# Corporate Taxation, Multinational Firms and Heterogeneity

Inauguraldissertation

zur

Erlangung des Doktorgrades

der

Wirtschafts- und Sozialwissenschaftlichen Fakultät

der

Universität zu Köln

2007

vorgelegt

von

Dipl.-Volksw. Johannes Becker

aus Münster (Westf.)

Referent: Prof. Dr. Clemens Fuest

Korreferent: Prof. Dr. Wolfgang Kitterer

Tag der Promotion: 8. Februar 2008

# Contents

# Chapter 1

# Introduction

## 1.1 Motivation and key questions

More than twenty years ago, public finance scholars started to focus on the phenomenon of international capital mobility and its consequences for public goods provision by national governments. The tax competition literature found considerable response in the political arena since it picked up some growing concern about the increasing limitations of the national state's scope for action. Since then, the economy, tax policy and the scholarly thinking about these two have evolved. In 1986, when some of the seminal tax competition papers were published, the worldwide net inflows of foreign direct investment amounted to around 90 billion US dollars and stocks reached a level of 940 billion dollars, whereas twenty years later, in 2006, investment flows and stocks reached a record level of 1.3 trillion and 12 trillion dollars, respectively, see UNCTAD (2007).[1] What was a newly perceived phenomenon back then in 1986, is long an omnipresent issue in the public debate. Meanwhile, public finance scholars have started to evaluate their theoretical predictions. In short, some of them turned out to be correct, others failed. The obvious mismatch of theories and empirical evidence in some cases triggered a second wave of tax competition papers, which sets out to reconcile international tax theory and the evidence. This book is part of this research program.

[1] Precisely, the investment flows reached their second highest level in history after the year 2000, while foreign held stocks were never higher than in 2006.

The theory was correct in predicting decreasing statutory corporate tax rates and a rising degree of multinational ownership structures. A race to the bottom, i.e. zero corporate tax rates, did not occur, though. The theory does not fit the data with regard to tax payments on corporate profits which remained stable over the last two decades. Furthermore, it cannot explain why governments broadened the tax base although a narrowing would help a country to immunize itself against international tax competition pressure. Finally, it may appear puzzling that even high-tax countries keep attracting substantial amounts of inbound FDI.

In this book, we consider firm heterogeneity as a possible explanation for some of these puzzles. A large part of the tax competition literature is (implicitly) based on the concept of homogeneous firms, i.e. taxation affects firms identically, or differences in their exposure to taxation are not relevant for the model predictions. In parallel to the International Economics branch, firm heterogeneity becomes more important, and it will be shown in the following, that the introduction of certain differences between firms requires considerable modifications of the standard theory and its predictions.

In the remainder of this first introductory chapter, we will proceed as follows. In the next subchapter, we will briefly lay the conceptual foundations of the subsequent chapters. Then, in subchapter 1.3, we will contextualize the different chapters and summarize their main results.

## 1.2 Some conceptual foundations

### 1.2.1 Source-based taxation in small open economies

This book concentrates on a set of policy instruments which affect income where it is generated, i.e. at source. The standard issue with source-based taxation has firstly been discussed in Zodrow and Mieszkowski (1986) and Wilson (1986)[2] and can be described as follows. Small open economies are supposed to face a perfectly elastic capital supply. This has the convenient implication for workers, or any other residual claimant, that capital cannot earn any rent since all domestic capital can

[2]Note, though, that these two contributions build on the important work by Tiebout (1956) and Oates (1972).

be replaced by foreign capital. However, as it is known from the theory of tax incidence, taxes on factors under perfect competition will be shifted forward by increased prices and/or higher factor remuneration. In a simple setting with just two production factors, labor and capital, this means that labor bears the whole tax burden on capital - and even some additional burden. This excess burden of source-based capital taxation results from the decreased stock of capital in the small open economy which translates into lower wages. Therefore, Gordon (1986) states that, even if alternative tax instruments, like wage taxes or residence-based taxes on savings, are distortive, the optimal tax system for small open economies implies zero source-based taxation of capital.

From a welfare point of view, there is no detrimental effect of capital mobility on welfare provided there are no restrictions on the use of available tax instruments and no redistributive objectives. However, if the number of tax instruments is limited or if source-based taxes on capital are used to redistribute from capital income to labor, capital mobility (i.e. the transition from a closed economy to an open economy) may have negative welfare effects which have to be weighed against the positive effects from better resource allocation.

For purpose of illustration, assume that source-based capital taxes are the only policy instrument available to attain either of the policy goals. In case of redistributive aims, perfect mobility of capital simply means that redistribution is not possible. The whole tax burden on capital is finally born by workers. In case of public goods provision, capital mobility leads to an underprovision of public goods. The benevolent government accounts for the efficiency cost of capital taxation and lowers the quantity of the publicly provided good until marginal benefit equals (the increased) marginal cost.

Both motivations for taxation, redistribution and public goods provision, imply that uncoordinated policies lead to inefficient outcomes. Welfare can be enhanced, if the governments of the small countries agree on policy coordination and increase the source-based (effective) tax rates on capital.

Of course, there are qualifications to this standard result of tax competition and the large number of tax competition papers reflect that their number is large. This implies asymmetries between countries, see Bucovetsky (1991), the existence of pure profits and the inability to fully tax them, see Zodrow and Mieszkowski

(1986), the availability of more tax instruments, see Bucovetsky and Wilson (1991), foreign firm ownership, see Huizinga and Nielsen (1997), and so on.

A more general caveat is that the standard results are built on the assumption that firms are all identical, at least from a tax perspective. As heterogeneity is in the center focus of this book, it is worth discussing it in more detail.

### 1.2.2 Firm heterogeneity

Heterogeneity as a concept is hard to capture since whatever dimension is considered, heterogeneity is possible and plausible. From this point of view, this book gives only examples of heterogeneity and illustrates the impact of introducing some kind of heterogeneity into the standard model. Two exclusion restrictions apply: Firstly, in order to be relevant, the heterogeneity in the aspect under consideration has to be systematically linked to some other observable feature of the firm. Secondly, the source of heterogeneity has to be tax relevant. In chapter 2, firm heterogeneity with regard to mobility *and* profitability is considered. Profitability is here equivalent to the size of the tax base. Chapter 3 introduces feedback effects of *foreign* investment on *domestic* profitability and is based on the assumption that firms or projects differ in the strength of feedback effects. These feedback effects determine the location of the tax base. Chapter 4 analyzes MNEs with differences in their access to tax havens, i.e. there is heterogeneity in the opportunities to manipulate the tax base. In chapters 5 and 6, heterogeneity in the exposure to foreign tax rate changes due to complementarities within the multinational firm is considered. Whereas in chapter 5, heterogeneity in ownership is considered, i.e. affiliates are analyzed which differ in the country of their headquarters, in chapter 6, the difference between multinational firms (MNE) and purely national firms (PNE) is analyzed.

Being a multinational or not is one of the obvious sources of firm heterogeneity and therefore deserves some more attention. From a public finance point of view, MNEs and PNEs differ in the way they are taxed. MNE may have foreign income which is subject to domestic repatriation taxes. If held by foreigners, MNE income may be subject to withholding taxes. Moreover, it is generally assumed that tax avoidance opportunities differ between MNEs and PNEs. MNEs may shift

profits to low-tax jurisdictions or tax havens, they may have better access to credit markets which has tax consequences, too, etc. Since multinational firms play such a central role in this book, the next subchapter deals with this kind of firm in more depth.

### 1.2.3 FDI and multinational firms

According to Markusen (2002), multinational enterprises are

> *firms that engage in foreign direct investment (FDI), defined as investments in which the firm acquires a substantial controlling interest in a foreign firm or sets up a subsidiary in a foreign country.* (p. 5)

Why are there multinational firms?[3] As Gordon and Hines (2002) state, there are three different lines along which the existence of MNEs may be explained.

Firstly, MNEs can be interpreted simply as vehicles for domestic households to invest abroad. In this case, investment via MNEs and via an international portfolio capital system organized by banks are a priori equivalent. Investors will prefer investing abroad through multinationals rather than through the banking system if the transaction costs of doing so are lower, if the relative tax treatment is advantageous or if multinationals have a comparative advantage in placing the most profitable investments.

Secondly, MNEs serve as instruments to exploit international tax avoidance opportunities. As the empirical literature shows, there is extensive profit-shifting activities by multinationals, an observation which will be intensively discussed in this book. Profit shifting may be achieved by transfer-pricing, the tax-induced choice of interest and royalty rates used for transactions between related parties, substitution between debt and equity finance, and careful consideration of where to locate investments with expected supernormal profits.

[3] This question is necessarily related to the question why are there firms with which a large literature deals. Starting with Coase (1937) who emphasizes that there is always the market as an alternative to organization through the firm, this literature stresses the importance of transaction costs, i.e. the costs involved using the markets, as well as problems of asymmetric information which translate in free-rider problems and monitoring costs, see Alchian and Demsetz (1972) and Holmstrom and Tirole (1989).

Thirdly, MNEs own intangible capital in the form of unique technologies or products, which they can profitably exploit in foreign countries. In principle, this could alternatively achieved by selling the right to use the technology or to sell the products, but - as Gordon and Hines (2002) state - this is effectively limited by problems of asymmetric information.

One could add a fourth explanation which is related to complex production structures. MNEs can disentangle the production chain in order to exploit international differences in location-specific cost structures. The MNE could locate the skill-intensive parts of production in countries where this production factor is relatively cheap and the labor-intensive part of production elsewhere. Seen from this perspective, MNEs promote the international division of labor without losing the advantages of internalization within a firm.

After having laid some conceptual foundations, we now turn to set out the agenda for this book.

## 1.3 The agenda

In the following, we will briefly summarize the content of the following five chapters and sketch the methods used as well as the main results. Chapter 7 will briefly draw conclusions.

### 1.3.1 Chapter 2: Mobility and profitability

Standard tax theory says that, in the presence of pure profits, corporate taxes do not need to be zero, but the marginal investment project should not be taxed. The analysis starts with a reconsideration of this benchmark result which is confronted with the empirical fact that depreciation allowances in developed countries are increasingly restricted which c.p. increases the taxation of the marginal investment. This trend is commonly called *tax rate cut cum base broadening*. We build a model with internationally mobile firms which differ in mobility and profitability. It can be shown that *tax rate cut cum base broadening* is an optimal tax policy if highly mobile firms are more profitable than the average firm in the economy. The reason is that, due to a lack of discriminating instruments, the broadening of the tax base

is used to distribute the tax burden from the highly mobile to the less mobile firms. Thus, the introduction of heterogeneity with respect to mobility and profitability - and the assumption, that both are systematically linked -, changes the standard result of tax theory.

### 1.3.2 Chapter 3: Feedback effects

This chapter departs from the theoretically derived expectation that taxes should lower the quantity of investment. There is a number of papers providing evidence that this is actually the case, but it seems nevertheless puzzling that high-tax countries, like Germany, still receive substantial amounts of inbound FDI. The general view on this observation is that other locational factors compensate the tax disadvantage; in other words, high-tax countries receive investment *despite of* high taxes. The main argument of this chapter implies that this could be true *because of* high taxes. It is based on a model in which foreign investment has some kind of feedback effect on domestic activities or profits. If foreign investment affects domestic profits, domestic taxes become a determinant of foreign investment. If domestic profits are increased, domestic taxes deter foreign investment, and if domestic profits are reduced (e.g. by cost increases), domestic taxes make investment abroad more attractive. In the model, we assume that firms can replace projects with certain feedback effects by others. Then, taxes affect the quality, not just the quantity of investment. Put simply, high-tax countries attract projects with small profits generated in their jurisdiction whereas low-tax countries receive highly profitable investment. This result has considerable consequences for the thinking about welfare effects of taxes. Firstly, the introduction of the quality notion implies that not all types of investment are equally welcome. Secondly, if taxes distort the quality of investment not only the quantity, the excess burden of taxation may be mismeasured by empirical studies, and our results imply that it is underestimated.

### 1.3.3 Chapter 4: Heterogeneous profit-shifting

If tax rates cannot be changed due to political constraints, e.g. if the jurisdiction is part of a union with harmonized tax rates, tax enforcement can be used as

a strategic instrument to attract mobile capital or firms. In such a setting, tax enforcement will be too low, as a benchmark result in the theoretical literature states. In this chapter, we build a model with heterogeneous multinational firms which differ in their access to tax havens. The benchmark result of underenforcement occurs if the multinational firm with tax haven access has a substantially larger tax base than the other firm which is supposed to have no access to tax havens. The main contribution of this chapter is to analyze the case in which the opposite is true, i.e. the non-haven-related firm has a larger tax base. As expected, the incentive to underenforce vanishes. Interestingly, under certain circumstances, governments even have the incentive to increase the enforcement level beyond the efficient threshold. The reason is that governments may want to deter investment by the haven-related multinational when these projects are replaced by non-haven-related projects. The enforcement level will be inefficiently high because an individual government does not take into account that enforcement increases the detrimental investment activity by the haven-related firm in the other country. Coordination of enforcement policies would then imply a reduction in overall enforcement expenditures.

### 1.3.4 Chapter 5: Tax effects on multinational firms

Public concerns with respect to increasing capital and firm mobility are based on the (implicit) assumption that foreign investment is a substitute for domestic investment. Chapter 5 starts from the observation reported in recent empirical contributions that foreign investment does not reduce domestic investment within a multinational firm, it rather increases it. If this is the case, then foreign and domestic activity or investment are not substitutes but rather complements. This may have important consequences for the thinking about international tax issues. Using a large firm-level dataset, we find that tax reforms in the headquarter countries affect affiliates in the same way they are supposed to affect the headquarter activity. That means, increasing corporate tax rates reduce the capital stocks in the foreign affiliates. This runs counter to the well-known externality due to profit-shifting. We find that complementarities compensate the positive externality due to profit-shifting to about one third.

### 1.3.5 Chapter 6: Multinationals and tax competition

The observation that domestic and foreign investment are complements rather than substitutes within a multinational firm is obviously at odds with the finding in aggregate data that foreign investment decreases domestic investment dollar for dollar. If domestic investment increases in response to foreign investment, some firm somewhere has to reduce investment if capital supply is not perfectly elastic. To analyze this aspect, we build a model where headquarter and affiliate production are complements. As has already been shown in the literature, complementarities c.p. may give rise to overtaxation. The contribution of this chapter is to show that if the capital market equilibrium is endogenized, complementarities never lead to overtaxation. But, the existence of multinational firms in which foreign and domestic capital stocks are complements mitigates the pressure from tax competition. The higher the fraction of multinational firms in the model economy, the higher are uncoordinated equilibrium tax rates.

# Chapter 2

# Mobility and profitability

*In this chapter, the implications of international firm mobility for optimal tax policy is considered. A benchmark result from the literature suggests that investment should not be taxed at the margin. Introducing heterogeneity in mobility and profitability, it is shown that taxation or subsidization of the marginal investment project may be an optimal tax policy response if the mobile firm's profitability differs from the average one's in the economy.*[1]

## 2.1 Introduction

Standard optimal tax theory recommends that small open economies should not impose source-based taxes on the normal return to capital if capital is internationally mobile, see Gordon (1986) and Sinn (1990). If capital is taxed at source, investment is distorted and national welfare declines. The literature has therefore proposed a whole class of investment-neutral tax systems in which (pure) profits can be taxed without distorting the investment decision. The main characteristic of these investment-neutral corporate tax systems is that tax payments are zero if the project return merely equals the cost of capital. In technical terms, the present value of depreciation allowances (PVDA) is equal to 100% of the purchase price of the capital good.[2]

[1] This chapter is based on Becker and Fuest (2007a).

[2] Under residence based taxation of capital income, investment neutrality requires tax depreciation to equal economic depreciation. We focus on source based tax systems as does a large

In 1982, the unweighted average of the PVDA for an investment in plant and machinery across a large number of OECD countries was 81%, the PVDA for industrial buildings 48% (Devereux, Griffith and Klemm (2002)). With the exception of Ireland, no country allowed for immediate depreciation or an equivalent in present value terms, i.e. a PVDA of 100% . Since then, the opening of capital markets and increasing economic integration among these countries should have increased the cost of distorting investment. In sum, we should have expected countries to reform their tax system lowering the taxation of the normal return, i.e. increasing the PVDA.

But, empirical observations do not support the view that governments pursued this kind of tax policy strategy. Twenty-one years later, in 2003, the unweighted average of the PVDA has dropped to 75% for plant and machinery and to 33% for industrial buildings. This means that, on average, countries seem to have taken the opposite direction of what standard optimal tax theory suggests.

In this chapter, we present an argument which contributes to explaining this empirically observable development as part of an optimal tax policy. In the presence of mobile firms, it may be optimal under certain circumstances to distort investment when this allows to reduce statutory tax rates, i.e. to pursue a *tax rate cut cum base broadening* strategy.

Using the Corporate Tax Data Base provided by the Institute for Fiscal Studies (IFS) and described and analyzed in Devereux et al. (2002), figure 2-1 depicts each change in the statutory tax rates and the PVDA of the OECD countries enumerated in footnote 2 in the years 1982-2003. The $x$-axis measures changes of the tax rate, the $y$-axis the variation in the tax base. Data points which are not on the axes present a simultaneous change of the tax rate and the tax base. Thus, we get four quadrants among which two are (potentially) revenue-neutral, because the variation of one tax parameter is "financed" by the variation of the other one. In addition, as long as the tax system is on the increasing part of the Laffer curve, tax reforms in quadrant II are clearly revenue-decreasing and those in quadrant IV are revenue-increasing.

---

part of the literature on international taxation because residence based taxes are difficult to implement.

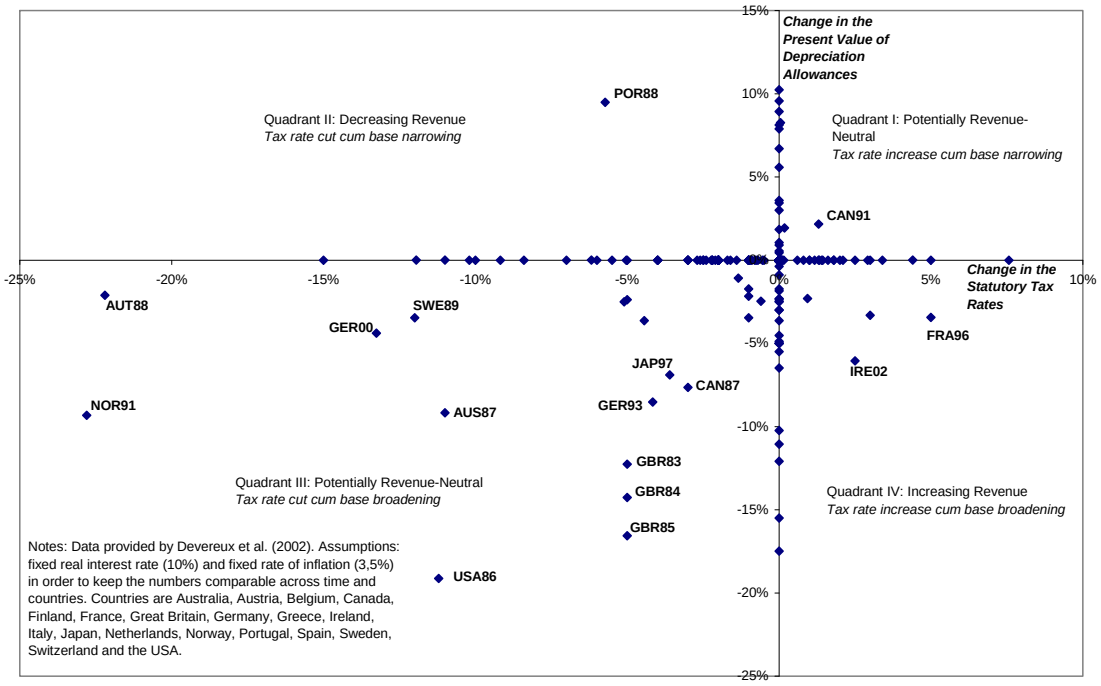


Figure 2-1 - Tax reforms in different OECD countries 1982-2003

As the figure shows, most tax policy reforms consist of a variation of either the tax rate or the tax base, i.e. the data points are located on the axes. Among the tax reforms which changed the tax rate and the tax base at the same time, only the Canadian tax reform of 1991 followed the pattern predicted by the standard theory; however, it just reversed the reform of 1990 to the same extent and may therefore be interpreted as a mere correction. The only country to implement a revenue decreasing tax reform of both the tax rate and base is Portugal in 1988, whereas the United States (1992), Finland (1995), France (1996) and Ireland (2002) implemented revenue increasing tax reforms (quadrant IV).

Most tax reforms which changed tax rate and base simultaneously were of the *tax rate cut cum base broadening* kind. Among those are tax reforms in Great Britain, Germany and Japan, and - probably known best - the US tax reform of 1986. It is striking that even the larger countries, which could be expected to be relatively autonomous in their tax policy, pursued this kind of strategy. The question of how this development can be explained arises. There are basically two approaches to explain this trend.

A first approach is based on the idea of 'policy learning', which is extensively discussed in the political science literature (see e.g. Steinmo (2003) and Swank and Steinmo (2002)): Inspired by the fundamental reforms in Great Britain and the US, policymakers around the world followed their example and adjusted their tax system to the new model (e.g. see Whalley (1990) and Gordon (1992)). The underlying assumption is that policymakers do not have an explicit model of the economy in mind and no clear efficiency goals, but they do observe other policymakers and try to copy their strategies when they observe successful ones.[3] The US tax reform of 1986 was considered to be a success in historic dimensions and could have triggered similar reforms in other countries (see diagram 1).

The second approach explains *tax rate cut cum base broadening* policy as an optimal response to a changing economic environment. Within this approach, Devereux et al. (2002) identify two possible reasons: income shifting and the presence of highly profitable multinational firms. Income shifting is analyzed by Haufler and Schjelderup (2000) who show that, if multinational firms earn supernormal profits and if the shifting of these profits to low tax countries via transfer pricing is possible, it is optimal to reduce tax rates and broaden tax bases, despite the distortion of investment caused by this policy. Fuest and Hemmelgarn (2005) show that a *tax rate cut cum base broadening* policy may be optimal in the presence of income shifting through thin capitalization even if there are no pure profits. The second argument is first provided by Bond (2000) who proposes to interpret the *tax rate cut cum base broadening* to be the optimal tax policy reaction to the existence of mobile and highly profitable firms. Without using a formal model, he suggests a setting in which multinational companies are assumed to be very sensitive to the effective *average* tax rate whereas investment by immobile firms is relatively insensitive to the effective *marginal* tax rate. Bond concludes that a government then might increase domestic investment by lowering the statutory tax rate and accepting a broader tax base, even though this results in a higher cost of capital.

In this chapter, we contribute to the second approach to explaining the trend

[3] Another aspect here is that the US was an important supplier of foreign direct investment at the time. The foreign tax credit system enables the host country to increase tax rates on US multinationals up to the US statutory rate without increasing the effective tax rate for these firms. When the US lowered the tax rates fundamentally, other countries were forced to do the same if they did not want to push the US firms out of the country (Slemrod (2004a)).

towards low tax rates and broad tax bases. Surprisingly, the literature on optimal corporate tax policy in the presence of internationally mobile firms is very small. Of course, firm mobility as such has been extensively analyzed in the literature on foreign direct investment (Lipsey (2001)) and the new economic geography (see Ottaviano and Thisse (2003) for a survey). There are also several contributions analyzing intergovernmental competition in corporate tax rates[4] with firm mobility (Richter and Wellisch (1996), Boadway, Cuff and Marceau (2002), Fuest (2005)). But, to the best of our knowledge, the only contribution which analyzes the optimal structure of the corporate tax system in the presence of firm mobility in a formal model is Osmundsen, Hagen and Schjelderup (1998). These authors consider a model where firms differ in mobility costs and tax policy is constrained by problems of asymmetric information. Their results and the relation to our analysis will be dicussed further in subchapter 2.4.

We analyze the optimal tax policy in the presence of mobile firms in a framework where firms differ in profitability and mobility costs. The government may use the tax base and the tax rate as policy parameters. In contrast to Osmundsen et al. (1998), the government cannot use nonlinear taxes to implement a separating equilibrium where firms reveal their type. Instead, a linear tax system is considered, which gives rise to a pooling equilibrium. We show that the mobility of firms across borders does create incentives for governments to deviate systematically from investment neutrality. The optimal policy depends on how profitable mobile firms are, relative to immobile firms. Essentially, changing the combination of tax rates and tax bases may be interpreted as a form of price discrimination. If the marginal mobile firm is more profitable than the average firm in the country, a *tax rate cut cum base broadening* policy is optimal. The reason is that this policy redistributes the tax burden from mobile to immobile firms. Thus, mobile firms can be prevented from leaving the country without sacrificing too much tax revenue. But if the marginal mobile firm is less profitable than the average firm in the economy, a *tax rate cut cum base broadening* policy reduces welfare. In this case, the optimal tax policy consists of subsidizing the normal return to capital and increasing the statutory tax rate.

The remainder of the chapter is organized as follows: In subchapter 2.2, we

[4]See Wilson and Wildasin (2004) for a survey of general tax competition issues.

present our argument in the framework of a stylized model. Subchapter 2.3 discusses some extensions. In 2.4 we discuss how our results relate to the findings in the literature and conclude.

## 2.2 The model

In this subchapter, we present the model and the main argument of this chapter. Firstly, we discuss the meaning of and the relationship between mobility and profitability (2.2.1), then we outline the precise setting of the model (2.2.2). In 2.2.3 the optimal tax policy in the presence of mobile firms is derived.

### 2.2.1 Mobility and profitability

Consider an economy with a large number of heterogeneous profit-maximizing firms. These firms differ in two characteristics, profitability and mobility. Profitability is defined as the average return per unit of capital input. Mobility means the opportunity to relocate to the foreign country. Whereas it is easy to understand the difference between more and less profitable firms, it is necessary to discuss the meaning of higher and lower mobility in greater detail.

Mobile firms are those for which a change of location has a relatively low cost. With $\pi$ and $\pi^*$ denoting the after tax profits at home and abroad, respectively, a relevant indicator of mobility could be the difference $\pi - \pi^*$. Firms with a high difference between these two profit indicators will be called immobile. This is true in both directions, i.e. firms which have a much higher profit when producing abroad are not mobile either. In contrast, firms where the difference $\pi - \pi^*$ approaches zero are those which may react to policy measures like tax reforms by changing their location. Those will be called mobile.

For the purpose of our argument, it is helpful to introduce the parameter $A$ which is an indicator of the profit difference $\pi - \pi^*$. Each firm is characterized by an individual value of $A$ defined by

$$\frac{\partial (\pi - \pi^*)}{\partial A} < 0 \tag{2.1}$$

For simplicity, we assume that $A$ is uniformly distributed over the interval $\{A^-, A^+\}$.[5] It is crucial to understand that this does neither imply that $A$ also correlates with profit itself ($\frac{\partial \pi}{\partial A} \lesseqgtr 0$) nor that $A$ is necessarily correlated with profitability ($\frac{\partial(\pi/K)}{\partial A} \lesseqgtr 0$). Figure 2-2 gives an example which illustrates how mobility and profitability could be linked. With $A$ on the x-axis, the profit-difference decreases continuously, which is given by definition of $A$. If any kind of policy is supposed to have an impact on the location decision of firms, there have to be firms which are indifferent between producing at home or abroad. Let $A^h$ denote the profitability parameter of this marginal firm:

$$\pi\left(A^h\right) = \pi^*\left(A^h\right) \tag{2.2}$$

The profitability of the firms in the economy can be positively or negatively correlated with $A$ or not at all. In the figure, mobile firms, i.e. those located around $A^h$ (the intersection of $\pi - \pi^* = 0$), have a higher profability than firms which are less mobile, which is illustrated by the "regression line". As will become clear later on, the profitability difference between these two, mobile and immobile firms, is crucial for our argument.

Immobile firms can be interpreted as companies which largely benefit from location specific advantages, e.g. coal mining companies. In contrast, mobile firms with intermediate values of $A$ are those which have large firm-specific advantages which are not lost when the location is changed.

A possible point of criticism is that we consider the firm's location decision as an all-or-nothing decision, i.e. the locations are mutually exclusive. Empirically, we rather observe multinational corporations with affiliates in more than one country. For the motivation of our approach, it is helpful to imagine an existing plant or production unit which can be relocated abroad. In the context of our model we call this plant or production unit 'firm'.

[5] The simplest example is $\pi = P$ and $\pi^* = P^* - \frac{1}{A}$, where profits $P$ and $P^*$ are assumed to depend on location. In this case, $A$ can be interpreted as the inverse of the moving cost. Another very simple example is $\pi = AP$ and $\pi^* = AP - G$, where profits $P$ are assumed to be equal in all locations and $G$ is some constant cost of relocation. The higher the $A$, the less important is the relocation cost $G$. Our model takes a more general form of profit function which comprises these examples as special cases, as is shown in the next subsection.

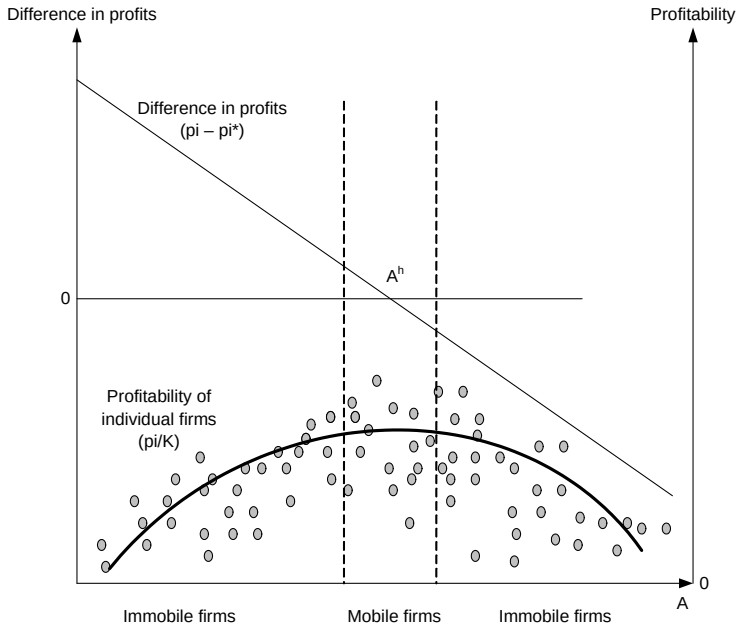


Figure 2-2 - Correlation between mobility and profitability

### 2.2.2 Firms

All firms are owned by domestic residents. Foreign firm ownership is discussed in the extensions in subchapter 2.3. Firms invest in capital $K$. Capital is provided by a world capital market at a given nontax cost of capital which is normalized to unity. Firms receive an income $F^i(K^i, A^i)$. The production technology $F^i$ differs across firms, which generates different levels of profitability, and is well-behaved ($F^i_{KK} < 0 < F^i_K$ and $F^i_A > 0$). In the following, we will suppress the firm-specific indices $i$ for a better reading. After-tax profits are:

$$\pi = (1-u)\,F(A,K) - (1-u\alpha)\,K \tag{2.3}$$

where $u$ is the statutory tax rate and $\alpha$ the rate of tax depreciation allowances. Here, we abstract from international profit-shifting e.g. by transfer pricing or internal debt, which will be analyzed in the extensions, subchapter 2.3.

Each firm faces a sequence of two decisions. At the first stage, the location decision is made, i.e. the firm chooses to locate either at home or abroad. At the second stage, the firm determines the optimal capital input.

Starting with the second stage, the optimal capital input is given by

$$\frac{\partial F(A)}{\partial K} = \frac{1-u\alpha}{1-u} \tag{2.4}$$

if the firm produces at home. Note that the functional form of $F$ determines whether or not the firm's optimal capital stock $K$ depends on $A$. If the firm produces abroad, its optimal investment is given by $\frac{\partial F^*(A)}{\partial K^*} = c^*$, where $c^*$ is the foreign capital cost.

Consider next the location decision at the first stage. The firm chooses the location where after tax profits are higher. The firm stays in the home country if and only if

$$(1-u)\,F(K,A) - (1-u\alpha)\,K \geq \pi^*(A) \tag{2.5}$$

It is assumed that the total number of firms is fixed in this model, i.e. we do not consider market exit of firms due to taxation. As is shown in the appendix, introducing market exit of firms in our model does not change any of our results.

### 2.2.3 Optimal tax policy with mobile firms

It is the purpose of this chapter to derive the optimal corporate tax policy of a small open economy[6] in the presence of mobile firms. We therefore assume that the government is benevolent and maximizes the welfare of its households, given the fixed public revenue constraint $T$ which is given by

$$T = \int_{A^-}^{A^h} u\,(F - \alpha K)\,dA \tag{2.6}$$

In the following, we consider variations in $u$ and $\alpha$ (e.g. a *tax rate cut cum base broadening* strategy) under the condition that $T$ remains constant. This is given by:

$$dT = T_u du + T_\alpha d\alpha = 0 \quad \Leftrightarrow \quad \frac{du}{d\alpha} = \frac{T_\alpha}{T_u} \tag{2.7}$$

First, consider the effect of a revenue-neutral variation on the profit of the

[6] Our assumption of a small open economy implies that we abstract from issues of strategic interaction between tax policies of different countries.

marginal firm (with mobility parameter $A^h$): Profits change by

$$d\pi^h = -\left(F^h\left(A^h, K^h\right) - \alpha K^h\right) du + uK^h d\alpha \tag{2.8}$$

Starting from a situation in which investment is not distorted, i.e. $\alpha = 1$, and using (2.7), it can easily be shown that an increase of $\alpha$ has the following effect on $\pi$ (see appendix):

$$\frac{d\pi^h}{d\alpha} = \Omega^p \left[\rho - \rho^h\right] \tag{2.9}$$

where $\Omega^p = \frac{uK^h}{T_u}\int_{A^-}^{A^h} KdA > 0$ is some scale parameter, $\rho = \frac{\int_{A^-}^{A^h}[F-K]dA}{\int_{A^-}^{A^h} KdA}$ and $\rho^h = \frac{F^h - K^h}{K^h}$. $\rho$ is the aggregate pre-tax profit generated in the domestic country divided by the aggregate capital stock. Thus, $\rho$ can be interpreted as the average profitability of firms located in the domestic country, where as $\rho^h$ is the profitabilty of the marginal firm. It follows from (2.9) that the marginal firm gains from a tax rate cut cum base broadening strategy ($d\alpha < 0$) if it is more profitable than the average of the whole economy. However, the fact that the marginal firm is better off with tax rate cut cum base broadening does not necessarily mean that such a reform is desirable from a social point of view. In the following, we therefore consider social welfare which we define as national income minus taxes (remember: there is a fixed tax revenue requirement).

Social welfare is given by

$$W = \int_{A^-}^{A^h} \left[(1-u)F - (1-u\alpha)K\right] dA + \int_{A^h}^{A^+} \pi^* dA \tag{2.10}$$

A variation in the tax rate $u$ and the tax base $\alpha$ has the following effect on social welfare:

$$dW = \left[\int_{A^-}^{A^h} -\left[F - \alpha K\right] dA\right] du + \left[\int_{A^-}^{A^h} uK dA\right] d\alpha \tag{2.11}$$

At the margin, a relocation of the $A^h$-firm has no impact on welfare because it is indifferent between producing at home or abroad. It has some effect on tax

revenue, though (see appendix).[7]

Again, we consider a tax revenue-neutral tax reform. This means that $u$ and $\alpha$ are changed according to (2.7). Starting from non-distortion of investment ($\alpha = 1$), it follows (after some rearrangements presented in the appendix):

$$\frac{dW}{d\alpha} = \Omega^s \left[\rho - \rho^h\right] \tag{2.12}$$

where $\Omega^s = -\frac{u^2}{T_u}\frac{\partial A^h}{\partial u}K^h \int_{A^-}^{A^h} KdA > 0$ and $\rho$,$\rho^h$ as defined above. The welfare effect of varying $\alpha$, evaluated at $\alpha = 1$, depends on whether the term in square brackets is positive or negative. To get the intuition, interpret the first term in the square brackets as the average return per unit of capital in the overall economy and the second term as the return per capital unit of the marginal firm. The findings derived in (2.12) can be summarized by

**Proposition 1** *Optimal tax policy in the presence of mobile firms depends on the profitability of the mobile firms relative to the rest of the economy. Precisely, optimal strategies are:*

***Non-distortion of investment*** *is optimal when mobility and profitability are not correlated:* $\rho - \rho^h = 0$ ($\frac{dW}{d\alpha} = 0$ *at* $\alpha = 1$).

***Tax rate cut cum base broadening*** *is optimal when mobility and profitability are positively correlated:* $\rho - \rho^h < 0$. ($\frac{dW}{d\alpha} < 0$ *at* $\alpha = 1$)

***Tax rate increase cum base narrowing*** *is optimal when mobility and profitability are negatively correlated:* $\rho - \rho^h > 0$. ($\frac{dW}{d\alpha} > 0$ *at* $\alpha = 1$)

Setting $\alpha = 1$ is an optimal strategy only if the marginal firm is as profitable as the average in the economy. However, if one assumes that the mobile firm is more profitable than the rest of the economy[8], as does Bond (2000), the term in square brackets as well as the whole RHS of equation (2.12) becomes negative. A

[7] For the same reason, we can abstract from firms which are driven out of the market. A marginal change in $u$ or $\alpha$ has no effect on $W$ because the marginal firm is just indifferent between producing and not producing. See also the appendix.

[8] In figure 2, the profitability spots of the immobile firms on the left hand side of the mobile firms area have to be lower on average than the spots of the mobile firms located around $A^h$. Note that the firms on the right hand side which have already left the domestic country are not part of the calculus.

reduction in the tax allowance $\alpha$, i.e. a broadening of the tax base, leads to a rise in welfare.

How can a distortion of investment lead to increasing welfare? By broadening the tax base and lowering the tax rate the government redistributes tax liabilities from the highly profitable firm to the less profitable firms. The reason is that highly profitable firms gain more from a tax rate cut than less profitable ones. The government can thus increase overall tax revenues without losing the mobile firm, i.e. it implements a form of price discriminiation. This comes at the cost of distorting the investment of all firms. But the welfare cost of introducing a small investment distortion, departing from an equilibrium with undistorted investment, is negligible. The optimal policy would equalize the marginal welfare loss resulting from the investment distortion to the marginal gain resulting from raising more tax revenue.

The opposite case is possible, too. Assume that the immobile firm is more profitable than the mobile firm. In this case, the government wants to redistribute tax liabilities from the less profitable firm to the more profitable one. It can do so by narrowing the tax base and increasing the tax rate, i.e. by subsidizing the marginal investment. Such a tax system hits the profitable and immobile firms harder than the non-profitable mobile ones. Essentially, deviations from investment neutrality may thus be understood as a form of price discrimination in a second best environment.[9]

## 2.3 Extensions

In this subchapter, we extend the model in two important dimensions. Firstly, we consider how profit-shifting affects our results (3.1) Secondly, we analyze the implications of foreign firm ownership (3.2).

[9] Note that the introduction of a progressive corporate tax system would not solve the problem since it is the difference in *profitability* which is decisive not the difference in the *absolute amounts of profits*.

### 2.3.1 Profit-shifting

It is interesting to ask how our results are related to those derived by Haufler and Schjelderup (2000), who focus on profit-shifting as an explanation for tax rate cut cum base broadening policies. Therefore we extend the model by the opportunity for firms to shift profits. Let $E$ denote the part of the profit which can be avoided and/or shifted to the foreign tax base. Let $C_i(E)$ denote the avoidance cost function for which we assume $C^i(0) = 0$ and $C^i_E, C^i_{EE} > 0$ which ensures an interior solution. We assume that the avoidance cost is not deductible from the tax base. From now on, we suppress the indices $i$ as we did before. The profit of the marginal firm is equal to

$$\pi^h = (1-u)F^h - (1-u\alpha)K^h + uE^h - C^h\left(E^h\right) = \pi^* \tag{2.13}$$

At the third stage of decision, the firm decides simultaneously on the optimal capital input $K$, which is not affected by the avoidance opportunity, and on the optimal avoidance level. Optimal avoidance is given by

$$u = C_E \tag{2.14}$$

Again, a revenue-neutral tax reform is considered. Tax revenue is now reduced by the shifted amount $E$:

$$T = \int_{A^-}^{A^h} \left[u\left(F - \alpha K - E\right)\right] dA \tag{2.15}$$

Social welfare is given by

$$W = \int_{A^-}^{A^h} \left[(1-u)F - (1-u\alpha)K + uE - C(E)\right] dA + \int_{A^h}^{A^+} \pi^* dA \tag{2.16}$$

Evaluated at $\alpha = 1$, an increase in $\alpha$ has the following effect on social welfare

$$\frac{dW}{d\alpha} = \Omega^s \left[\frac{\int_{A^-}^{A^h}\left[F - K - E\right] dA}{\int_{A^-}^{A^h} K dA} - \frac{F^h - K^h - E^h}{K^h}\right] - \Omega^E \left[\int_{A^-}^{A^h} \left[E_u\right] dA\right] \tag{2.17}$$

where $\Omega^s > 0$, as defined above, and $\Omega^E = \frac{u^2}{T_u} \int_{A^-}^{A^h} K dA > 0$ is some scale parameter.

The impact of profit-shifting can be illustrated by assuming that we are in a situation where the right hand side of eq. (2.12) is equal to zero, i.e. where, in the absence of profit-shifting, marginal profitability and average profitability equalize. Then, equation (2.17) boils down to

$$\frac{dW}{d\alpha} = \Omega^s \left[ \frac{E^h}{K^h} - \frac{\int_{A^-}^{A^h} E dA}{\int_{A^-}^{A^h} K dA} \right] - \Omega^E \left[ \int_{A^-}^{A^h} [E_u] \, dA \right] \tag{2.18}$$

Consider firstly the last term on the right hand side, which is the effect derived in similar form by Haufler and Schjelderup (2000). Assuming that the first two terms in square brackets on the right hand side are equal and sum up to zero, profit-shifting creates the incentive to distort investment, since $E_u > 0$.

Now, consider the first term on the right hand side. If the level of profit-shifting of the marginal firm (measured as a fraction of the capital stock) is higher than the average level, there is a countervailing effect resulting from the mobility of firms. In this case, a tax rate cut cum base broadening policy which makes profit-shifting less attractive also redistributes the tax burden from immobile to mobile firms. But in the presence of firm mobility, the government wants to do the opposite. If this mobility effect becomes very large, it might overcompensate the Haufler-Schjelderup-effect. Our findings can be summarized as

**Proposition 2** *If profit-shifting is not correlated with mobility, the existence of profit-shifting unambiguously generates incentives to pursue a tax rate cut cum base broadening policy.*

*If the marginal firm's avoidance level is (much) higher than the average avoidance in the economy, the existence of profit-shifting may induce policy-makers to pursue a tax rate increase cum base narrowing strategy.*

### 2.3.2 Foreign firm ownership

In the presence of foreign firm ownership (ffo) the government may have the incentive to increase corporate taxes beyond the level which is optimal in the case

of purely domestic firm ownership, see Huizinga and Nielsen (1997). The reason is that corporate taxes can be used to redistribute income from foreign firm owners to domestic households.[10] However, the effect of foreign firm ownership on the optimal combination of tax rates and tax bases is less clear. Haufler and Schjelderup (2000) demonstrate that the introduction of ffo aggravates the tendency towards broadening the tax base and cutting tax rates. The same is true in a context where corporate taxes serve as a backstop, as shown by Fuest and Hemmelgarn (2005).

Assume that foreign firm ownership means that foreigners which are not part of the domestic welfare function receive a fraction $\theta_i$ of the private return of firm $i$. Again, the indices $i$ will be suppressed henceforth. Since there are only source-based taxes in our model, tax revenue is not affected by foreign firm ownership. Social welfare is given by

$$W = \int_{A^-}^{A^h} (1-\theta)\left[(1-u)\,F - (1-u\alpha)\,K\right] dA + \int_{A^h}^{A^+} (1-\theta)\,\pi^* dA \tag{2.19}$$

The marginal firm satisfies $(1-\theta)\left[(1-u)\,F^h - (1-u\alpha)\,K^h\right] = (1-\theta)\,\pi^{h*}$, which is equivalent to equation (2.5), i.e. foreign firm ownership c.p. does not affect location. A variation in the two tax parameters under consideration has the following effect on $W$:

$$dW = \left[\int_{A^-}^{A^h} -(1-\theta)\left[F - \alpha K\right] dA\right] du + \left[\int_{A^-}^{A^h} (1-\theta)\,uK dA\right] d\alpha \tag{2.20}$$

The fixed revenue constraint requires that $u$ and $\alpha$ are changed according to (2.7). It follows:

$$\frac{dW}{d\alpha} = \Omega^\theta \left[\rho^\theta - \rho^h\right] \tag{2.21}$$

where $\Omega^\theta = \frac{-u^2 \frac{\partial A^h}{\partial u} K^h}{T_u} \int_{A^-}^{A^h} (1-\theta)\,K dA > 0$ and $\rho^\theta = \frac{\int_{A^-}^{A^h} (1-\theta)[F-K] dA}{\int_{A^-}^{A^h} (1-\theta) K dA}$.

How can (2.21) be interpreted? If the fraction of foreign firm ownership is equal for all firms in the economy, $\theta_i = \theta$, it follows that $\rho^\theta = \rho$, as defined in (2.12). In this case, ffo does not alter the results derived in subchapter 2.2 in qualitative

[10] Note that this argument requires a different model framework than ours, which is based on the assumption of a fixed revenue constraint.

terms.

The image changes if ffo correlates with profitability. If this correlation is positive (negative), $\rho^\theta < \rho$ ($\rho^\theta > \rho$), and the optimal tax policy is taxation (subsidization) of investment, starting from a situation in which $\rho = \rho^h$. The reason is that the existence of ffo changes the redistributive effects of a revenue-neutral tax reform from the national perspective. If ffo is positively correlated with profitability, this has the same effect as if immobile firms were less profitable (because a larger part of the profitable firms' income is captured by foreigners). Therefore, the government will implement a tax policy which redistributes the tax burden from the mobile to the immobile firms by broadening the tax base and cutting tax rates. The findings resulting from (2.21) can be summarized in

**Proposition 3** *Assume that $\rho = \rho^h$, i.e. without foreign firm ownership (ffo), optimal tax policy is not to distort investment. Introducing foreign firm ownership has the following effect on optimal tax policy:*

*If ffo is perfectly uncorrelated to profitability, $\rho^\theta = \rho$, foreign firm ownership has no impact on optimal tax policy.*

*If ffo is positively (negatively) correlated with profitability, $\rho^\theta < \rho$ ($\rho^\theta > \rho$), foreign firm ownership makes the tax rate cut cum base broadening strategy (tax rate increase cum base narrowing) an optimal policy.*

## 2.4 Discussion and concluding remarks

The analysis in the preceding subchapter has shown that, under simple assumptions on firm mobility, the efficiency property of a tax system which is neutral for investment vanishes. Depending on the relative profitability of different groups of firms, the optimal tax policy implies a *tax rate cut cum base broadening* strategy which gives rise to a positive tax rate on the marginal investment, or the opposite. In other words, the introduction of heterogeneity puts the standard result into question. Depending on how these two sources of heterogeneity are correlated, the optimal tax policy deviates from the standard recommendation in the one or the other direction. In addition, the optimal policy depends on the correlation of profit-shifting opportunities and foreign firm ownership with mobility. How do our

results relate to the findings of the existing literature?

Our model can be understood as part of the literature that explains distortionary elements in existing tax systems by the lack of appropriate tax instruments.[11] In the presence of internationally mobile firms the government would like to discriminate between mobile and immobile firms. Our model directly shows that the government would set the firm specific tax rate so that each firm would receive its reservation profit (i.e. the profit it could earn abroad). There would be no reason to distort investment. However, in this chapter we assumed that the government faces informational or political constraints and has no means to do so directly. Given this, the tax base is used as an instrument for price discrimination.

Of course, the basic idea that economic distortions are caused by a lack of tax instruments is not without problems. If there are informational constraints, in contrast, one could argue that the government might implement instruments to separate tax-payers according to the unobservable characteristic. This is the case in the model presented by Osmundsen et al. (1998). Here, the government cannot observe firm specific mobility. Therefore, if the government announces high taxes on immobile firms and low taxes on mobile firms, the immobile firms will mimick the mobile firms. However, the government can exploit the fact that firms with high location specific rents and low mobility want to invest more than firms with low location specific rents and high mobility. Therefore, the optimal tax policy will induce the mobile firms to invest less than in the first best. This reduces the incentives of immobile firms to mimick the mobile ones. One way of doing so would be to cut depreciation allowances for the mobile firms.

While in Osmundsen et al. (1998) the distortion of investment is used as a device to separate mobile from immobile firms, we show that the distortion of investment is equally optimal in a pooling equilibrium if mobile firms are more profitable than the average firm. In our model, the distortion of investment is used as a redistribution device between mobile firms and immobile ones. Our model thus relies on a fundamentally different mechanism than the one by Osmundsen et al. (1998).

[11] Other examples of this literature are the paper by Haufler and Schjelderup (2000) and Fuest and Hemmelgarn (2005), as discussed in the introductory section. Hong and Smart (2007) show that tax havens can be efficiency enhancing because they allow mobile firms to lower their effective tax rate without leaving the country in which they produce.

The optimality of the tax rate cut cum base broadening strategy crucially depends on the relative profitability of mobile firms compared to immobile firms. In a recent contribution, Helpman, Melitz and Yeaple (2004) develop a model where heterogeneous firms invest abroad if the gain from avoiding trade costs outweighs the cost of maintaing multiple production plants (proximity-concentration trade-off). In their model, only the most productive firms in the export sector decide to invest abroad. They also find empirical support for their results. Devereux et al. (2002) provide evidence for a positive correlation between profitability and the probability of producing in more than one country. Further evidence can be found in Barba Navaretti and Venables (2004). In terms of our model, this would suggest that the optimal tax policy predicted by our model would be consistent with the empirically observed policy.

Finally, one important assumption made in our analysis is the absence of residence based taxes. In a purely residence based system of capital income taxation, the domestic government would be able to tax firms owned by domestic residents irrespective of where they produce. The problem of firm mobility and tax competition would vanish. Existing tax systems, though, are a mixture of the source and the residence principle. Most taxes levied at the firm level are effectively source based taxes[12] whereas taxes levied at the household level are residence based. The interaction between these taxes depends very much on assumptions on the prevailing system of dividend taxation and the identity of the marginal shareholder. If the marginal shareholder is an international investor, the results of the analysis in this chapter continue to hold even in the presence of residence based taxation. If the marginal shareholder is a domestic resident, investment neutrality requires that tax depreciation equals economic depreciation, see Sinn (1990). The benchmark tax policy will thus be different but optimal deviations from investment neutrality are likely to be driven by the same forces as in our model. This is a point to be investigated in future research.

To conclude, the analysis in this chapter departs from the observation that the *tax rate cut cum base broadening* reforms implemented by many countries are hard to reconcile with the traditional result from optimal tax theory that the effective

[12]Note that, at the corporate level, most industrialised countries either exempt foreign profits of domestic firms from domestic taxation or defer domestic taxation until repatriation.

tax rate on the marginal investment should be equal to zero. The analysis has shown that firm mobility may be a reason to deviate from investment neutrality. The direction of the deviation, though, is ambiguous. Our analysis confirms the proposition made by Bond (2000) that a *tax rate cut cum base broadening* policy may be optimal if mobile firms are highly profitable. However, if mobile firms are less profitable than the average in the economy, a tax rate increase cum base narrowing policy might be optimal, too. This could be true in the presence of high location-specific rents.

Thus, our model provides an economic rationale for the observed tax policy, which acts as a complementary explanation next to profit-shifting and policy-learning. Interestingly, the plausible assumption that more mobile firms have easier access to profit-shifting implies that tax rate cut cum base broadening policies become less attractive in our model. For empirical research, our analysis primarily raises the question of whether more profitable firms are more or less sensitive to tax differences across countries than less profitable firms.

## 2.5 Appendix

This appendix derives equations (2.9) and (2.12) in the text. Before we do so, it is helpful to clarify why the introduction of market exit of firms does not change our results. A marginal variation in the tax parameters changes the number of firms if there is at least one firm which is indifferent between producing and leaving the market. This firm has an after-tax profit of zero $(1-u)\,F(K,A)-(1-u\alpha)\,K=0$. Since our analysis concentrates on the case in which $\alpha=1$, the after-tax profit can be expressed as $(1-u)\,(F(K,A)-K)=0$. With $u<1$, this implies that the net profit is zero, as well as tax payments. That means that the marginal firm does not contribute neither to social welfare nor to tax revenue. Therefore, the firm's decision whether to leave or to stay in the market is irrelevant to optimal tax policy, and the government can simply ignore it.

The derivatives of (2.6) with respect to $\alpha$ and $u$ , evaluated at $\alpha=1$, are given

by

$$\begin{aligned} T_\alpha &= \int_{A^-}^{A^h} uKdA - \left[u\left(F^h - \alpha K^h\right)\right]\frac{\partial A^h}{\partial \alpha} \\ T_u &= \int_{A^-}^{A^h} \left[F - \alpha K\right] dA + \left[u\left(F^h - \alpha K^h\right)\right]\frac{\partial A^h}{\partial u} \end{aligned}$$

We can therefore write

$$\frac{d\pi}{d\alpha} = -\left(F^h - \alpha K\right)\frac{\int_{A^-}^{A^h} uKdA - \left[u\left(F^h - \alpha K^h\right)\right]\frac{\partial A^h}{\partial \alpha}}{\int_{A^-}^{A^h}\left[F - \alpha K\right]dA + \left[u\left(F^h - \alpha K^h\right)\right]\frac{\partial A^h}{\partial u}} + uK^h$$

Since $\frac{\partial A^h}{\partial \alpha} = -\frac{\partial A^h}{\partial u}\frac{uK^h}{F^h - \alpha K^h}$, it follows for $\alpha = 1$:

$$\frac{d\pi}{d\alpha} = u\frac{-\left(F^h - K^h\right)\left[\int_{A^-}^{A^h} KdA + uK^h\frac{\partial A^h}{\partial u}\right] + K\left[\int_{A^-}^{A^h}\left[F - K\right]dA + \left[u\left(F^h - K^h\right)\right]\frac{\partial A^h}{\partial u}\right]}{\int_{A^-}^{A^h}\left[F - K\right]dA + \left[u\left(F^h - K^h\right)\right]\frac{\partial A^h}{\partial u}}$$

which can be simplified to equation (2.9) in the text.

Equivalently, we can rewrite equation (2.11) as

$$\frac{dW}{d\alpha} = \frac{u}{T_u}\left[\begin{array}{c} \int_{A^-}^{A^h} -\left(F - K\right)dA\left[\int_{A^-}^{A^h} KdA - uK^h\frac{\partial A^h}{\partial \alpha}\right] \\ +\int_{A^-}^{A^h} KdA\left[\int_{A^-}^{A^h}\left(F - K\right)dA + u\left(F^h - K^h\right)\frac{\partial A^h}{\partial u}\right] \end{array}\right]$$

where we have used $\frac{\partial A^h}{\partial \alpha} = -\frac{\partial A^h}{\partial u}\frac{uK^h}{F^h - \alpha K^h}$ and $\alpha = 1$. This equation can be simplified to equation (2.12) in the text.

# Chapter 3

# Feedback effects

*This chapter introduces feedback effects of foreign investment on domestic profits. It is shown that, if foreign investment causes domestic profits to change, corporate taxes distort the quality, not just the quantity of cross-border investment. The most important implication of this result is that the distortions due to corporate taxation may be much larger than usually measured by empirical studies focussing on investment quantities. We provide empirical evidence that high-tax countries receive inbound investment which contribute less to tax revenue than does inbound investment in low-tax countries.*[1]

## 3.1 Introduction

Standard models of tax effects on international investment assume that investing abroad has no direct impact on the profitability of domestic activities of the investing firm.[2] However, there is extensive empirical evidence that investing abroad, be it greenfield investment or mergers and acquisition (m&a), strongly influences the profitability, productivity, employment etc. of the investor firm. In this chapter, we present a simple model which allows for such feedback effects of foreign direct investment on domestic activity. We find that, in the presence of heterogeneity in feedback effects, corporate taxes distort the quality, not just the quantity, of for-

[1] This chapter is based on Becker and Fuest (2007b).

[2] See the surveys in Haufler (2001), Wilson and Wildasin (2004), Fuest, Huber and Mintz (2005) and Devereux (2007).

eign direct investment. High tax countries are likely to attract investment projects which yield low profits in the host country and contribute little to its corporate tax revenue whereas low tax countries can expect the opposite. We call this the composition effect of corporate taxation on foreign direct investment.

We provide empirical evidence supporting the main prediction of our model with regard to tax revenues. We find that the contribution of foreign direct investment to tax revenue is positive for low tax countries but declines with increasing tax rates. If the effective average tax rate exceeds approximately 30 per cent, an increase in foreign direct investment reduces corporate tax revenue.

In the literature, the observation that profitability tends to be lower in high tax countries is usually interpreted as reflecting that firms shift book profits to low tax countries.[3] This chapter offers a complementary explanation for tax driven differences in profitability. Our analysis suggests that existing studies may overestimate the importance of profit-shifting. This may have important policy implications. We discuss this issue further in subchapter 3.5.

In research on international taxation, feedback effects of foreign investment on the investor firm have been neglected completely. In contrast, the literature on multinational firms recognizes their importance and points out that synergies between different firms of a multinational group and complementarities of their assets are an important factor for the formation and the existence of these firms.[4] We define synergies as an increase in profits for the whole group caused by border-crossing investment. A multinational group will realize an investment project if the after tax profit change for the whole group is at least as high as the cost of capital. The firm is indifferent about where these profits are generated, in the headquarter or in the new production plant. But, from a national tax policy perspective, the distribution of profits across subsidiaries of the multinational firm located in different countries is of key importance. It is the purpose of this chapter to analyze the effect of taxes on cross-border investment when the profit change is not restricted to occur in the country of the initial investment.

In principle, there are three possible ways in which a foreign investment project may change the distribution of profits within the multinational group. Firstly,

[3] See e.g. Grubert and Mutti (1991), Hines and Rice (1994) and the studies cited in section 5.

[4] See e.g. the introduction to the theory of multinational firms in Markusen (2002), ch. 1.

the investment may not affect the profit generated by the parent company in its country of residence, as usually assumed in standard models of international investment. In this case, the marginal investment project has a return equal to the cost of capital. Secondly, the transaction may reduce the profits of the parent company. This may happen, for instance, if a plant built abroad produces a good which competes with a good produced by the parent company. In this case, the project will only be undertaken if it increases the profitability of the subsidiary by more than the cost of capital. Thirdly, the investment project may increase the profits of the parent company. A possible reason could be that the subsidiary provides market access or specific know how to the parent company. In this case, the marginal investment project may imply that profits in the subsidiary are very low or even negative because the higher profits of the parent company make the investment worthwhile.

Recent evidence shows that investment abroad has a significant impact on all types of performance indicators of the parent company, independent of whether investment takes the form of greenfield projects or m&a. Desai, Foley and Hines (2005a) find that investment abroad increases the aggregate domestic investment activity by US multinationals. Desai, Foley and Hines (2005b) use firm-level data of US multinationals and show that foreign investment in plant, property and equipment (PPE) is associated with higher domestic PPE investment. Similarly, Egger and Pfaffermayer (2003) find that foreign investment increases domestic investment in tangible assets and does not decrease investment in intangibles. Castellani and Barba Navaretti (2004) and Jaeckle (2006) show that going abroad increases domestic productivity and competitiveness. In addition, there are several empirical studies, surveyed by Andrade, Mitchell and Stafford (2001), analyzing the effects of m&a on the investor firm's performance. There is empirical evidence that m&a create efficiency gains which seem to be distributed asymmetrically, though, as e.g. McGuckin and Nguyen (1995) report. While recently acquired firms experience productivity improvements, the investor firm's plants suffer productivity losses, making the net change for the investor firm essentially zero.

Our main argument is the following. If investment abroad has some effect on the performance of the investor company in the domestic country, then the marginal return generated in the foreign location may differ from the cost of capital. For

example, if domestic profits increase, then the marginal foreign investment may even yield negative returns. Given this, taxes affect the selection of border crossing investment projects which are carried out. If a potential host country increases its taxes, it will deter projects which produce high profits in the host country (and low profits or losses in the country where the parent company resides). At the same time, this country will attract more projects which produce low profits or losses in the host country and high profits in the country where the parent company resides. As a result, the quantity of capital imports may increase, decline or remain constant in response to the higher tax. But the quality of inbound investment in the host country as measured by its contribution to the domestic profit tax base will unambiguously deteriorate. This is what we call the composition effect of corporate taxation on cross-border investment.

The composition effect has some important implications. Firstly, the welfare cost of tax distortions may be higher than suggested by studies focusing on the quantity aspect alone. Secondly, as mentioned above, observed tax induced profitability differences may not only be due to the shifting of book profits across countries. Thirdly and more generally, policies which aim at attracting foreign direct investment may have to pay more attention to the qualitative dimension of this investment.

The rest of the chapter is set up as follows. In subchapter 3.2, we present the model. Subchapter 3.3 discusses some extensions. In 3.4, we provide suggestive evidence for the main hypotheses. Subchapter 3.5 concludes.

## 3.2 The model

In this subchapter, the model setup is presented (3.2.1) before we derive tax effects on investment quality (3.2.2). Then, tax rate effects on tax revenues are considered (3.2.3). Finally, we ask for the optimal tax policy strategy and tax effects on welfare (3.2.4).

### 3.2.1 Setup

The world consists of two countries, domestic and foreign. In the domestic country, there is a representative household endowed with $N$ units of capital. Moreover, there are many identical firms which have some ongoing production in the two countries. These firms consider investment projects in the foreign country. Cross-border investment has two effects. Firstly, the project generates profit income (or losses) in the foreign investment location, denoted by $\Phi^*$. Henceforth, the asterisk denotes the location in the foreign country. Secondly, the profit of the domestic investor firm generated in its country of residence changes by $\Delta$.[5]

More formally, each domestic firm $i$ randomly draws a project and then decides whether or not realize it. The project is characterized by a pair $(\Delta_i, \Phi_i^*)$ of profit changes at the investor's and the investment location. $\Delta, \Phi^*$ are two jointly distributed variables $(\Delta, \Phi^*) \in \mathbb{R}^2$. For simplicity, we assume that the two variables are uniformly distributed over the intervals $\Delta \in \{\Delta^-, \Delta^+\}$ and $\Phi^* \in \{\Phi^{*-}, \Phi^{*+}\}$. Each project requires one unit of capital which can be rented at a price of $\rho$ in the world capital market.

Standard models virtually always assume that $\Delta$ is equal to zero. It is the main novelty of this model to allow for profit level changes in the investor firm, i.e. we consider positive, negative or zero values of $\Delta$. In other words, the investment project may effectively increase or decrease profits of the parent company, or it may not affect them at all. If $\Delta < 0$ , the transaction reduces the profits of the parent company. A possible reason would be that the new subsidiary produces a good which competes with products exported by the parent company. $\Delta > 0$, i.e. an increase in profits of the parent company, may occur, for instance, if the subsidiary owns technical knowledge or offers market access which is beneficial to the parent company.

Thus, in the absence of taxes, the profit of a border crossing investment project is:

$$\Delta + \Phi^* - \rho \tag{3.1}$$

[5] In the following, we will use the terms profit and profit changes equivalently. The term profit is more adequate if new production facilities are established, whereas profit change is more exact if existing production plants are modified, i.e. in the course of an acquisition or merger.

Denote by $\Phi^{*c}$ the marginal project for a given $\Delta$. In equilibrium, each marginal project will satisfy $\Delta + \Phi^{*c} = \rho$.

Now, taxes are introduced. In our model, profits are subject to corporate income taxes. Foreign source income is exempt from domestic tax, i.e. we assume that international investment income is taxed according to the exemption system. The nontax capital cost is not deductible, i.e. we assume equity financing. Projects are realized if posttax-profits, aggregated over the domestic and the foreign location, are nonnegative, i.e. $\Delta(1-\tau)+\Phi^*(1-\tau^*) \geq \rho$, where $\tau$ is the domestic corporate tax rate and $\tau^*$ is the corporate tax rate of the foreign country. For each $\Delta$, there is a marginal project which satisfies:

$$\Phi^{*c} = \frac{\rho}{1-\tau^*} - \Delta\left(\frac{1-\tau}{1-\tau^*}\right) \tag{3.2}$$

Projects with $\Phi^* < \Phi^{*c}$ are not realized. The right hand side of (3.2) may be interpreted as the cost of capital of foreign direct investment. The first term is increasing in $\rho$ and the corporate tax rate of the country where the investment is located. This effect is well known from standard tax models of international investment. The second term on the right hand side of (3.2) is in the focus of this chapter. It reflects that the new foreign investment project may affect the ongoing activity of the multinational firm in its country of residence. If $\Delta > 0$, the second term reduces the cost of capital. The reason is that foreign investment increases the profits of the parent company. Accordingly, $\Delta < 0$ implies that foreign investment reduces domestic profits, so that the minimum foreign profit required to make the project worthwhile increases.

The foreign country has no capital endowment. It only imports capital and taxes profits generated by investment of multinational firms. This asymmetry assumption is made for the following reason. In this setup, investment of multinational firms in the foreign country is the only source of capital demand. Given that the supply of capital is fixed, the quantity of capital exported from the domestic country to the foreign country is given. This allows us to focus on the quality side of capital flows. In 3.3.1, we extend the model to allow for changes in both the quality and the quantity of border crossing capital flows.

### 3.2.2 Tax rate effects on investment quality

Equation (3.2) shows that taxes may distort investment. In the standard model, with $\Delta = 0$, the implications are clearcut. For $\tau > 0$, it follows $\Phi^{*c} > \rho$, i.e. the return of the marginal unit of capital invested abroad is lower than the marginal return in the absence of taxes. In contrast, if we allow for $\Delta \neq 0$, the picture may change. For large and positive $\Delta$, the minimum required project returns at the investment location $\Phi^{*c}$ may become negative. This has important consequences for the effect of corporate taxation on investment. Holding $\rho$ constant, a marginal increase of the domestic and foreign corporate tax rate has the following effect on outbound investment:

$$\frac{\partial \Phi^{*c}}{\partial \tau^*} = \frac{\Phi^{*c}}{1-\tau^*} \quad \text{and} \quad \frac{\partial \Phi^{*c}}{\partial \tau} = \frac{\Delta}{1-\tau^*} \tag{3.3}$$

These expressions can be interpreted as follows. A positive sign of the derivative means that a tax rate increase raises the required profit of the foreign investment project. In this case, higher taxes deter investment. Accordingly, negative values represent cases where higher taxes increase investment. Now, consider the standard case with $\Delta = 0$. In this case, it follows from equation (3.2) that $\Phi^{*c} > 0$, i.e. the profit change in the foreign country caused by the marginal investment project must be positive. In this case, higher foreign taxes deter investment ($\frac{\partial \Phi^{*c}}{\partial \tau^*}$). $\Delta = 0$ also implies that domestic corporate taxes do not affect outbound investment, i.e. $\frac{\partial \Phi^{*c}}{\partial \tau} = 0$.

This changes if we allow foreign investment to affect the profits of the domestic parent company, i.e. $\Delta \neq 0$. If $\Delta$ is positive and sufficiently large, the profit change at the investment location caused by the marginal project ($\Phi^{*c}$) becomes negative, i.e. $\Phi^{*c} < 0$. In this case, the effect of corporate taxes on investment is reversed: $\frac{\partial \Phi^{*c}}{\partial \tau^*} < 0$. In other words, higher foreign tax rates c.p. *increase* investment in the foreign country. The reason is that the after tax cost of the decline in foreign profits caused by the marginal investment project is smaller, the higher the tax rate. The other interesting effect is that corporate taxes in the domestic country may c.p. deter outbound investment. This also occurs if the profit change at the parent company location is positive: $\frac{\partial \Phi^{*c}}{\partial \tau} = \frac{\Delta}{1-\tau^*} > 0$.

So far, we have discussed the effects of tax changes in our model assuming that

the interest rate $\rho$ is constant. But of course, a variation in the tax rate will also change the interest rate $\rho$ in our model. Total tax effects are therefore given by

$$\frac{d\Phi^{*c}}{d\tau^*} = \frac{\Phi^{*c}}{1-\tau^*} + \frac{1}{1-\tau^*}\frac{d\rho}{d\tau^*} \tag{3.4}$$

The capital market equilibrium is given by the equation

$$\int_{\Delta^-}^{\Delta^+} \int_{\Phi^{*c}(\rho,\tau,\tau^*)}^{\Phi^{*+}} d\Phi^* d\Delta = N \tag{3.5}$$

Since the supply of capital is fixed, $\rho$ will adjust to tax changes so that overall capital demand remains constant. Total differentiation yields

$$\frac{d\rho}{d\tau^*} = -\frac{\int_{\Delta^-}^{\Delta^+} \frac{\partial \Phi^{*c}}{\partial \tau^*} d\Delta}{\int_{\Delta^-}^{\Delta^+} \frac{\partial \Phi^{*c}}{\partial \rho} d\Delta} = -\int_{\Delta^-}^{\Delta^+} \Phi^{*c} d\Delta \equiv -\bar{\Phi}^{*c} \tag{3.6}$$

where we have used $\int_{\Delta^-}^{\Delta^+} d\Delta = 1$. $\bar{\Phi}^{*c}$ can be interpreted as the average host country profit generated by the marginal projects ($\Phi^{*c}$). The total effect of a change in the foreign tax rate on investment is therefore given by

$$\frac{d\Phi^{*c}}{d\tau^*} = \frac{1}{1-\tau^*}\left(\Phi^{*c} - \bar{\Phi}^{*c}\right) = -\frac{(1-\tau)}{(1-\tau^*)^2}\left(\Delta - \bar{\Delta}\right) \tag{3.7}$$

where $\bar{\Delta} \equiv \int_{\Delta^-}^{\Delta^+} \Delta d\Delta$ is the average $\Delta$. Equation (3.7) is of key importance for our analysis. It has the following interpretation. Depending on the value of $\Delta$ , $\Phi^{*c}$ may be larger or smaller than $\bar{\Phi}^{*c}$. Consider first the firms where $\Phi^{*c} > \bar{\Phi}^{*c}$. These are marginal projects where the profit generated in the foreign country is above the average of all marginal projects. Accordingly, profits generated by these projects in the domestic country are lower than on average $\left(\Delta < \bar{\Delta}\right)$. These investment projects will be crowded out by higher foreign taxes ($\frac{d\Phi^{*c}}{d\tau^*} > 0$). They will be replaced by an expansion of projects which generate lower than average profits in the foreign country $\left(\Phi^{*c} < \bar{\Phi}^{*c}\right)$. This substitution of projects which generate high foreign profits by projects which generate lower foreign profits or even losses is what we refer to as the composition effect of corporate taxation on foreign direct investment. While the mere quantity cannot change in our model, the quality of

foreign direct investment changes. If a country increases its tax rate, it attracts fewer projects which generate local profits and more project which generate profits somewhere else.

In parallel to equations (3.4) and (3.6), we can derive $\frac{d\Phi^{*c}}{d\tau} = \frac{\Delta}{1-\tau^*} + \frac{1}{1-\tau^*}\frac{d\rho}{d\tau}$ and $\frac{d\rho}{d\tau} = -\int_{\Delta^-}^{\Delta^+} \Delta d\Delta \equiv -\bar{\Delta}$. The effect of a small increase of the domestic corporate tax rate on outbound investment is then given by

$$\frac{d\Phi^{*c}}{d\tau} = \frac{1}{1-\tau^*}\left(\Delta - \bar{\Delta}\right) = -\frac{1}{1-\tau}\left(\Phi^{*c} - \bar{\Phi}^{*c}\right) \tag{3.8}$$

which can interpreted equivalently. Note that, again, the tax effect of foreign taxes on foreign inbound investment would be zero in the standard model. The reason is that the number of projects is fixed and does not change in response to changes in $\tau^*$.

These results can be summarized as

**Proposition 4** ***Composition effect:*** *In the presence of feedback effects of foreign investment on domestic performance, an increase in the corporate tax rate changes the quality of investment projects. If the overall number of projects is fixed, an increase in foreign taxes leads to a decline in investment in the foreign country with above average foreign profitability* $\left(\Phi^{*c} > \bar{\Phi}^{*c}\right)$ *and an increase in investment with below average foreign profitability* $\left(\Phi^{*c} < \bar{\Phi}^{*c}\right)$*. An increase in the domestic tax rate has the opposite effect.*

Figure 3-1 illustrates the effects of corporate taxation on investment decisions in our model, seen from the perspective of a high-tax country, i.e. assuming that $\tau > \tau^*$. The lines that separate the hatched area from the blank one show the locus of marginal investment as a function of different values for $\Delta$ and $\Phi^*$. Consider first the case without taxes, depicted on the left hand side of the figure. At the margin, $\Phi^{*c} = \rho$ if $\Delta = 0$, and $\Delta = \rho$ if $\Phi^{*c} = 0$. The slope of the curve is given by $\frac{d\Delta}{d\Phi^{*c}} = -1$. All transactions above the line will be realized whereas possible investment projects in the shaded area are rejected.

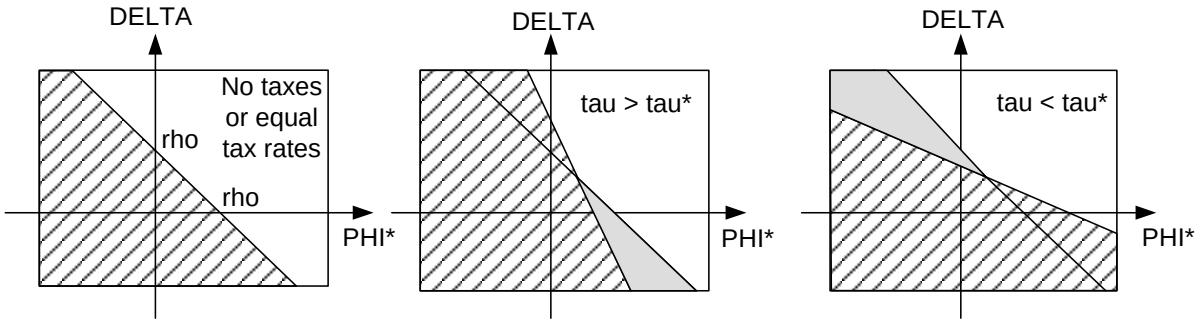


Figure 3-1 - The composition effect of corporate taxation on foreign investment

The graph in the center of figure 3-1 illustrates the space of feasible investment in the presence of taxes assuming $\tau > \tau^*$. Note that, if both tax rates $\tau$ and $\tau^*$ are equal, $\rho$ adjusts until all capital is employed. Then, the graph is the same as on the left hand side with points of intersection $\frac{\rho}{1-\tau}$, $\frac{\rho}{1-\tau^*}$. For $\tau \neq \tau^*$, though, the points of intersection with the x- and the y-axis are shifted according to equation (3.2). The slope of the marginal investment curve becomes steeper, $\frac{d\Delta}{d\Phi^{*c}} = -\frac{1-\tau^*}{1-\tau} < -1$. Corporate taxes now have two effects: The first is that projects are not realized any more in the low-tax country that would have been in the absence of taxes (hatched area above the no-tax-line). But, in addition, some projects are now realized that would not have been without taxes (shaded area beneath the no-tax-line). These projects are characterized by high positive profit changes in the foreign country and negative profit changes in the domestic high-tax country. The graph on the right hand side shows the case of $\tau < \tau^*$. The slope of the marginal investment line is flatter now, $\frac{d\Delta}{d\Phi^{*c}} > -1$. There are some projects (high $\Phi^*$, low $\Delta$) which are not realized anymore and some projects realized which were rejected in the absence of taxes (low $\Phi^*$, high $\Delta$).

### 3.2.3 Tax rate effects on tax revenue

What are the effects of tax rate increases on tax revenue if the quality dimension matters? Before we derive these effects in our model, recall the standard model. An increase in corporate tax rates has essentially two effects. It increases revenue by raising the tax burden for each project, and it decreases revenue by lowering the number of projects carried out. These countervailing effects generate the typical shape of the Laffer-curve which has a maximum at the revenue-maximizing tax

rate. But if the number of projects is fixed, there is no countervailing effect in the standard model, since there is no qualitative dimension, and the revenue-maximizing tax rate would be $\tau = 100\%$.

In our model, the tax revenue of the foreign, capital importing country is given by

$$T^* = \tau^* B^* = \tau^* \int_{\Delta^-}^{\Delta^+} \int_{\Phi^{*c}}^{\Phi^{*+}} \Phi^* d\Phi^* d\Delta \tag{3.9}$$

where $B^*$ denotes the tax base. A small increase in the corporate tax rate $\tau^*$ has the following effect: $dT^* = d\tau^* B^* + \tau^* dB^* = \left(B^* + \tau^* \frac{\partial B^*}{\partial \tau^*}\right) d\tau^* + \tau^* \frac{\partial B^*}{\partial \rho} d\rho$ . $dB^*$ can be expressed as

$$dB^* = -\int_{\Delta^-}^{\Delta^+} \frac{\partial \Phi^{*c}}{\partial \tau^*} \Phi^* d\Delta d\tau^* - \int_{\Delta^-}^{\Delta^+} \frac{\partial \Phi^{*c}}{\partial \rho} \Phi^* d\Delta d\rho \tag{3.10}$$

Using equation (3.6), it follows:

$$\frac{dB^*}{d\tau^*} = -\frac{1}{1-\tau^*} var\left(\Phi^{*c}\right) < 0 \tag{3.11}$$

where $var\left(\Phi^{*c}\right)$ is the variance of $\Phi^{*c}$.[6] In the standard model, there is no qualitative dimension of investment, and therefore $var\left(\Phi^{*c}\right) = 0$. In this model, where $var\left(\Phi^{*c}\right) > 0$, an increase in the foreign tax rate decreases the foreign tax base because of the composition effect, i.e. because the tax increase leads to a substitution of investment projects with a high local profitability by projects with lower profits. The effect of the tax increase on foreign tax revenue is

$$\frac{dT^*}{d\tau^*} = B^* - \frac{\tau^*}{1-\tau^*} var\left(\Phi^{*c}\right) \tag{3.12}$$

Consider next the effect of an increase in the domestic tax rate on tax revenue in the foreign country. The derivation is analogous and yields

$$\frac{dT^*}{d\tau} = -\frac{\tau^*}{1-\tau^*} cov\left(\Delta, \Phi^{*c}\right) \tag{3.13}$$

[6] The variance is given by $var\left(\Phi^{*c}\right) = \int_{\Delta^-}^{\Delta^+} \Phi^{*c2} d\Delta - \left(\int_{\Delta^-}^{\Delta^+} \Phi^{*c} d\Delta\right)^2$.

where $cov\left(\Delta, \Phi^{*c}\right)$ is the covariance of $\Delta$ and $\Phi^{*c}$.[7] Equation (3.2) implies that the covariances are negative. Therefore, an increase in the domestic tax rate increases foreign tax revenue: $\frac{dT^*}{d\tau} > 0$. In the same way, we can derive the effects of tax changes on domestic tax revenue. The impact of a change in the domestic tax rate is

$$\frac{dT}{d\tau} = B - \frac{\tau}{1-\tau^*} var\left(\Delta\right) \tag{3.14}$$

where $var\left(\Delta\right)$ is the variance of $\Delta$.[8] A change in the foreign tax rate yields

$$\frac{dT}{d\tau^*} = -\frac{\tau}{1-\tau^*} cov\left(\Delta, \Phi^{*c}\right). \tag{3.15}$$

These results may be summarized as

**Proposition 5** *An increase in the foreign tax rate unambiguously reduces the foreign tax base and increases the domestic tax base (and vice versa), although the number of projects remains constant.*

The unambiguously negative effect of a tax increase on the domestic tax base is due to the composition effect of corporate taxation. The tax increase encourages investment projects which produce losses and discourages profitable projects.

This effect of investment on tax revenue is one of the empirically testable implications of our model. If our model actually explains part of real world investment flows then we should observe that high-tax countries have less gain from inbound investment in terms of tax revenue than low-tax countries. In subchapter 3.4, we test this hypothesis empirically. We find that the higher the tax rate the lower is the additional tax revenue per unit of foreign direct investment. Above a certain level of the tax rate the contribution of FDI to tax revenues even becomes negative.

### 3.2.4 Optimal tax policy and welfare

In this subchapter, we derive the optimal tax policy of the doemstic and the foreign country. In both countries, the governments maximize the welfare of a

[7] The covariance is given by $cov\left(\Delta, \Phi^{*c}\right) = \int_{\Delta^-}^{\Delta^+} \Delta\Phi^{*c} d\Phi^* d\Delta - \left(\int_{\Delta^-}^{\Delta^+} \Phi^{*c} d\Delta\right)\left(\int_{\Delta^-}^{\Delta^+} \Delta d\Delta\right)$.

[8] The variance is given by $var\left(\Delta\right) = \int_{\Delta^-}^{\Delta^+} \Delta^2 d\Delta - \left(\int_{\Delta^-}^{\Delta^+} \Delta d\Delta\right)^2$.

representative household. Consider first the domestic country. The welfare of the domestic household ($W$) is assumed to depend on private consumption $C$ and publicly provided goods $G$: $W = W(C, G)$. To ease notation, we assume $W = C + H(G)$. Private consumption is given by the private return to investment

$$C = \rho N + \int_{\Delta^-}^{\Delta^+} \int_{\Phi^{*c}}^{\Phi^{*+}} \left[\Delta(1-\tau) + \Phi^*(1-\tau^*) - \rho\right] d\Phi^* d\Delta \tag{3.16}$$

Since the entire capital stock and all firms belong to the domestic household (3.16) boils down to

$$C = \int_{\Delta^-}^{\Delta^+} \int_{\Phi^{*c}}^{\Phi^{*+}} \left[\Delta(1-\tau) + \Phi^*(1-\tau^*)\right] d\Phi^* d\Delta \tag{3.17}$$

$G$ is financed by corporate tax revenues only. Domestic welfare is given by

$$W = \int_{\Delta^-}^{\Delta^+} \int_{\Phi^{*c}}^{\Phi^{*+}} \left[\Delta(1-\tau) + \Phi^*(1-\tau^*)\right] d\Phi^* d\Delta + H\left(\tau \int_{\Delta^-}^{\Delta^+} \int_{\Phi^{*c}}^{\Phi^{*+}} \Delta d\Phi^* d\Delta\right) \tag{3.18}$$

The effect of a small increase in $\tau$ on domestic welfare is given by $\frac{dW}{d\tau} = \frac{\partial W}{\partial \tau} + \frac{\partial W}{\partial \rho}\frac{d\rho}{d\tau}$. After some rearrangements, presented in the appendix, it follows

$$\frac{dW}{d\tau} = (H' - 1) \int_{\Delta^-}^{\Delta^+} \int_{\Phi^{*c}}^{\Phi^{*+}} \Delta d\Phi^* d\Delta - H' \frac{\tau}{1-\tau^*} var(\Delta) \tag{3.19}$$

The optimal tax policy involves the following tradeoff: The first term on the right hand side of (3.19) reflects that a higher tax rate shifts income from the domestic household to the government. This increases welfare if the marginal utility from public consumption exceeds the marginal utility of private consumption $H' - 1 > 0$. The second term is unambiguously negative if the tax rate is positive and reflects that a tax rate increase reduces the tax base. This trade-off is familiar from standard models of tax policy in models with capital mobility. The difference is that the tax base effect results from a change in the quality of investment, ratehr than the quantity.

How does an increase in the foreign tax rate affect domestic welfare? The welfare effect is given by $\frac{dW}{d\tau^*} = \frac{\partial W}{\partial \tau^*} + \frac{\partial W}{\partial \rho}\frac{\partial \rho}{\partial \tau^*}$ which can be rearranged (see appendix)

to

$$\frac{dW}{d\tau^*} = -\int_{\Delta^-}^{\Delta^+}\int_{\Phi^{*c}}^{\Phi^{*+}} \Phi^* d\Phi^* d\Delta - H' \frac{\tau}{1-\tau^*} cov\left(\Delta, \Phi^{*c}\right) \tag{3.20}$$

The first term on the r.h.s. of (3.20) is negative and reflects that an increase in the foreign tax reduces the profit income of domestic households.[9] The second term is unambiguously positive. It represents the positive fiscal externality of a foreign tax rate increase on domestic tax revenue. The overall welfare effect is ambiguous.

The foreign country maximizes revenue from taxing firms. It benefits from an increase in domestic taxes. It is beyond the scope of this chapter to fully analyze tax competition in the presence of quality aspects of investment. However, it is clear that the scope and the direction of potential coordination policies depends on the fiscal externalities mentioned above. The fiscal externalities are similar to those in the standard model.

## 3.3 Extension: Quality and quantity dimensions

So far, we have assumed that the number of projects realized by domestic investors in the foreign country is fixed. We now relax this assumption by introducing a world capital market with an exogenously given interest rate of $r$. Firms may use the rented capital to finance cross-border investment projects. This implies that the marginal project is defined as yielding a return which equals the world interest rate $r$:

$$\Phi^{*c}\left(1-\tau^*\right) + \Delta\left(1-\tau\right) = r \tag{3.21}$$

Assuming that the interest rate does not react to tax changes, tax effects are given by

$$\frac{\partial \Phi^{*c}}{\partial \tau^*} = \frac{\Phi^{*c}}{1-\tau^*} \quad \text{and} \quad \frac{\partial \Phi^{*c}}{\partial \tau} = \frac{\Delta}{1-\tau^*} \tag{3.22}$$

Aggregate investment, i.e. the overall number investment projects realized in

[9] From the viewpoint of the foreign government, the domestic ownership of foreign assets may imply the incentive to overtax corporate profits, see Huizinga and Nielsen (1997).

the foreign country ($K^*$), is now endogenously determined and equal to:

$$K^* = \int_{\Delta^-}^{\Delta} \int_{\Phi^{*c}}^{\Phi^{*+}} d\Phi^* d\Delta \tag{3.23}$$

At a given interest rate in the world capital market, a marginal increase in the foreign corporate tax rate has the following effect on aggregate investment:

$$\frac{\partial K^*}{\partial \tau^*} = -\int_{\Delta^-}^{\Delta} \frac{\partial \Phi^{*c}}{\partial \tau^*} d\Delta = -\frac{\bar{\Phi}^{*c}}{1-\tau^*} \tag{3.24}$$

The tax effect on investment depends on an expression, $\bar{\Phi}^{*c} = \int_{\Delta^-}^{\Delta} \Phi^{*c} d\Delta$, which can be interpreted as the mean marginal profit generated by foreign investment in the foreign country. In the standard model, this expression is equal to $\frac{\partial K^*}{\partial \tau^*} = -\frac{r}{(1-\tau^*)^2}$ since $\Delta$ is assumed to be zero and therefore $\Phi^{*c}$ is equal to $\frac{r}{1-\tau^*}$. In our model, though, the expression can be negative. In this case higher taxes increase inbound investment, seen from the foreign government's perspective. The possibility that higher taxes may attract additional investment is due to the fact that the value of losses is higher with high tax rates. If projects with negative marginal profits dominate, an increase in the corporate tax rate increases the value of these projects and leads to an increase in total investment.

Thus, we may state that the qualitative aspects of investment may dominate the quantitative side. In the case of $\int_{\Delta^-}^{\Delta} \Phi^{*c} d\Delta = 0$, tax rate variations do not change the number of projects at all (although the number of projects is endogenously determined), but they have a composition effect, i.e. they change the qualitative dimension of investment flows.

What are the effects on tax revenue if we allow for the quantitative dimension of investment? Tax revenue is given by

$$T^* = \tau^* B^* = \tau^* \int_{\Delta^-}^{\Delta^+} \int_{\Phi^{*c}}^{\Phi^{*+}} \Phi^{*c} d\Phi^* d\Delta \tag{3.25}$$

where $B$ is the tax base. In the standard model, the effect of a small increase of the corporate tax rate on the tax base is negative because higher tax rates reduce

the capital stock. In our model, the effect is given by

$$\frac{\partial T^*}{\partial \tau^*} = B^* - \frac{\tau^*}{1-\tau^*} \int_{\Delta^-}^{\Delta^+} \Phi^{*c2} d\Delta \tag{3.26}$$

Thus, although a higher tax may increase or decrease the foreign capital stock, the effect of a higher foreign tax rate on the tax base is unambiguously negative. The first term on the right hand side is the revenue increasing effect of increasing the tax rate with a given tax base. The second term denotes the tax rate effect on the tax base which is negative.

These results may be summarized as

**Proposition 6** *An increase in the foreign tax rate may increase or decrease aggregate investment in the foreign country but always reduces the foreign corporate income tax base.*

## 3.4 Empirical analysis

In this subchapter, we provide some suggestive evidence for the relevance of the composition effect of corporate taxation on FDI. It seems that, fortunately, there is already a large number of papers which may be interpreted as providing evidence for the existence of the composition effect and the qualitative dimension of FDI. The empirical literature on tax effects on profit-shifting usually starts from the observation that the returns per unit of capital (our $\Phi$ and $\Delta$) differ between domestic and foreign affiliates within a multinational company, and that the difference depends on the tax rate differential between the two jurisdictions. These contributions implicitely assume that, besides profit-shifting, capital returns in the domestic and the foreign affiliate do not depend on each other. This is a very strong assumption. If foreign investment projects have feedback effects on domestic profits, then the observed effects may arise even in the absence of profit-shifting.

If investment has a qualitative dimension, high tax countries will be more likely than low tax countries to attract investment projects which lead to low or zero tax payments (or even negative tax payments when the losses can be set against other income). In the following, we therefore measure the impact of FDI on tax

revenue. The above presented model predicts that high-tax countries will attract FDI that increases their tax revenues less than FDI in low-tax countries does. We will estimate an equation of the following form:

$$Tax\ base = \alpha_0 + \alpha_1 Tax\ rate + \alpha_2 FDI + \alpha_3 FDI \times Tax\ rate + \sum \alpha_j X + \varepsilon \quad (3.27)$$

If there is a composition effect on FDI, a higher tax rate will lower the increase in tax revenue per unit of incoming FDI or even decrease it in absolute terms. That means that the model predicts a negative estimated coefficient $\alpha_3$. Note that in the standard model taxes decrease the quantity of FDI. But when the quantity is controlled for, there is no prediction for the sign or the size of $\alpha_3$. Note further that the model yields symmetric predictions for inbound and outbound FDI. Both directions of investment should have a negative estimate of $\alpha_3$.

Table 3.1 shows the summary statistic of the main variables used for estimation. It reports the number of observations, the mean, the standard deviation and the median value.

**Table 3.1: Summary statistic**

| | No. obs. | Mean | St.dev. | Median |
|---|---|---|---|---|
| EATR | 468 | 0.3052 | 0.0685 | 0.2800 |
| Tax rate | 479 | 0.4082 | 0.0924 | 0.3900 |
| Tax revenue | 388 | 0.0302 | 0.0144 | 0.0285 |
| Tax base | 368 | 0.0802 | 0.0734 | 0.0441 |
| Corporate VA | 235 | 0.5534 | 0.0796 | 0.5639 |
| Gross operating surplus | 304 | 0.1981 | 0.0358 | 0.2003 |
| Inbound FDI | 398 | 0.1859 | 0.1696 | 0.1413 |
| Outbound FDI | 392 | 0.2432 | 0.3060 | 0.1444 |
| GDP | 405 | 1,154,263 | 1,924,153 | 373,573 |

Note: Data sources are given in the text.

All numbers represent shares of GDP except for tax rates and GDP itself. The EATR and the (statutory) tax rates are taken from the IFS corporate tax database described in Devereux et al. (2002). For countries not included in the IFS database we added tax rates from KPMG (2006). The tax revenue figures are taken from the OECD database, as well as the share of corporate value added and the gross operating surplus. The tax base is calculated by dividing tax revenues through statutory tax rates. Since this is no perfect measure, we run regression for both tax bases and revenues. Inbound and outbound FDI are provided by

UNCTAD. It would be useful to have FDI-weighted investor country tax rates. Unfortunately, it turns out that the share of FDI for which we have tax rate data is too low to construct reliable indicators. Therefore, our estimations are based on the assumption that the host tax rates are a good measure for the (relative) tax burden. This is necessarily true in the aggregate but it may generate biases for individual countries.

Table 3.2 reports the results of five different estimation specifications. All specifications use host country fixed effects and year fixed effects. In column 1, regression results of equation (3.27) are presented with the FDI term split in inbound and outbound FDI stocks. As expected, the gross operating surplus has high predictive power for the size of the tax base. The inbound and outbound terms are not significant. However, their coefficients show the same signs and the same structure. Whereas inbound and outbound FDI have a positive coefficient, the interaction terms are negative. Since both inbound and outboud FDI are highly correlated the lack of significance is potentially due to collinearity. Since our model yields symmetric predictions for both directions of FDI, i.e. both incoming and outgoing FDI are supposed to have negative interaction terms with the EATR (or other tax indicator), we go on by using total FDI which is the sum of the two variables.

And, indeed, using the sum of FDI instead of inbound and outbound FDI separately yields significant coefficient estimates for the FDI term which similar properties compared to the estimations reported in column 1. The coefficients have the expected signs: In general, foreign direct investment increases the tax base. However, high-tax countries gain less tax base or even lose some fraction of the tax base. The control variables remain virtually the same and also the R-squared does not decrease.

It may be that the coefficient estimates for the FDI terms are artefacts if high-tax countries differ systematically from low-tax countries with regard to other variables. In column 3, we therefore add interaction terms with the EATR for the control variables. The FDI coefficients are slightly decreased but remain strongly significant.

How should the results be interpreted? The estimation reported in column 3

suggests that a marginal increase in FDI has the following effect on the tax base

$$\frac{\partial\,(Tax\ base/GDP)}{\partial\,(FDI/GDP)} = 0.1930 - 0.6275 \times EATR$$

This means that FDI does not add anything to the tax base and even reduces it above a tax rate of 30%. Whereas Germany is predicted to lose tax base on average with its EATR tax rates of 0.32 (in 2005), the UK and France gain with tax rates at 0.24 and 0.25. The US (0.29) taxbase is virtually unaffected by FDI.

**Table 3.2: Regression results**

| | (1) | | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|---|
| | | | | Tax base | | | Tax revenue | |
| | EATR | | EATR | EATR | EATR | Stat. tax rate | EATR | Stat. tax rate |
| EATR | 0.0872 | | 0.0841 | 0.2718 | 0.1865 | | 0.0291 | |
| | (0.0659) | | (0.0617) | (0.2403) | (0.1924) | | (0.0868) | |
| Statutory tax rate | | | | | | 0.5511 | | 0.1595 |
| | | | | | | (0.1659)** | | (0.0545)** |
| Corporate VA | -0.2479 | | -0.2619 | -0.0305 | | 0.0041 | -0.0827 | -0.0363 |
| | (0.1883) | | (0.1593) | (0.1597) | | (0.1560) | (0.0526) | (0.0541) |
| Corp VA x TR | | | | -0.0000 | | -0.0000 | -0.0000 | -0.0000 |
| | | | | (0.0000)** | | (0.0000)** | (0.0000)** | (0.0000)** |
| Gross operating | 0.8913 | | 0.9336 | 1.2679 | 1.0510 | 1.6395 | 0.2238 | 0.3898 |
| surplus | (0.1795)** | | (0.1321)** | (0.3146)** | (0.2827)** | (0.3168)** | (0.1060)* | (0.0966)** |
| GOS x TR | | | | -1.5318 | -1.2175 | -2.4204 | 0.2917 | -0.3233 |
| | | | | (0.9854) | (0.9308) | (0.7098)** | (0.3599) | (0.2356) |
| Inbound FDI | 0.2571 | | | | | | | |
| | (0.2215) | Total FDI | 0.2474 | 0.1930 | 0.1859 | 0.1724 | 0.0532 | 0.0453 |
| Inbound FDI | -0.9970 | | (0.0466)** | (0.0451)** | (0.0416)** | (0.0423)** | (0.0138)** | (0.0127)** |
| x TR | (0.8369) | | | | | | | |
| Outbound FDI | 0.1599 | Total FDI | -0.8159 | -0.6275 | -0.6106 | -0.4787 | -0.1795 | -0.1239 |
| | (0.1596) | x TR | (0.1726)** | (0.1636)** | (0.1515)** | (0.1213)** | (0.0515)** | (0.0384)** |
| Outbound FDI | -0.4401 | | | | | | | |
| x TR | (0.6538) | | | | | | | |
| GDP | 0.0000 | | 0.0000 | -0.0000 | -0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | (0.0000) | | (0.0000) | (0.0000) | (0.0000)** | (0.0000) | (0.0000) | (0.0000)** |
| GDP x TR | | | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | | | | (0.0000)** | (0.0000)** | (0.0000)** | (0.0000)** | (0.0000)* |
| Constant | 0.0199 | | 0.0180 | -0.1466 | -0.1230 | -0.2741 | 0.0115 | -0.0601 |
| | (0.0883) | | (0.0820) | (0.1095) | (0.0598)* | (0.1117)* | (0.0361) | (0.0364) |
| Observations | 215 | | 215 | 215 | 283 | 226 | 215 | 226 |
| No. of countries | 15 | | 15 | 15 | 18 | 16 | 15 | 16 |
| R-squared | 0.72 | | 0.72 | 0.74 | 0.71 | 0.76 | 0.63 | 0.64 |

Notes: Dependent variables are tax base (columns 1-5) and tax revenue (columns 6 and 7), both measured as a fraction of GDP. All specifications use year and country fixed effects. Robust standard errors in parentheses, * significant at 5%; ** significant at 1%. Corporate value added, gross operating surplus and FDI are measured as a fraction of GDP as well. TR stands for EATR or the statutory tax rate, respectively; see column headline.

Columns 4 to 7 include some robustness checks. In column 4, we repeat the regression without the corporate value added of which we only have data for a

limited number of countries and periods. The number of observations is increased to 283. The results remain stable, though. In column 4 we use the statutory tax rate as a control variable and as interaction variable. The results are qualitatively the same; the statutory tax rate at which the contribution of FDI to the tax base becomes zero is equal to 36%. Germany and the USA are above this level, the UK and France are beneath.

In columns 6 and 7, tax revenues are used as a dependent variable and are regressed, and the tax variable is the EATR and the statutory tax rate, respectively. The results are qualitatively and quantitatively very similar. The tax indicators at which FDI does not contribute to tax revenues anymore is 29.6% and 36.6%, respectively.

## 3.5 Discussion and concluding remarks

The main contribution of this chapter is to relax the assumption that foreign direct investment of multinational firms only affects profits at the investment location itself. We introduce investment projects that yield profit changes at the investment *and* the investor's location. Therefore, the marginal profit level at the investment location does not need to be equal to the cost of capital as defined in the usual way. Depending on the profit change at the investor's location, it can be higher or lower.

Our analysis implies that there is a dimension of capital flows which is largely neglected by the standard model: the quality dimension. With negative local profits generated by marginal projects, higher inbound investment may reduce the domestic tax base. This is confirmed by the evidence presented in this chapter. Using aggregate investment and tax revenue data, we find that, on average, high-tax countries lose tax revenue in response to incoming FDI while low-tax countries gain tax revenue. We calculate a break-even effective average tax rate of 30 per cent at which the contribution of an additional unit of FDI has a zero impact on tax revenues. Above this rate, incoming FDI decreases tax revenues.

The idea that higher taxes reduce the tax base is familiar from studies on tax induced profit-shifting. These studies argue that firms react to international tax differences by shifting book profits from high tax countries to low tax countries by

means of transfer pricing or intra firm debt contracts, so that reported profits are lower in high tax countries. Our theory, in contrast, explains these differences as a result of tax induced project selection. This does not stand in direct opposition to the profit-shifting story, it rather offers a complementary explanation. However, accounting for project selection, as opposed to profit-shifting, may have important consequences for empirical estimations on the one hand and policy recommendations on the other hand.

Firstly, a large part of the empirical literature on profit-shifting starts from the observation that profitability is higher in low-tax affiliates than in high-tax affiliates. These tax-related differences are interpreted as a result of profit-shifting, see e.g. Grubert and Mutti (1991), Hines and Rice (1994), Huizinga and Laeven (2007) and Weichenrieder (2007). Accounting for project selection as an alternative explanation suggests that associating all tax-related profitability differences solely with profit-shifting activities will overestimate its importance. Project selection therefore is a possible explanation for the puzzle that international profit-shifting is large when measured through cross-country profitability differences, as in Huizinga and Laeven (2007), but small when the use of profit-shifting instruments is considered. E.g., Laeven, Nicodème and Huizinga (2007) and Buettner and Wamser (2007) show that taxes only have a small impact on the use of intra-firm loans. With regard to transfer pricing, the evidence is rather mixed. Whereas Swenson (2001) only finds a small impact of taxes on trade prices, Clausing (2003) reports a considerable influence. In contrast, tax practitioners report that the use of transfer pricing is substantially limited by legal provisions of the high-tax countries.

Clearly, the empirical analysis presented in the chapter does not provide evidence in favour of project selection as opposed to profit-shifting. Even though it would be highly desirable, it seems hard to test empirically which part of the tax driven profitability differences is due to profit-shifting and which part is explained by real economic effects.

Secondly, when it comes to policy implications, it is important to know whether profitability differences are due to profit-shifting or project selection. If we interpret all tax induced profitability differences as a result of profit-shifting, it is natural to conclude that anti tax avoidance measures like e.g. transfer pricing documentation requirements or thin capitalization rules may increase corporate

tax revenues. But if the composition effect partly explains these differences, the revenue raising potential of measures directed against the shifting of book profits is overestimated. Given that these policies may imply substantial costs and distortions of firm behavior, a misinterpretation of the data may lead to unnecessary welfare losses.

Another important implication of our analysis is that, if marginal profits are allowed to be negative, then the effects of tax changes on the *quantity* of investment can be reversed: Higher taxes may attract more investment, lower taxes may deter investment. From 1990 to 2000, Germany increased its stock of foreign held capital by about 520% (source: OECD) and performed much better in attracting foreign FDI than the UK (115%), France (205%), the US (180%) or Japan (410%). The standard way of reading these figures is that Germany attracted FDI *despite* its relatively high tax rates (before the tax reform in 2001, the corporate tax rates in Germany were between 52% and 58% and thus among the highest throughout the developed world). Our model provides an argument for a different interpretation: It could be that Germany attracted as much FDI *because* of its high tax rates.

A broader issue raised by our analysis is that, from the perspective of a host country, not every kind of inbound FDI is desirable. The quality dimension emphasized in our model suggests that there might be "good" types of inbound investment projects (those which increase production, employment and tax payments) and "bad" types (those which decrease activity and tax payments). Our model thus makes a first step towards providing a rationale for the skepticism towards certain types of foreign inbound investment which has always been present in the public debate.

Our model shows that more inbound investment can lead to smaller domestic tax bases. This may explain why inbound investment - especially in the form of m&a - is often regarded as not very attractive from the public point of view. But our model also shows that high taxes attract this kind of harmful investment projects. Thus, if our model captures some aspects of the real world, then tax policy makers should not promise *more* investment inflows in response to a possible tax cut but *different* investment inflows.

## 3.6 Appendix

This appendix derives equations (3.19) and (3.20). The partial derivative of welfare with respect to $\tau$ is given by

$$\frac{\partial W}{\partial \tau} = (H'-1)\int_{\Delta^-}^{\Delta^+}\int_{\Phi^{*c}}^{\Phi^{*+}} \Delta d\Phi^* d\Delta - \rho\int_{\Delta^-}^{\Delta^+} \frac{\Delta}{1-\tau^*} d\Delta - \tau H'\left[\int_{\Delta^-}^{\Delta^+} \frac{\Delta}{1-\tau^*}\Delta d\Delta\right]$$

where we have used $\frac{\partial \Phi^{*c}}{\partial \tau} = \frac{\Delta}{1-\tau^*}$. Taking the change in the price of capital into account, the total tax effect is $\frac{dW}{d\tau} = W_\tau + W_\rho \rho_\tau$. Where as $\rho_\tau$ is given in the text in equation (3.6), $W_\rho$ is equal to

$$\frac{W}{\rho} = -\frac{\rho}{1-\tau^*} - H'\frac{\tau}{1-\tau^*}\int_{\Delta^-}^{\Delta^+} \Delta d\Delta$$

using $\frac{\partial \Phi^{*c}}{\partial \rho} = \frac{1}{1-\tau^*}$. It follows that $\frac{dW}{d\tau}$ can be expressed as

$$\frac{dW}{d\tau} = (H'-1)\int_{\Delta^-}^{\Delta^+}\int_{\Phi^{*c}}^{\Phi^{*+}} \Delta d\Phi^* d\Delta - \frac{\tau}{1-\tau^*}H'\left[\int_{\Delta^-}^{\Delta^+} \Delta^2 d\Delta - \left(\int_{\Delta^-}^{\Delta^+} \Delta d\Delta\right)^2\right]$$

Now, consider the partial derivative of $W$ with respect to the foreign tax rate $\tau^*$:

$$\frac{\partial W}{\partial \tau^*} = -\int_{\Delta^-}^{\Delta^+}\int_{\Phi^{*c}}^{\Phi^{*+}} [\Phi^*]\, d\Phi^* d\Delta - \rho\int_{\Delta^-}^{\Delta^+} \frac{\Phi^{*c}}{1-\tau^*} d\Delta - H'\left[\tau\int_{\Delta^-}^{\Delta^+} \frac{\Phi^{*c}}{1-\tau^*}\Delta d\Delta\right]$$

where we used $\frac{\partial \Phi^{*c}}{\partial \tau^*} = \frac{\Phi^{*c}}{1-\tau^*}$. Again, the total tax effect is equal to $\frac{dW}{d\tau^*} = W_{\tau^*} + W_\rho \rho_{\tau^*}$ or

$$\frac{dW}{d\tau^*} = -\int_{\Delta^-}^{\Delta^+}\int_{\Phi^{*c}}^{\Phi^{*+}} \Phi^* d\Phi^* d\Delta - H'\frac{\tau}{1-\tau^*}\left[\int_{\Delta^-}^{\Delta^+} \Phi^{*c}\Delta d\Delta - \int_{\Delta^-}^{\Delta^+} \Delta d\Delta \int_{\Delta^-}^{\Delta^+} \Phi^{*c} d\Delta\right]$$

# Chapter 4

# Heterogeneous profit-shifting

*If tax rates cuts are not available as a policy instrument to attract mobile capital, governments can lower the level of tax enforcement in order to reduce the effective tax burden on multinational enterprises. In this chapter, optimal enforcement policy is reconsidered in the presence of heterogeneity in tax avoidance opportunities. It is shown that, under certain circumstances, governments have an incentive to choose inefficiently high levels of tax enforcement. The reason is that an individual government does not take into account that the tax avoiding multinational reacts to higher enforcement by increasing investment in the foreign country, thereby crowding out investment of other firms and effectively reducing the foreign tax base.*[1]

## 4.1 Introduction

Slowly but steadily, political pressure for harmonized corporate taxation within the European Union increases. The question arises what happens if tax rates are harmonized while enforcement policies remain uncoordinated. The standard view, firstly expressed by Cremer and Gahvari (2000), suggests that tax competition is reintroduced *"through the backdoor"* which implies that equilibrium enforcement is inefficiently low. In this chapter, we review the existing arguments on the efficiency properties of uncoordinated enforcement policies and add a complementary

[1] This chapter is based on Becker (2007).

argument stating that, under certain circumstances, uncoordinated policies lead to inefficiently high levels of enforcement.

Tax enforcement is necessary because tax authorities have to rely on what companies report as their taxable income. The complexity of the tax law, the tax advisors' creativity and the fact that many transactions are not observable for tax authorities make it possible that reported income deviates substantially from 'true' income. It is generally assumed that cross-border transactions multiply the tax avoidance opportunities. Above all, this means access to tax havens which requires a multinational firm structure. Tax havens are generally not used as a location for real investment, they rather serve as pass-through entities whose sole task is to reduce the tax payments of MNEs in their main location.

The use of tax havens may be the most important means by which corporations avoid (or evade) taxes. But, in the context of this chapter (and most contributions in this field) tax havens are equivalent to other means of avoidance like the use of black market, legal loopholes, simple underreporting etc. Therefore, the following analysis on optimal enforcement or shutting down of tax havens can (and should be) translated into the general issue of restricting corporate tax avoidance.

The discussion on competition over enforcement policies (i.e. shutting down tax havens) have been fueled by two recent strands of literature which Slemrod and Wilson (2006) call the *tax-havens-are-good*-literature. Firstly, empirical studies e.g. by Desai, Foley & Hines (2006a,b) show that multinational firms increase their non-haven investment in response to tax haven investments. This raises the question whether restriction of tax haven access from the perspective of an individual country is truly desirable. Secondly, a recent contribution by Hong and Smart (2007) claims that the existence of tax havens may paradoxically mitigate tax competition pressure, and partial access to tax havens may be welfare-enhancing. This opens the question whether more enforcement is desirable from a world point of view.

We will proceed as follows. In the next subchapter, we briefly review the literature and the standard arguments on the efficiency and welfare properties of uncoordinated enforcement activities. In subchapter 4.3, we present a model with heterogeneous firms. Several cases are considered which allow analysing what determines an efficient enforcement equilibrium or under- or overenforcement.

Subchapter 4.4 considers some model extensions. Subchapter 4.5 discusses the results and concludes.

## 4.2 The literature

### 4.2.1 Corporate tax avoidance, profit-shifting and tax havens from the empirical perspective

Slemrod (2001) establishes a "trichotomy" of corporate behavioral responses to taxation. The first type of response is timing of transaction, the second type is accounting which includes the manipulation of book profits, the third type is finally real decisions taking the form of investment, employment etc. Due to the nature of tax avoidance, the direct observation of choices aiming at reducing the tax burden is hard if not impossible. Therefore, most studies concentrate just on a subset of tax avoidance instruments. In the context of this chapter, cross-border profit-shifting and the use of tax havens are of greatest importance.

Generally spoken, multinational firms are able to declare profits in some jurisdiction where taxes are lower (or even zero) than in the location where profits are generated (and where they should be declared from an economic point of view). In principle, this kind of profit-shifting may occur in all situations where the MNE has access to two different locations with a non-zero difference in tax rates.

The importance of international income shifting is documented by a growing empirical literature, see e.g. Grubert and Mutti (1991), Hines and Rice (1994) as well as the recent contributions by Huizinga and Laeven (2007) and Weichenrieder (2007). Since profit-shifting as a corporate choice has already been discussed in chapter 3, it suffices to state that all these studies find a significant and economically substantial impact of taxation on the location of profits. Recent initiatives of the European Commission to implement a system of formula apportionment as well as national measures taken to prevent profit-shifting (like thin capitalization rules) show that also policy-makers believe that corporate tax avoidance through cross-border channels is an issue.

An especially aggressive kind of profit-shifting occurs when the MNE invests in a location and the only purpose of this investment is to prepare profit-shifting. If

the location supports this kind of investment, it is called a "tax haven".[2] Depending on the definition, the number of tax havens is somewhere in the neighbourhood of 40, see Dharmapala and Hines (2006). These countries receive extensive foreign investment and have experienced rapid economic growth over the past 25 years, see Hines (2005). Desai et al. (2006b) analyze which firms seek tax haven access, i.e. the demand for tax havens, whereas Dharmapala and Hines (2006) deal with the supply of tax haven services by asking "*which countries become tax havens*". In the last decade, the OECD and the European Union have taken various measures to limit the extent to which multinational firms use tax havens. The current debate hints at the remaining scope for both international organizations and individual countries to take action against this kind of cross-border tax avoidance.

### 4.2.2 Tax havens are bad (or aren't they?)

Tax havens attract substantial amounts of foreign direct investment. Even if this capital is only passed through the tax haven and the real investment projects are realized in other locations, there will be transaction costs involved which would not be there in the absence of taxes. Thus, it seems obvious that the existence of tax havens is detrimental with regard to efficiency and welfare. The incentives for an individual country to shut down tax havens are potentially limited, as will be discussed below, but it seems clear that an obvious policy recommendation for the group of all non-haven countries is to eliminate all access to tax havens. Accordingly, the existence of tax havens may be interpreted as reflecting the inability of non-haven countries to cooperate or the existence of costs of shutting down tax havens. But, nevertheless, this does not alter the view that tax havens as such reduce world welfare.

Recently, Hong and Smart (2007) questioned this consensus upon tax havens. They apply an argument firstly developed by Keen (2001) in a slightly different context and ask whether it is desirable to coordinate on shutting down all tax

[2] Whereas the OECD is more concerned about information exchange and transparency in its definition of tax havens, see www.oecd.org/ctp/htp, Desai, Foley and Hines (2006b) define tax havens as "*low-tax jurisdictions that provide investors opportunities for tax avoidance.*" (p. 514) In this chapter, I adopt this simple definition by assuming that tax havens are countries with zero taxes.

havens when coordination on tax rates fails. Under rather restrictive assumptions[3], they show that tax havens relax the pressure of tax competition on tax rates. The reason is that allowing for tax haven access leads to an effective discrimination between the immobile and the mobile sectors, allows for higher effective taxation of immobile firms and thus mitigates the underprovision of public goods.

The argument brought forward by Hong and Smart (2007) has been criticized by two papers. Slemrod and Wilson (2006) show in a different framework that it is always optimal to shut down some tax havens. Bucovetsky and Haufler (forthcoming) hint at potential distortions which may arise from loopholes for multinational firms. If firms decide on their organizational form, i.e. whether being a multinational or a national company, these loopholes may lead to an excessive number of multinational firms and efficiency losses.

### 4.2.3 The efficiency properties of uncoordinated enforcement policies

This chapter contributes to the discussion of the efficiency properties of uncoordinated enforcement policies.[4] It is useful to start with a review of the arguments concerning efficient or inefficient enforcement by assuming that tax rates are fixed. This may be the case because a subset of countries agreed upon coordination in tax policy or because some other reasons make it impossible to adjust tax rates.[5]

**Argument 1a:** Assume that the firm's decisions on optimal investment and optimal profit-shifting do not depend on each other. Then, if profits are shifted towards a jurisdiction with positive tax rates, enforcement may be excessively high. The reason is that the government does not take into account that profit-shifting generates a positive fiscal externality on the other country's tax revenue.

[3] The authors assume that the corporate tax applies for two sectors. In the internationally immobile sector, capital stocks are fixed which implies an optimal tax rate of 100 per cent. This means, though, that the capital return may fall beneath the world market interest rate which will not be sustainable in the presence of positive rates of economic depreciation.

[4] Enforcement issues in general are discussed in Cowell (2004) and Slemrod (2004b).

[5] As the analysis in Hong and Smart (2007) shows, a simultaneous determination of tax rates and enforcement levels only yields unambiguous results at the price of relatively strong assumptions. Therefore, the analysis in this chapter has to be interpreted for the case of harmonized tax rates.

If the other country, or tax haven, has zero tax rates, this externality is zero and enforcement is efficient.

**Argument 1b:** Under formula apportionment, enforcement may be too low because of the positive effect on the overall tax base which is distributed among member countries. The common tax base is some kind of public good where an individual country can free-ride on without contributing through increased enforcement, see Becker and Fuest (2007c). The same argument can be made for federal systems in which tax revenues have to be shared with other government tiers, see Stöwhase and Traxler (2005). In both of these cases, the return to enforcement has to be shared with other jurisdictional entities whereas the cost of enforcement has to be born solely by the enforcing entity itself.

**Argument 2** Assume that tax haven use affects the cost of capital, as it has firstly been analyzed by Grubert and Slemrod (1998). Alternatively, assume that firms or projects are mobile, what Devereux and Griffith (2003) call "*discrete*" investment choices. In both cases, the restriction of tax haven use will affect investment since effective tax rates are increased. Then, the standard tax competition argument applies: Effective tax rates, i.e. enforcement, may be too low because of the positive externalities of taxation on the other country's welfare, see Cremer and Gahvari (2000) for the general argument and Peralta, Wauthy and Ypersele (2006) as well as Hong and Smart (2007) for an application to corporate taxes. Grubert and Slemrod (1998) as well as Mintz and Smart (2004) provide empirical evidence that the opportunity of income shifting affects the volume and the direction of investment. Desai, Foley and Hines (2006a) show that granting access to tax havens increases domestic investment of US multinational firms.

**Argument 3** If tax havens services face increasing marginal cost curves, as assumed by Slemrod and Wilson (2006), then enforcement will be too high. The reason is that the individual small country does not take into account that its enforcement lowers the demand for tax haven services. Lower demand means reduced prices and an increase in demand for tax haven services in all other non-haven countries. Enforcement therefore has a negative external effect which implies

inefficiently high enforcement levels in the non-cooperative equilibrium.

**Argument 4** If some firms are owned by foreigners, there is an additional reason why governments should increase enforcement since the increased tax burden is partially born by foreigners. This argument, firstly developed by Huizinga and Nielsen (1997), can be combined with the former three arguments which implies that enforcement becomes inefficiently high(er) where it is efficient or already too high, and inefficiently low(er) where it is too low in the absence of foreign firm ownership.

### 4.2.4 The contribution of this chapter

The contribution of this chapter starts with the observation reported by Desai et al. (2006a) who ask whether "*tax havens divert economic activity*" from non-havens. Using US firm-level data, they find that US investment increases in response to tax haven investment. The authors do not draw welfare conclusions but the evidence seems to suggest that the worst concerns are not justified by the data. However, assuming that the world capital stock is fixed, the increase in haven-using MNE investment necessarily implies a reduction in investment of some other firm in some (other) jurisdiction. With uncoordinated policies, the question of who reduces activity where is of crucial importance.

In this chapter, we present a model in which firms have heterogeneous access to a tax haven, i.e. in the stylized model, one firm has access, the other has none. Due to general equilibrium effects, giving access to tax havens reduces investment by the non-haven-related MNE. We show that it depends on the relative profitability of the marginal investment how this policy has to be evaluated in terms of welfare.

With regard to the preceding subchapter, this chapter contributes the argument that enforcement may be too high because it drives out investment of the firm that has access to the tax haven and thus increases haven-related investment in the other country. By increasing enforcement, both countries try to increase the quality of their investment, where good quality investment means non-haven related investment. Since - by assumption - overall quality is fixed, the increase in quality has a negative externality on the other country's quality or welfare,

respectively. Therefore, overall enforcement levels are too high.

## 4.3 The model

In this subchapter, we present the model (4.3.1). Then, optimal enforcement is considered for the general case (4.3.2) and four variants of the model (4.3.3 - 4.3.6).

### 4.3.1 The setup

Consider a world with two identical countries, called the domestic and the foreign country, and a tax haven. The domestic and the foreign country are investment locations, the tax haven only serves as a pass-through entity for shielding income from tax.

In the domestic (foreign) country, there is a representative household owning a fraction $\gamma$ $(1-\gamma)$ of the firm population in both countries. Moreover, the household has a fixed labor supply of $L$ $(L^*)$. The reservation wage is zero. The asterisk denotes the foreign country. Thus, the consumption $C$ of the domestic household is given by

$$C = \gamma\left(\Pi + \Pi^*\right) + wL \tag{4.1}$$

where $\Pi$ and are $\Pi^*$ are total after-tax firm profits in the domestic and the foreign country, respectively, and $w$ is the domestic wage rate. Equivalently, the foreign household's consumption is given by

$$C^* = (1-\gamma)\left(\Pi + \Pi^*\right) + w^*L^* \tag{4.2}$$

Assume that there are two representative firms which consider investment projects in the domestic and the foreign location. The number of projects of both firms is limited. Whether all projects are realized or not depends on the quality of the other firm's projects, taxes, access to tax havens and so on. These firms consider projects which yield a location-specific profit of $\pi^i \in \{\pi^{i-}, \pi^{i+}\}$ and $\pi^{*i} \in \{\pi^{*i-}, \pi^{*i+}\}$, respectively, with $i = 1, 2$. Each project requires an input of one unit of labor. Labor cost is denoted by $w$ and is deductible from the corporate tax base. The assumption of fixed labour supply implies that the overall number

of projects in each country is fixed. As in Chapter 3, tax competition will therefore affect the quality but not the quantity of projects.[6]

The two firms differ in the access to tax havens. Firm 1 has access to tax havens which means that it shifts a fraction $a$ of its profits to the tax haven from which it can be costlessly repatriated. Profit-shifting generates a cost $c(a)$ with $c', c'' > 0$. Firm 2 has no access to the tax haven.

After-tax profits are thus given by

$$\Pi^i = \left(\pi^i - w\right)(1-\tau) + \tau a^i - c\left(a^i\right) \quad \text{for } i = 1,2 \tag{4.3}$$

where $a^2 = 0$. Projects abroad yield

$$\Pi^{*i} = \left(\pi^{*i} - w^*\right)(1-\tau) + \tau a^{*i} - c\left(a^{*i}\right) \quad \text{for } i = 1,2 \tag{4.4}$$

where $a^{*2} = 0$. The marginal project satisfies $\Pi^i_c = 0$ or $\Pi^i_c = \Pi^{*i}_c$, depending on whether the firm can realize just a subset or all of its projects. The marginal project $\pi^i_c$ satisfies

$$\pi^i_c - w + \frac{(\tau a^i - c(a))}{1-\tau} = \max\left\{0, \pi^{*i}_c - w^* + \frac{\tau a^{i*} - c(a^{i*})}{1-\tau}\right\} \tag{4.5}$$

In the former case, the firm stops investing when net profits are zero. In the latter case, the firm equalizes net profits in both countries. Note that in the presence of profit-shifting, the marginal investment, $\Pi^1_c = 0$, implies that the marginal pretax profit, $\pi^1_c$, is below the wage payment $w$: $\pi^i_c - w = -\frac{\left(\tau a^i - c(a)\right)}{1-\tau}$. This is due to the assumption that the opportunity of profit-shifting is project related. A similar idea of modelling this can be found in Grubert & Slemrod (1998) where the "*avoidance adjusted cost of capital*" may fall below the world market interest rate. This assumption implies that, next to the project yield, there is some other positive income, against which project-specific tax savings can be credited. In an

[6] Note that there is no capital in this model, at least not as an explicit model parameter. However, the model can be reinterpreted as follows: Firms are endowed with firm-specific capital which is already invested and needs a unit of labor to become productive. The heterogeneity in $\pi$ and $\pi^*$ may be generated by different endowments of firm-specific capital or differences in capital quality. In such a model, the overall stock of capital is not fixed, it rather depends on the structure of the firm population which itself depends on taxes, wages etc.

extension, we consider the case in which tax payments per project are bound to be non-negative.

In both countries, there is a benevolent government which is assumed to maximize its residents' utility. It has two policy instruments, the corporate tax rate $\tau$ and a policy variable $\alpha$ which regulates the access to tax havens. By setting $\alpha$, the government defines an upper bound to the tax haven access $a$ chosen by the multinational firm. We consider two cases. Firstly, optimal tax haven policies are derived assuming that $\alpha$ can be set costlessly. Secondly, we account for the more plausible case that restricting the access to tax havens is costly. The government has to invest $\theta$ in order to reduce tax haven access according to a function $\alpha(\theta)$ with $\alpha' < 0 < \alpha''$.

Its budget constraint is therefore given by

$$G = \tau \left[ \int_{\pi_c^1}^{\pi^{1+}} \left(\pi^1 - w - a\right) d\pi^1 + \int_{\pi_c^2}^{\pi^{2+}} \left(\pi^2 - w\right) d\pi^2 \right] - \theta \tag{4.6}$$

where $a$ is the minimum of $\alpha$ or the optimally set $a$ in the absence of tax haven access restrictions.

### 4.3.2 Optimal policy against tax havens

In order to keep the analysis tractable, assume that the foreign and the domestic country form a union with equal tax rates $\tau = \tau^*$. In contrast, enforcement which means the regulation of tax haven access is not coordinated. The benevolent government is supposed to maximize the welfare of its citizens. The representative domestic household receives utility from private consumption $C$ and a publicly provided good $G$. The welfare function is given by $W = U(C) + H(G)$, where $C$ is equal to

$$C = \gamma \left( \int_{\pi_c^1}^{\pi^{1+}} \Pi^1 d\pi^1 + \int_{\pi_c^{*1}}^{\pi^{*1+}} \Pi^{*1} d\pi^{*1} + \int_{\pi_c^2}^{\pi^{2+}} \Pi^2 d\pi^2 + \int_{\pi_c^{*2}}^{\pi^{*2+}} \Pi^{*2} d\pi^{*2} \right) + wL \tag{4.7}$$

The public good $G$ is given in equation (4.6).

Firstly consider that the government maximizes $W$ by costlessly controlling

$\alpha$, assuming that foreign wages and foreign policies are given. In the extensions subchapter, we consider the case in which the government accounts for foreign wage adjustments. How does investment react to changes in enforcement policies? Differentiating the cut-off level $\pi_c^i$ with respect to $\alpha$, $w$, $\pi_c^{*i}$ and $w^*$ gives

$$d\pi_c^i = \frac{\partial \pi_c^i}{\partial \alpha} d\alpha + dw + \frac{\partial \pi_c^i}{\partial \pi_c^{*i}} d\pi_c^{*i} + \frac{\partial \pi_c^i}{\partial w^*} dw^* \quad \text{with } i = 1, 2 \tag{4.8}$$

with $\frac{\partial \pi_c^1}{\partial \alpha} = -\frac{\tau - c'}{1-\tau}$ and $\frac{\partial \pi_c^2}{\partial \alpha} = 0$. Note that $\frac{\partial \pi_c^i}{\partial \pi_c^{*i}}, \frac{\partial \pi_c^i}{\partial w^*} = 0$ if firm $i$ earns zero marginal profits. If the marginal project yields positive profits, an increase in domestic projects implies a reduction of foreign profits, $\frac{\partial \pi_c^i}{\partial \pi_c^{*i}} = -1$, and foreign wages affect the number of domestic projects, $\frac{\partial \pi_c^i}{\partial w^*} = -1$. Thus, the total tax effects depend on the assumptions on the marginal project. This will be discussed in the next subchapters where different sets of assumptions are considered.

Optimal access to tax havens implies $\frac{\partial W}{\partial \alpha} = 0$ with

$$\begin{aligned} \frac{\partial W}{\partial \alpha} \quad = \quad & \gamma U' \int (\tau - c')\, d\pi^1 - H' \int \tau d\pi^1 + \left( (1-\gamma)(1-\tau) U' - \tau (H' - U') \right) \frac{\partial w}{\partial \alpha} L \\ & - H' \left[ \tau \left( \pi_c^1 - w - a \right) \frac{d\pi_c^1}{d\alpha} + \tau \left( \pi_c^2 - w \right) \frac{d\pi_c^2}{d\alpha} \right] \end{aligned} \tag{4.9}$$

The first two terms on the right hand side include the net private gain from profit-shifting and the loss in tax revenue. Even with full domestic ownership of all firms, $\gamma = 1$, these two terms are negative, given that $H' \geq U'$. The third term represents the welfare effect of wage responses to increased tax haven access. On the one hand, with $\gamma < 1$, there is a net gain from a wage increase because part of the wage cost increase is born by foreign firms. On the other hand, if public goods are underprovided, $H' > U'$, then the increased deduction in response to increased wages implies a welfare loss because tax revenue is c.p. decreased. In the following, we will assume that

$$\tau < \frac{(1-\gamma) U'}{H' - U' + (1-\gamma) U'} \tag{4.10}$$

holds, which implies that the third term has the same sign as the wage rate response to an increase in $\alpha$: $\frac{\partial w}{\partial \alpha}$. If public goods underprovision gets less important,

$H' - U' \longrightarrow 0$, then the required $\tau$ approaches a maximum of 100%. The fourth term denotes the welfare effect due to a change in the tax base size.

If there is no enforcement, firms choose a level of shifting which satisfies $\tau = c'$. It follows that $\frac{\partial \pi_c^1}{\partial \alpha} = \frac{\partial \pi_c^2}{\partial \alpha} = 0$, and accordingly, $\frac{\partial w}{\partial \alpha} = \frac{\partial w^*}{\partial \alpha} = 0$. Equation (4.9) then boils down to

$$\frac{\partial W}{\partial \alpha} = -H' \int \tau d\pi^1 < 0 \tag{4.11}$$

This implies that governments have always the incentive to shut down some tax havens. Whether it is desirable to shut down all tax haven access will be analyzed in the different scenarios later on.

What are the effects of foreign policies on domestic welfare?

$$\begin{aligned} \frac{\partial W}{\partial \alpha^*} &= U'\gamma \int (\tau^* - c^{*\prime})\, d\pi^{*1} + (U'(1-\tau) - \tau(H' - U'))\, \frac{\partial w}{\partial \alpha^*} L \\ &\quad -H' \left[ \tau \left( \pi_c^1 - w - a \right) \frac{d\pi_c^1}{d\alpha^*} + \tau \left( \pi_c^2 - w \right) \frac{d\pi_c^2}{d\alpha^*} \right] \end{aligned} \tag{4.12}$$

The first term on the r.h.s. is positive and reflects the welfare gain due to increased foreign income through an easier access to tax havens. The second term represents the welfare effect of wage changes. This effect has the same sign as the wage change if

$$\tau < \frac{U'}{H'} \tag{4.13}$$

which is identical to the restriction in (4.10) for $\gamma = 0$ and therefore larger, i.e. less binding. The third term denotes the welfare effect due to a change in the tax base size in response to changes in the foreign access to tax havens.

Now, turn to the more plausible case that the restriction of the access to tax havens has some cost. Optimal choice of $\theta$ implies

$$\frac{\partial W}{\partial \theta} = \frac{\partial W}{\partial \alpha} \frac{\partial \alpha}{\partial \theta} - 1 = 0 \tag{4.14}$$

This implies that in the presence of an interior solution, the marginal welfare effect of restricting tax haven access is positive, $\frac{\partial W}{\partial \alpha} = \left( \frac{\partial \alpha}{\partial \theta} \right)^{-1} < 0$.

A coordinated increase in the expenditures for tax haven restrictions has the

following effect on domestic welfare:

$$\frac{\partial W}{\partial \bar{\theta}} = \underbrace{\frac{\partial W}{\partial a}\frac{\partial \alpha}{\partial \theta} - 1}_{=0} + \frac{\partial W}{\partial \alpha^*}\frac{\partial \alpha^*}{\partial \theta^*} = \frac{\partial W}{\partial \alpha^*}\frac{\partial \alpha^*}{\partial \theta^*} \tag{4.15}$$

where $\bar{\theta}$ is the coordinated enforcement level.

In the following, we will consider four different scenarios which correspond to four different stories about multinational investment, profit-shifting and enforcement. It will be shown that the welfare implications differ substantially across scenarios. Figure 4-1 summarizes the different scenarios. Each diagram has labor on the abscissa and profits $\pi$ and wages on the ordinate. Profits of firm 1 are depicted on the left ordinate, profits of firm 2 on the right ordinate. In scenario 1, both firms do not realize all of their projects, i.e. both have marginal projects with zero profits (see left hand graph in Figure 4-1). Scenario 2 assumes that the haven-related firm realizes all of its projects, i.e. at the margin, the projects yield a positive after-tax profit which is equal in both locations. In scenario 3, the equivalent case for the non-haven related firm is discussed. Scenario 4 implies zero wages because some labor remains unemployed; both firms have marginal projects with positive profits.

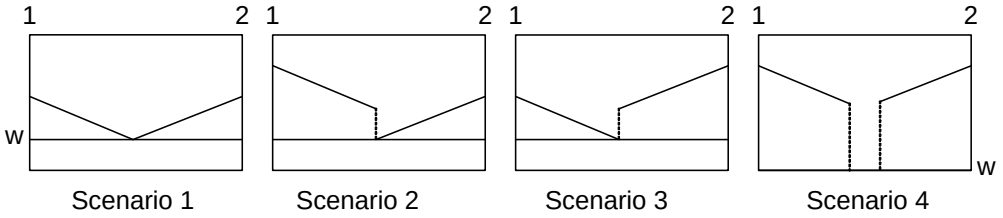


Figure 4-1 - Four scenarios

### 4.3.3 Scenario 1: Both firms have marginal profits of zero

Consider firstly the case in which both firms do not realize all of their projects since some of them yield a negative profit. This means that, for both firms, the marginal project yields a profit of zero:

$$\pi_c^1 - w + \frac{\tau a - c(a)}{1-\tau} = 0 \quad \text{and} \quad \pi_c^2 - w = 0 \tag{4.16}$$

In the appendix, it is shown that in this case wages respond to an increase in $\alpha$ according to $\frac{\partial w}{\partial \alpha} = -\frac{1}{2}\frac{\partial \pi_c^i}{\partial \alpha}$. Therefore, total tax effects according to (4.8) are

$$\frac{d\pi_c^1}{d\alpha} = \frac{1}{2}\frac{\partial \pi_c^1}{\partial \alpha} \quad \text{and} \quad \frac{d\pi_c^2}{d\alpha} = -\frac{1}{2}\frac{\partial \pi_c^1}{\partial \alpha} \tag{4.17}$$

with $\frac{\partial \pi_c^1}{\partial \alpha} = -\frac{\tau - c'}{1-\tau}$. Optimal access to tax havens is implied by $\frac{\partial W}{\partial \alpha} = 0$ with

$$\begin{aligned} \frac{\partial W}{\partial \alpha} &= -H' \int \tau d\pi^1 + U'\gamma \int (\tau - c')\, d\pi^1 + \left(U'(1-\gamma)(1-\tau) - \tau\left(H' - U'\right)\right)\frac{\partial w}{\partial \alpha} L \\ &\quad -H'\tau\left[\pi_c^1 - w - a\right]\frac{d\pi_c^1}{d\alpha} \end{aligned} \tag{4.18}$$

where we used $\frac{d\pi_c^1}{d\alpha} = -\frac{d\pi_c^2}{d\alpha}$ and $\pi_c^2 - w = 0$. As indicated above, the first two terms are negative in sum, and the marginal tax base is negative, too, $\pi_c^1 - w - a < 0$. In contrast, there is a welfare gain from increased wages if (4.10) holds. If this countervailing effect is dominated by the negative effects of increasing $\alpha$, the optimal policy is therefore to set $\alpha = 0$. If tax haven access is free and firms choose $a$ without restriction, equation (4.18) boils down to $\frac{\partial W}{\partial a} = -H' \int \tau d\pi_i^m < 0$. That means, it is always welfare-enhancing to partially decrease tax haven access, cf. Slemrod and Wilson (2006).

What are the effects of foreign policies on domestic welfare?

$$\frac{\partial W}{\partial \alpha^*} = U'\gamma \int (\tau^* - c^{*\prime})\, d\pi^{*1} \tag{4.19}$$

In the presence of domestic ownership of foreign firms, $\gamma > 0$, granting access to the tax haven has a positive external effect on welfare. If enforcement is costly, that means that enforcement is excessively high. Coordination on enforcement policies would imply a reduction in $\theta$ and $\theta^*$:

$$\frac{\partial W}{\partial \bar{\theta}} = \frac{\partial W}{\partial \alpha^*}\frac{\partial \alpha^*}{\partial \theta^*} < 0 \tag{4.20}$$

Note that this is only true for the case of costly enforcement which ensures an optimal level of $\alpha$ for which $\frac{\partial W}{\partial \theta} = 0$. Since, even at $\alpha = 0$, $\frac{\partial W}{\partial a} < 0$, coordination policies would not imply an increase in $\alpha$: $\frac{\partial W}{\partial \alpha} + \frac{\partial W^*}{\partial \alpha} < 0$ which follows from (4.18)

and (4.19).

### 4.3.4 Scenario 2: Haven-MNE earns super-normal marginal profits

Now, assume that the firm with access to the tax haven realizes all of its projects. That means that, at the margin, it equalizes profits at home and abroad. In contrast, the second firm invests until the marginal profit is equal to zero.

$$\pi_c^1 - w - \frac{\tau a - c(a)}{1-\tau} = \pi_c^{*i} - w^* + \frac{\tau a^* - c(a^*)}{1-\tau} \quad \text{and} \quad \pi_c^2 - w = 0 \tag{4.21}$$

In the appendix, we show that $\frac{dw}{d\alpha} = -\frac{2}{3}\frac{\partial \pi_c^1}{\partial \alpha} = -\frac{dw^*}{d\alpha}$. This implies that total tax effects are given by

$$\frac{d\pi_c^1}{d\alpha} = \frac{2}{3}\frac{\partial \pi_c^1}{\partial \alpha} = -\frac{d\pi_c^2}{d\alpha} \tag{4.22}$$

Optimal access to tax havens is implied by $\frac{\partial W}{\partial \alpha} = 0$ which is given in (4.18). As a difference, the change in the tax base, $\pi_c^1 - w - a$, may now be positive. The domestic government now faces the trade-off between a reduction in the tax base due to increased profit-shifting and an increase in the tax base due to the higher number of profitable projects. Thus, it becomes possible that the optimal access to tax havens is non-zero: $\alpha > 0$. Such an equilibrium is more probable for very high levels of tax base changes. We may therefore state

**Proposition 7** *For large values of the marginal change in tax base, $\pi_c^1 - w - a$, it may be in the interest of the domestic country to partially grant access to the tax haven.*

The story of the second scenario is very much in line with some of the discussions in the *"Are tax havens good or bad?"* literature. These debates are centered around the presumption of an empirical correlation between profitability and the access to tax havens. If highly profitable MNEs are those which have access to and use tax havens, then scenario 2 applies.

What are the effects of restricting tax haven access on the other country's welfare? If the foreign government increases $\alpha^*$ domestic welfare changes according to

$$\begin{aligned}\frac{\partial W}{\partial \alpha^*} &= U'\gamma \int (\tau^* - c^{*\prime})\, d\pi^{*1} + \left(U'(1-\tau) - \tau\left(H' - U'\right)\right) \frac{\partial w}{\partial \alpha^*} L \\ &\quad -H'\tau\left(\pi_c^1 - w - a\right) \frac{d\pi_c^1}{d\alpha^*} \end{aligned} \tag{4.23}$$

In addition to the welfare gain due to domestic ownership of foreign firms (first term), there is a welfare loss due to lower wages, given that (4.13) holds. Furthermore, the tax base change (third term) is negative for positive values of $\pi_c^1 - w - a$ since $\frac{d\pi_c^1}{d\alpha^*} > 0$. If the tax base change is large enough, the whole welfare change becomes negative. Coordination policy would imply an increase in enforcement expenditures $\theta$ and $\theta^*$ because uncoordinated levels are too low due to the positive externality of enforcement. We may therefore state

**Proposition 8** ***Underenforcement as a strategic device:*** *Under tax competition, governments are likely to choose levels of enforcement which are inefficiently low from a union point of view.*

### 4.3.5 Scenario 3: Non-haven-MNE earns super-normal profits

Now, consider the opposite assumption compared to scenario 2. Assume that it is the firm without access to tax havens which chooses between the domestic and the foreign country as a location of its marginal project. In this case, wage effects as derived in the appendix are given by $\frac{dw}{d\alpha} = -\frac{2}{3}\frac{\partial \pi_c^1}{\partial \alpha}$ and $\frac{dw^*}{d\alpha} = -\frac{1}{3}\frac{\partial \pi_c^1}{\partial \alpha}$. Total tax effects are therefore given by

$$\frac{d\pi_c^1}{d\alpha} = \frac{\partial \pi_c^i}{\partial \alpha} - \frac{2}{3}\frac{\partial \pi_c^1}{\partial \alpha} = \frac{1}{3}\frac{\partial \pi_c^1}{\partial \alpha} \tag{4.24}$$

$$\frac{d\pi_c^2}{d\alpha} = -\frac{2}{3}\frac{\partial \pi_c^1}{\partial \alpha} + \frac{1}{3}\frac{\partial \pi_c^1}{\partial \alpha} = -\frac{1}{3}\frac{\partial \pi_c^1}{\partial \alpha} \tag{4.25}$$

The optimal access to tax havens implies

$$\begin{aligned}\frac{\partial W}{\partial \alpha} &= -H' \int \tau d\pi^1 + U'\gamma \int (\tau - c')\, d\pi^1 + \left(U'(1-\gamma)(1-\tau) - \tau\left(H' - U'\right)\right)\frac{\partial w}{\partial \alpha} L \\ &\quad -H'\tau\left[\left(\pi_c^1 - w - a\right) - \left(\pi_c^2 - w\right)\right]\frac{d\pi_c^1}{d\alpha} \qquad (4.26)\end{aligned}$$

The first three terms are the same as in (4.18). With $\pi_c^1 - w - a < 0$ and $\pi_c^2 - w > 0$, the reduction in $\pi_c^1$ through an increase in $\alpha$ reduces the tax base through two channels: It increases the number of "tax-stealing" tax-haven-related projects and reduces the tax paying non-haven-projects.

What are the effects of foreign policies on domestic welfare?

$$\begin{aligned}\frac{\partial W}{\partial \alpha^*} &= U'\gamma \int (\tau^* - c^{*\prime})\, d\pi^{*1} + \left(U'(1-\tau) - \tau\left(H' - U'\right)\right)\frac{\partial w}{\partial \alpha^*} L \\ &\quad +H'\tau\left[\left(\pi_c^1 - w - a\right) - \left(\pi_c^2 - w\right)\right]\frac{d\pi_c^1}{d\alpha} \qquad (4.27)\end{aligned}$$

where we used $\frac{d\pi_c^1}{da^*} = -\frac{d\pi_c^1}{da}$ and $\frac{d\pi_c^2}{da^*} = -\frac{d\pi_c^2}{da}$. With $\frac{\partial w}{\partial a^*} > 0$, and under (4.13), the externality of increasing $\alpha^*$ on domestic welfare is unambiguously positive. That means that increasing $\theta^*$ has a negative externality which leads to inefficiently high levels of enforcement in the uncoordinated equilibrium - even in the absence of domestic ownership of foreign firms:

$$\frac{\partial W}{\partial \bar{\theta}} = \frac{\partial W}{\partial \alpha^*}\frac{\partial \alpha^*}{\partial \theta^*} < 0 \quad \text{for all } \gamma \qquad (4.28)$$

The reason is that each government has an incentive to drive out projects of the firm with tax haven access. But, as the overall number of projects with tax haven access is fixed (by assumption), decreasing the number of domestic projects with tax haven access necessarily increases its number in the foreign country. In other words, the overall quality of investment is constant for the world. We may therefore state

**Proposition 9** ***Overenforcement as a strategic device:*** *If the non-haven-related MNE earns non-zero profits at the margin, the enforcement level, i.e. the measures taken to improve investment quality, is inefficiently high. Coordination*

*on enforcement policies therefore implies a reduction of enforcement expenditures.*

### 4.3.6 Scenario 4: Both MNEs earn super-normal profits

For sake of completeness, consider the case in which both MNEs realize all of their projects. In this case, some labor is unemployed, the wage rate is zero and does not react to changes in the investment level. Optimal access to tax havens is implied by $\frac{\partial W}{\partial \alpha} = 0$ with

$$\frac{\partial W}{\partial \alpha} = -H' \int \tau d\pi^1 + U'\gamma \int (\tau - c')\, d\pi^1 - H'\tau \left[\pi_c^1 - a\right] \frac{d\pi_c^1}{da} \tag{4.29}$$

which is positive for large values of $\pi_c^1 - a$. The external effect is given by

$$\frac{\partial W}{\partial \alpha^*} = U'\gamma \int (\tau^* - c^{*\prime})\, d\pi^{*1} - H'\tau \left(\pi_c^1 - a\right) \frac{d\pi_c^1}{da^*} \tag{4.30}$$

which becomes negative if $\pi_c^1 - a$ is large. Thus, in the absence of wage effects, the underenforcement result applies.

## 4.4 Extensions

In this subchapter, we briefly present the results of the model with slightly modified assumptions. In 4.4.1, we relax the assumption that the domestic government does not take into account that foreign wages adapt to its policy changes. In 4.4.2, we consider the case in which tax payments *per project* are restricted to be non-negative.

### 4.4.1 Large country

If tax competition among large countries instead of small countries is considered, each government will take into account the wage changes in the other country.

Equation (4.9) becomes

$$\begin{aligned}\frac{\partial W}{\partial \alpha} &= \gamma U' \int (\tau - c')\, d\pi^1 - H' \int \tau d\pi^1 + \left[(1-\tau)\, U' - \tau\,(H' - U')\right] \frac{\partial w}{\partial \alpha} L \\ &\quad -H' \left[\tau \left(\pi_c^1 - w - a\right) \frac{d\pi_c^1}{d\alpha} + \tau \left(\pi_c^2 - w\right) \frac{d\pi_c^2}{d\alpha}\right] \end{aligned} \tag{4.31}$$

In qualitative terms, nothing changes so far but the requirement for $\tau$ ensuring that the third term has the same sign as $\frac{\partial w}{\partial \alpha}$ which is given by (4.13).

### 4.4.2 Zero shifting at the margin

If tax payments are bound to be non-negative, it is straight-forward to show that profit-shifting at the margin equals zero:

$$\underbrace{\left(\pi_c^1 - w - a\right)(1-\tau)}_{\lesseqgtr 0} + \underbrace{a - c\,(a)}_{\geq 0} = 0$$

The second term on the left hand side can only be zero if $a = 0$. Assuming this has implications for scenarios 1 and 3. If $a = 0$ at the margin, then changes in $\alpha$ have no effect on wages and tax bases. In both scenarios, the welfare effect of increasing $\alpha$ is changed to

$$\frac{\partial W}{\partial \alpha} = -H' \int \tau d\pi^1 + U'\gamma \int (\tau - c')\, d\pi^1$$

which is unambiguously negative even if the modified integral borders are taken into account. In contrast, the effect of foreign tax haven policies on domestic welfare is given by (4.19), also in scenario 3, and is unambiguously non-negative.

## 4.5 Discussion and concluding remarks

In this chapter, we considered optimal enforcement policy in the presence of heterogeneous multinational firms. We assumed that these firms differ in their access to tax havens. Depending on the characteristics of the firm which has access to tax havens, interjurisdictional competition leads to under- or overenforcement. From

a policy point of view, the results of this chapter suggest that the existence of profit-shifting alone does not justify the concern of underenforcement. It is rather important to know *which* firms engage in profit-shifting and which firms do not.

We showed that it is a crucial aspect of optimal policy consideration whether there is a correlation between profitability and tax haven access. In so far, this chapter is related to chapter 2 in which results are driven by correlations between two types of firm-specific characteristics, like mobility and profitability.

As in chapter 3, policy has an impact on the quality of investment, i.e. in response to a policy reform, some kind of investment is increased, some other is reduced. Whereas in chapter 3, taxation has a positive impact on the quality of investment in the other country, here, the increase of effective taxes on haven-using MNEs may have a negative external effect on the other country's welfare. The reason is that some of the haven-related projects are shifted abroad and erode the foreign tax base. The undertaxation result in the preceding chapter is thus contrasted with the overenforcement result in this chapter.

## 4.6 Appendix

This appendix derives the effects of policy changes with regard to enforcement on the labor markets. Therefore, recall that the amount of labor in the domestic and the foreign country is fixed.

$$\begin{aligned} \int_{\pi_c^1}^{\pi^{1+}} d\pi^1 + \int_{\pi_c^2}^{\pi^{2+}} d\pi^2 &= \bar{L} \\ \int_{\pi_c^{*1}}^{\pi^{*1+}} d\pi^{*1} + \int_{\pi_c^{*2}}^{\pi^{*2+}} d\pi^{*2} &= \bar{L} \end{aligned}$$

Differentiating with respect to $\alpha$, $w$ and $w^*$ gives

$$\left(\frac{\partial \pi_c^1}{\partial \alpha} + \frac{\partial \pi_c^1}{\partial \pi_c^{*1}} \frac{\partial \pi_c^{*1}}{\partial \alpha}\right) d\alpha + \left(\frac{\partial \pi_c^1}{\partial w} + \frac{\partial \pi_c^2}{\partial w}\right) dw + \left(\frac{\partial \pi_c^1}{\partial w^*} + \frac{\partial \pi_c^2}{\partial w^*}\right) dw^* = 0$$

and

$$\left(\frac{\partial \pi_c^{*1}}{\partial \alpha}+\frac{\partial \pi_c^{*1}}{\partial \pi_c^1}\frac{\partial \pi_c^1}{\partial \alpha}\right)d\alpha+\left(\frac{\partial \pi_c^{*1}}{\partial w}+\frac{\partial \pi_c^{*2}}{\partial w}\right)dw+\left(\frac{\partial \pi_c^{*1}}{\partial w^*}+\frac{\partial \pi_c^{*2}}{\partial w^*}\right)dw^*=0$$

Replace $dw^*=-\frac{\left(\frac{\partial \pi_c^{*1}}{\partial \alpha}-\frac{\partial \pi_c^{*1}}{\partial \pi_c^1}\frac{\partial \pi_c^1}{\partial \alpha}\right)d\alpha+\left(\frac{\partial \pi_c^{*1}}{\partial w}+\frac{\partial \pi_c^{*2}}{\partial w}\right)dw}{\frac{\partial \pi_c^{*1}}{\partial w^*}+\frac{\partial \pi_c^{*2}}{\partial w^*}}$ in the first differentiated equations:

$$\frac{dw}{d\alpha}=-\frac{\left(\frac{\partial \pi_c^1}{\partial \alpha}-\frac{\partial \pi_c^1}{\partial \pi_c^{*1}}\frac{\partial \pi_c^{*1}}{\partial \alpha}\right)\left(\frac{\partial \pi_c^{*1}}{\partial w^*}+\frac{\partial \pi_c^{*2}}{\partial w^*}\right)-\left(\frac{\partial \pi_c^1}{\partial w^*}+\frac{\partial \pi_c^2}{\partial w^*}\right)\left(\frac{\partial \pi_c^{*1}}{\partial \alpha}-\frac{\partial \pi_c^{*1}}{\partial \pi_c^1}\frac{\partial \pi_c^1}{\partial \alpha}\right)}{\left(\frac{\partial \pi_c^1}{\partial w}+\frac{\partial \pi_c^2}{\partial w}\right)\left(\frac{\partial \pi_c^{*1}}{\partial w^*}+\frac{\partial \pi_c^{*2}}{\partial w^*}\right)-\left(\frac{\partial \pi_c^1}{\partial w^*}+\frac{\partial \pi_c^2}{\partial w^*}\right)\left(\frac{\partial \pi_c^{*1}}{\partial w}+\frac{\partial \pi_c^{*2}}{\partial w}\right)}$$

and

$$\frac{dw^*}{d\alpha}=-\frac{\left(\frac{\partial \pi_c^{*1}}{\partial \alpha}-\frac{\partial \pi_c^{*1}}{\partial \pi_c^1}\frac{\partial \pi_c^1}{\partial \alpha}\right)\left(\frac{\partial \pi_c^1}{\partial w}+\frac{\partial \pi_c^2}{\partial w}\right)-\left(\frac{\partial \pi_c^{*1}}{\partial w}+\frac{\partial \pi_c^{*2}}{\partial w}\right)\left(\frac{\partial \pi_c^1}{\partial \alpha}-\frac{\partial \pi_c^1}{\partial \pi_c^{*1}}\frac{\partial \pi_c^{*1}}{\partial \alpha}\right)}{\left(\frac{\partial \pi_c^1}{\partial w}+\frac{\partial \pi_c^2}{\partial w}\right)\left(\frac{\partial \pi_c^{*1}}{\partial w^*}+\frac{\partial \pi_c^{*2}}{\partial w^*}\right)-\left(\frac{\partial \pi_c^1}{\partial w^*}+\frac{\partial \pi_c^2}{\partial w^*}\right)\left(\frac{\partial \pi_c^{*1}}{\partial w}+\frac{\partial \pi_c^{*2}}{\partial w}\right)}$$

In case 1, $\frac{\partial \pi_c^1}{\partial \pi_c^{*1}}=\frac{\partial \pi_c^{*1}}{\partial \pi_c^1}=\frac{\partial \pi_c^{*1}}{\partial \alpha}=\frac{\partial \pi_c^1}{\partial w^*}=\frac{\partial \pi_c^2}{\partial w^*}=\frac{\partial \pi_c^{*1}}{\partial w}=\frac{\partial \pi_c^{*2}}{\partial w}=0$ which implies

$$\begin{aligned}\frac{dw}{d\alpha} &= -\frac{1}{2}\frac{\partial \pi_c^1}{\partial \alpha}\\ \frac{dw^*}{d\alpha} &= 0\end{aligned}$$

In case 2, $\frac{\partial \pi_c^2}{\partial w^*}, \frac{\partial \pi_c^{*2}}{\partial w}=0$, $\frac{\partial \pi_c^1}{\partial \pi_c^{*1}}, \frac{\partial \pi_c^{*1}}{\partial \pi_c^1}=-1$, $\frac{\partial \pi_c^1}{\partial \alpha}=-\frac{\partial \pi_c^{*1}}{\partial \alpha}$which implies

$$\begin{aligned}\frac{dw}{d\alpha} &= -\frac{2}{3}\frac{\partial \pi_c^1}{\partial \alpha}\\ \frac{dw^*}{d\alpha} &= \frac{2}{3}\frac{\partial \pi_c^1}{\partial \alpha}\end{aligned}$$

In case 3, $\frac{\partial \pi_c^1}{\partial w^*}=\frac{\partial \pi_c^{*1}}{\partial w}=0$, $\frac{\partial \pi_c^1}{\partial \pi_c^{*1}}=\frac{\partial \pi_c^{*1}}{\partial \pi_c^1}=0$, $\frac{\partial \pi_c^{*1}}{\partial \alpha}=0$:

$$\begin{aligned}\frac{dw}{d\alpha} &= -\frac{2}{3}\frac{\partial \pi_c^1}{\partial \alpha}\\ \frac{dw^*}{d\alpha} &= -\frac{1}{3}\end{aligned}$$

In case 4, there are no effects on labor markets since the wage is bound to be zero.

# Chapter 5

# Tax effects on multinational firms

*In this chapter, we measure the impact of corporate tax reforms in the domestic country on foreign affiliate investment. Using a large panel of European multinationals, we find a strong and robust negative impact of domestic taxes on foreign affiliate investment. Thus, corporate taxes may have a negative externality on the foreign country's tax base. We evaluate this externality against the positive externality due to profit-shifting and find that around one third of the latter is compensated.*[1]

## 5.1 Introduction

In the public opinion, multinational enterprises (MNE) are considered to be accelerators of the process of globalization. From a fiscal point of view, MNEs are supposed to adjust their tax base elastically to corporate tax increases - by reallocating either production or profits abroad. To be precise, MNEs are believed to substitute domestic capital or taxable profits by foreign capital or taxable profits. But, as recent studies show, foreign investment does not reduce domestic investment within a multinational firm, it rather boosts it. In technical terms, foreign and domestic activities are not substitutes, they are complements.

This observation may have important consequences for the thinking about international tax issues, some of which are considered in this and the following

[1] This chapter is based on Becker and Riedel (2007b).

chapter. The purpose of this chapter is to measure the impact of domestic taxation on foreign capital stocks held by domestic multinational firms. In the presence of complementarities, the effect may be negative. Using a large firm-level data set, we show that there is a strong and economically significant negative effect of domestic taxes on foreign assets. Thus, domestic corporate taxes have a negative externality through the channel of complementarities within a multinational firm.

This effect obviously runs counter to the well-established positive externality due to profit-shifting. In simple words, domestic taxes increase foreign tax revenue because reported foreign profits increase due to shifting activities, and they reduce foreign tax revenue because foreign activity is deterred due to complementarity effects. We try to quantify the externalities caused by the intra-firm complementarities and profit-shifting behavior. Here, our results indicate that the profit-shifting effect dominates. However, the complementarity effect is shown to compensate a substantial part of the profit-shifting externality on foreign affiliates' pre-tax profits (around 30%).

In the context of the preceding chapters, it is heterogeneity in ownership which is in the center focus of this chapter. Our presumption is that two otherwise identical affiliates may behave differently because the one is owned by a parent company in a high-tax country and the other is held by some owner in the low-tax country.

Observable complementarity in activities may have different reasons. At least, three stories can be told. Firstly, and perhaps most plausibly, there may be complementarities in production, i.e. technological reasons for the observed empirical pattern in investment. If the affiliate produces some input necessary for the production of output at the headquarter, the two levels of activity are complements rather than substitutes. If the headquarter invests in technology, which can also be used in the affiliate, in the brand name or in research and development, then activities are complements, too.

Secondly, a purely tax-driven type of complementarity occurs in the following setting. If the cost of profit-shifting negatively depends on the size of the capital stock, profit-shifting lowers the cost of capital, as has been discussed in chapter 4. In this case, the opportunity of shifting inflates both capital stocks, in the domestic and the foreign country. If the foreign country increases its tax rate, profit-shifting

is reduced, the "avoidance-adjusted cost of capital" (Grubert and Slemrod (1998)) is increased and both capital stocks are reduced. The opposite is true, though, if the high-tax country increases its tax rate.

Thirdly, if multinational firms are liquidity- or credit-constraint, then corporate tax cuts (increases) will have an income effect on investment in both locations. If the income effect dominates the substitution effect due to modified relative locational costs of capital, an observable complementarity will occur.

The available evidence so far does not deal with tax reforms, so we can be quite sure that the observable complementarity is not entirely due to profit-shifting effects. Moreover, one can doubt whether multinational firms are substantially credit-constraint which concerns the plausibility of the third story. Under these considerations, we will derive the hypotheses in a model with production externalities. In the empirical subchapter, we will ask for the empirically observable relationship between foreign and domestic investment in response to tax reforms without putting too much emphasis on the precise channel. In the extensions subchapter, we will nevertheless consider the profit-shifting story since its built-in asymmetry allows for some degree of identification against other stories.

The literature on the causal relationship between foreign and domestic investment starts with Feldstein (1995) who provides evidence using aggregate investment data and claims that investment abroad reduces domestic investment 'dollar for dollar'. Desai et al. (2005a) confirm this result with respect to aggregate values but they also find that US multinationals increase their domestic capital stock in response to investment abroad. In Desai et al. (2005b), they use firm-level data of US multinationals and show that foreign investment in plant, property and equipment (PPE) is associated with higher domestic PPE investment. Similarly, Egger and Pfaffermayer (2003) find that foreign investment increases domestic investment in tangible assets and does not decrease investment in intangibles. Castellani and Barba Navaretti (2004) and Jaeckle (2006) show that going abroad increases domestic productivity and competitiveness. Lipsey (1995) analyzes a cross-section of American multinational firms, reporting a mild positive correlation between foreign production and domestic employment levels. Stevens and Lipsey (1992) analyze the investment behavior of seven multinational firms, concluding that investments in different locations substitute for each other due

to costly external financing. Devereux and Freeman (1995) come to a different conclusion in their study of bilateral flows of aggregate investment funds between seven OECD countries, finding no evidence of tax-induced substitution between domestic and foreign investment. Desai et al. (2006a) ask whether investment in tax havens diverts activity from non-havens and find that non-haven activity rises in response to tax haven investment activity.

One often discussed issue in this literature is endogeneity: The increase in foreign and domestic activity may be caused by some unobservable factor like a new invention, a productivity shock etc. Our approach can be interpreted as one possible solution for this problem. As tax rate changes can be considered exogenous from the individual firm's point of view, our approach provides additional evidence for the existence of complementarities within the firm without being exposed to the same methodological problems as other studies (although there may be and will be others).

Apart from this, there is extensive evidence that profits are shifted across borders in response to tax rate differentials (e.g. Hines and Rice (1994) and Clausing (2003)). Moreover, a large number of studies shows that multinational investment decreases in the national corporate tax rate (see e.g. Devereux (2007) for a survey).

The remainder of this chapter is organized as follows. In the next subchapter, two hypotheses are developed and the estimation methodology is set out. Subchapter 5.3 presents the data, gives some descriptive statistics and reports the results. In subchapter 5.4, we consider several extensions of the analysis. Subchapter 5.5 discusses some implications and concludes.

## 5.2 Hypotheses and estimation methodology

In this subchapter, we derive two theoretical hypotheses (5.2.1) and outline the basic estimation methodology to identify the proposed effects (5.2.2).

### 5.2.1 Hypotheses

Consider the following illustrative model. There are two countries, called the domestic and the foreign country, in a large world capital market. The domestic

country hosts the headquarter of a representative MNE, the foreign country the affiliate. The MNE produces output in both locations using capital $K$ as the only production input. Capital is provided by the world capital market at an interest rate of $r$. For the headquarter level, output reads $F^h\left(K^h\right)$ where $h$ denotes the headquarter. For the affiliate level, output is given by $F^a\left(K^h, K^a\right)$, the superscript $a$ denotes the affiliate. The affiliate's output depends on the affiliate's capital stock and the headquarter endowment with capital.

What is the intuition of this assumption? The affiliate's output may depend on the headquarter capital stock if research and development (R&D) is carried out at the headquarter, and affiliate investment becomes more profitable and/or productive if R&D is successful. Moreover, if an increased headquarter capital stock increases the quality of the product for which affiliate output is a complement, the profitability (i.e. the marginal productivity) of the affiliate capital stock is increased. Alternatively, a third story would consider the affiliate as a pure distribution center which has some fixed cost but very low marginal cost for distributing one extra unit of output. If the headquarter's capital stock and output increases, the value of the capital at the subsidiary rises, too.

Thus, the after-tax profits of the MNE is given by

$$\begin{aligned}\Pi &= F^h\left(K^h\right)\left(1-\tau^h\right)+F^a\left(K^h,K^a\right)(1-\tau)-r\left(K^h+K^a\right)\\ &\quad+\left(\tau^h-\tau\right)s-C\left(s\right)\end{aligned} \tag{5.1}$$

whereas $\tau^h$ and $\tau$ denote the corporate tax rates at country $h$ and country $a$ respectively. For simplicity reasons, we assume that capital cost are not deductible from the corporate tax base which corresponds to full equity finance of the investment projects.

Moreover, the MNE may shift profits between the headquarter and its affiliate. The amount of profits shifted from the headquarter to the affiliate is thereby denoted by $s$, whereas $s > 0$ ($s < 0$) if profits are shifted from the headquarter to the affiliate (from the affiliate to the headquarter). To derive an interior solution, we assume that profit-shifting causes convex concealment cost of $C\left(s\right)$ with $\partial C/\partial s = sign(\tau^h - \tau)$ and $\partial^2 C/\partial s^2 > 0$. Optimal profit-shifting activities are

determined by the first order condition $C_s = \tau^h - \tau$. Optimal investment implies

$$K^h \quad : \quad F_h^h + F_h^a \frac{1-\tau}{1-\tau^h} = \frac{r}{1-\tau^h} \tag{5.2}$$

$$K^a \quad : \quad F_a^a = \frac{r}{1-\tau} \tag{5.3}$$

with $F_h^h = \partial F^h / \partial K^h$, $F_h^a = \partial F^a / \partial K^h$, $F_a^a = \partial F^a / \partial K^a$. Equations (5.2) and (5.3) determine the capital demand functions for $K^h$ and $K^a$.

As laid out above, we are interested in the corporate tax effects on the own and foreign capital stock. From equations (5.2) and (5.3) it follows that the marginal effect of a corporate tax increase at the parent firm on headquarter and subsidiary investment reads

$$\frac{dK^h}{d\tau^h} = \frac{F_{aa}^a}{(1-\tau^h) F_{hh}^h F_{aa}^a + (1-\tau)\left(F_{hh}^a F_{aa}^a - F_{ha}^a F_{ah}^a\right)} \cdot F_h^h \tag{5.4}$$

$$\frac{dK^a}{d\tau^h} = -\frac{F_{ah}^a}{(1-\tau^h) F_{hh}^h F_{aa}^a + (1-\tau)\left(F_{hh}^a F_{aa}^a - F_{ha}^a F_{ah}^a\right)} \cdot F_h^h \tag{5.5}$$

We assume that $F_{hh}^a F_{aa}^a - F_{ha}^a F_{ah}^a > 0$ holds, which ensures concavity of the production function $F^a$ in $K^h$ and $K^a$. Moreover, we presume $F_{ah}^a > 0$ which corresponds to a complementary relationship between capital investment at the affiliate and subsidiary level. It follows then directly that $dK^h/d\tau^h < 0$, and $dK^a/d\tau^h < 0$. Intuitively, increases in the headquarter tax rate inflate the local capital cost and reduce investment at the headquarter location. If production at the affiliate and headquarter level are complements as suggested by the empirical work cited in the introduction, the investment reduction at the headquarter location translates in a drop of investment at the affiliate. Note that, in the absence of any interdependencies, i.e. $F_{ah}^a, F_{ha}^a = 0$, tax effects are given by $dK^h/d\tau^h = \frac{r}{F_{hh}^h\left(1-\tau^h\right)^2}$ and $dK^a/d\tau^h = 0$. Note that expressions (5.4) and (5.5) are derived assuming constant interest rates.[2] Hypothesis 1 directly follows

[2] It seems that the assumption of constant interest rates is justified in the framework of our empirical purpose. The sample under consideration mainly consists of MNEs located in European countries which may be considered small from world capital point of view. However, interest rate effects will be discussed where necessary.

**Hypothesis 1** *Consider the investment at the headquarter and affiliate location to be complements. Then a corporate tax increase at the headquarter location reduces capital investment at the subsidiary level.*

If hypothesis 1 is true, then domestic taxes may have a negative externality on the foreign country's tax revenue. This can be illustrated as follows. Let $T_i = \tau_i \cdot B_i$, $i \in \{h, a\}$, denote the tax revenue in the domestic and the foreign country, whereas $B_i$ describes the local tax base which is given by the representative multinational's pre-tax profit $B^h = F(K^h) - s$ and $B^a = F(K^a, K^h) + s$. The effect of the domestic country's tax rate increase on the foreign country's tax revenue is given by $dT_a/d\tau^h = \tau \cdot dB_a/d\tau^h$ with

$$\frac{dB_a}{d\tau^h} = \frac{\partial F^a}{\partial K^a}\frac{\partial K^a}{\partial \tau^h} + \frac{\partial F^a}{\partial K^h}\frac{\partial K^h}{\partial \tau^h} + \frac{\partial s}{\partial \tau^h} \tag{5.6}$$

In the absence of these complementarities, the externality caused by corporate taxation would comprise solely the profit-shifting effect $\frac{\partial s}{\partial \tau^h} > 0$. This is the externality usually associated with national tax policy in the presence of multinational entities: If the parent company faces a higher tax rate, then profits are shifted to the affiliate country which increases the corporate tax base of the affiliate location.

However, in the presence of complementarities in production, $\partial K^a/\partial \tau^h > 0$ and $\partial F^a/\partial K^h > 0$, the positive profit-shifting externality may be compensated by a negative externality of the headquarter tax on the affiliate's capital stock. A corporate tax increase at the headquarter location does not only induce the shifting of paper profits to the subsidiary, but additionally reduces headquarter capital investment that translates into a lower investment level at the subsidiary location in the presence of intra-firm complementarities. In sum, the externality of corporate taxation may be positive or negative. In terms of tax competition, that implies that equilibrium tax rates may be inefficiently low or high. This is captured by the following hypothesis:

**Hypothesis 2** *The positive fiscal externality due to profit-shifting opportunities of MNEs is (partially) compensated by the negative fiscal externality due to production complementarities.*

It is worth discussing briefly how hypothesis 2 relates to the standard literature on multinational profit-shifting in the presence of tax differentials between countries. Especially, we could ask if hypothesis 2 implies that studies measuring the impact of tax differentials on profit-shifting are misled. From our point of view, the answer is no, because these studies usually choose as dependent variable the profitability of each affiliate as reported by the multinational firm, where profitability means the ratio of reported profits over assets. By dividing profits through assets, this approach abstracts from all effects on assets. We argue that these studies correctly measure the profit-shifting activity *per unit of capital*. Estimations of the total amount shifted by multinational firms, though, will be biased if the complementarity externality is not taken into account. Our results imply that low-tax countries profit far less than expected from high tax environments in other countries.

However, as indicated above, production complementarities are not the only story to explain foreign investment responding negatively to corporate tax increases. At least two alternative stories can be told, profit-shifting effects which occur in interaction with capital investment and funding restrictions. In what follows, though, we restrict ourselves to provide evidence that a negative causal relationship exists.

### 5.2.2 Estimation methodology

The purpose of the empirical section is to test for the hypotheses derived above. We first determine the effect of corporate taxes at the headquarter location on foreign subsidiaries' capital stock. This is captured by the following estimation equation

$$\log\ k_{i,t} = \beta_0 + \beta_1\ \tau_{i,t} + \beta_2 \tau_{hi,t} + \beta_3 x_{i,t} + \beta_4 x_{hi,t} + \phi_i + \epsilon_{i,t} \tag{5.7}$$

whereas $k_{i,t}$ denotes the fixed assets of affiliate $i$ at time $t$. Since the distribution of fixed assets is rather skewed, we employ the logarithm as endogeneous variable. To determine the cross effect of headquarter taxes on foreign subsidiaries' investment, we include the corporate tax rate at the headquarter location $\tau_{hi,t}$ as explanatory variable. Additionally, the estimation approach controls for affiliate fixed effects $\phi_i$

that capture unobserved time-constant plant-characteristics, and for time-varying locational and industry characteristics $x_{i,t}$, as well as time-varying characteristics of the parent country $x_{hi,t}$.

The aim of the analysis is to capture the effect of parent country taxes on subsidiary investment accounting for other possible investment determinants. The theory predicts that subsidiaries with parents in high-tax countries invest less than subsidiaries with parents in low-tax countries. Therefore, we expect $\beta_2$ to be negative. In some specifications, we include country-year fixed effects which fully capture the impact of tax rate and other policy variable changes at the subsidiary's location. Hence, we are able to implicitly compare capital investment of subsidiaries in the same country that only differ in their parent's location and thus in the parent country's tax policy. Note that if tax rate changes have effects on the interest rate, these effects will be equal for all firms and will therefore be absorbed by the country-year fixed effects, too.[3]

As a robustness test of our analysis, we will rerun the estimations using the affiliate's actual tax payments as explanatory variable. Since there might be some reverse causality concerns with respect to the impact of actual tax payments on the corporate capital stock, we estimate equation (5.7) employing a first-difference approach which follows Arellano and Bond (1991). First-differencing controls for affiliate fixed effects, and if there is no serial correlation, the lagged tax payments is not correlated with the differenced error term and is therefore a valid instrument for the current tax payments. Lack of serial correlation provides a moment restriction, so that equation (5.8) can be estimated using the general methods of moments restriction. In comparison to conventional instrumental variables estimators, this moment restriction provides additional instruments so that this GMM estimator is more efficient. To test the validity of these instruments we use a Sargan/Hansen test (Sargan (1958), Hansen (1982)) of overidentifying restrictions. Because the model is estimated in first-differences, the equation will be characterized by the

[3] Of course, we are also interested in the sign and the size of $\beta_1$ which measures the effect of the subsidiary's location tax rate on the subsidiary's asset stock size. Note, though, that we cannot fully exclude that other unobserved policy changes drive the result in the regressions in which we include the national corporate tax rate as explanatory variable since the national corporate rate affects all (profitable) corporations in a given country in the same way and hence, a 'control group' to the analysis within the same country is missing. However, we address this problem in an extension section by regressing the capital stock on the actual corporate tax payments.

presence of first-order serial correlation. But the validity of the GMM estimator relies on the absence of second-order serial correlation. The tests for second-order serial correlation by Arellano and Bond (1991) will be reported at the bottom of the result tables.[4]

In a second step, we will quantify the impact of corporate taxes on the multinational's pre-tax profit. If complementarities in asset stocks are accounted for, there are two effects which compensate each other. Firstly, higher tax rates at the parent's location increase the reported profits of the subsidiary due to profit-shifting activities. Secondly, higher parent location tax rates reduce the subsidiary's stock of capital and thereby reduces the subsidiary's profits. The estimated equation is given by

$$\Delta \log\ b_{i,t} = \alpha_1 \Delta\ (\tau_{hi,t} - \tau_{i,t}) + \alpha_2 \Delta \log\ k_{i,t} + \alpha_3 \Delta x_{i,t} + \alpha_4 \Delta x_{hi,t} + \Delta \epsilon_{i,t} \quad (5.8)$$

The coefficient $\alpha_1$ measures the impact of the corporate tax rate *difference* $\tau_{hi,t} - \tau_{i,t}$ between the headquarter and the affiliate country on the reported pre-tax profits $b_{i,t}$. In contrast, $\alpha_2$ captures the effect via the asset stock size $k_{i,t}$ which may be affected by the parent tax rate; $x_{i,t}$ and $x_{hi,t}$ are control variables as defined above.

In contrast to the profit-shifting channel, the impact of the firm's assets on profits may be mismeasured due to reverse causality problems: high profits may equally trigger high capital investment. Therefore, we estimate the effect of an asset increase on profits by employing the first-difference approach by Arellano and Bond (1991) shortly described above. Note, that $\Delta$ denotes the first difference of a variable. First-differencing controls for affiliate fixed effects, and if there is no serial correlation, lagged fixed assets are not correlated with the differenced error term and are therefore valid instruments for the current fixed assets. Following equation (5.7) we additionally include the corporate tax rates at the affiliate and parent location as instruments for affiliate fixed assets. To test the validity of these instruments we again use a Sargan test of overidentifying restrictions.[5]

[4] We choose the lags of the instruments on the basis of the serial correlation test and the Sargan Hansen test.

[5] Note moreover, that the standard errors of the GMM model presented in the Result Section are robust one-step errors. Simulation studies have shown that the efficiency gain from using the

## 5.3 Data, descriptive statistics and results

In this subchapter, we describe the data base (5.3.1), give some descriptive statistics (5.3.2) and report the result of the estimation approach outlined above (5.3.3).

### 5.3.1 Data set

Our empirical analysis relies on the AMADEUS data base which is compiled by Bureau van Dijck and contains detailed accounting and firm structure information for 1.6 million corporations in 38 countries. The data is available from 1995 to 2005, but unbalanced in structure. Since our analysis centers around corporate tax effects on multinational firms, we restrict our sample to subsidiaries which are directly and ultimately owned by a foreign parent company.[6] Additionally, for an affiliate to be included in the data set it has to be ultimately owned by an industrial corporation and has to employ more than 10 workers (see for example Barba Navaretti, Checchi and Turrini (2003)).

Apart from this, we include companies based on the availability of the essential information needed for our analysis (fixed assets, corporate tax rate at affiliate and parent location). Additionally, affiliate observations will only be used in the regressions if the link to the global ultimate owner as well as basic information on this parent corporation is available with AMADEUS. Last, we have to restrict the sample to corporate groups with unconsolidated accounting information.

The ownership information in our data refers to the last reported date which is the year 2005 for most corporations in our data set. Thus, ownership has a cross sectional dimension only. In line with previous work based on the same data, we are not too concerned about this assumption. To the extent that we are potentially including a few affiliates which were not affiliated in earlier years, we are introducing a measurement error that biases our results towards zero (Budd, Konings and Slaughter (2005), Barba Navaretti et al. (2003)).

---

two-step procedure is very modest even in the presence of considerable heteroscedasticity, see Arellano and Bond (1991).

[6] The AMADEUS data contains information on a corporation's direct investment in other firms. For a corporation to be identified as parent company, it has to own 100% of the subsidiary directly and ultimately.

Matching parent companies to foreign affiliates gives an unbalanced panel with 5429 affiliates and 2049 parent corporations over 10 years. Table 5-1 exhibits the country distribution which is basically consistent with patterns of multinational firms in Europe. Most of the global ultimate owners are concentrated in Western European countries like France, Germany and Belgium. In contrast, many subsidiaries are located in the European South (Spain and Italy) as well as in new EU member states like the Czech Republic and Poland.

**Table 5.1: Country Statistic**

| | *Affiliate* | *Parent* | | *Affiliate* | *Parent* |
|---|---|---|---|---|---|
| Austria | 61 | 42 | Hungary | 104 | 2 |
| Belgium | 416 | 146 | Ireland | 208 | 58 |
| Cyprus | 0 | 2 | Italy | 379 | 144 |
| Czech Republic | 181 | 0 | Lithuania | 26 | 2 |
| Germany | 292 | 311 | Luxembourg | 27 | 28 |
| Denmark | 232 | 136 | Latvia | 39 | 1 |
| Estonia | 91 | 6 | Netherlands | 352 | 219 |
| Spain | 785 | 82 | Poland | 302 | 6 |
| Finland | 196 | 79 | Portugal | 78 | 17 |
| France | 730 | 209 | Sweden | 306 | 233 |
| United Kingdom | 834 | 317 | Slovenia | 2 | 2 |
| Greece | 49 | 4 | Slovakia | 39 | 0 |
| | | | **Sum** | **5,429** | **2,049** |

Since our analysis investigates corporate tax effects on capital investment and pre-tax profit, we merge the firm data with data on the statutory corporate tax rates for EU 25 countries as well as other country characteristics like GDP per capita, GDP growth rate, the population size and an earnings index for the manufacturing industry. The corporate tax rates are thereby taken from the Commission (2006), while the information on GDP per capita and population size is obtained from the OECD webpage.

### 5.3.2 Sample statistics

The data contains 34237 affiliate-year observations. Thus, the accounting information is available for 6.3 years on average. Table 5-2 summarizes basic sample statistics.

**Table 5.2: Descriptive Statistics**

| *Variable* | *Number of Observations* | *Mean* | *Standard Deviation* |
|---|---|---|---|
| **Affiliate** | | | |
| Fixed Assets | 34,237 | 36,254.54 | 428470.5 |
| Employment | 25,433 | 250.33 | 857.16 |
| Profit Loss Before Tax | 32,299 | 3,400.60 | 54808.74 |
| Statutory Tax Rate | 34,237 | 0.3300 | 0.071 |
| Average Tax Payment | 21,343 | 0.0379 | 0.0459 |
| GDP per Capita | 31,386 | 24,396.27 | 5763.54 |
| **Parent Company** | | | |
| Statutory Tax Rate | 34,237 | 0.3515 | 0.0777 |
| Average Tax Payment | 10,392 | 0.0180 | 0.0245 |
| GDP per Capita | 32,143 | 27,022.56 | 4737.58 |

The average amount of fixed assets at the affiliate level is measured to be 36 million US Dollar. Moreover, the average employment level amounts to 250 employees while the corporations earn a pre-tax profit of 3 million US dollar on average. The average corporate tax rate at the parent location is measured with 0.35 and is, hence, slightly higher than the corporate tax rate at the affiliate location which is 0.33. This observation is in line with the common perception that headquarters are mainly located in western European high-tax countries while production also takes place through affiliates in Eastern and Southern European countries with lower corporate tax rates. Additionally, we will run sensitivity checks on our regressions using the actual corporate tax payments instead of the national tax rate as explanatory variable. We calculate this measure by dividing actual corporate tax payments by corporate total asset. Total assets are used because this information is available for more parent corporations than pre-tax profits or fixed assets and hence, we hedge us against loosing too many observations. The average tax payment per total assets amounts to 0.04 at the affiliate level and 0.02 at the headquarter location. Interestingly, (assuming equal productivity) the headquarter thus carries a lower tax burden than the subsidiaries.

### 5.3.3 Estimation results

Our central aim is to determine the effect of the corporate tax rate at the affiliate and parent level on the volume of affiliate's fixed assets. In a second step,

we will determine the corporate tax effect on *pre-tax profits* distinguishing the complementarity effect from the profit-shifting effect.

Table 5-3 contains fixed-effect estimations of the corporate fixed assets on the statutory corporate tax rate at the affiliate and parent location. In specification (1), we include a full set of year and affiliate dummies to control for time-constant affiliate characteristics and shocks common to all affiliates over time. We find a significantly negative effect of both, the domestic and the foreign statutory tax rate, on fixed assets. The semi-elasticities are calculated with $-0.6903$ and $-0.3874$ respectively. Specification (2) reestimates the relationship including a set of variables controlling for time-varying country characteristics at the affiliate and parent location. We account for GDP per capita, population size, the growth rate of GDP per capita and earnings in the manufacturing industry. Multinational firms tend to locate high investment levels in countries with high populations, while a large population at the parent country deters investment. This is in line with the basic proximity concentration trade-off known from trade-theory models. The service of large markets via exports is associated with high transport costs. That increases the attractiveness of FDI compared to exports. Moreover, a high GDP growth and high earnings in manufacturing tend to increase multinational capital investment, whereas we find also weak evidence that high levels of these controls in the parent country tend to increase the fixed asset stock at the affiliate.[7] Although GDP per capita at the affiliate exhibits an unexpected negative sign, this can be explained by the additional inclusion of earnings in the manufacturing index as a proxy for the (change) in national income as well. Without the inclusion of manufacturing earnings, GDP per capita captures the positive income effect on capital investment.

[7] All control variables despite the GDP growth rate enter the estimation equation in log form. This specification is chosen since it seems to fit the data slightly better than an inclusion in levels. Note, however, that the estimated corporate tax coefficient are neither qualitatively nor quantitatively sensitive to the specification of the controls.

**Table 5.3: Fixed Effect Estimation, End. Variable: Log Fixed Assets**

| *Variable* | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* |
|---|---|---|---|---|---|
| Statutory Tax Rate, Affiliate | -0.6903*** | -1.1138*** | -1.1496*** | -0.7971*** | |
| | 0.2024 | (0.2334) | (0.2371) | (0.2527) | |
| Statutory Tax Rate, Parent | -0.3874** | -0.6337** | -0.6383*** | -0.6245*** | -0.4632*** |
| | (0.1615) | (0.2074) | (0.2090) | (0.2112) | (0.2142) |
| GDP per Capita, Affiliate | | -0.6094** | -0.6521** | -1.4252*** | |
| | | (0.2812) | (0.2841) | (0.3455) | |
| GDP per Capita, Parent | | 0.5287* | 0.6528*** | 0.5186 | 0.3665 |
| | | (0.3252) | (0.3277) | (0.3290) | (0.3363) |
| Population, Affiliate | | 4.9737*** | 4.9246*** | 7.8969*** | |
| | | (0.7787) | (0.7862) | (0.8642) | |
| Population, Parent | | -0.5319*** | -1.3602 | -1.0686 | -0.9196 |
| | | (1.0742) | (1.0800) | (1.1018) | (1.1343) |
| GDP Growth, Affiliate | | 1.8278*** | 1.7136*** | 1.3708*** | |
| | | (0.4093) | (0.4132) | (0.4394) | |
| GDP Growth, Parent | | 0.6063 | 0.3852 | 0.4059 | 0.4547 |
| | | (0.4515) | (0.4549) | (0.4553) | (0.4663) |
| Earnings Manufacturing, Affiliate | | 1.2860*** | 1.3755*** | 1.1449*** | -0.2531 |
| | | (0.1197) | (0.1203) | (0.2635) | (0.9952) |
| Earnings Manufacturing, Parent | | 0.6063 | 0.2640 | 0.4615 | 0.6195 |
| | | (0.4515) | (0.3727) | (0.3982) | (0.4053) |
| Year Dummies | yes | yes | yes | yes | yes |
| Year-Industry Dummies | | | yes | yes | yes |
| Year-Eastern Europe Dummies | | | | yes | yes |
| Year-Country Dummies | | | | | yes |
| Number of Observations | 34237 | 29928 | 29292 | 29292 | 29292 |
| Number of Firms | 5429 | 5157 | 5043 | 5043 | 5043 |
| R-squared | 0.90 | 0.91 | 0.91 | 0.91 | 0.91 |

The inclusion of the additional country controls substantially increases the estimated coefficients for the statutory tax at the affiliate as well as at the parent country. Specifications (3) and (4) additionally include a set of industry year dummies and a set of year-Eastern Europe dummies accounting for possible differences in shocks to Western and Eastern Europe over time. Industry is thereby specified at the NACE 1-digit level. The estimated taxation coefficients are robust to these inclusions and remain large and statistically significant. The semi-elasticities estimated in specification (4) are $-0.6903$ for the tax at the affiliate country and $-0.3874$ for the tax at the parent country. Last, in specification (5) we add country-year effects which absorb all country-specific shocks to the subsidiary and also capture the corporate tax effect on local investment (hence, there is no coefficient estimate reported for this effect). For this specification, the estimated coefficient slightly drops in size but remains statistically significant at

the 1% level. In Table 5-4, we re-estimate the model including the corporate tax effects in log-form. The coefficient estimates are qualitatively and quantitatively similar to the results for the semi-logarithmic form. Controlling for country-year effects, specification (5) suggests that a 10% increase in the parent tax rate reduces investment at the affiliate level by 1.9%.

**Table 5.4: Fixed Effect Estimation, End. Variable: Log Fixed Assets**

| *Variable* | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* |
|---|---|---|---|---|---|
| Log Statutory Tax Rate, Affiliate | -0.3735*** | -0.5038*** | -0.5048*** | -0.3740*** | |
| | 0.0670 | (0.0799) | (0.0807) | (0.0906) | |
| Log Statutory Tax Rate, Parent | -0.1348** | -0.2688*** | -0.2702*** | -0.2592*** | -0.1885** |
| | (0.0689) | (0.0907) | (0.0913) | (0.0925) | (0.0939) |
| GDP per Capita, Affiliate | | -0.6564** | -0.7067*** | -1.3880*** | |
| | | (0.2764) | (0.2794) | (0.3415) | |
| GDP per Capita, Parent | | 0.5090 | 0.6307** | 0.5020 | 0.3389 |
| | | (0.3238) | (0.3263) | (0.3277) | (0.3351) |
| Population, Affiliate | | 4.9737*** | 5.5568*** | 8.1747*** | |
| | | (0.7787) | (0.8016) | (0.8703) | |
| Population, Parent | | -0.4695 | -1.2842 | -1.0341 | -0.8262 |
| | | (1.0758) | (1.0817) | (1.1028) | (1.1352) |
| GDP Growth, Affiliate | | 1.7605*** | 1.6497*** | 1.3582*** | |
| | | (0.4096) | (0.4134) | (0.4394) | |
| GDP Growth, Parent | | 0.5891 | 0.3718 | 0.4047 | 0.4690 |
| | | (0.4511) | (0.4545) | (0.4551) | (0.4660) |
| Earnings Manufacturing, Affiliate | | 1.286*** | 1.3611*** | 1.1477*** | 0.6120 |
| | | (0.1196) | (0.1201) | (0.2633) | (0.4082) |
| Earnings Manufacturing, Parent | | 0.2228 | 0.2892 | 0.4713 | 0.6195 |
| | | (0.3719) | (0.3744) | (0.4005) | (0.4053) |
| Year Dummies | yes | yes | yes | yes | yes |
| Year-Industry Dummies | | | yes | yes | yes |
| Year-Eastern Europe Dummies | | | | yes | yes |
| Year-Country Dummies | | | | | yes |
| Number of Observations | 34237 | 29928 | 29292 | 29292 | 29292 |
| Number of Firms | 5429 | 5157 | 5043 | 5043 | 5043 |
| R-squared | 0.90 | 0.91 | 0.91 | 0.91 | 0.91 |

Thus, we can conclude that there is quite robust evidence for a negative and significant impact of home country taxes on host country activity. This generates a potentially important externality of domestic tax policy on the foreign country's tax revenue. Therefore, this finding may have implications for tax efficiency in the presence of multinational corporations and is thus related to another hotly debated question: inefficiencies caused by cross-border profit-shifting. It is straightforward to ask how these two externalities are related to each other. While tax

rate increases exert a positive externality on the other country's tax revenue via the profit-shifting channel, complementarities generate a negative externality. Our aim is to quantitatively weigh these two effects against each other.

Therefore, we investigate the causal effect of domestic and foreign corporate taxes on corporate pre-tax profit, thereby differentiating the profit-shifting and the complementarity effect. One unique feature of profit-shifting activity is that the shifting volume is determined by the *tax differential* defined as domestic statutory corporate tax rate minus parent statutory corporate tax rate. Thus, we can capture the profit-shifting effect by including the tax rate differential in the estimation equation for corporate pre-tax profit. In contrast, the complementarity effect is driven by the impact of foreign corporate taxes on domestic input factor choice which in turn affects domestic corporate pre-tax profit. Hence, we include fixed assets in the estimation equation. Following our analysis so far we estimate a GMM model where we instrument for fixed assets using the domestic and foreign statutory corporate tax rates. Moreover the third to fifth lag of the fixed assets variable are included among others to instrument for the change in fixed assets.[8]

Table 5-5 presents several model specifications. Specification (1) controls for GDP per capita and population at the affiliate and parent country and year dummies. The tax rate differential enters with a negative sign, as expected, the semi-elasticity is estimated with $-0.7189$. Thus, a larger difference between the statutory tax rate at the affiliate level and statutory taxes at the parent location reduces the MNE's pre-tax profit. This observation is in line with profit-shifting behavior. The coefficient estimate on fixed assets indicates that a 1% increase in fixed assets raises pre-tax profits by 0.42% on average. The following estimations (2) to (4) additionally control for industry-year dummies and the GDP growth rate as well as the earnings in manufacturing. Especially, the inclusion of the additional country control variables lead to a slight drop in the absolute size of both coefficients, the estimated coefficient for the fixed asset investment as well as the coefficient for the difference in statutory tax rates.

[8] The lags of instruments are chosen based on the test of second order autocorrelation and the Sargan/Hansen test.

**Table 5.5: Endogeneous Variable: Log Profit Before Tax**

| *Variable* | *(1)* | *(2)* | *(3)* | *(4)* |
|---|---|---|---|---|
| Log Profit/Loss Before Tax, Lag1 | 0.1934*** | 0.2299*** | 0.1742*** | 0.2207*** |
| | (0.0688) | (0.0712) | (0.0707) | (0.0740) |
| Tax Rate Differential | -0.7189** | -0.6455* | -0.7316** | -0.6688* |
| | (0.3434) | (0.3648) | (0.3542) | (0.3786) |
| Log Fixed Assets | 0.4178*** | 0.3342** | 0.3912*** | 0.3015** |
| | (0.1419) | (0.1490) | (0.1432) | (0.1503) |
| GDP per Capita, Affiliate | 1.6901*** | -2.2670 | 0.958 | -2.1576 |
| | (0.3063) | (2.3276) | (0.6059) | (2.4166) |
| GDP per Capita, Parent | -0.6320* | 2.7974 | 0.6471 | 3.3277 |
| | (0.3316) | (2.1964) | (0.7331) | (2.2538) |
| Population, Affiliate | -3.1975* | 1.5058 | -3.2930* | 1.2461 |
| | (1.7875) | (3.8639) | (1.7913) | (3.9950) |
| Population, Parent | -0.5169 | -0.0857 | -0.1864 | -0.11278 |
| | (2.8615) | 4.9902 | (2.8514) | (5.1257) |
| GDP per Capita Growth, Affiliate | | 3.9304* | | 4.0450* |
| | | (2.1527) | | (2.2173) |
| GDP per Capita Growth, Parent | | -2.6185 | | -3.3005 |
| | | (2.5160) | | (2.5985) |
| Earnings, Affiliate | | 1.8665 | | 1.4639 |
| | | (2.4429) | | (2.5916) |
| Earnings, Parent | | -2.9354 | | -3.7479 |
| | | 3.3751 | | (3.4695) |
| Year Dummies | yes | yes | yes | yes |
| Year-Industry Dummies | | | yes | yes |
| Number of Observations | 10785 | 10513 | 10593 | 10321 |
| Number of Firms | 2935 | 2895 | 2874 | 2834 |
| Test for 2nd Order Autocorrelation (z-Value) | 0.608 | 0.886 | 0.349 | 0.641 |
| Sargan Test (p-Value) | 0.253 | 0.469 | 0.228 | 0.513 |

## 5.4 Extensions

### 5.4.1 Effective corporate tax rates

Our results in the previous subchapter provide evidence that the statutory corporate tax rate at the headquarter location exerts a negative impact on investment at the affiliate level. Although our theory section does not distinguish between the statutory corporate tax and the effective corporate tax rate, it is obvious that the complementarity effect hinges on the effective corporate tax rate for which the statutory rate was used as a proxy above. As a sensitivity check we therefore reestimate the causal impact of headquarters' taxes on affiliate employment using

the actual corporate tax payment per unit of total assets at the headquarter's location as explanatory variable. Since the inclusion of actual corporate tax payment in the capital investment equation may be prone to endogeneity problems, we again employ the Arellano and Bond (1991) approach estimating a first-differenced equation with lagged corporate taxation levels as instruments for the change in tax payment. The results can be found in Table 5-6. The first equation controls for time fixed effects while the second specification additionally includes industry-year dummies.[9] Both estimations provide evidence in line with our results and indicate that an increase in the corporate tax burden at the headquarter location translates in significantly lower investment levels at the affiliates.

**Table 5.6: Endogeneous Variable: Log Fixed Assets**

| *Variable* | *(1)* | *(2)* |
|---|---|---|
| Log Fixed Assets, Lag1 | 0.4003*** | 0.3448*** |
| | (0.1015) | (0.0975) |
| Log Average Tax Payment, Affiliate | -0.0681*** | -0.0660*** |
| | (0.0217) | (0.0212) |
| Log Average Tax Payment, Parent | -0.0301** | -0.03450** |
| | (0.0154) | (0.0162) |
| Year Dummies | yes | yes |
| Year-Industry Dummies | | yes |
| Number of Observations | 3252 | 3208 |
| Number of Firms | 1157 | 1140 |
| Test for Second Order Autocorrelation (z-Value) | 0.75 | 0.74 |
| Sargan Test (p-Value) | 0.20 | 0.36 |

### 5.4.2 Investment effects of profit-shifting

Our simple model presented in the theory section abstracted from corporate tax effects on multinational capital investment that is driven by profit-shifting considerations. In the preceding subchapter, we measured the impact of domestic tax reforms on related affiliates in the foreign country without specifying the precise channel through which tax changes translate into investment effects. As already indicated in the introduction, the profit-shifting story yields asymmetric effects depending on where, in the low-tax country or in the high-tax country, the tax change takes place. Part of the literature suggests that profit-shifting is facilitated

[9] Both specifications employ the second lag of effective average tax payments as instruments.

with increasing size of corporate investment at the affiliate location. This reflects the notion that enlarged investment activity corresponds to an increased intra-firm trade connection between the affiliates which makes it easier to shift profits between the locations (see e.g. Grubert and Slemrod (1998), who introduce the term of "avoidance-adjusted cost of capital"). The modeling strategy would for example presume that profits can be shifted per unit of capital at the affiliate location and hence multinational after-tax profits could be summarized as

$$\begin{aligned}\Pi &= F^h\left(K^h\right)\left(1-\tau^h\right)+F^a\left(K^h,K^a\right)(1-\tau)-r\left(K^h+K^a\right)\\ &\quad+\left[\left(\tau^h-\tau\right)s-C\left(s\right)\right]K^a \end{aligned} \tag{5.9}$$

Thus, optimal investment at the affiliate location is given by

$$F_a^a=\frac{r-\left[(\tau^h-\tau)s-C\right]}{1-\tau} \tag{5.10}$$

It holds that $(\tau^h-\tau)s-C>0$ since the multinational would otherwise not engage in paper profit-shifting. This implies that positive profit-shifting activities lead to increased investment at the affiliate level whereas the investment is higher the larger the amount shifted. Assuming shifting costs to be constant across multinational firms located in different countries, profit-shifting activity increases in the gross shifting gains which are given by the *absolute* tax rate difference between two locations. Therefore, the theoretical extension would predict that the affiliate capital stock raises in the absolute tax difference to the home country.

Calculating the effect of headquarter taxes on the affiliates' capital investment gives

$$\begin{aligned}\frac{dK^a}{d\tau^h} &= -\frac{F_{ah}^a}{\left(1-\tau^h\right)F_{hh}^hF_{aa}^a+(1-\tau)\left(F_{hh}^aF_{aa}^a-F_{ha}^aF_{ah}^a\right)}\cdot F_h^h\\ &\quad-\frac{\left(1-\tau^h\right)F_{hh}^h+(1-\tau)F_{hh}^a}{\left(1-\tau^h\right)F_{hh}^hF_{aa}^a+(1-\tau)\left(F_{hh}^aF_{aa}^a-F_{ha}^aF_{ah}^a\right)}\cdot\frac{s}{1-t}\end{aligned} \tag{5.11}$$

The first term on the right hand side corresponds to equation (5.4). The second term reflects the impact of profit-shifting on investment behavior. For a better understanding, assume for the moment that there are no complementarities,

$F^a_{ah} = F^a_{ha} = 0$. The expression then becomes:

$$\frac{dK^a}{d\tau^h} = -\frac{1}{F^a_{aa}} \cdot \frac{s}{1-t} \tag{5.12}$$

It is obvious that the effect of the parent location's tax rate carries the same sign as the profit-shifting term $s$. If the parent location's tax rate is lower than the subsidiary location's, $\tau^h < \tau$, then increasing $\tau^h$ leads to an decrease in the subsidiary's stock of capital. The intuition for the result is very simple. An increase in $\tau^h$ leads to an decrease in the tax differential between parent and subsidiary firm. This reduces the incentive to shift profits and to decrease the avoidance-adjusted cost of capital by enlarging the subsidiary's stock of capital.

To test for these capital effects, we include the absolute tax rate differential between the headquarter and the corporate subsidiary in the fixed effect estimation described by equation 5.7. The results are presented in Table 5-7. In line with the theoretical prediction, the absolute tax rate difference exerts a significantly positive impact on affiliate investment and is robust against the inclusion of industry-year and country-year dummies. The estimated coefficient for the absolute corporate tax rate difference in specification (3) presents a semi-elasticity of 0.4567.

The size of the effects of headquarter's taxes on affiliate investment thus depends on the relation of corporate taxes. If the headquarter's tax falls short from the tax rate at the affiliate location, the complementarity and profit-shifting investment effect point in the same direction. Increases in the corporate tax rate at the headquarter location lead to a substantial drop in affiliates' assets. In turn, if the headquarter's tax exceeds the corporate tax at the affiliate location, then an increase in the headquarter tax reduces affiliate investment through the complementarity effect but may, however, increase corporate investment due to profit-shifting induced considerations. According to specification (3) in Table 5-7, we find that the effect of corporate taxes at the parent location on fixed assets at the affiliate is represented by a semi-elasticity of $-1.2278$ $(= -0.7711 - 0.4567)$ if $\tau^h < \tau$. In turn, if the headquarter country is the high-tax country and $\tau^h > \tau$ holds, then the complementarity investment effect and the profit-shifting investment effect point in different directions. This translates in an estimated semi-elasticity of $-0.3144$ $(= -0.7711 + 0.4567)$. This implies that if (equilibrium) tax rates feature

$\tau^h < \tau$, then the described investment effects dampen the profit-shifting effect by 55% ($0.6688 - 0.3015 \cdot 1.2278 = 0.2986$). In contrast, if (equilibrium) tax rates feature $\tau^h > \tau$ then the share of the profit-shifting effect amounts to 14% only ($0.6688 - 0.3015 \cdot 0.3144 = 0.5740$).

**Table 5.7: Fixed Effect Estimation, End. Variable: log Fixed Assets**

| *Variable* | *(1)* | *(2)* | *(3)* |
|---|---|---|---|
| Statutory Tax Rate, Affiliate | -1.2092*** | -1.2392*** | |
| | (0.2351) | (0.2385) | |
| Statutory Tax Rate, Parent | -1.1219*** | -1.1525*** | -0.7711*** |
| | (0.2537) | (0.2577) | (0.2899) |
| Absolute Difference Statutory Taxes | 0.6744*** | 0.7014*** | 0.4567* |
| | (0.2018) | (0.2051) | (0.2589) |
| GDP per Capita, Affiliate | -0.6789** | -0.7273*** | |
| | (0.2819) | (0.2848) | |
| GDP per Capita, Parent | 0.5442* | 0.6668** | 0.3968 |
| | (0.3252) | (0.3277) | (0.3360) |
| Population, Affiliate | 5.1771*** | 5.1261*** | |
| | (0.7809) | (0.7882) | |
| Population Parent | -0.6534 | -0.7002 | |
| | (1.0746) | (1.1141) | |
| Earnings Manufacturing, Affiliate | 1.2835*** | 1.3562*** | |
| | (0.1200) | (0.1204) | |
| Earnings, Manufacturing, Parent | 0.2742 | 0.3484 | 0.4738 |
| | (0.3710) | (0.3734) | (0.3792) |
| Growth Rate Per Capita, Affiliate | 1.8295*** | 1.7149*** | |
| | (0.4093) | (0.4131) | |
| Growth Rate Per Capita, Parent | 0.6037 | 0.3854 | 0.4394 |
| | (0.4514) | (0.4548) | (0.4656) |
| Year Dummies | yes | yes | yes |
| Year-Industry Dummies | | yes | yes |
| Year-Country Dummies | | | yes |
| Number of Observations | 29, 928 | 29, 292 | 29, 292 |
| Number of Firms | 5, 157 | 5, 043 | 5, 043 |
| R-squared | 0.91 | 0.91 | 0.91 |

In this context it is interesting to note that in our sample 52% of the affiliates have their direct parent corporation in a country with a higher statutory corporate tax rate while 48% are owned by parent corporations that pay a lower statutory tax rate on average.

## 5.5 Discussion and concluding remarks

In this chapter, we used a large firm-level data set to test for tax policy effects in the presence of complementarities within multinational enterprises. Our results show that tax increases at the domestic parent location negatively affect the foreign subsidiary's stock of capital. Consequently, domestic tax policy imposes a negative externality on the foreign country's tax revenue. In a second step we quantified this externality and contrasted it with the well-established positive externality due to profit-shifting. We found that the shifting externality is considerably compensated by up to 34%. We concluded that low-tax countries do not profit as much from tax rate increases in high-tax countries than is usually assumed.

Our results may change the perspective from which multinational enterprises are considered. An often cited view is that multinational firms, as opposed to nationally operating firms, accelerate tax competition. Our analysis shows that multinational firms "export" the tax burden on the headquarter to its affiliates. That means, if real economic activity and not accounting profits are concerned, the existence of multinational firms may dampen the pressure from tax competition. This question is analyzed in the next chapter. Whereas this chapter has focused on heterogeneity in ownership, the next chapter will be centered around the difference between multinational firms and national firms.

# Chapter 6

# Multinationals and tax competition

*If domestic taxes reduce foreign affiliate investment, as shown in the previous chapter, the standard model of tax competition may be misspecified. In this chapter, we build a tax competition model where domestic and foreign production are complements. It is shown that, in the presence of complementarities, domestic taxes c.p. exert a negative effect on the foreign affiliate capital stock. But, the positive externality via the world capital market (taking the form of lower interest rates) always dominates the negative externality due to complementarities. However, equilibrium tax rates under tax competition increase in the share of multinationals which runs counter to the intuition expressed in the public debate and some scholarly work.*[1]

## 6.1 Introduction

As we have shown in the preceding chapter, and as is confirmed by a number of other papers, foreign investment does not reduce domestic investment within a multinational group, it rather increases it. However, if the world capital supply is not perfectly elastic, an increase of the multinational's investment level has to result in a decrease of investment in some other firm. Potential candidates are

[1] This chapter is based on Becker and Riedel (2007a).

multinational firms in other countries or purely nationally operating firms. The purpose of this chapter is to ask how tax effects look like in a world where domestic and foreign investments are complements within a multinational group. We build a model in which capital is transferred across borders through two distinct channels: via the world capital market and via multinational firms. Taxes may distort the use of these channels, and complementarities in international investment projects may change the results derived in the standard tax competition framework. This concerns the underprovision of public goods in the competitive equilibrium and the scope for welfare enhancing coordination policies.

There are only a few papers which are concerned with complementarity (or substitutability) of production technology within multinational groups. Grubert and Mutti (1995) analyze a multinational firm with R&D activity resulting in a firm-wide productivity gain. Nielsen, Raimondos-Møller and Schjelderup (2004) show that production in the multinational firm's affiliate and headquarter can be complementary in the presence of a firm-wide public good (e.g. a brand, patent, etc.). They build a model in which taxes have negative fiscal externalities and suggest that complementary production structures may give rise to overtaxation. Furthermore, this chapter refers to the standard tax competition model as established in the seminal papers by Zodrow and Mieszkowski (1986) and Wilson (1986).[2]

Our theoretical results show that international tax rate differentials distort the sizes of the multinational and the national firm sectors. Surprisingly, in the presence of complementarities within a firm group, higher taxes lead to an excessive size of the multinational sector. Moreover, we find a negative fiscal externality of domestic corporate taxation on the tax revenue of the foreign country due to the existence of multinational firms. We ask whether this externality results in overtaxation of business profits, but find that this negative externality is unambiguously dominated by the positive externality which causes underprovision of public goods and which is well-known from the standard tax competition literature.

The remainder of this chapter is organized as follows: In the next subchapter, the model and the main results are presented. Subchapter 6.3 presents some extensions. Subchapter 6.4 discusses the implications of the results and concludes.

[2] The theoretical literature is surveyed by Wilson and Wildasin (2004) and Fuest et al. (2005).

## 6.2 The model

This subchapter starts with a model of a firm group, consisting of a headquarter and an affiliate. We derive tax effects depending on the status of the firm, i.e. whether it is a purely national or a multinational firm. Then, we build a two-country model with uncoordinated tax policies and analyze the welfare implications of complementarities in the firms' production technology. We consider tax coordination policies and derive its welfare effects.

### 6.2.1 A model of the (multinational) firm

Consider a firm with two sites of production which will be called the headquarter (H) and the affiliate (A). If both production sites are located in the same jurisdiction, the firm will be called 'purely national firm' (PNE). In contrast, the firm will be called 'multinational firm' (MNE), if the two sites are located in distinct jurisdictions. Assume that there is no decision to become an MNE or not[3] and that production technology does not depend on the status (MNE or PNE) of the firm.[4]

The firm produces one good with some decreasing returns to scale technology which gives rise to pure profits. Production takes place in both sites. It is the focus of our interest how production in one location relates to production in the other location. The simplest case is that both sites are perfectly independent of each other, i.e. the whole production chain is established in both sites. In this case, the two sites act as if they were non-related firms with the only difference being that they have the same owner. We also allow for specialization among production sites on different parts of the production chain, i.e. the activity of the affiliate may depend on the activity in the headquarter, and vice versa.

All these cases (independency, complementarity, substitutability) are accounted

[3] See Bucovetsky and Haufler (forthcoming) for an analysis of tax effect on the organizational decision.

[4] As the recent literature on heterogeneous firms shows, and as has been discussed in the introductory chapter, MNEs do differ considerably from PNEs in terms of technology, profitability and other characteristics. Assuming identical technology in both types of firms has the purpose to isolate those effects which are purely due to the status of being a multinational firm compared to producing in just one country.

for by assuming a production technology of $F\left(K^H, K^A\right)$, where $K^H$ is the capital stock at the head quarter and $K^A$ is the capital stock at the affiliate production site.[5] In the absence of taxes, corporate profits are given by $\Pi = F\left(K^H, K^A\right) - r\left(K^H + K^A\right)$, where $r$ is the interest rate determined on the world capital market. Optimal capital input is given by $F^H = F^A = r$, where $F^H = \frac{\partial F}{\partial K^H}$, $F^A = \frac{\partial F}{\partial K^A}$.

Now, taxes are introduced. We consider taxes on capital returns levied at the firm-level and not on profits, for presentational reasons which are discussed in the extensions subchapter. We rule out other financing sources than equity. Thus, the after-tax income of the firm is given by

$$\Pi = F\left(K^H, K^A\right) - r\left(1+\tau^H\right)K^H - r\left(1+\tau^A\right)K^A \tag{6.1}$$

Optimal capital inputs are given by $F^H = r\left(1+\tau^H\right)$ and $F^A = r\left(1+\tau^A\right)$. How does the capital stock react to tax rate changes? Differentiating both equations with respect to $K^H$, $K^A$ and $\tau^H$ gives us

$$\frac{dK^H}{d\tau^H} = \Omega^{-1}F^{AA}r \quad \text{and} \quad \frac{dK^H}{d\tau^A} = \Omega^{-1}F^{HA}r \tag{6.2}$$

$$\frac{dK^A}{d\tau^A} = \Omega^{-1}F^{HH}r \quad \text{and} \quad \frac{dK^A}{d\tau^H} = \Omega^{-1}F^{AH}r \tag{6.3}$$

with $\Omega = F^{HH}F^{AA} - F^{HA}F^{AH} > 0$, by assumption[6], and $F^{AA} = \frac{\partial^2 F}{\partial (K^A)^2}$, $F^{HA} = \frac{\partial^2 F}{\partial K^H \partial K^A}$ etc. If the two production sites are not linked at all, $F^{AH}, F^{HA} = 0$, then taxes have the standard effects: $\frac{dK^H}{d\tau^H} = \frac{r}{F^{HH}} < 0$ and $\frac{dK^A}{d\tau^A} = \frac{r}{F^{AA}} < 0$. Then, with a given interest rate, taxes at the affiliate do not influence the headquarter capital stock, $\frac{dK^H}{d\tau^A} = 0$, and vice versa, $\frac{dK^A}{d\tau^H} = 0$. However, if production in the two locations is complementary, $F^{AH}, F^{HA} > 0$, affiliate taxes decrease the headquarter capital stock, and vice versa. Affiliate taxes increase the headquarter capital stock if the two capital stocks are substitutes.

[5] An example for complementary production is the following explicit production function $F = \left(K^H\right)^{\alpha}\left(K^A\right)^{1-\alpha}$: $F^H = \alpha\left(\frac{K^A}{K^H}\right)^{1-\alpha}$, $F^{HA} = \alpha(1-\alpha)\left(\frac{1}{K^H}\right)^{1-\alpha}\left(\frac{1}{K^A}\right)^{\alpha} > 0$. An example for substitutability is given by $F = \left(K^H + K^A\right)^{\alpha}$: $F^H = \alpha\left(K^H + K^A\right)^{\alpha-1}$, $F^{HA} = -\alpha(1-\alpha)\left(K^H + K^A\right)^{\alpha-2} < 0$.

[6] $\Omega > 0$ is implied by the concavity assumption of the production technology; it ensures the existence of a profit maximum.

In the following, we will analyze firm group behaviour and tax effects in a two-country model with a closed capital market. There will be two types of firms, PNEs and MNEs. In fact, the only difference between these two types of firms which we are interested in is that, for the domestic PNE, $\tau^H = \tau^A = \tau$ where $\tau$ is the domestic tax rate, whereas $\tau^H = \tau$ and $\tau^A = \tau^*$ for the domestic MNE, where $\tau^*$ is the foreign tax rate. Our main interest is whether the existence of complementarity (or substitutability) in the production technology changes the main results of the standard tax competition model.

### 6.2.2 A two country model with two types of firms

There are two investment locations, the domestic and the foreign country. In both countries there is a representative household owning a fixed capital stock. The stock is rented by the representative investor at a rental price of $r$ which is endogenously determined at the world capital market. Capital $K$ is the only production input.

In both countries there are many identical firms which only differ in the location of their affiliates. The purely national firms (PNE) have both the headquarter and the affiliate in either the domestic or the foreign country, whereas the domestic (foreign) multinational firm (MNE) has located its affiliate in the foreign (domestic) country. The overall number of firms per country is normalized to unity, $\gamma$ of them are MNEs, $1-\gamma$ are PNEs.

From the beginning, we make strong assumptions on symmetry, for purpose of simplicity. Here, that means that we assume that the number of firms and their distribution between MNEs and PNEs is equal in both countries.

The representative investor has an after-tax income of

$$\begin{aligned}\Pi \;=\; & \gamma\left(F_m + F_m^*\right) + (1-\gamma)\left(F_n + F_n^*\right) \\ & -r\left(1+\tau\right)\left(\gamma\left(K_m^H + K_m^A\right) + (1-\gamma)\left(K_n^H + K_n^A\right)\right) \\ & -r\left(1+\tau^*\right)\left(\gamma\left(K_m^{A*} + K_m^{H*}\right) + (1-\gamma)\left(K_n^{H*} + K_n^{A*}\right)\right)\end{aligned} \tag{6.4}$$

The capital demand can be derived using the first order conditions in (6.2) and (6.3) where $H$ and $A$ are either in the domestic or the foreign location, and $\tau^H$

and $\tau^A$ are either the domestic tax rate $\tau$ or the foreign tax rate $\tau^*$, depending on the type of firm under consideration. The capital stocks of the domestic MNE (subscript $m$) are affected by tax rate changes as follows:

$$\frac{dK_m^H}{d\tau} = \Omega^{-1}F^{AA}r \quad \text{and} \quad \frac{dK_m^H}{d\tau^*} = \Omega^{-1}F^{HA}r \tag{6.5}$$

$$\frac{dK_m^{*A}}{d\tau^*} = \Omega^{-1}F^{HH}r \quad \text{and} \quad \frac{dK_m^{*A}}{d\tau} = \Omega^{-1}F^{AH}r \tag{6.6}$$

and the domestic PNE (subscript $n$):

$$\frac{dK_n^H}{d\tau} = \Omega^{-1}\left(F^{AA} - F^{HA}\right)r \quad \text{and} \quad \frac{dK_n^H}{d\tau^*} = 0 \tag{6.7}$$

$$\frac{dK_n^A}{d\tau^*} = 0 \quad \text{and} \quad \frac{dK^A}{d\tau} = \Omega^{-1}\left(F^{HH} - F^{AH}\right)r \tag{6.8}$$

Equivalent expressions can be deducted for the foreign MNE and the foreign PNE. Actually, this is the core feature of our model, that purely national firms (PNE) and multinational firms (MNE) react differently to uncoordinated tax rate changes although their production technology and structure may be perfectly identical. When PNEs and MNEs coexist, then taxes may distort the production structure of the economy, i.e. the relative sizes of the PNE sector and the MNE sector.

### 6.2.3 Capital market equilibrium

Capital market equilibrium requires that the sum of capital stocks equals the capital supply $S$ which is exogenously given and constant.

$$S = \gamma\left(K_m^H + K_m^{A*} + K_m^{H*} + K_m^A\right) + (1-\gamma)\left(K_n^H + K_n^A + K_n^{H*} + K_n^{A*}\right) \tag{6.9}$$

First consider a unilateral increase in the domestic corporate tax rate. The appendix shows that total differentiation of (6.9) yields the interest rate response to an increase in $\tau$:

$$\frac{dr}{d\tau} = -\frac{\left(F_m^{AA} + F_m^{HH} - F_m^{HA} - F_m^{AH}\right)\Omega^{-1}}{2\left(F^{HH} + F^{AA} - F^{HA} - F^{AH}\right)\Omega^{-1}}\frac{r}{1+\tau} = -0,5\frac{r}{1+\tau} \tag{6.10}$$

A coordinated tax increase, i.e. $d\tau = d\tau^*$, starting from $\tau = \tau^* = \tau^+$ yields $\frac{dr}{d\tau} = -\frac{r}{1+\tau}$, where $\tau^+$ denotes the coordinated common tax rate. This can be illustrated as follows. Since the world capital stock is fixed and capital stocks have their optimal size when tax rates are equal, a coordinated increase does not change the size of the capital stocks. This can only be the case if the cost of capital $c$ stays constant: $dc = \frac{\partial c}{\partial \tau^+} d\tau^+ + \frac{\partial c}{\partial r} dr = 0$. With $\frac{\partial c}{\partial \tau^+} = r$ and $\frac{\partial c}{\partial r} = 1 + \tau^+$, it follows $\frac{dr}{d\tau} = -\frac{r}{1+\tau^+}$.

### 6.2.4 Equilibrium tax effects

Taking equilibrium effects on the interest rate into account, the effect of a small increase in the domestic tax rate on the multinational's stock of capital is given by $\frac{dK_m^H}{d\tau} = \frac{\partial K_m^H}{\partial \tau} + \frac{\partial K_m^H}{\partial r}\frac{dr}{d\tau}$ or

$$\frac{dK_m^H}{d\tau} = 0,5r\Omega^{-1}\left(F^{AA} + F^{HA}\right) \tag{6.11}$$

whereas the equilibrium tax effect on the PNE's headquarter is given by

$$\frac{dK_n^H}{d\tau} = 0,5r\Omega^{-1}\left(F^{AA} - F^{HA}\right) \tag{6.12}$$

If there are no complementarities or substitutabilities in the production structure, then both effects are equal. If, however, headquarter and affiliate production is complementary (substitutable), the equilibrium effects on multinationals are weaker (stronger) than on purely national firms. Note again, that in terms of production technology both types of firms are perfectly identical.

Now, consider the effect of an increase in the domestic tax rate on the foreign affiliate of the domestic multinational firm and the foreign affiliate of the foreign purely national firm.

$$\frac{dK_m^{A*}}{d\tau} = -0,5r\Omega^{-1}\left(F^{HH} + F^{AH}\right) \tag{6.13}$$

$$\frac{dK_n^{A*}}{d\tau} = -0,5r\Omega^{-1}\left(F^{HH} - F^{AH}\right) \tag{6.14}$$

Again, with complementarity (substitutability) in production technologies, the

effect on the multinational's capital stock is weaker than the effect on the purely national firm's stock of capital.

We summarize this in

**Proposition 10** ***Sectoral distortion:*** *When the production technology in headquarters and affiliates is complementary, an increase in the domestic tax rate changes the relative sector sizes in both countries. Under perfect symmetry assumptions, increasing domestic tax rates*

*- reduces the domestic PNE's capital stock more than the domestic MNE's.*

*- increases the foreign PNE's capital stock more than the foreign MNE's.*

*The opposite is true if production technology is characterized by substitutability.*

The above proposition deserves some interpretation. As discussed in the introductory subchapter, the empirical literature suggests complementary production technologies. If this is true, then in high-tax countries the multinational sector is too large whereas the purely national sector is too small. Equivalently, in low-tax countries, the multinational sector is too small. This runs counter to the intuition as it appears in the public debate. Many of the tax rate cuts observed in the past years were motivated by the hope that multinational firms would react by increasing their investment. This may be true but, if our model captures some features of reality, stronger effects can be expected in the PNE sector. Note, though, that this expectation is based on the assumption that there are no systematical differences between national and multinational firms. However, if they are systematically different, tax effects that differ from those in the model are due to these differences in technology, profitability etc. and not to the status of being national or multinational (although these two dimensions of characteristics may be related by causal linkages).

Another implication is that domestic tax policy has an externality on the capital stock of the foreign country. In addition to the well-known fiscal externality on the foreign country's tax revenue, domestic tax policy has an external effect on the foreign production structure, i.e. the size of the PNE sector relative to the MNE sector. Whether this externality changes the standard tax competition results will be analyzed in the following subchapter.

### 6.2.5 Optimal tax policy and tax coordination

Welfare is assumed to depend on private consumption $C$ and a publicly provided good $G$. The welfare function is given by $W = U(C) + H(G)$. Public goods are financed by corporate tax revenue:

$$G = \gamma\tau r\left(K_m^H + K_m^A\right) + (1-\gamma)\,\tau r\left(K_n^H + K_n^A\right) \tag{6.15}$$

The domestic household's private consumption is equal to $C = \theta\Pi + 0,5rS$, where $\theta$ is the fraction that the household owns of the representative investor's shares. Using the fact that half of the capital stock is owned by the household as well as (6.9) and (6.4), $C$ can be expressed as

$$\begin{aligned} C &= \theta\gamma\left(F_m + F_m^* - \tau r\left(K_m^H + K_m^A\right) - \tau^* r\left(K_m^{A*} + K_m^{H*}\right)\right) \\ &\quad +\theta\,(1-\gamma)\left(F_n + F_n^* - \tau r\left(K_n^H + K_n^A\right) - \tau^* r\left(K_n^{H*} + K_n^{A*}\right)\right) \end{aligned} \tag{6.16}$$

The effect of a small increase in the domestic tax rate $\tau$ on welfare at a given interest rate $r$ is equal to $\frac{\partial W}{\partial \tau} = U'\frac{\partial C}{\partial \tau} + H'\frac{\partial G}{\partial \tau}$ or

$$\begin{aligned} \frac{\partial W}{\partial \tau} &= \gamma\left[\left(H' - \theta U'\right)\left(K_m^H + K_m^A\right)r + H'\tau r\left(\frac{\partial K_m^H}{\partial \tau} + \frac{\partial K_m^A}{\partial \tau}\right)\right] \\ &\quad +(1-\gamma)\left[\left(H' - \theta U'\right)\left(K_n^H + K_n^A\right)r + H'\tau r\left(\frac{\partial K_n^H}{\partial \tau} + \frac{\partial K_n^A}{\partial \tau}\right)\right] \end{aligned} \tag{6.17}$$

At $\tau = \tau^*$, the capital stocks in the MNE's and the PNE's headquarters and affiliates are of equal size, $K^H$ and $K^A$. Using that $\frac{\partial K_m^H}{\partial \tau} + \frac{\partial K_m^H}{\partial \tau^*} = \frac{\partial K_n^H}{\partial \tau}$, $\frac{\partial K_m^A}{\partial \tau} + \frac{\partial K_m^A}{\partial \tau^*} = \frac{\partial K_n^A}{\partial \tau}$, if evaluated at $\tau = \tau^*$, the above equation boils down to

$$\begin{aligned} \frac{\partial W}{\partial \tau} &= \left(H' - \theta U'\right)\left(K^H + K^A\right)r + H'\tau r\left(\frac{\partial K_n^H}{\partial \tau} + \frac{\partial K_n^A}{\partial \tau}\right) \\ &\quad -\gamma H'\tau r\left(\frac{\partial K_m^H}{\partial \tau^*} + \frac{\partial K_m^A}{\partial \tau^*}\right) \end{aligned} \tag{6.18}$$

The first term in square brackets on the r.h.s. is the welfare gain due to increased tax revenue. The second term is the negative impact due to the reduction of the domestic capital stock in response to increased capital taxation. The third

term is negative, if $F^{HH} < F^{AH}$ and depends on the fraction of PNE in the economy. In other words, the higher the fraction of multinational firms in the economy the higher is the welfare gain from increasing taxes, and the lower is the elasticity of the domestic capital stock. Optimal tax policy implies $\frac{\partial W}{\partial \tau} = 0$.[7] The optimal tax rate $\tau$ is given by

$$\tau = -\left(1 - \theta \frac{U'}{H'}\right) \frac{\left(K^H + K^A\right) r}{\frac{\partial K_n^H}{\partial \tau} + \frac{\partial K_n^A}{\partial \tau} - \gamma \left(\frac{\partial K_m^H}{\partial \tau^*} + \frac{\partial K_m^A}{\partial \tau^*}\right)} \tag{6.19}$$

The optimal tax rate increases in the degree of foreign firm ownership $(1-\theta)$, the difference between $H'$ and $U'$ and the size of the tax base, $\left(K^H + K^A\right) r$. The optimal tax rate is lower, the more elastically capital stocks react to tax changes, see the denominator. Moreover, if headquarter and affiliate capital stocks are complementary, i.e. $\frac{\partial K_m^H}{\partial \tau^*}, \frac{\partial K_m^A}{\partial \tau^*} < 0$, the tax rate increases in the fraction $\gamma$ of multinational firms.

We may summarize these results in

**Proposition 11** *The higher the fraction of multinational firms in the economy, the higher (lower) is the optimal tax rate $\tau$ if headquarter and affiliate production are complements (substitutes).*

The welfare change with respect to $\tau^*$ is given by $\frac{\partial W}{\partial \tau^*} = U' \frac{\partial C}{\partial \tau^*} + H' \frac{\partial G}{\partial \tau^*}$ or

$$\frac{\partial W}{\partial \tau^*} = -U' \theta r \left(K^{A*} + K^{H*}\right) + \gamma H' \tau r \left(\frac{\partial K_m^H}{\partial \tau^*} + \frac{\partial K_m^A}{\partial \tau^*}\right) \tag{6.20}$$

where we used the equality in capital stock sizes, wich is given for $\tau = \tau^*$. The first term on the r.h.s. is the well-known effect which is due to foreign firm ownership. The second term is new and results from the interdependence of capital stocks across borders within a multinational firm. The foreign tax c.p. decreases the capital stock in the domestic country, if capital stocks are complementary, $\frac{\partial K_m^H}{\partial \tau^*}, \frac{\partial K_m^A}{\partial \tau^*} < 0$, and thus reduces the tax base. In contrast, if capital stocks are substitutes, then there is a positive externality due to production interdependency:

[7] Note that, due to foreign firm ownership ($\theta < 1$), it is not clear whether there is underprovision of public goods, whether $H' > U'$.

$\frac{\partial K_m^H}{\partial \tau^*}, \frac{\partial K_m^A}{\partial \tau^*} > 0$. Note that the second term is equal to zero if the fraction of multinational firms in the economy is zero or the capital stocks are independently determined.

The question arises whether this "new" externality may change the standard tax competition result of underprovision of public goods, and precisely, whether tax coordination is still welfare-enhancing in the presence of capital stock complementarities. In the following, we consider a coordinated increase in tax rates $\tau$ and $\tau^*$, starting from a symmetric situation in which both countries are perfectly indentical and both tax rates are equal $\tau = \tau^*$. Furthermore, the increase satisfies $d\tau = d\tau^*$. The effect on welfare is $dW = \frac{\partial W}{\partial \tau} d\tau + \frac{\partial W}{\partial \tau^*} d\tau^* + \frac{\partial W}{\partial r} dr$, i.e. $\frac{dW}{d\tau^+} = \frac{\partial W}{\partial \tau} + \frac{\partial W}{\partial \tau^*} + \frac{\partial W}{\partial r} \frac{dr}{d\tau^+}$.

With the domestic tax rate $\tau$ optimally set, $\frac{\partial W}{\partial \tau} = 0$, the appendix shows that the effect of a coordinated increase can be expressed as

$$\begin{aligned} \frac{dW}{d\tau^+} &= -\theta U' \frac{r}{1+\tau} \left(K^H + K^A\right) - \left(H' - \theta U'\right) \frac{\tau}{1+\tau} r \left(K^H + K^A\right) \\ &\quad -H'\tau r \left(\frac{\partial K^H}{\partial r} + \frac{\partial K^A}{\partial r}\right) \frac{r}{1+\tau} + \gamma H'\tau r \left(\frac{\partial K_m^H}{\partial \tau^*} + \frac{\partial K_m^A}{\partial \tau^*}\right) \end{aligned} \quad (6.21)$$

The first two terms have a negative sign reflecting the averse welfare effects of higher taxes on consumption (due to foreign firm ownership) and lower interest rates. The third term is positive and captures the capital stock increases in response to lower interest rates. The last term is negative and depends on the fraction of MNEs in the economy. The larger the share of MNEs the lower is the welfare gain from coordination. This mirrors the lower efficiency loss due to the existence of MNEs in setting the domestic tax rate $\tau$ optimally, see equation (6.20).

The appendix shows that the coordination effect on welfare can be rearranged to

$$\frac{dW}{d\tau^+} = -U'\theta \left(K^{A*} + K^{H*}\right) \frac{r}{1+\tau} + \left(H' - \theta U'\right) \left(K^H + K^A\right) \frac{r}{1+\tau} \quad (6.22)$$

which is strictly positive if $\theta < \frac{1}{2} \frac{H'}{U'}$. The assumption of perfect symmetry implies that $\theta = 0,5$. It follows that tax coordination has an unambiguously

positive impact on welfare as long as there is underprovision of public goods. This result does not depend on the fraction $\gamma$ of multinational firms.

We can therefore state

**Proposition 12** *Although there is a negative fiscal externality of corporate taxation due to the interdependence of capital stocks, a coordinated increase of $\tau$ unambiguously increases welfare (if one abstracts from the countervailing effect of foreign firm ownership). That means that the negative externality is dominated by the positive externality.*

## 6.3 Extensions

In this subchapter, we consider an alternative way of modelling the corporate tax system and ask for the optimal system of repatriation taxes in the presence of complementarities.

### 6.3.1 Profit taxes instead of capital taxes

The corporate tax has two features. It is levied upon the pure profits part of the firm's income and it increases the cost of capital. In the model above, we only consider the latter feature of the corporate tax. This is useful for two reasons. Firstly, it simplifies the analysis in notational terms. Secondly, we do not have to deal explicitly with the allocation of profits across production locations. Implicitly, we assume that profits are apportioned to the locations according to the capital stock size.

In the model, the after-tax income of the firm is given by

$$\Pi = F\left(K^H, K^A\right) - r\left(1+\tau\right)K^H - r\left(1+\tau^*\right)K^A \tag{6.23}$$

In contrast, the standard corporate tax rate is levied upon output minus deductible cost (the latter being normalized to zero) minus a depreciation allowance

for capital expenditures. In a simple manner, this could be expressed as

$$\begin{aligned}\Pi &= (1 - m\lambda - m^*(1-\lambda))\, F\left(K^H, K^A\right) \\ &\quad -r\,(1-\alpha m)\, K^H - (1-\alpha^* m^*)\, r K^A \end{aligned} \tag{6.24}$$

where $m$ ($m^*$) is the domestic (foreign) statutory tax rate and $\lambda$ is the fraction of output allocated to the headquarter for tax reasons. Parameters $\alpha$ and $\alpha^*$ denote the allowance for corporate capital in the domestic and the foreign location, respectively.

Optimal capital input at the domestic headquarter is given by

$$F^H = r\left(\frac{1-\alpha m}{1-m}\right) + \left(\frac{m^* - m}{1-m}\right)\left(\frac{\partial \lambda}{\partial K^H} F\left(K^H, K^A\right) - (1-\lambda)\, F^H\right) \tag{6.25}$$

If the depreciation parameter $\alpha$ is set equal to 1 and if we assume a symmetric situation, then taxes do not distort investment: $F^H = r$. Our model therefore can be interpreted as analysis of a tax system which, for some reason[8], deviates from full depreciation:

$$F^H = r\left(\frac{1-\alpha m}{1-m}\right) \equiv r\,(1+\tau) \tag{6.26}$$

with $\tau = \frac{m}{1-m}(1-\alpha)$. In the context of our model, it is helpful to assume a situation with $m = m^*$ where governments decide on the optimal level of $\alpha$ (thereby determining $\tau$).

### 6.3.2 Repatriation taxation

Now, consider the question how optimal repatriation taxation looks like in a model with production complementarities within a multinational firm. Assume that there is only one MNE owned by the domestic household. The optimal capital input is given by

$$F^H = (1+\tau)\, r \quad \text{and} \quad F^{*A} = (1 + \tau^* + T)\, r \tag{6.27}$$

where $T$ is the repatriation tax levied by the domestic government.

[8] These reasons are analyzed and discussed in e.g. Haufler and Schjelderup (2000) and Becker and Fuest (2007a).

National income is given by

$$Y = F\left(K^H, K - K^H\right) - rK^H - (1+\tau^*)\, r\left(K - K^H\right) \tag{6.28}$$

Nationally optimal repatriation taxation implies

$$\frac{dY}{dT} = \left(F^H - r - \left(F^{*A} - (1+\tau^*)\, r\right)\right) \frac{dK^H}{dT} = 0 \tag{6.29}$$

The term in brackets is zero if $T = \tau$, which is equivalent to the full taxation after deduction system. This can be explained as follows. Gross interest is given by $r + r\tau^*$. $T$ is levied upon the net interest rate, i.e. after deducting foreign taxes. This result does not depend on the degree of complementarity.

## 6.4 Discussion and concluding remarks

Recent evidence, including the estimations reported in the preceding chapter, suggests that foreign and domestic activities are linked through complementarities in production and capital stocks. In this chapter, we analyzed tax competition in the presence of complementarities (or substitutabilities). Therefore, we built a model in which all firms are identical; the only difference is that some domestic (foreign) firms have located their affiliates in the foreign (domestic) country. Those firms are called multinational firms.

It turns out, that counter to the intuition increasing tax rates increase the relative size of the multinational sector if headquarter and affiliates are linked through complementarities. The reason is that multinational firms are able to "export" part of the deterring tax effects. The implication is that corporate tax rates c.p. have a negative externality on the foreign country's capital stocks and, thus, tax bases. In a closed model, i.e. with endogenous interest rates, this negative externality is always dominated by the positive externality taking the form of lower interest rates and increased investment in the foreign country.

The main implication of our model results is that the existence of multinational firms dampens the pressure from tax competition rather than fueling it. The standard view is to think about MNEs as accelerators of globalization and tax

competition. This ignores that capital can be shifted abroad through the capital market channel instead of within the MNE. If there are no production complementarities, these two channels are equivalent. If, however, domestic and foreign capital stocks are linked through complementarities, as suggested by the above mentioned literature, the use of the MNE channel mitigates the pressure from tax competition since it leads to a kind of tax burden sharing between countries.

# Appendix

## App. 1

This appendix derives (6.10)

$$\frac{dr}{d\tau} = -\frac{\gamma\left(\frac{\partial K_m^H}{\partial \tau} + \frac{\partial K_m^{A*}}{\partial \tau} + \frac{\partial K_m^{H*}}{\partial \tau} + \frac{\partial K_m^A}{\partial \tau}\right) + (1-\gamma)\left(\frac{\partial K_n^H}{\partial \tau} + \frac{\partial K_n^A}{\partial \tau}\right)}{\gamma\left(\frac{\partial K_m^H}{\partial r} + \frac{\partial K_m^{A*}}{\partial r} + \frac{\partial K_m^{H*}}{\partial r} + \frac{\partial K_m^A}{\partial r}\right) + (1-\gamma)\left(\frac{\partial K_n^H}{\partial r} + \frac{\partial K_n^A}{\partial r} + \frac{\partial K_n^{H*}}{\partial r} + \frac{\partial K_n^{A*}}{\partial r}\right)}$$

Under symmetry the numerator is given by

$$\Omega^{-1}\left(F_m^{AA} + F_m^{HH} - F_m^{HA} - F_m^{AH}\right) r$$

Under symmetry, the denominator is given by

$$2\left(1+\tau\right)\left(F^{HH} + F^{AA} - F^{HA} - F^{AH}\right)\Omega^{-1}$$

Denominator and numerator form equation (6.10) in the text.

## App. 2

Now, equations (6.21) and (6.22) are formally derived. With $\frac{dr}{d\tau} = -\frac{r}{1-\tau}$, what is the effect of a change in the interest rate on welfare? The welfare effect is

$\frac{\partial W}{\partial r} = U' \frac{\partial C}{\partial r} + H' \frac{\partial G}{\partial r}$ or

$$\begin{aligned}
\frac{\partial W}{\partial r} &= -\gamma\theta U' \left(\tau \left(K_m^H + K_m^A\right) + \tau^* \left(K_m^{A*} + K_m^{H*}\right)\right) \\
&\quad +\gamma H' \tau \left[K_m^H + K_m^A + r\left(\frac{\partial K_m^H}{\partial r} + \frac{\partial K_m^A}{\partial r}\right)\right] \\
&\quad -(1-\gamma)\,\theta U' \left(\tau \left(K_n^H + K_n^A\right) + \tau^* \left(K_n^{H*} + K_n^{A*}\right)\right) \\
&\quad +(1-\gamma)\,H' \tau \left[K_n^H + K_n^A + r\left(\frac{\partial K_n^H}{\partial r} + \frac{\partial K_n^A}{\partial r}\right)\right]
\end{aligned}$$

The welfare effects of taxes are given by

$$\begin{aligned}
\frac{\partial W}{\partial \tau} &= \left(H' - \theta U'\right) \left(\gamma \left(K_m^H + K_m^A\right) + (1-\gamma)\left(K_n^H + K_n^A\right)\right) r \\
&\quad +H' \tau r \left(\frac{\partial K_n^H}{\partial \tau} + \frac{\partial K_n^A}{\partial \tau}\right) - \gamma H' \tau r \left(\frac{\partial K_m^H}{\partial \tau^*} + \frac{\partial K_m^A}{\partial \tau^*}\right) \\
\frac{\partial W}{\partial \tau^*} &= -U' \theta r \left(\gamma \left(K_m^{A*} + K_m^{H*}\right) + (1-\gamma)\left(K_n^{H*} + K_n^{A*}\right)\right) \\
&\quad +H' \tau r \gamma \left(\frac{\partial K_m^H}{\partial \tau^*} + \frac{\partial K_m^A}{\partial \tau^*}\right)
\end{aligned}$$

As derived in the text, the effect of a coordinated tax increase on the interest rate is given by $\frac{dr}{d\tau^+} = -\frac{r}{1+\tau}$. With $\tau$ optimally chosen, i.e. $\frac{\partial W}{\partial \tau} = 0$, the welfare effect is $\frac{dW}{d\tau^+} = \frac{\partial W}{\partial \tau^*} + \frac{\partial W}{\partial r}\frac{dr}{d\tau^+}$.

$$\begin{aligned}
\frac{dW}{d\tau^+} &= -U' \theta r \left(\gamma \left(K_m^{A*} + K_m^{H*}\right) + (1-\gamma)\left(K_n^{H*} + K_n^{A*}\right)\right) \\
&\quad +H' \tau r \gamma \left(\frac{\partial K_m^H}{\partial \tau^*} + \frac{\partial K_m^A}{\partial \tau^*}\right) \\
&\quad -\gamma\theta U' \left(\tau \left(K_m^H + K_m^A\right) + \tau^* \left(K_m^{A*} + K_m^{H*}\right)\right) \left(-\frac{r}{1+\tau}\right) \\
&\quad +\gamma H' \tau \left[K_m^H + K_m^A + r\left(\frac{\partial K_m^H}{\partial r} + \frac{\partial K_m^A}{\partial r}\right)\right] \left(-\frac{r}{1+\tau}\right) \\
&\quad -(1-\gamma)\,\theta U' \left(\tau \left(K_n^H + K_n^A\right) + \tau^* \left(K_n^{H*} + K_n^{A*}\right)\right) \left(-\frac{r}{1+\tau}\right) \\
&\quad +(1-\gamma)\,H' \tau \left[K_n^H + K_n^A + r\left(\frac{\partial K_n^H}{\partial r} + \frac{\partial K_n^A}{\partial r}\right)\right] \left(-\frac{r}{1+\tau}\right)
\end{aligned}$$

In the following, we use $K_m^H = K_n^H = K^H$ etc.

$$\begin{aligned}\frac{dW}{d\tau^+} &= -U'\theta r\left(K^H + K^A\right)\left(\frac{1}{1+\tau}\right) - \left(H' - U'\theta\right)\frac{\tau}{1+\tau}r\left(K^H + K^A\right) \\ &\quad -H'\tau r\left[\gamma\left(\frac{\partial K_m^H}{\partial \tau} + \frac{\partial K_m^A}{\partial \tau}\right) + (1-\gamma)\left(\frac{\partial K_n^H}{\partial r} + \frac{\partial K_n^A}{\partial r}\right)\frac{r}{1+\tau}\right]\end{aligned}$$

With $\frac{\partial K_m^H}{\partial \tau} = \frac{\partial K_m^H}{\partial r}\frac{r}{1+\tau} - \frac{\partial K_m^H}{\partial \tau^*}$, $\frac{\partial K_m^A}{\partial \tau} = \frac{\partial K_m^A}{\partial r}\frac{r}{1+\tau} - \frac{\partial K_m^A}{\partial \tau^*}$ and $\frac{\partial K_n^H}{\partial r} = \frac{\partial K_m^H}{\partial r}$, $\frac{\partial K_n^A}{\partial r} = \frac{\partial K_m^A}{\partial r}$ at $\tau = \tau^*$, it follows

$$\begin{aligned}\frac{dW}{d\tau^+} &= -U'\theta r\left(K^H + K^A\right)\left(\frac{1}{1+\tau}\right) - \left(H' - U'\theta\right)\frac{\tau}{1+\tau}r\left(K^H + K^A\right) \\ &\quad -H'\tau r\left(\frac{\partial K^H}{\partial r} + \frac{\partial K^A}{\partial r}\right)\frac{r}{1+\tau} + \gamma H'\tau r\left(\frac{\partial K_m^H}{\partial \tau^*} + \frac{\partial K_m^A}{\partial \tau^*}\right)\end{aligned}$$

which is equation (6.21) in the text.

Alternatively, the welfare effect can be derived alternatively by using the entire expression of $\frac{dW}{d\tau^+} = \frac{\partial W}{\partial \tau} + \frac{\partial W}{\partial \tau^*} + \frac{\partial W}{\partial r}\frac{dr}{d\tau^+}$:

$$\frac{dW}{d\tau^+} = -\theta U'\left(K^{A*} + K^{H*}\right)\frac{r}{1+\tau} + \left(H' - \theta U'\right)\left(K^H + K^A\right)\frac{r}{1+\tau}$$

which is equation (6.22) in the text.

# Chapter 7

# Conclusions

In the previous chapters, different sources of firm heterogeneity were considered and introduced into standard models of tax analysis. It was shown that assuming differences among firms with respect to various aspects challenges several of the standard results in tax economics and often changes them substantially. In chapter 2, the introduction of heterogeneity in mobility and profitability changed the standard results that the marginal unit of invested capital should not be taxed. Chapter 3 showed that the existence of feedback effects of foreign investment on domestic profits looses the relationship between taxes and the quantity of investment and, under certain circumstances, can even turn it around. In chapter 4, we showed that heterogeneity in the access to tax havens may imply that tax competition leads to inefficiently high levels of tax enforcement. In chapter 5, heterogeneity in ownership determines how affiliates are exposed to tax changes in other countries than their own. In chapter 6, finally, the differences between national and multinational firms affect the degree of tax competition.

To sum up, what can be learnt is that observable sources of heterogeneity may change the outcomes of tax competition in a non-negligible way. The range of heterogeneity sources is too broad to imagine a unifying framework. Therefore, one should interpret the studies presented in the previous chapters as exemplary cases in which heterogeneity turned out to be important and changed some results of the standard tax literature. In addition, since an infinity of heterogeneity sources can be imagined, it remains an empirical question and research task to identify

those aspects of heterogeneity which are important from a public finance point of view.

The policy implications of the previous chapters can be summarized as follows. Firstly, in the presence of heterogeneous firms, the policy recommendations of standard tax theory, i.e. zero taxation of the marginal investment project, may be misleading and certainly need revision, see chapter 2. Secondly, the focus on the quantity of investment, both in the public debate and in the empirical scholarly work, may miss important qualitative aspects of cross-border investment flows. In other words, if a country receives large amounts of inbound FDI, this does not need to mean that its tax or economic policy is successful. A closer look to who invests and which projects are realized is necessary, see chapters 3 and 4. Finally, we may have to reconsider the role of multinational firms in the process of globalization. The often cited view that multinational firms should be blamed for aggravating the pressure from tax competition and for forcing governments to reduce corporate tax rates, is not (or less) justified if complementarities within the multinational are accounted for. In contrast, a world in which integration is mainly achieved by border crossing firm structures may be less vulnerable to interjurisdictional competition than a world in which capital is shifted via banks and other financial intermediaires, see chapters 5 and 6.

# Bibliography


Alchian, A. and Demsetz, H. (1972). Production, information costs, and economic organization, *American Economic Review* **62**: 777–95.

Andrade, G., Mitchell, M. and Stafford, E. (2001). New Evidence and Perspectives on Mergers, *Journal of Economic Perspectives* **15**(2): 103–120.

Arellano, M. and Bond, S. R. (1991). Some Test of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations, *Review of Economic Studies* **58**(2): 277–297.

Barba Navaretti, G., Checchi, D. and Turrini, A. (2003). Adjusting Labor Demand: Multinational versus National Firms: A Cross-European Analysis, *Journal of the European Economic Association* **1**(2-3): 708–719.

Barba Navaretti, G. and Venables, A. J. (2004). *Multinational Firms in the World Economy*, Princeton University Press.

Becker, J. (2007). Competition in Enforcement Policies with Heterogeneous Profit Shifting, *University of Cologne Working Paper* .

Becker, J. and Fuest, C. (2007a). Optimal Tax Policy When Firms Are Internationally Mobile, *University of Cologne Working Paper* .

Becker, J. and Fuest, C. (2007b). Quantity versus Quality - The Composition Effect of Corporate Taxation on Foreign Direct Investment, *CESifo Working Paper No. 2126* .

Becker, J. and Fuest, C. (2007c). Tax Enforcement and Tax Havens Under Formula Apportionment, *CPE Working Paper* .

Becker, J. and Riedel, N. (2007a). Tax Competition and Investment by Multinational Firms, *University of Cologne Working Paper* .

Becker, J. and Riedel, N. (2007b). Tax Effects on Multinational Firms - Theory and European Evidence, *University of Cologne Working Paper* .

Boadway, R., Cuff, K. and Marceau, N. (2002). Inter-Jurisdictional Competition for Firms, *International Economic Review* **43**(3): 761–82.

Bond, S. R. (2000). Levelling Up or Levelling Down? Some Reflections on the ACE and CBIT Proposals, and the Future of the Corporate Tax Base, *in* S. Cnossen (ed.), *Taxing Capital Income in the European Union. Issues and Options for Reform*, Oxford University Press, pp. 161–179.

Bucovetsky, S. (1991). Asymmetric Tax Competition, *Journal of Urban Economics* **30**: 67–181.

Bucovetsky, S. and Haufler, A. (forthcoming). Tax Competition When Firms Choose their Organizational Form: Should Tax Loopholes for Multinationals Be Closed?, *Journal of International Economics* .

Bucovetsky, S. and Wilson, J. (1991). Tax Competition with Two Tax Instruments, *Regional Science and Urban Economics* **21**: 333–350.

Budd, J. W., Konings, J. and Slaughter, M. J. (2005). Wages and International Rent Sharing in Multinational Firms, *Review of Economics and Statistics* **87**(1): 73–84.

Buettner, T. and Wamser, G. (2007). Intercompany Loans and Profit Shifting - Evidence from Company-Level Data, *CESifo Working Paper No. 1959* .

Castellani, D. and Barba Navaretti, G. (2004). Investments Abroad and Performance at Home: Evidence from Italian Multinationals, *CEPR Discussion Paper No. 4284* .

Clausing, K. A. (2003). Tax-Motivated Transfer Pricing and US Intrafirm Trade Prices, *Journal of Public Economics* **87**(9-10): 2207–2223.

Coase, R. (1937). The Nature of the Firm, *Economica* **4**: 386–405.

Commission, E. (2006). Structures of the Taxation Systems in the European Union, *Directorate Generale Taxation and Customs Union.* .

Cowell, F. (2004). Sticks and Carrots, *in* H. Aaron and J. Slemrod (eds), *The Crisis in Tax Administration*, Brookings Institution Press, Washington, D.C., pp. 230–275.

Cremer, H. and Gahvari, F. (2000). Tax Evasion, Fiscal Competition and Economic Integration, *European Economic Review* **44**(9): 1633–1657.

Desai, M. A., Foley, C. F. and Hines, J. R. (2005a). Foreign Direct Investment and the Domestic Capital Stock, *American Economic Review* **95**(2): 33–38.

Desai, M. A., Foley, C. F. and Hines, J. R. (2005b). Foreign Direct Investment and the Domestic Economic Activity, *NBER Working Paper Series* **11075**.

Desai, M. A., Foley, C. F. and Hines, J. R. (2006a). Do Tax Havens Divert Economic Activity?, *Economics Letters* **90**(2): 219–224.

Desai, M. A., Foley, C. F. and Hines, J. R. J. (2006b). The Demand for Tax Haven Operations, *Journal of Public Economics* **90**(3): 513–31.

Devereux, M. P. (2007). The Impact of Taxation on the Location of Capital, Firms and Profit: A Survey of Empirical Evidence, *Oxford University Centre for Business Taxation Working Paper Series No. 07/2* .

Devereux, M. P. and Freeman, H. (1995). The Impact of Tax on Foreign Direct Investment: Empirical Evidence and the Implications for Tax Integration Schemes, *International Tax and Public Finance* **2**: 85–106.

Devereux, M. P. and Griffith, R. (2003). Evaluating Tax Policy for Location Decisions, *International Tax and Public Finance* **10**(2): 107–126.

Devereux, M. P., Griffith, R. and Klemm, A. (2002). Corporate Income Tax Reforms and International Tax Competition, *Economic Policy* **17**(2): 450–493.

Dharmapala, D. and Hines, J. R. (2006). Which Countries Become Tax Havens?, *NBER Working Papers: 12802* .

Egger, P. and Pfaffermayer, M. (2003). The Counterfactual to Investing Abroad: An Endogenous Treatment Approach of Foreign Affiliate Activity, *University of Innsbruck Working Papers in Economics No. 2003-2* .

Feldstein, M. (1995). The Effects of Outbound Foreign Direct Investment on the Domestic Capital Stock, *in* M. Feldstein, J. R. Hines and R. G. Hubbard (eds), *The effects of taxation on multinational corporations, A National Bureau of Economic Research Project Report*, University of Chicago Press, Chicago and London.

Fuest, C. (2005). Economic Integration and Tax Policy with Endogenous Foreign Firm Ownership, *Journal of Public Economics* **89**(9-10): 1823–1840.

Fuest, C. and Hemmelgarn, T. (2005). Corporate Tax Policy, Foreign Firm Ownership and Thin Capitalization, *Regional Science and Urban Economics* **35**(5): 508–526.

Fuest, C., Huber, B. and Mintz, J. (2005). Capital Mobility and Tax Competition, *Foundations and Trends in Microeconomics* **1**(1): 1–62.

Gordon, R. H. (1986). Taxation of Investment and Savings in the World Economy, *American Economic Review* **76**(5): 1086–1102.

Gordon, R. H. (1992). Can Capital Income Taxes Survive in Open Economies?, *Journal of Finance* **47**(3): 1159–1180.

Gordon, R. H. and Hines, J. R. (2002). International Taxation, *in* A. J. Auerbach and M. Feldstein (eds), *Handbook of Public Economics*, Vol. 4 of *Handbooks in Economics*, North-Holland, Amsterdam, chapter 28, pp. 1935–1995.

Grubert, H. and Mutti, J. (1995). Taxing Multinationals in a World with Portfolio Flows and R&D - Is Capital Export Neutrality Obsolete?, *International Tax and Public Finance* **2**(3): 439–457.

Grubert, H. and Mutti, J. H. (1991). Taxes, Tariffs and Transfer Pricing in Multinational Corporate Decision Making, *Review of Economics and Statistics* **73**: 285–293.

Grubert, H. and Slemrod, J. (1998). The Effect of Taxes on Investment and Income Shifting to Puerto Rico, *Review of Economics and Statistics* **80**(3): 365–373.

Hansen, L. P. (1982). Large Sample Properties of Generalized Method of Moments Estimators, *Econometrica* **50**(4): 1029–1054.

Haufler, A. (2001). *Taxation in a Global Economy*, Cambridge University Press, Cambridge.

Haufler, A. and Schjelderup, G. (2000). Corporate Tax Systems and Cross Country Profit Shifting, *Oxford Economic Papers* **52**(2): 306–325.

Helpman, E., Melitz, M. J. and Yeaple, S. R. (2004). Export versus FDI with Heterogeneous Firms, *American Economic Review* **94**(1): 300–316.

Hines, J. R. (2005). Do Tax Havens Flourish?, *in* J. M. Poterba (ed.), *Tax Policy and the Economy*, MIT Press, Cambridge and London, pp. 65–99.

Hines, J. R. and Rice, E. M. (1994). Fiscal Paradise: Foreign Tax Havens and American Business, *Quarterly Journal of Economics* **109**(1): 149–182.

Holmstrom, B. R. and Tirole, J. (1989). The Theory of the Firm, *in* R. Schmalensee and R. D. Willig (eds), *The Handbook of Industrial Organization*, Vol. 1, North Holland, Amsterdam, pp. 61–133.

Hong, Q. and Smart, M. (2007). In Praise of Tax Havens: International Tax Planning and Foreign Direct Investment, *CESifo Working Paper No. 1942* .

Huizinga, H. and Laeven, L. (2007). International Profit Shifting Within European Multinationals, *CEPR Working Paper No. 6048* .

Huizinga, H. and Nielsen, S. B. (1997). Capital Income and Profit Taxation with Foreign Ownership of Firms, *Journal of International Economics* **42**: 149–165.

Jaeckle, R. (2006). Going Multinational: What Are the Effects on Home Market Performance?, *Bundesbank Discussion Paper No. 3-2006* .

Keen, M. (2001). Preferential regimes can make tax competition less harmful, *National Tax Journal* **LIV**(4): 757–761.

KPMG (2006). Corporate Tax Rate Survey.

Laeven, L., Nicodème, G. and Huizinga, H. (2007). Capital Structure and International Debt Shifting, *IMF Working Papers: 07/39* .

Lipsey, R. E. (1995). Outward Direct Investment and the U.S. Economy, *in* M. Feldstein, J. R. Hines and R. G. Hubbard (eds), *The Effects of Taxation on Multinational Corporations*, University of Chicago Press, Chicago, pp. 7–33.

Lipsey, R. E. (2001). Foreign Direct Investment and the Operations of Multinational Firms: Concepts, History and Data. NBER Working Paper No. 8665.

Markusen, J. R. (2002). *Multinational Firms and the Theory of International Trade*, Massachussets Institute of Technology, Cambridge, USA.

McGuckin, R. and Nguyen, S. (1995). On Productivity and Plant Ownership Change - New Evidence from the Longitudinal Research Database, *Rand Journal of Economics* **26**(2): 257–276.

Mintz, J. and Smart, M. (2004). Income Shifting, Investment, and Tax Competition: Theory and Evidence from Provincial Taxation in Canada, *Journal of Public Economics* **88**: 1149–1168.

Nielsen, S. B., Raimondos-Møller, P. and Schjelderup, G. (2004). Company Taxation and Tax Spillovers: Separate Accounting versus Formula Apportionment, *Working Paper* .

Oates, W. (1972). *Fiscal Federalism*, Harcourt-Brace, New York.

Osmundsen, P., Hagen, K. P. and Schjelderup, G. (1998). Internationally Mobile Firms and Tax Policy, *Journal of International Economics* **45**(1): 97–113.

Ottaviano, G. I. P. and Thisse, J.-F. (2003). Agglomeration and Economic Geograpy. CEPR Discussion Paper No. 3838.

Peralta, S., Wauthy, X. and Ypersele, T. V. (2006). Should Countries Control International Profit Shifting?, *Journal of International Economics* **68**(1): 24–37.

Richter, W. and Wellisch, D. (1996). The Provision of Local Public Goods and Factors in the Presence of Firm and Household Mobility, *Journal of Public Economics* **60**: 73–93.

Sargan, J. D. (1958). The Estimation of Economic Relationships Using Instrumental Variables, *Econometrica* **26**: 329–338.

Sinn, H.-W. (1990). Tax Harmonization and Tax Competition in Europe, *European Economic Review* **34**(2-3): 489–504.

Slemrod, J. (2001). A General Model of the Behavioral Response to Taxation, *International Tax and Public Finance* **8**(2): 119–128.

Slemrod, J. (2004a). Are Corporate Tax Rates, or Countries, Converging?, *Journal of Public Economics* **88**(6): 1169–1186.

Slemrod, J. (2004b). The Economics of Corporate Tax Selfishness, *National Tax Journal* **57**(4): 877–899.

Slemrod, J. and Wilson, J. D. (2006). Tax Competition and Parasitic Tax Havens, *NBER Working Papers No. 12225* .

Steinmo, S. (2003). The Evolution of Policy Ideas: Tax Policy in the 20th Century, *British Journal of Politics and International Relations* **5**(2): 206–236.

Stevens, G. G. and Lipsey, R. E. (1992). Interactions between Domestic and Foreign Investment, *Journal of International Money and Finance* **11**(1): 40–62.

Stöwhase, S. and Traxler, C. (2005). Tax Evasion and Auditing in a Federal Economy, *International Tax and Public Finance* **12**(4): 515–531.

Swank, D. and Steinmo, S. (2002). The New Political Economy of Taxation in Advanced Capitalist Democracies, *American Journal of Political Science* **46**(3): 642–655.

Swenson, D. L. (2001). Tax Reforms and Evidence of Transfer Pricing, *National Tax Journal* **54**(1): 7–25.

Tiebout, C. M. (1956). A Pure Theory of Local Expenditure, *Journal of Political Economy* **64**: 416–424.

UNCTAD (2007). World Investment Report.

Weichenrieder, A. J. (2007). Profit Shifting in the EU: Evidence from Germany, *CESifo Working Paper No. 2043* .

Whalley, J. (1990). Foreign Responses to US Tax Reform, *in* J. Slemrod (ed.), *Do taxes matter? The impact of the Tax Reform Act of 1986*, MIT Press, Cambridge and London, pp. 286–314.

Wilson, J. D. (1986). A Theory of Interregional Tax Competition, *Journal of Urban Economics* **19**: 296–315.

Wilson, J. D. and Wildasin, D. E. (2004). Capital Tax Competition: Bane or Boon, *Journal of Public Economics, Special Issue* **88**(6): 1065–91.

Zodrow, G. R. and Mieszkowski, P. (1986). Pigou, Tiebout, Property Taxation, and the Underprovision of Local Public Goods, *Journal of Urban Economics* **19**: 356–370.