquired company's name, its host economy, and industry *The largest TNCs database:* • Total and foreign sales • Assets and employment by company and by industry • Index of transnationality
Sources of data and collection methods	UNCTAD collects published and unpublished national, official FDI data from central banks, statistical offices, or national authorities on an aggregated and disaggregated basis. These data are further complemented by data obtained from: (i) other international organisations such as the International Monetary Fund (IMF), the World Bank, and the OECD; (ii) regional organisations such as the Association of Southeast Asian Nations Secretariat and the European Bank for Reconstruction and Development; (iii) Banque Centrale de l'Afrique de l'Ouest; (iv) Banque Centrale des États de l'Afrique Centrale, and (vi) UNCTAD's own estimates.
Drawbacks of the data	There are limitations in data comparability due to differences in national definitions. Data for some countries are missing and therefore estimated.
Availability	Data are available at the UNCTAD website: www.unctad.org/fdistatistics. For the largest TNCs database, data are available in UNCTAD (2008).
Information on the dataset	UNCTAD (2008)

Table A.6: US Operations of Multinational Companies Database (BEA)

Coverage	US direct investment abroad data focus on the overall operations of the US affiliates whose assets, sales, or net income exceed $1 million (inward investment), and on the overall domestic and foreign operations of US multinationals, that is parent companies and their affiliates in which the parent owns at least 10 per cent of the capital. Foreign direct investment in the place US data cover existing US business enterprises in which foreign direct investors acquired (directly or through their US affiliates) at least a 10 per cent ownership interest, and new US business enterprises established by foreign direct investors. *Type of data*: Financial and operation data for US companies and their foreign affiliates and for US affiliates of foreign companies providing indicators of the overall domestic and foreign operations of US multinational companies, irrespective of the degree of intra-MNC funding. *Frequency*: annual *Unit of observation*: country (United States) and country of investment.
Variables	*Financial and operating data*(i) • Income statement items • Balance sheet items • External financial position • Property, plant, and equipment • Number of employees • Employees' compensation *Tax variables* • Direct foreign and home taxes paid • Indirect home and foreign taxes paid
Sources of data and collection methods	Financial and operating data are collected through a mandatory annual survey and a mandatory benchmark survey organised every five years. The BEA Benchmark Survey contains more detailed and complete information. Establishment and acquisition data are collected through an annual mandatory survey.
Drawbacks of the data	The FDI data are based on a benchmark survey carried out every four years. For non-benchmark years, all the series are estimated by extrapolating the benchmark data based on sample data from the quarterly survey. When new benchmark data are available, previous estimates are not revised and this could lead to an incorrect estimate of the true FDI. The bias would worsen, the further the year is away from the benchmark year.
Availability	Available on the BEA website: http://www.bea.gov/international/
Information on dataset	Barefoot and Mataloni (2009); Mataloni (1995); Quijano (1990)

(i) For US multinationals (outward investment), financial and operating data are separately tabulated for two foreign-affiliate groups: all foreign affiliates and majority-owned foreign affiliates (MOFAs). MOFAs are foreign affiliates in which the combined ownership of all US parents exceeds 50 per cent.

Table A.7: OECD Activities of Foreign Affiliates (AFA) Database

Coverage	*Type of data*: The AFA database contains information (inward and outward investment) on activity of majority-foreign-owned affiliates (more than 50 per cent of the firm's capital is owned by a foreign enterprise)(i) or majority- and minority-foreign-owned (more than 10 per cent) mainly in the manufacturing sector. Data are provided for the following declaring countries: Canada, the Czech Republic, Finland, France, Germany, Hungary, Ireland, Italy, Japan, Luxembourg, Mexico, the Netherlands, Norway, Poland, Sweden, Turkey, the United Kingdom, and the United States. *Frequency*: annual *Unit of observation:* industrial sector (based on International Standard Industrial Classification (ISIC) Revision 3) of country of origin.
Variables	*Variables*: • Number of enterprises and (or) establishments • Number of employees • Production, turnover, and value added • Wages and salaries • R&D expenditure and number of researchers • Gross fixed capital formation • Total imports and exports • Intra-firm imports and exports • Gross operating surplus • Technological payments and receipts • Stock of foreign direct investment
Sources of data and collection methods	The AFA database is based on a survey sent out by the OECD Directorate for Science, Technology, and Industry. Member countries report to the OECD based on their own surveys or their own business register's information.
Drawbacks of the data	The AFA database does not contain the capital stock of the enterprises. Data availability varies according to country. There might be problems in comparing different countries. Discrepancies are related to different definitions of foreign-controlled affiliates, the use of different sources, and different definitions of the variables.
Availability	Available online at OECD.Stat under the section Globalisation, Activity of Multinationals.
Information on dataset	Giovannini (2008); OECD (2007).
Note	Unlike data on FDI flows covering all transactions representing more than 10 per cent of the firms' capital, AFA data are based on the notion of control (50 per cent of the capital) (Giovannini (2008)). The AFA dataset can be merged with the OECD Structural Analysis database (see Table A.8). The OECD produces also the Foreign Affiliates Trade in Services database gathering inward and outward FDI of multinationals in the services sector.

(i) This definition of majority-foreign-owned affiliate can change across countries and across time.

Table A.8: OECD Structural Analysis (STAN) Database

Coverage	OECD countries, excluding Mexico and Turkey. It covers all activities (including services). *Type of data*: Sector-level data on output, labour input, investment, and international trade. Sectors are classified according to the ISIC of all economic activities, Revision 3. *Frequency*: annual *Unit of observation*: country-sector.
Variables	*Bilateral Trade data*: • Import and export of goods *Database for structural analysis*: • Gross output • Intermediate inputs • Value added • Labour costs, wages, and salaries • Number of employees and full-time equivalents • Self-employed • Gross fixed capital formation • Gross and net operating surplus *Indicators*: • Export/import ratio • Value added shares • Distribution of R&D expenditures • R&D intensity • Employment shares • Labour share in value added • Labour productivity
Sources of data and collection methods	STAN is primarily based on Member countries' annual national accounts by activity tables. It also uses data from other sources, such as national industrial surveys and censuses.
Drawbacks of the data	Some data points in STAN are estimated.
Availability	STAN can be accessed via OECD's data dissemination service OECD.Stat under the chapter Industry and Services.
Information on the dataset	www.oecd.org/sti/stan/
Note	STAN can be merged with the OECD AFA database (Table A.7). For more details, see Criscuolo (2005).

Table A.9: COMPUSTAT Industrial and Commercial Database

Coverage	*Type of data*: Financial and accounting data including income statement items, balance sheet and cash flow items in both consolidated and unconsolidated form. *Compustat North America* covers US and Canadian publicly traded companies and data from wholly owned subsidiaries of companies required to file with the US Securities and Exchange Commission. *Compustat Global* covers non-US and non-Canadian publicly traded companies in more than 80 countries, representing 90 per cent of the world's market capitalisation. *Frequency*: annual and quarterly *Unit of observation*: firm
Variables	*Some examples*: • Labour costs and number of employees • R&D expenditures • Foreign pre-tax earnings • Property, plant, and equipment (capital expenditures) • Interest expenses and long-term debt (total, issuance, reduction) *Geographic segment file* • Exports to unaffiliated foreign customers • Sales from foreign operations to unaffiliated foreign customers *Prices-Dividends-Earnings file* • Monthly stock prices • Dividends (cash, preferred) • Issued capital *Tax variables* • Total tax expenses • Cash taxes paid • Income taxes (state and other) • Deferred taxes and investment tax credit • Foreign taxes paid
Sources of data and collection methods	The producers of the dataset employ original company sources by extracting financial information, removing reporting biases, and reconciling data discrepancies. They standardise data by financial statement and by specific data item definition, preparing information that is broadly comparable across companies, industries, time, and sectors.
Drawbacks of the data	Not possible to link parent data with subsidiaries.
Availability	Created and sold by Standard and Poor's.
Information on the dataset	www.compustat.com
Note	Standard and Poor's also sells the *Compustat Global Financial Service file* which contains information on the income statement, the balance sheet, and the flow of funds for financial companies.

Table A.10: ORBIS and Firm-level Datasets Produced by Bureau van Dijk

Coverage	*Type of data*: Accounting and financial data including P&L accounts and balance sheet items and securities and price information, (i) in a consolidated and unconsolidated form. Population of 57 million public and private companies around the world (ii) (July 2009). For about 21 per cent of the sample, detailed financial data are available. For 42 per cent of the sample, only summary financial information is recorded and for the rest, no financial information is available (July 2009). *Frequency*: annual *Unit of observation*: firm
Variables	*Some examples*: • Number of employees and total employees' compensation • Interest expenses *Ownership variables*: • Country, name, and identifier of shareholders and subsidiaries • Direct/total percentages of ownership • Type of shareholders (iii) • Independence indicator • Country, identifier, and financial information on ultimate global owner *Tax variables*: • Taxes charged to the P&L account
Sources of data and collection methods	Data are derived from the official balance sheet, P&L account, and notes to financial statements, and are complemented with news, market research, information from official bodies (for example, stock exchanges), and private correspondence. The producer of the data has developed a uniform format which is applied to each entity analysed to address comparison issues.
Drawbacks of the data	There might be differences in accounting standards which could make the comparison difficult.
Availability	The data set is compiled by the Bureau van Dijk and can be accessed online with an annual subscription or bought as a DVD.
Information on dataset	www.bvdep.com

continued...

Table A.10: ORBIS and Firm-level Datasets Produced by Bureau van Dijk (*continued*)

Note	Many national and sector subsets of ORBIS have been used in the literature. They broadly contain the same information as ORBIS, even though some items might be recorded in more detail. This happens because some specific items are dropped, or are aggregated in the cross-country and cross-sector dataset for the sake of comparability. Some of the subsets used in the literature cited in the thesis are: • AMADEUS which contains accounting and ownership information for public and private companies in 41 European countries • OSIRIS which contains information for listed companies, banks, and insurance companies around the world • AIDA which contains information on Italian public and private companies • FAME which contains information on UK public and private companies • BANKSCOPE which contains financial and ownership information on public and private banks around the world

(i) The data available include current, monthly, and annual market capitalisation figures, together with current and annual stock data, and valuation, security information, type of share, market price, and price trends in any stock exchange on which the company is listed. Beta values, correlation coefficients to the main indexes and monthly pricing series are also available. (ii) There are three different modules available. The very large companies' module contains data for all listed companies, regardless of their size and for companies satisfying at least one of the following criteria: operating revenues larger than US$130 million, total assets larger than US$260 million, or number of employees greater than 1000. In the large companies' module, companies are included if they satisfy at least one of the following criteria: operating revenues larger than US$13 million, total assets larger than US$26 million, or number of employees greater than 150. In the medium companies' module, companies are included if their operating revenues are greater than US$1.3 million, their total assets are larger than US$2.6 million, or their number of employees is greater then 15. Small companies include the entities not fulfilling the aforementioned criteria. (iii) Shareholder types are divided into 11 categories: banks and financial companies, insurance companies, industrial companies, public authorities/State/Government, one or more individuals or families, foundations (including research institutes), mutual and pension funds/nominees/trusts/trustees, employees/managers/directors, unnamed individuals and families, bulk lists of companies and private owners, public (used only for publicly listed companies).

Table A.11: ZEPHYR

Coverage	It contains information on the merger and acquisitions deals and financial summary indicators for the participating entities. Deals covered are acquisitions, initial public offerings, institutional buy-outs, joint ventures, management buy-ins, management buy-outs, mergers, minority stakes, planned initial public offerings, and share buy-backs. (i) There is no minimum deal value for being included in the dataset. It contains about 671,000 deals (July 2009). The geographic coverage should be worldwide but new countries have been added in different years. *Unit of observation*: deal
Variables	*Some examples:* • Deal structure • Deal value • Equity value • Enterprise value or estimated enterprise value • Name of target plus activity and country *Ownership variables:* • Name, activity, country, and parent of acquirer • Name, activity, country, and parent of vendor • Global ultimate owner, shareholders, and subsidiaries of target *Financial variables (for target company):* • Turnover • EBIT • Pre-tax profits and losses • Total assets
Sources of data and collection methods	Bureau van Dijk has established a subsidiary called Zephus whose main task is to collect information on M&A deals. Information is collected from different sources and complemented with news, market research, and information from official bodies.
Drawbacks of the data	The geographic and time coverage of ZEPHYR has increased substantially from 2001 onwards. Previous years record a smaller number of deals.
Availability	The data set is compiled by the Bureau van Dijk and can be accessed online with an annual subscription or bought as a DVD.
Information on the dataset	www.bvdep.com
Note	ZEPHYR can be merged with ORBIS to recover more financial information on the companies participating in the deal.

(i) Sub deal type covered are contested bid, exit, hostile bid, leveraged buy-out, partial exit, private investments in public equity, privatisation, public takeover, capital pool, demerger, exit, partial exit, exit new stake, hostile initially became recommended, recommended initially became hostile, unsolicited bid, recommended bid, reverse take-over or start up.

Table A.12: Affiliate-level Operations of US Multinational Companies Database (BEA)

Coverage	*Type of data:* unconsolidated accounting and financial data (i) The Inward Investment database contains data for all non-bank US affiliates of foreign companies (owned 10 per cent or more). Data are separately tabulated for two foreign-affiliate groups: all foreign affiliates and majority-owned foreign affiliates (MOFAs). MOFAs are foreign affiliates in which the combined ownership of all foreign parents exceeds 50 percent. The Outward Investment database contains data for all foreign business enterprises owned 10 per cent or more, directly or indirectly, by a US person or corporation. *Frequency*: every five years and annual *Unit of observation*: affiliate
Variables	*Some examples:* • Number of employees and employees' compensation (ii) • US parent's and affiliates' domestic sales • Affiliates' arms-length sales to United States (iii) • Foreign sales (iv) • Intermediate inputs shipped intra-firm (in both directions) • R&D expenditures • Capital expenditures • Property, plant, and equipment • Dividends and (or) net income to owners • Location of subsidiaries (including tax havens) *Tax variables* • Direct and indirect taxes paid (v) • Foreign income and indirect taxes paid
Sources of data and collection methods	Data are taken from the mandatory Benchmark and Annual Surveys of US Direct Investment Abroad. In non-benchmark survey years, a sample survey is conducted, which excludes small affiliates, to reduce the reporting burden on them. The BEA estimates the data for these affiliates by extrapolating their data from the most recent Benchmark Survey.
Drawbacks of the dataset	For smaller firms, data between two Benchmark Surveys are estimated.
Availability	It can be accessed only on-site at the Bureau of Economic Analysis through the 'BEA Program for Outside Researchers'. An aggregated version of the same data is publicly available. For more details, see Table A.6.
Information on the dataset	www.bea.org Barefoot and Mataloni (2009); Mataloni (1995); Quijano (1990)

(i) Information on foreign subsidiaries is collected according to US accounting principles. This implies that variables are comparable across subsidiaries located in different countries Desai et al. (2006b). (ii) As explained in Desai et al. (2006b), payroll taxes are reported as an indistinguishable component of employee compensation. (iii) The BEA data do not contain US parents' arms-length sales to the country where the affiliate is located. (iv) These are sales to unaffiliated foreign customers from foreign operations. (v) The indirect tax burden is reported as a sum of sales taxes, value added taxes, and excise taxes paid. For more information, see Desai et al. (2006b).

Table A.13: Deutsche Bundesbank Microdatabase on Direct Investment (MiDi)

Coverage	*Type of data*: Unconsolidated (and sometimes consolidated) balance sheet data of foreign-owned firms based in Germany and foreign affiliates of German parent companies. *Period:* Panel data are available from 1996. From 1989 to 2001, only semi-aggregated data by country and (or) by sector are available. *Frequency:* annual *Unit of observation:* affiliate
Variables	*Some examples:* • Number of foreign affiliates • Country of affiliate and parents (including tax havens) • Number of employees • Liabilities • Liabilities to shareholders and (or) affiliates • Total balance sheet of affiliates and parent • Stock of foreign direct and indirect investment (in German affiliates) (i) • Shares in the assets and liability positions of the non-residents • Capital invested in property, plant, and equipment • P&L after tax and before dividend distributions
Sources of data and collection methods	According to the Foreign Trade and Payments Regulation (*Aussenwirtschaftsverordnung*) and the Law on Foreign Trade and Payments (*Aussenwirtschaftsgesetz*), foreign-owned firms based in Germany have to submit answers to an annual stock survey, organised by the Deutsche Bundesbank, if the enterprise has a balance sheet total of more than 3 million in which a non-resident (or several economically linked non-residents) holds 10 per cent or more of the shares or voting rights, directly or indirectly. Reports are also required if foreign-owned branches or permanent establishments located Germany have operating assets in excess of 3 million. German-owned enterprises have to report their foreign direct investments if either the capital shares or voting rights in the foreign affiliate exceed directly, or indirectly, some threshold (10 per cent starting in 2002) and (or) the balance sheet total of the foreign affiliate is above a threshold (3 million EUR starting in 2002).
Advantages of the data	Coverage of both flow and stock data for all affiliates, irrespective of their level of affiliation.
Drawbacks of the data	Data for the foreign parent are scarce; information is restricted to the economic sector and the country in which the firm is active. There are neither income statement items, except for after-tax balance sheet profits, or tax data. Threshold for mandatory reporting of data varies over time and therefore the number of firms available every year varies before 2002.
Availability	Data are confidential and available only on-site at the Research Centre of the Deutsche Bundesbank Central Office in Frankfurt.
Information on the data	Lipponer (2008).
Note	From 2005 onwards, the dataset contains the same parent company's identification number available in ORBIS. This means that the two datasets can be merged.

(i) This variable gives the sum of equity capital of the foreign affiliate, capital reserves, and retained earnings which are held by a foreign-owned firm based in Germany.

Table A.14: UK Annual Inquiry into Foreign Direct Investment (AFDI)

Coverage	*Type of data*: Financial flows in the form of FDI for foreign affiliates of UK entities (*Outward Inquiry*) and foreign-owned firms based in the United Kingdom (*Inward Inquiry*). It covers all UK firms engaging or receiving FDI if the investor holds at least 10 per cent of the capital of the recipients. *Frequency*: annual *Unit of observation*: affiliate
Variables	*Some examples:* • Subsidiary or branch net profit, profit, and loss • Country of affiliate or branch (including tax havens) • Interest (net, received, paid) • Branch and (or) head office debt from and to the United Kingdom • Percentage owned • Subsidiary or branch net earnings • Total net earnings • Subsidiary unremitted profits • Subsidiary dividends • Subsidiary or branch net investment *Tax data* • Subsidiary tax credits • Subsidiary tax refunds
Sources of data and collection methods	Data are collected through survey forms sent to the head of enterprise groups in the United Kingdom. Firms are sampled from different registers, including HM Customs and Revenue, Dunn and Bradstreet's 'Worldbase' system, and ONS inquiries on Acquisitions and Mergers. The largest firms all receive the survey forms every year, while only a proportion of the smaller firms do.
Drawbacks of the data	Information on FDI is not always entered promptly, depending on when the Office of National Statistics learns about the investment from various sources. Tax data are rarely available.
Availability	Data are confidential and available only on-site at the Office of National Statistics in London or Newport.
Information on the data	www.ons.gov.uk Criscuolo and Martin (2009); Criscuolo and Martin (2007); Gilhooly (2007)
Note	Through the enterprise group reference, the AFDI can be linked to the Annual Respondents Database (ARD) to derive more balance sheet and P&L account information on the domestic- and foreign-owned establishments based in the United Kingdom. Information in ARD includes turnover, costs of intermediate inputs, number of employees, and labour costs. The dataset can also be merged with AMADEUS, the European subset of ORBIS (see Table A.10)

Table A.15: US Firm-level Tax Returns

Coverage	*Type of data:* Tax return data for all companies filing tax returns in the United States. *Frequency*: annual *Unit of observation*: parent company and affiliate
Variables	*Some examples:* • Inter-company transactions • R&D expenditures of the parent • Income of the parent and of the controlled foreign-controlled company (CFC) *Tax variables:* • Income taxes paid • Deductions • Foreign taxes paid
Sources of data and collection methods	Data are taken directly from US tax returns Forms 1120, 1118, and 5471. The former is the basic parent corporate income tax return. The second is the form used to claim a foreign tax, and the latter contains the CFC's income, foreign taxes paid, and transactions with related parties, including the parent company.
Availability	Data are confidential and not publicly available.
Information on the dataset	Grubert and Mutti (2000); Altshuler et al. (2001)

Table A.16: Other Firm-level Datasets Available

Country	Inward/ Outward	Name of Dataset	Coverage
France	Inward	*L'Implantation Etrangère dans l'Industrie*, Service des Statistique Industrielles, Ministère de l'Industrie, de la Poste e des Télécommunications.	Foreign-owned manufacturing enterprises with 20 or more employees.
	Outward	*Liaison Financières*, annual mandatory survey developed by the Institute National de la Statistique et des Études Économiques.	Private enterprises with 20 or more employees.
Ireland	Inward	*Census of Industrial Production*, annual survey elaborated by the Irish Central Statistics Office.	Enterprises based in Ireland with at least three employees and owned at least at the 50 per cent level by foreign companies or individuals.
Italy	Inward/Outward	*Reprint Database* developed at the Department of Economics and Production of the *Politecnico di Milano* with the support of the National Institute for Foreign Trade and the Italian National Council for Economy and Labour.	Mining and manufacturing firms based in Italy and controlled by foreign companies or foreign entities controlled by Italian companies.
Japan	Inward/Outward	*Annual Survey on Trends in Business Activities of Foreign Affiliates in Japan and on Japanese Investors and their Foreign Affiliates* carried out by the Enterprise Statistics Division, Research and Statistics Department, and the International Business Affairs Division, Industrial Policy Bureau.	Majority foreign-owned firms based in Japan (excluding financial, insurance, and real estate sector) and Japanese investors abroad.
Spain	Inward	*Central de Balances del Banco de España dataset* of the Central Balance Sheet Office of the Bank of Spain. It reports shares of a firm's capital owned by non-residents. Thus, it is possible to recognise foreign-owned entities.	Panel of Spanish manufacturing companies (excluding companies in the energy sector).
	Inward/Outward	*Encuesta sobre Estrategias Empresariales dataset* (Inquiry on the Firms' Strategies). It reports Spanish firms' capital shares owned by non-residents and the number of foreign countries where a Spanish-owned firm has establishments.	Unbalanced panel of Spanish manufacturing companies.
Sweden	Inward	*Annual surveys on foreign-owned enterprises in Sweden*, by the Swedish National Board for Industrial and Technical Development with Statistics Sweden.	Majority foreign-owned Swedish enterprises
	Outward	*Surveys on Swedish-owned enterprises abroad* conducted by the Swedish National Board for Industrial and Technical Development.	All Swedish groups having subsidiaries abroad with more than one employee
		Repeated survey (every 4 to 5 years) prepared by the Research Institute of Industrial Economics.	Manufacturing Swedish companies with 50 or more employees

Table A.17: Forward-looking Tax Measures

Description	*EMTR:* Proportionate difference between pre-tax and post-tax required rates of return: $EMTR = \frac{(p^* - r)}{p^*}$ where $p^*$is the cost of capital for the marginal unit of investment and r is the associated post-tax rate of return. The higher the EMTR, the greater the required pre-tax rate of return, and thus the lower the incentive to invest. *EATR:* For a given value of the cost of capital, the EATR is the net present value of tax payments expressed as a proportion of the net present value of total pre-tax capital income: $EATR = \frac{NPV\ (tax\ payments)}{NPV\ (total\ pre-tax\ capital\ income)} = \frac{p^*}{(1+r)}$. For a given investment, the EATR represents the share of profits which is taken by taxes.
Developed by	The EMTR was developed by King and Fullerton (1984) for domestic investment. Alworth (1988); OECD (1991); and Keen (1991) extended this to cross-border investment. Devereux and Griffith (1998); Devereux and Griffith (2003) proposed an alternative methodology for the EMTR. They also developed a measure of the EATR.
Availability	Devereux et al. (2008) provide a wide range of EATRs and EMTRs for the 27 European Union countries, Japan, and the United States.
Advantages	Based on a theoretical neoclassical model of investment and therefore appropriate for measuring tax burden on marginal and average investment
Drawbacks	The EMTR and the EATR depend on assumptions made about the type of investment, personal income taxation, the source of finance for the investment, and on whether inflation and the market rate of interest fluctuate.

Table A.18: Backward-looking Measures: Implicit Tax Rates (ITRs)

Description	The implicit tax rate (ITR) is calculated by dividing total tax revenues by a measure of the operating surplus of the economy. The ITR can be calculated for different parts of the economy such as labour, consumption, and capital.
Developed by	Mendoza et al. (1994); European Commission (2003)
Availability	For the 27 European Union member countries, EUROSTAT provides implicit tax rates on capital for corporations. Data are available free of charge from the website: www.europa.eu/eurostat
Information on ITRs	EUROSTAT (2007b); Carey and Rabesona (2004); Clark (2004); European Commission (2004)
Advantages	The calculation of implicit tax rates is relatively straightforward and requires less statistical input than, for example, marginal tax rates. ITRs allow for comparisons across countries, years, and types of taxes.
Drawbacks	ITRs are not based on a theoretical model of investment; they group together different taxes. The potential tax base used in the calculations does not necessarily coincide with the actual tax bases as defined in the legislation. In practice, there might be problems in linking developments in the implicit tax rates to tax policy changes.

Table A.19: Micro-level Average Tax Rates (ATRs)

Description	Micro-level ATRs are computed as the ratio of taxes paid by a firm divided by a measure of its operating surplus.
Availability	Data necessary for building an ATR are available from tax returns and accounting data (for example, ORBIS, BEA firm-level data, Compustat).
Advantages	Easy to calculate once firm-level data are available.
Drawbacks	ATRs only denote the impact of taxes at one period and not over the life of a particular investment. They depend on the history of the firm, since many variables such as business losses are carried forward to the following years.

Table A.20: OECD Tax Database

Description	The OECD Tax Database contains detailed information on personal and corporate income taxes, consumption taxes, and social security contributions levied on both the employers and employees. Information concerns both tax systems and tax rates. Information includes: • Basic corporate statutory income tax rates (for central, sub-central, and combined rates) • Surtaxes • Small businesses tax rates • Other targeted provisions • Statutory tax rate on dividend income • Effective statutory tax rates on distributions of domestic source income (i) Information is available annually from 2000.
Developed by	OECD Centre for Tax Policy and Administration
Availability	Publicly available at the following website: www.oecd.org/ctp/taxdatabase
Advantages	There is very detailed information on many aspects of taxation. Tax rates are also reported for the different levels of governments. It is a very useful tool for international comparisons.

(i) This variable takes into account the corporate income tax, the personal income tax, and any type of integration or relief to reduce the effects of double taxation.

Table A.21: OECD Revenue Statistics

Description	OECD Revenue Statistics has collected tax and non-tax government revenues, including social security contributions, for all member countries since 1984; these are classified by levels of government. Some interesting variables for the aforementioned analysis are: • Corporate taxes on income and profits • Taxes levied on the capital gains of corporate enterprises
Developed by	OECD Centre for Tax Policy and Analysis
Availability	OECD (2008) Data are also available online at OECD.Stat under the section Public Sector, Taxation, and Market Regulation.
Advantages	The tax revenues are classified in very detailed categories and sub-categories so that taxes paid can be easily linked to the related economic activity.

Table A.22: IMF Government Finance Statistics

Description	IMF Government Finance Statistics collect data on revenue, expense, transactions in assets and liabilities, and stocks of assets and liabilities for the general government sector and its sub-sectors. Data are available in levels and as a percent of GDP. *Tax variables:* • Taxes on income, profits, and capital gains (divided between taxes on individuals and taxes on corporations and other enterprises) • Taxes on payroll and workforce • Taxes on property • Taxes on goods and services, including value added taxes, sales taxes, and excise taxes • Taxes on international trade, including customs and other taxes on import duties and taxes on exports • Social contributions • Other taxes
Developed by	International Monetary Fund
Availability	www.imf.org
Advantages	It provides tax revenues for a wide rage of developing and developed economies. It separates tax revenues raised from individuals from taxes raised from corporations together with other businesses.
Drawbacks	Some series have missing data. There might be discrepancies with other IMF data sources such as the IMF country reports.

Appendix B

Dataset Used in Chapter 2

In this Appendix, we describe the construction of the dataset used in the empirical analysis. The starting point is the ORBIS database provided by Bureau van Dijk (2007) (2007 CD version) which records data for nine million companies around the world. The database includes information for each company on the country of residence, the industry, and the accounting date. It also provides broad information on balance sheet and P&L account items.

We calculate value added per employee as either EBIT (**427**)[1] plus costs of employees (**435**), or as sales (**426**) minus costs of materials (**434**). We proxy the capital stock with either fixed assets (**404**), or tangible fixed assets (**406**) and we use data on the number of employees (**425**).

The database also provides information on the firms' ownership structure. This includes information on direct owners (including their shareholdings in the com-

[1]The ORBIS reference number for each item is in parentheses in bold.

pany), on the ultimate or 'global' owner (including its relevant direct and total capital ownership share), on companies' subsidiaries, if any, and the corresponding percentages of ownership. Only the most recently reported ownership information (usually for 2004) is recorded.

We exclude micro firms as defined by European Commission (2003) by including only companies with total assets (**412**) exceeding 2 million Euros for two consecutive years since 2001. This yields a starting sample of 931,324 firms from 1993 to 2005. Below, we describe how we derived the final sample from this initial dataset (see Table B.1). We first illustrate how we use the ownership information. We then explain the treatment of financial data.

Ownership Information

We classify companies in our sample as either being part of a multinational group or as domestic entities. The latter are either stand-alone companies with no affiliates or they belong to a domestic group which has neither affiliates nor corporate global owners abroad. Firms are classified as being part of a multinational group if their ultimate owner (as reported in ORBIS) is a corporation and it is resident abroad, or if other corporate affiliates in the group are resident in a different jurisdiction. We allocate companies to their global ultimate owner directly if this information is provided by ORBIS. If this is not possible, we create a chain of ownership employing the data on the direct owners (DOs). The latter are classified according to their type: individual or corporate owners where the latter group includes banks, financial, industrial, and insurance companies. If these DOs are not found in the sample,[2] the ownership chain is interrupted and a global owner

[2]To be identified by our procedure, direct owners have to be within the initial sample of 931,324 companies.

cannot be identified. In this case, we exclude the firm from the sample. If DOs are available, we first check their shareholding. If none of them holds more than 50 per cent of the firm's capital and the firm does not itself own subsidiaries abroad, then the company is classified as domestic. The same happens if the main DO is an individual, irrespective of whether they have the majority of the firm's capital. If the DO is found in our starting sample and it is both a corporation and independent,[3] then it is defined as the global owner. If it is not independent, then its DO (that is, second level owner) is identified and the process continues until no other corporate DO with more than 50 per cent shareholding can be identified. If the DO with a majority shareholding in the firm is a fund or an individual, then the last corporate DO in the chain is designated as the global owner.

Financial Data

From the initial sample of 931,324 firms, we remove companies for which only consolidated accounts are reported. This avoids duplication and allows us to distinguish among different affiliates. We then drop observations with number of employees, EBIT, cost of employees, or fixed assets either missing or equal to zero. We also eliminate observations with a negative value for the sum of EBIT plus cost of employees. Observations with accounting closing dates from July of year x until June of year $x+1$ are assigned to calendar year x. To ensure that the accounting period between two subsequent calendar years is close to twelve months, we drop observations that are less than 11 months or more than 13 months distant from the end of the previous accounting period. In the next step, we remove observations with clear mistakes. We sum the P&L account and the balance sheet sub-items

[3] A company is defined as independent if it does not have any corporate shareholders owning more than 50 per cent of its capital.

(for example, current assets and fixed assets) which should add up to a core item (for example, total assets). Observations are dropped if the sum of these sub-items amounts to less than 95 per cent or more than 101 per cent of the corresponding core item. In addition, we eliminate observations with negative total assets, negative total liabilities (**423**), or interest payments (**437**).

At this stage, we merge the financial data with the ownership data. We only keep companies which we are able to classify as either domestic or multinational entities. Among MNCs, we keep only firms whose global owner is an industrial company.

To work with comparable production functions and to avoid problems in the definition of TFP, we focus only on the manufacturing sector by keeping firms with NACE code (Rev 1.1) between 15.00 and 40.00.[4] The coverage for some countries is quite poor before 1998 and in 2005. Hence, we only retain observations between 1998 and 2004, inclusive. Subsequently, we drop countries with very few firms (that is, less than 15 domestic or multinational companies). To make the domestic companies more comparable to the multinational companies, we eliminate very small entities in the first group and very large firms in the second one. Specifically, we drop domestic companies whose size in terms of total assets is smaller than the 5th percentile of the multinationals' size[5] distribution. We also drop multinational companies with total assets greater than the 95th percentile of the domestics' size distribution. We also drop outliers in the financial data. We define outliers with respect to two ratios: (i) fixed assets over employees and (ii) cost of employees over the sum of EBIT and wage bill (that is, value added). Every observation that

[4]To calculate TFP as in equation (2.4), we have divided the sample into three manufacturing sub-sectors. The first one includes companies with a NACE code (Rev. 1.1) between 15.00 and 20.00. The second group contains companies with NACE code between 20.00 and 30.00. The rest of the firms are grouped in the third sector (that is, NACE code between 30.00 and 40.00).

[5]Here size is measured as total assets.

falls in the top or bottom 1 per cent of those two ratios is dropped. Finally, we keep only firms with no missing values for EBIT and costs of employees for three consecutive years between 1998–2004 to limit the confounding effect of entry and exit from the sample. This reduces the number of countries. Some of them have less than 15 domestic firms or 15 multinationals in each year. These countries are dropped. As shown in Table B.1, the final sample contains 16,022 firms for a total of 85,606 observations.

Time-varying Ownership Dummy

During the sample period, some companies might have changed their ownership status from domestic to multinational or vice versa. More specifically, multinational companies might have taken over highly productive domestic companies after a cut in the corporate tax rate. In this case, the multinational dummy would be endogenous. As mentioned above, ORBIS does not contain time-varying ownership information. To track changes in the ownership dummy we use a dataset called ZEPHYR. It records M&A operations involving some of the companies in our regression sample as targets, acquirers, or vendors. ZEPHYR is also compiled by Bureau van Dijk as ORBIS and it is therefore possible to merge the two datasets with the potential to create changes in the multinational dummy. Unfortunately, ZEPHYR does not always contain enough information to know with certainty whether a firm has really changed its status from domestic to multinational or vice versa. In the robustness checks of Table 2.7, we then decided to drop companies involved in a M&A deal during the sample period.[6]

[6]Table B.2 describes the country distribution of these observations.

The Construction of Ownership Changes Using ZEPHYR

In a M&A deal, a company can act as a target, an acquirer, or a vendor. To encompass all possible cases, we downloaded three different datasets from ZEPHYR. The first includes deals for which targets are located in Belgium, the Czech Republic, Finland, France, United Kingdom, Norway, Poland, Spain, and Sweden (as in our regression sample), the second includes acquirers, and the third includes vendors located in the same countries.

All possible changes in ownership are summarised in tables B.3 to B.5. For our analysis, the cells on the south-west to north-east diagonals are the most interesting, as they record changes in the multinational dummy.

The number of deals reported in ZEPHYR increases substantially from 2002 onwards. In previous years, the coverage is less effective. This is reflected in Table B.6 which shows a breakdown by years of the number of deals affecting companies in our sample. About 40 per cent of the M&A operations take place in the United Kingdom. Belgium, France, Spain and Sweden represent each about 10 per cent of the deals (see Table B.2).

Initially we downloaded deals between 1998 and 2004 in which targets are located in Belgium, the Czech Republic, Finland, France, United Kingdom, Norway, Poland, Spain, and Sweden. For a description of the dataset, see Table B.7.

We use the information in this dataset to establish which companies in our regression sample have been part of a deal and, as a consequence, have changed their ownership status from domestic to multinational or vice versa. If a company in ORBIS is also present in ZEPHYR as a target, it is possible to trace changes in its ownership in the way shown in Figures B.1 and B.2 below.

To identify the status of the target before the deal[7], we first need to know the country of the vendor. Unfortunately, in the targets dataset about 50 per cent of the deals (129 out of 256 deals) do not report any information on the vendor. This means that the id number, the country, the name, and the parent of the vendor are missing. For these observations, it is impossible to identify what the ownership status of the target was before the deal.

If the country of the vendor is available and it is different from the country of the target, the latter can be classified as part of a multinational group before the deal (that is, Box 1 of Figure B.1). If the country of the target and the country of the vendor are the same, we need information on the ownership structure of both the vendor and the target, as shown in Figure B.1. Among the observations for which the country of the vendor is available (121), about 70 per cent record a country of the vendor which is the same as the country of the target. This could be interpreted as evidence that the company was part of a domestic group before the deal[8]. However, the vendor might in fact be part of a multinational group itself and (or) the target might have foreign subsidiaries. Since we do not have ownership information for companies before 2004, we are unable to establish the ownership status of the vendor and of the target. Consequently, we cannot distinguish between Box 2 and Box 3 in Figure B.1.

The ownership status of the target after an M&A operation could easily be approximated with its ownership structure available in ORBIS for 2004 (see Figure B.2).

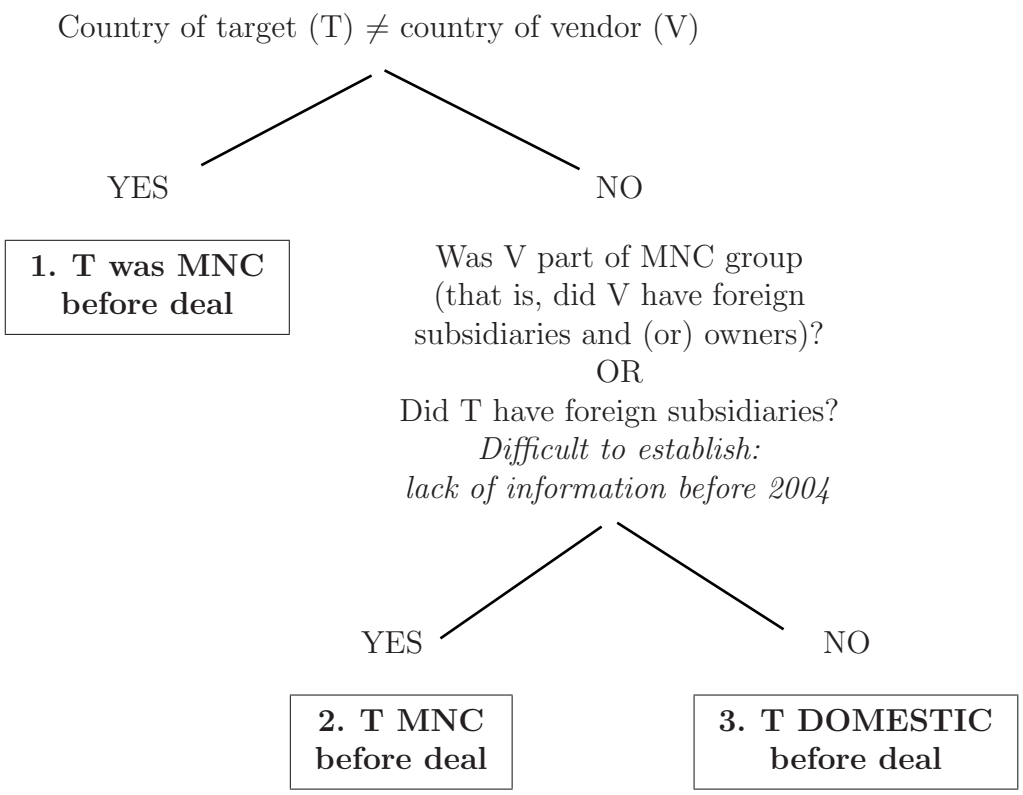
In summary, provided that the information on the country of the vendor is available, we can identify some of the cases in the third row of Table B.3 (that is, when the target was a multinational entity before the deal). Unfortunately, without

[7]This means identifying from which cell of the second column of Table B.3 the firm starts.

[8]Also, if the vendor is an individual, the company could have been a stand-alone.

further assumptions we are unable to identify the fourth row (that is, when the target was a domestic entity before the deal). We cannot decide whether the firm was truly a domestic entity (that is, decide between Box 2 and Box 3 in Figure B.1) when the country of the vendor and the country of the target are the same. We could make an assumption. When the target and the vendor are resident in the same country, we could consider the former as being domestic before the deal occurred (see Table B.7).

Figure B.1: How to Identify the Ownership Before a Deal Occurred (ZEPHYR targets)

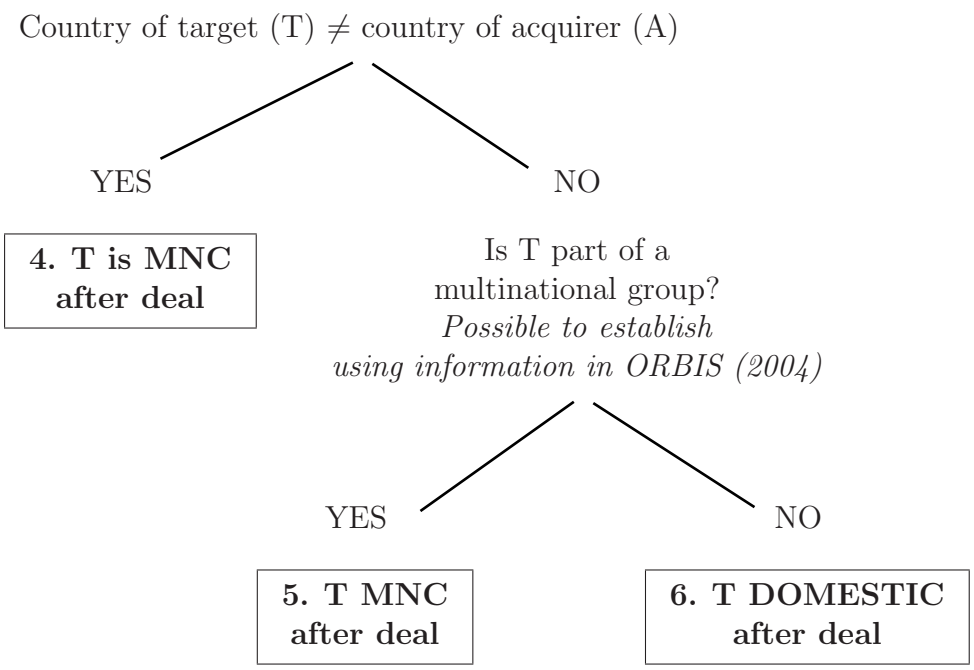


ZEPHYR-Acquirers

The second dataset contains deals in which the acquirers are located in Belgium, the Czech Republic, Finland, France, United Kingdom, Norway, Poland, Spain, and Sweden. For a description of the dataset, see Table B.8.

For the acquirers in ZEPHYR, it is hard to establish their ownership status before the deal because there is no information on the ownership structure before 2004. We can only identify two cases. First, when the acquirer is classified as a domestic entity in ORBIS in 2004, by acquiring the firm the same company could have only been domestic before the deal. Second, when the acquirer is classified as multina-

Figure B.2: How to Identify the Ownership After a Deal Occurred (ZEPHYR targets)



tional in ORBIS and at the same time it acquires a company located in the same country, it must have been multinational before the deal. For the acquirers classified as multinationals in 2004, and buying a foreign subsidiary, it is not possible to identify their ownership status before the M&A operation. They could have been domestic and become multinational purely through the acquisition recorded in ZEPHYR[9] or they could have already been part of an international group. In terms of Table B.4, we are only able to identify some of the elements of the main diagonal. We could make a strong assumption. We could assume that the foreign subsidiary acquired is the only foreign subsidiary of the group. This would mean that the acquirer was a domestic entity before the deal and that it has become a multinational entity only because of the acquisition recorded in ZEPHYR.

[9]This would in fact be the most interesting case for our analysis.

ZEPHYR-Vendors

The third dataset contains vendors involved in M&A operations between 1998 and 2004 and located in Belgium, the Czech Republic, Finland, France, United Kingdom, Norway, Poland, Spain, and Sweden. For a description of the dataset, see Table B.9.

If a company in ORBIS is also available in ZEPHYR as the vendor, we can easily establish its multinational status before the deal when the country of the target is different from the country of the vendor (see Box 7 of Figure B.3). In this case, the vendor was a multinational before the deal. After the deal, it can either remain part of a multinational group or become a domestic entity if the sold subsidiary was its only foreign subsidiary. We can distinguish between those two cases employing the ORBIS ownership structure for 2004. Problems arise when the countries of the vendor and of the target are the same. As shown in B.3, we are unable to distinguish between Box 8 and Box 9 as we do not have information on the ownership structure of the vendor and of the target before 2004. Even if the target is located in the same country as the vendor, we cannot identify the latter as part of a domestic entity before the deal. If the target had foreign subsidiaries, the vendor would be part of a multinational group before the M&A operation.

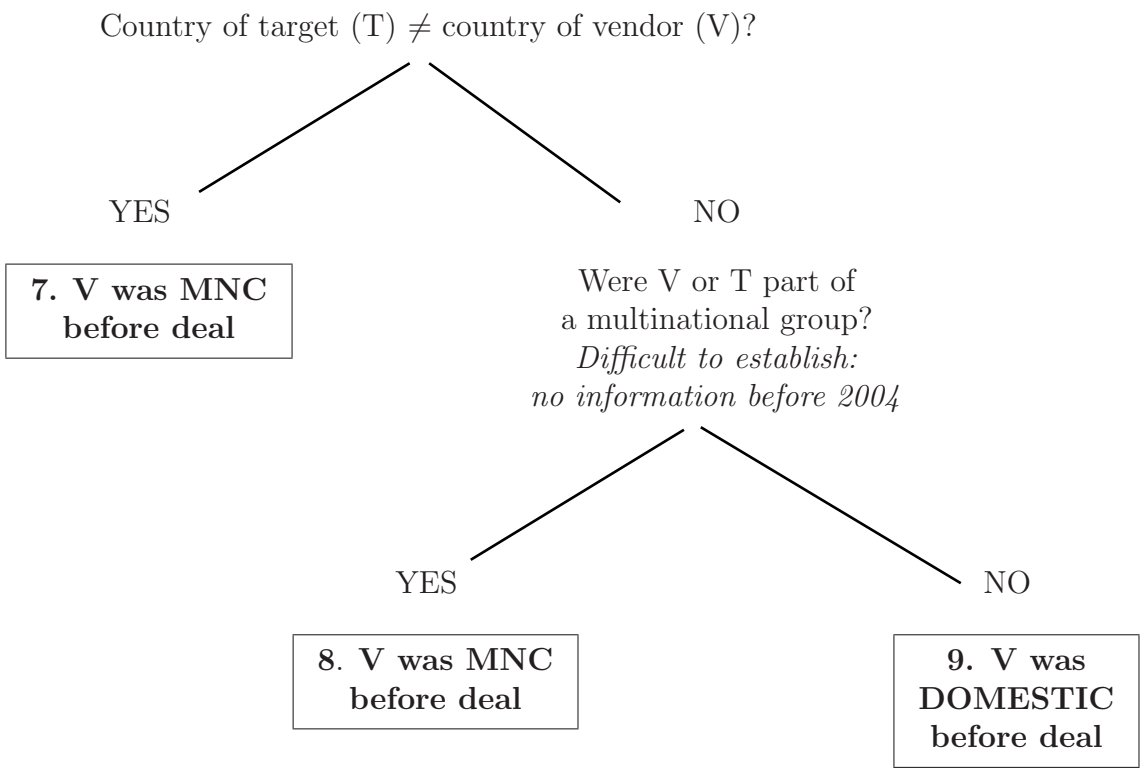
In summary, when a company is involved in M&A operations as a vendor, we can identify the third row of Table B.5. We are able to identify some of the vendors which were part of a multinational group before the deal[10]. Unfortunately, because of the lack of information before 2004, we are unable to identify multinational companies which become domestic by selling domestic subsidiaries with foreign operations.

As for the targets dataset, we could make an assumption. When the target and

[10]This refers to the vendors which sell a foreign subsidiary, but not to the vendors which sell a target located in their country but with foreign subsidiaries.

the vendor are resident in the same country, we could consider the latter as being domestic before the deal occurred (see Table B.9).

Figure B.3: How to Identify the Ownership Before a Deal Occurred (ZEPHYR vendors)



Merging ZEPHYR with ORBIS

We merge the three datasets downloaded from ZEPHYR with ORBIS in order to create a changing ownership dummy. Tables B.2 to B.10 describe some of the characteristics of the new dataset. Table B.11 summarises all the changes in the ownership structure that we are able to classify, including those identified through the assumptions outlined in the paragraphs above and summarised below[11]:

1. TARGETS dataset. When the target and the vendor are resident in the same country, we consider the former as being domestic before the deal occurred (see Table B.7).

2. ACQUIRERS dataset. The foreign subsidiary acquired is the only foreign subsidiary of what is classified in ORBIS as an international group in 2004. This means that the acquirer was a domestic entity before the deal and that it has become a multinational entity with the acquisition recorded in ZEPHYR (see Table B.8).

3. VENDORS dataset. When the target and the vendor are resident in the same country and the vendor is recorded as a domestic company in ORBIS, we consider the latter as being domestic before the deal occurred (see Table B.9).

[11]Overall the changes classified using the aforementioned assumption are 119, about 28 per cent of the observations included reported in ZEPHYR and 0.14 per cent of the whole sample.

Table B.1: Creation of the Sample

Steps	Firms	Observations
Starting sample	931,324	12,107,212
Keep only unconsolidated data	809,715	10,526,295
Drop if variable requirements not met$^{(i)}$	464,903	2,656,419
Drop long or short accounting periods	464,892	2,644,260
Drop accounting mistakes	462,862	2,588,187
Keep firms with known ownership status	120,243	697,303
Keep firms within the manufacturing sector	35,456	224,655
Drop if year$<$ 1998 and year = 2005	34,876	174,094
Drop host countries with small sample sizes	29,466	154,725
Create comparable sample in terms of size	23,498	109,641
Drop outliers	21,804	94,930
Keep firms with three consecutive years of observations	16,022	85,606

(i) We drop observations with EBIT, cost of employees, fixed assets and number of employees either missing or equal to zero. We also drop observations with the sum of the cost of employees plus EBIT either equal to or smaller than zero.

Table B.2: Country Distribution of Deals in ZEPHYR

Country	MNCs	Domestic groups	Stand-alones	Total	Per cent
Belgium	22	17	1	40	9.57%
Czech Republic	5	0	0	5	1.20
Finland	16	10	2	28	6.70
France	20	15	4	39	9.33
Italy	16	7	5	28	6.70
Norway	11	7	2	20	4.78
Poland	2	3	3	8	1.91
Spain	16	14	14	44	10.53
Sweden	22	23	0	45	10.77
United Kingdom	91	67	3	161	38.52
Total	221	163	34	418	100

Table B.3: Matrix for Changing Ownership Status –Targets

		After the deal	
		MNC	Domestic
Before the deal	MNC	PI; NPI(ii)	PI; NPI(ii)
	Domestic	NPI	NPI

(i) PI: possible to identify. NPI: not possible to identify without further assumptions. (ii) These cases are identifiable with certainty only if the country of vendor is different from the country of target. If the country is the same, we cannot decide whether the vendor was really domestic or part of an international group. We flag these unidentifiable cases with NPI.

Table B.4: Matrix for Changing Ownership Status –Acquirers

		After the deal	
		MNC	Domestic
Before the deal	MNC	PI; NPI(ii)	NPH
	Domestic	NPI	PI

(i) PI: possible to identify. NPI: not possible to identify without further assumptions. NPH: not possible to happen. (ii) These cases are identifiable with certainty only if the country of acquirer is the same as the country of target. We flag these unidentifiable cases with NPI.

Table B.5: Matrix for Changing Ownership Status –Vendors

		After the deal	
		MNC	Domestic
Before the deal	MNC	PI	PI; NPI(ii)
	Domestic	NPH	NPI

(i) PI: possible to identify. NPI: not possible to identify without further assumptions. NPH: not possible to happen. (ii) These cases are identifiable with certainty only if the country of vendor is different from the country of target. We flag these unidentifiable cases with NPI.

Table B.6: Year Distribution of Deals in ZEPHYR

Year	MNCs	Domestic	Stand-alones	Total	Per cent
1998	9	3	0	12	2.87
1999	9	5	0	14	3.35
2000	11	6	2	19	4.55
2001	13	9	0	22	5.26
2002	52	56	14	122	29.19
2003	56	39	9	104	24.88
2004	71	45	9	125	29.90
Total	221	163	34	418	100

Table B.7: ZEPHYR –Targets Dataset

	Deals	Firms	Observations
M&As only	276,562		
Targets in 9 countries(i)	80,504		
Time: 1998-2004	42,034		
Min final stake 50%	23,738		
Completed deals only	21,891	NA	25,478
Drop if id missing	12,844	12,619	13,298
Time: 1998-2004(ii)	10,428	10,260	10,789
After merging with ORBIS	NA	249(iii)	256
- *no info on country of vendor*		*134*	*135*
- *MNC to MNC*		*24*	*24*
- *MNC to Domestic*		*12*	*12*
- *Domestic to MNC*(iv)		*38*	*40*
- *Domestic to Domestic*(iv)		*44*	*45*

(i) Countries are the same as in the regression sample: Belgium, the Czech Republic, Finland, France, United Kingdom, Italy, Norway, Poland, Spain, and Sweden. (ii) Although we have already selected years in Zephyr, the download from the website is not precise. Therefore, in STATA we have to drop some observations left before 1998 or after 2005. (iii) The numbers below do not add up to 249 but to 252, as the same company might report the country of the vendor in one deal and not report it in another one. (iv) These observations were identified using the following assumption: when the country of the target and of the vendor are the same, the target is considered as domestic before the deal.

Table B.8: ZEPHYR –Acquirers Dataset

Acquirers in Zephyr			
	Deals	Firms	Observations
M&As only	276,562		
Acquirers in 9 countries(i)	78,215		
Time: 1998-2004	40,913		
Min final stake 50%	22,930		
Completed deals only	21,541	NA	24,898
Drop if id missing	18,031	10,095	18,322
Time: 1998-2004(ii)	14,927	8,724	15,172
After merging with ORBIS	NA	130	136
- *no info on country of target*		*2*	*2*
- *MNC to MNC*		*42*	*44*
- *Domestic to MNC*(iii)		*16*	*17*
- *Domestic to Domestic*		*70*	*73*

(i) Countries are the same as in the regression sample: Belgium, the Czech Republic, Finland, France, United Kingdom, Italy, Norway, Poland, Spain, and Sweden. (ii) Although we have already selected years in Zephyr, the download from the website is not precise. Therefore, in STATA we have to drop some observations left before 1998 or after 2005. (iii) These observations have been identified assuming that the foreign subsidiary bought in the deal has made a domestic company become part of a multinational group. This assumption is likely not to hold for many cases.

Table B.9: ZEPHYR –Vendors Dataset

Vendors in Zephyr			
	Deals	Firms	Observations
M&As only	276,562		
Vendors in 9 countries(i)	36,424		
Time: 1998-2004	18,303		
Min final stake 50%	10,459		
Completed deals only	9,399	NA	12,701
Drop if id missing	6,824	4,781	7,837
Time: 1998-2004(ii)	5,674	4,101	4,989
After merging with ORBIS	NA	32	32
- *no info on country of target*		*0*	*0*
- *MNC to MNC*		*14*	*14*
- *MNC to Domestic*		*1*	*1*
- *Domestic to Domestic*(iii)		*17*	*17*

(i) Countries are the same as in the regression sample: Belgium, the Czech Republic, Finland, France, United Kingdom, Italy, Norway, Poland, Spain, and Sweden. (ii) Although we have already selected years in Zephyr, the download from the website is not precise. Therefore, in STATA we have to drop some observations left before 1998 or after 2005. (iii) These observations were identified using the following assumption: when the country of the target and of the vendor are the same, the vendor is considered as domestic before the deal.

Table B.10: Firms with at Least One Observation in ZEPHYR

Companies with information in Zephyr				
		as Target	as Acquirer	as Vendor
MNCs	213 (3.64%)	144	59	14
Domestic groups	152 (3.05%)	83	62	16
Stand-alones	33 (0.64%)	22	9	2
TOTAL	398 (2.49%)	249	130	32

(i) Percentages of entire sample in parentheses. (ii) The last three columns do not always add up to the second one as companies might act as target, acquirer, and vendor across years.

Table B.11: Changes in Ownership –Observations (Number of Companies)

		After the deal		
		MNC	Domestic	TOTAL
Before the deal	MNC	81 (79)	13 (13)	94 (92)
	Domestic	57 (54)	135 (126)	192 (180)
	TOTAL	138 (133)	148 (139)	286 (272)

(i) The observations in the fourth row were identified using the following assumption: when the country of the target and of the vendor are the same, the firms are considered to be domestic before the deal.

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