Multinational Enterprises and Corporate Taxation:

An Empirical Assessment of the Location of Assets, Profits and Debt

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Chapter 1

Introduction

The globalized world economy is experiencing a rising importance of multinational enterprises (MNEs). Referring to OECD data, worldwide foreign direct investment (FDI) has sextupled since the early 1990s. These days, more than one third of international trade is intra-company trade of MNEs with affiliates in different locations worldwide. Hence, for the modern firm it is optimal to fragment the production process across national borders irrespective of tax considerations (e.g. Krugman, 1995). At this level of decision, when the firm has generally decided on establishing a production plant abroad versus the alternative of exporting, the firm can then choose between different locations, also taking national corporation taxes into account.[1] From a theoretical view, the incentive to locate in a specific country increases with a smaller effective average corporate tax rate of that country.

This doctoral dissertation is concerned with the subsequent two levels of decision for MNEs. First, conditional on locating in a particular country, the firm has the continuous choice of the size of investment. The empirical literature has brought forward comprehensive evidence that the level of FDI is negatively affected by corporate taxes (see Devereux and Maffini, 2007, for an extensive survey). Second, conditional on the level of investments, the firm can decide the reallocation of realized profits among their affiliate locations worldwide by applying various tax avoidance strategies of income shifting. The focus of this doctoral thesis is the empirical assessment of corporate tax effects on MNEs' location decision of assets, profits and debt. Thereby, the aim is to analyze with a large database of European MNEs and with modern and sophisticated econometric methods that explicitly control for unobserved heterogeneity between multinational affiliates if corporate taxes and, more precisely, corporate tax rate differences between affiliates of MNEs are relevant on these two latter levels of decision and, if yes, to determine the extent of these tax effects.

The activities of MNEs may have various positive effects on the welfare of a country. For example, multinational firms exhibit a higher profitability than domestic corporations which, on the one hand, leads to higher wages for employees of a MNE and, on the other hand, yields positive spillovers for domestic corporations with respect to firm productivity. In addition, the capital stock of a country may rise due to increasing FDI undertaken by MNEs. Given these positive consequences, the analysis of the impact of corporate taxation on the level of investments as well as on the level of profits of MNEs is a highly relevant topic.

[1] For example, Devereux and Griffith (1998) provide evidence that the fundamental, discrete decision of setting up a subsidiary abroad is to a much lesser extent influenced by tax considerations than the concrete choice of investing in a particular country.

The corporate tax system in the European Union (EU) is characterized by the separate taxation of corporate income of each MNE's foreign subsidiary (*separate accounting*). Therefore, along with different national corporate tax rates, this tax principle provides MNEs with the opportunity to shift profits from high-tax to low-tax countries. Generally, three strategies of shifting profits can be distinguished. First, charging intra-company (intermediate) goods for a higher or a lower than the arm's length price, i.e. the market price, to manipulate the gross profits of the trading affiliates in an overall tax-minimizing way (*transfer pricing*). Second, *overhead costs* e.g. for research and development (R&D) or headquarters services can be allocated strategically to affiliates in different countries in order to bias their pre-tax profits. Third, MNEs can shift profits via the channel of intra-company *financial transactions* by strategies of debt shifting, i.e. by the granting of an internal credit of a low-tax affiliate to a high-tax affiliate to benefit from the interest depreciation tax shield. However, the current proposal of the European Commission (2001) for the introduction of a *Common Consolidated Corporate Tax Base* (CCCTB) aims to eliminate such profit shifting activities by consolidating all corporate tax bases of a MNE and reallocating the global profit to the different affiliate locations according to a specific formula (*formula apportionment*).[2] Providing quantitative evidence of profit shifting may support the argumentation for the implementation of such a formula apportionment tax system (CCCTB) in the EU, which is assumed to be more efficient than the current system of separate accounting in many dimensions, but at the same time might suffer from ambiguous and potential adverse effects (see e.g. Riedel and Runkel, 2007).

In the context of international tax competition, the possibility for MNEs to shift profits from high-tax to low-tax locations has two opposed effects on the level of national statutory corporate tax rates. On the one hand, obviously, the possibility to shift profits intensifies tax competition in the sense of lower corporate taxes as countries not only compete over mobile firms and capital but additionally over shifty profits (see e.g. Devereux, Lockwood, and Redoano, 2008). On the other hand, under the assumption that profit shifting is not completely suppressed by national tax authorities, the possibility to shift profits attenuates tax competition at the level of attracting firm and FDI with lower corporate taxes. If MNEs have the opportunity to shift income away from locations with a relatively high tax rate at sufficiently moderate costs they might have a higher incentive to locate at such a high-tax country or might have a lower incentive to relocate their business from the high-tax to a low-tax country, respectively.

[2]See Fuest (2008) for a comprehensive survey on the current state of the European Commission's proposal. In addition, see European Commission (2008) for possible parts of the final proposal.

Hence, besides corporate tax rates, countries have an additional instrument via the control intensity of profit shifting activities (and via the rate of the fine) to compete with each other (Haufler and Bucovetsky, 2008). As a conclusion, tax competition within the European Union can only be completely prevented if not only statutory corporate tax rates are harmonized but also the imposition of taxes is harmonized, potentially with a centralized EU tax collection authority.

The globalized world economy is not only characterized by a high degree of firm and capital mobility due to open national borders, decreasing tariffs and cheap travel, communication and transportation costs. These developments have likewise intensified the competition between MNEs on a worldwide scale. Therefore, the need to save expenses and costs is much higher nowadays for a modern firm that wants to be internationally competitive. On top of this, the ambition to operate cost efficiently is also getting more extreme due to the rising importance of the so-called *shareholder value principle* as more firms are quoted and their shares are traded at the major international stock exchanges. According to this principle, the corporate activity consistently and exclusively aims at maximizing the company value from the view of the shareholders. Consequently, in the spirit of this business philosophy and due to the competitive pressure from globalization, the optimal saving and avoidance of taxes has likewise become a more and more indispensable practice. But the planning, implementing and monitoring of tax avoidance strategies like profit shifting requires specific knowledge by business experts. However, the access to such know-how has become easier and cheaper for MNEs over the past few decades as the international level of education has increased and thus allowed relatively more white-collar and high-skilled workers to be employed at MNEs.

The main conclusion of this doctoral thesis is that MNEs' corporate activity is significantly influenced by corporate taxation. Thereby MNEs use various strategies to minimize, as well as to avoid, corporate taxes by relocating profitable assets and functions, as well as by shifting profits from high-tax to low-tax countries. With regards to research content, this thesis comprises four chapters which all exhibit an empirical focus. Three sections (Chapter 2, 3 and 5) deal with empirical evidence of MNEs' investment and profit shifting strategies to reduce their global corporate tax liability. One section (Chapter 4) highlights the importance of the MNEs' headquarters location versus their foreign subsidiaries and finds various implications for public economics, like the impact on tax revenue or on firm's profit shifting behavior. Each chapter can be read separately apart from the others as each is designed as a stand-alone research project that also includes its own introduction and conclusions.

Chapter 2 (a revised version of Dischinger, 2008) provides evidence of profit shifting activities between an affiliated multinational firm and its foreign parent. The influence of the ownership share on the shifting volume between the two affiliates is analyzed as well. This study is mainly inspired by an article of Huizinga and Laeven (2008) and employs a large micro database which includes detailed accounting and ownership information of mainly European MNEs for the years 1995 to 2005 that are located in 25 countries of the EU. While controlling for unobservable time-constant heterogeneity between affiliates, the estimations explain variations in affiliates' pre-tax profits with various firm and country characteristics and in addition with the statutory corporate tax rate difference to its foreign parent firm. This tax measure captures the direct profit shifting incentive which is shown prior to the econometric analysis with a simple theoretical model that yields testable hypotheses. The results show a strongly negative relationship between an affiliated company's tax rate differential and the affiliate's gross profits. Quantitatively, a 10 percentage points decrease in the tax rate of the affiliate (relative to the parent) increases its pre-tax profitability by about 7%, if all else is kept equal. Various robustness checks support this profit shifting inference. Furthermore, the analysis presents first evidence that a higher parent's ownership share of its subsidiary leads to intensified shifting activities between these affiliates. The quantitative results are compared with existing studies using U.S. and European micro data and divergent econometric methods. Subsequent to this systematic observation of statistically and economically significant responses of a multinational affiliate's pre-tax profitability to tax rate differences, the next chapter deals with the responsiveness of highly profitable assets like intangibles to international tax differentials.

Chapter 3 is based on a joint project with Nadine Riedel (a revised version of Dischinger and Riedel, 2008).[3] In this teamwork, we analyze corporate tax rate differences within a MNE and the location of intangible assets. Our study is amongst others inspired by the work of Grubert (2003) and also by anecdotal evidence of MNEs like Microsoft, Pfizer, Shell or Vodafone who transferred their R&D units, product design centers or intellectual property & licensing departments to affiliates in Ireland or Switzerland, respectively. These affiliates then charge royalties to operating affiliates worldwide. In general, intangible assets like patents and trademarks are increasingly seen as the key to competitive success and as the drivers of corporate profit. Moreover, they constitute a major source of profit shifting opportunities in MNEs due to a highly

[3]Nadine Riedel holds a Ph.D. in Economics of the University of Munich since 2008, is a research fellow at the Oxford University Centre for Business Taxation of the Saïd Business School and is a research affiliate of the CESifo Research Network, Munich.

intransparent transfer pricing process. We argue that for both reasons, MNEs have an incentive to locate intangible property at affiliates with a relatively low corporate tax rate. To receive this hypothesis for our estimation approach, the chapter starts out with a simple model of intangible asset location. In addition, we provide a short overview of European accounting practices with respect to intangible assets to achieve a clear identification strategy. Using the same micro panel data as in the analysis of Chapter 2 and controlling for unobserved time-constant heterogeneity between affiliates, we find that the lower a subsidiary's corporate tax rate *relative* to other affiliates of the multinational group, the higher is its level of intangible asset investment. The effect is statistically and economically significant, even after controlling for subsidiary size, year effects, and country characteristics. Furthermore, the effect appears across a range of specification and estimation model choices that address endogeneity issues and the dynamic pattern of the intangible asset investment. Quantitatively, the estimations suggest a semi-elasticity of around -1.4, meaning that a decrease in the average tax differential to other group affiliates by 10 percentage points raises a subsidiary's intangible property investment by around 14% on average. Finally, we additionally provide evidence that suggests more extensive profit shifting activities of MNEs which exhibit a large share of their intangible asset holdings at low-tax affiliates within the group. In the next chapter, we study among other things if, also as a consequence of this, the profitability of foreign subsidiaries really has increased over the last decade relative to parent firms.

Chapter 4 is again based on a joint work with Nadine Riedel (Dischinger and Riedel, 2009; Dischinger and Riedel, 2010). This time, we analyze the importance of the MNE's headquarters location versus the locations of their foreign subsidiaries in allocating profitable assets and profits within the multinational group by comparing the profitability rates of parents with the rates of subsidiary firms. Using a large panel dataset of European MNEs for the years 1999 to 2006 and located in 27 European countries, we provide evidence that operations at multinational headquarters are significantly more profitable than operations at their foreign subsidiaries. Our most conservative estimates quantify the profitability gap with around 30%. The results turn out to be robust against the use of different profitability measures and the inclusion of a large set of control variables like the firm age, the leverage ratio, the size of the input factors, country and industry fixed effects, and multinational group fixed effects. Our findings suggest that the profitability gap is partly driven by agency costs which arise if value-driving functions are managed by a subsidiary that is geographically separated from the headquarters management. We additionally show that this gap likewise exists between headquarters and their *domestic* subsidiaries, whereas it is measured to be

around two thirds smaller. In addition, in line with falling communication and travel costs over the last decade, we provide robust evidence that the profitability gap between headquarters and their foreign subsidiaries is declining over time by at least 1.5 percentage points per year. Apart from that, our results indicate that a higher competitiveness of MNEs in their home markets also contributes to the profitability gap. Furthermore, we discuss various implications of our findings for public economics. For example, we additionally show that tax payments at multinational headquarters are found to be about 60% larger than at their foreign subsidiaries. With regard to profit shifting behavior, we empirically observe that, on the one hand, MNEs are reluctant to shift profits away from high-tax headquarters to low-tax subsidiaries and, vice versa, that MNEs are eager to shift profits from high-tax subsidiaries to low-tax headquarters. Overall, this chapter provides evidence for the increasing mobility of profitable assets in the last decade which results in a growing profitability of foreign subsidiaries reducing the gap to the parent. This observation is in line with the results of Chapter 3 of intangible asset relocations to low-tax affiliates.

Chapter 5 is carried out with the assistance of Ulrich Glogowsky and Marcus Strobel (Dischinger, Glogowsky, and Strobel, 2010).[4] In this research project, we study the more complex method of shifting profits via intra-company financial transactions. This work is amongst others inspired by an article by Mintz and Smart (2004) which argues that a strategic allocation of debt and equity within the multinational group by borrowing from low-tax affiliates and lending to high-tax affiliates allows the latter to deduct interest expenses from the tax base and, consequently, overall results in tax savings for the MNE. We analyze multinational affiliates' leverage responses to tax rate changes and also identify debt shifting activities of MNEs. In addition, we highlight the impact of the firm-specific risk on these financing strategies. In general, multinational as well as domestic firms have the incentive to enhance debt financing with higher corporate tax rates due to the increased value of interest deductions from the tax base. However, external debt is relatively costly for corporations with a high firm-specific risk. Moreover, for MNEs, the shifting of internal debt opens up additional tax saving opportunities. Using a large database of MNEs for the years 1998 to 2006 and located in 30 European countries, we first provide evidence that the debt-to-assets ratio is positively affected by the statutory corporate tax rate. Second, we show that multinational subsidiaries use debt shifting with the parent firm as well as external debt to get advantage of the depreciation tax shield. Third, we provide evidence that

[4]Ulrich Glogowsky and Marcus Strobel are students in Economics at the University of Munich and student research assistants at the Seminar for Economic Policy of the University of Munich.

subsidiaries with a high firm-specific risk are more involved in debt shifting than low-risk subsidiaries. Vice-versa, low-risk affiliates use external debt more intensively in a tax-minimizing way. We address endogeneity concerns on our firm-specific risk proxies with a sectoral analysis comparing high-risk with low-risk industries based on exogenous information and find a similar, even more extreme pattern. Our panel estimations control for firm size, profitability, firm age, and various country characteristics as well as for time and affiliate fixed effects. Overall, this chapter again highlights the ambition of MNEs to minimize their global tax liability and stresses the flexibility of MNEs in adjusting likewise their financial structure as a reaction to changes in corporate tax rates and international tax differentials.

Chapter 2

Profit Shifting by Multinationals and the Ownership Share: Evidence from European Micro Data

2.1 Introduction

The current corporate tax principle in the European single market is characterized by a separate taxation of profits of each foreign subsidiary (*separate accounting*). This main principle in addition with different national statutory corporate tax rates in the European Union (EU) thus provides multinational enterprises (MNEs) with the opportunity to shift profits from high-tax to low-tax countries. The incentive to relocate corporate income could be even larger for European MNEs compared to U.S.-based multinationals, as tax differences in Europe can be large even among neighboring states. Additionally, most EU countries employ the *exemption system* for taxing foreign corporate profits, under which international tax differentials in the source country of the investment are directly relevant for the after-tax profits of companies.[1] It is therefore of fundamental importance for governments in EU high-tax countries to protect their national corporate tax revenue against various kinds of profit shifting.[2] However, the tax auditing of the MNEs' transfer pricing documentations constitutes substantial costs for governments and, furthermore, in many cases it is unfeasible to reveal all potential shifting activities of a MNE. The current proposal of the European Commission (2001) aims to eliminate or at least substantially reduce these tax avoidance incentives by consolidating all corporate tax bases of a MNE and reallocating this profit to the different subsidiary locations according to a specific formula (*formula apportionment*). Fuest (2008) gives a comprehensive review on the current state of the European Commission´s renewed proposal for a directive on the introduction of a *Common Consolidated Corporate Tax Base* (CCCTB), which were supposed to be submitted at the end of 2008.[3]

With respect to this proposed changeover to a EU corporate tax system of *formula apportionment*, it is of fundamental importance to evaluate the actual magnitude of

[1] The system of foreign *tax credit* applied in the U.S. aims to equalize international differences in corporate tax rates through compensating supplementary taxation of foreign source income in the parent country. This should induce fewer incentives to shift profits, other things being equal.

[2] Basically, three methods of shifting profits can be distinguished. First, charging intra-company intermediate goods for a higher or a lower than the arm's length price (*transfer pricing*). Second, *overhead costs*, e.g. for R&D or headquarter services, can be allocated strategically to subsidiaries in different countries in order to bias their pre-tax profits. Third, MNEs can shift profits via the channel of intra-company *financial transactions* by internal borrowing and lending between affiliates to get advantage of the interest depreciation tax shield.

[3] See European Commission (2008) for a recent working paper by the Commission´s working group which presents and discusses possible parts of the final proposal.

profit shifting in the EU under the current principle of *separate accounting*. A high dimension of multinational income shifting activities would give one strong argument for the transition to *formula apportionment*. This paper estimates the intensity of profit shifting behavior in the EU and thus can contribute to this decision making problem; particularly, as empirical studies on profit shifting with European data are still scarce. Hence, the results could help to assess the level of the bias in national corporate tax bases in the EU that results from the relocation of profits. I analyze this issue using a broad European micro data set in a panel structure (AMADEUS database) which thus allows the application of the fixed-effects method. While controlling for unobservable time-constant heterogeneity between affiliates, I explain variations in affiliate's pre-tax profits with various firm and country characteristics and additionally with the statutory corporate tax rate differential to the parent firm. This tax measure captures the direct profit shifting incentive. The baseline sample consists of 67,804 observations from 14,077 multinational subsidiaries within the EU–25 for the years 1995 to 2005. The results show a robust inverse relationship between the statutory tax rate of a subsidiary relative to the parent firm location and the subsidiary's unconsolidated pre-tax profitability which can be interpreted as indirect evidence of profit shifting. Quantitatively, I find a semi-elasticity of $-.73$, meaning that a decrease in a subsidiary's statutory tax rate difference to its parent by 10 percentage points increases the subsidiary's pre-tax profitability by 7.3%, other things being equal. Various robustness tests support this profit shifting inference.

In addition, the paper provides evidence that a higher parent's ownership share of a subsidiary leads to an increase in the level of profit shifted between these two affiliates, and vice versa. Theoretically, the ownership share is highly relevant for a MNE's profit shifting activities as it directly affects the feasibility of implementing tax planning strategies and thus determines the shifting cost.[4] For example, an increase in the parent's ownership share can lead to a boost in shifting activities via an eased enforceability of tax strategies. This may result since more management influence at the subsidiary via more share voting rights is reached, as opposed management interests from other parties involved are now reduced (*management effect*). Robust empirical evidence for this positive impact of the ownership share on the intensity of profit shifting is scarce in the existing literature. However, on the outbound side of German

[4]See Desai, Foley, and Hines (2004a) for an analysis that includes the conflict of interests in the transfer pricing process (coordination costs) when more than one owner is involved in the shareholding. Furthermore, Mintz and Weichenrieder (2005) and Büttner and Wamser (2007) empirically show that the ownership share positively affects corporate tax effects on intra-company borrowing and lending.

FDI, Weichenrieder (2009) finds some evidence of the ownership share impact on profit shifting behavior comparing tax rate effects for affiliates that are wholly owned vs. non-wholly owned. My continuous ownership effect strengthen this result of Weichenrieder (2009) by providing evidence that changes in the tax differential yield a stronger effect on pre-tax profitability for multinational subsidiaries that are owned by their foreign parent with a higher ownership share. My result is confirmed by a robustness check using separate estimation samples with different ownership thresholds.

The existing empirical literature on profit shifting focuses mainly on U.S. data (see Hines, 1997, Hines, 1999, and Devereux and Maffini, 2007, for comprehensive surveys). Most studies provide *indirect* evidence as data on intra-firm transactions is limited even in the U.S..[5] In doing so, the standard method used in this literature tries to explain differences in (unconsolidated) pre-tax profits of affiliated companies by the statutory corporate tax *rate* which is effective at the affiliate's location, while controlling for firm and country characteristics. Grubert and Mutti (1991) and Hines and Rice (1994), for example, perform this with aggregate data on affiliates by country, whereas e.g. Harris, Morck, Slemrod, and Yeung (1993) and Collins, Kemsley, and Lang (1998), with a similar methodology, use firm-level data. A more precise tax measure is however to describe the incentive of a MNE to shift profits between two affiliates with the bilateral statutory tax rate *difference* of an affiliated multinational corporation to its foreign parent firm. In my paper, I use this tax differential for the identification of shifting activities.

Evidence of profit shifting with European data is still rare. Weichenrieder (2009) confirms profit shifting into and out of Germany with German panel FDI-data (MiDi database), using statutory tax rates and after-tax profits as identification. With the same database, Overesch (2006) demonstrates for German MNEs a negative impact of the statutory tax rate on the size of balance sheet items that reflect intra-company sales. Huizinga and Laeven (2008), with a methodology close to Hines and Rice (1994), perform a cross-section analysis for the year 1999 with affiliate level data from the AMADEUS database to provide evidence of profit shifting within European MNEs by explaining variations in *Earnings before Interest and Taxes (EBIT)* with various tax differentials, among firm and country controls. I use the same micro database as Huizinga and Laeven (2008), but undertake a panel analysis over 11 years controlling for fixed firm effects. This method can alleviate the endogeneity problem of unobservable firm-specific characteristics in explaining variations in profits. A firm's profitability is

[5]So far, only a few papers yield *direct* evidence of profit shifting by using affiliate level data on intra-company *transfer prices* (Swenson, 2001; Clausing, 2003; Bernard, Jensen, and Schott, 2006).

likely to be driven by internal firm-specific factors, which are impossible to control for by variables available in standard accounting databases (e.g. management quality, degree of product innovation, product popularity, etc.). Therefore, to analyze firm behavior issues, using panel data in combination with the fixed-effects estimation model should lead to more reliable and robust results.

The remainder of the paper is organized as follows. In Section 2.2, a simple model of profit shifting is presented. From this model, I derive hypotheses for the econometric specifications. Section 2.3 describes the data and the sample composition. Section 2.4 presents the estimation approach, the empirical results and various robustness checks. Section 2.5 concludes.

2.2 A Simple Model of Profit Shifting

I set up a simple and well-established theoretical model of profit shifting.[6] For this purpose, I relate for instance to Grubert (2003) but incorporate a parameter for the ownership share, as first introduced by Weichenrieder (2009). This model serves to derive testable hypotheses for the empirical analysis of Section 2.4.

I assume a MNE with some degree of market power and with one foreign subsidiary. The parent firm, subscripted with p, has to bear the statutory corporate tax rate $0 \leq t_p < 1$, the subsidiary, subscripted with s, has to bear $0 \leq t_s < 1$. The two affiliates engage in exogenous *intra-company, i.e. inter-affiliate, transactions* $T > 0$, that is they purchase and sell a given amount of intermediate products or intra-company services. This provides the MNE with the opportunity to shift profits by deviating from the arm's length price for these intra-company sales.

Profit shifting is modeled through the *shifting parameter* s which represents the amount of profit shifted *per* transaction. If $t_p > t_s$, profits are shifted from the parent to the subsidiary, i.e. $s > 0$, and a higher s means more shifting. The opposite results for a reversed tax scenario. The parameter $\rho > 0$ represents *all expected costs of shifting*, including the probability of detection, the penalty, potential image loss, costs of distorted management incentives, etc.

The parameter $0 < \delta \leq 1$ denotes the *parent's ownership share of its subsidiary*, with $\delta = 1$ indicating a wholly owned affiliate. I incorporate a major effect that the parent's

[6] See e.g. Haufler and Schjelderup (2000) for a detailed theoretical analysis why it is optimal for a MNE to shift pre-tax profits from the parent to the subsidiary firm if the statutory corporate tax rate of the parent is larger than the tax rate of the subsidiary, and vice versa.

ownership share of its foreign subsidiary can have on the level of profits shifted from or to this affiliate. A lower ownership share results in a limited enforceability of profit shifting strategies due to more potentially opposed management interests from other parties involved, and vice versa. I call this the *management effect* of the ownership share on the shifting intensity and model this effect by an increase in the costs of shifting if the ownership share declines, and vice versa.[7]

The output of the parent, $F_p(K_p, L_p)$, is produced with mobile capital and immobile labor with cost r and w_p, respectively. I assume no depreciation of capital. The deductibility of the tax penalty is fully embodied in ρ. Hence, the after-tax profit of the parent is given by

$$\begin{aligned} \pi_p^{net} &= (1-t_p)\left[F_p(K_p, L_p) - rK_p - w_pL_p - s\,T\right] \\ &\quad - (\rho/2)(s/\delta)^2\,T \end{aligned} \tag{2.1}$$

The last term gives a quadratic specification of the *expected shifting costs function* which is frequently used in the literature. I also assume that these costs are solely borne by the parent.[8] The respective after-tax profit of the subsidiary is

$$\pi_s^{net} = (1-t_s)\left[F_s(K_s, L_s) - rK_s - w_sL_s + s\,T\right] \tag{2.2}$$

Summing up these two affiliates' profits yields the overall after-tax profit of the MNE:[9]

$$\begin{aligned} \Pi^{net} &= (1-t_p)\left[F_p(K_p, L_p) - rK_p - w_pL_p\right] \\ &\quad + (1-t_s)\left[F_s(K_s, L_s) - rK_s - w_sL_s\right] \\ &\quad + (t_p - t_s)s\,T - (\rho/2)(s/\delta)^2\,T \end{aligned} \tag{2.3}$$

The *shifting term* (first term in the last row of Equation (2.3)) reflects the tax gain from shifting profits (before penalties). Maximizing overall net profits of the MNE holding *all* input factors fixed yields the *optimal level of shifting*

$$s^* = \frac{(t_p - t_s)\,\delta^2}{\rho} \tag{2.4}$$

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[7] For simplicity, I assume the share of ownership to be determined by exogenous factors. See Weichenrieder (2009) for a similar procedure.

[8] I do not assume any effect of the ownership share on the probability of detection, i.e. I expect that a parent with a partly owned affiliate (e.g. 51% of the shares) is treated equal by the tax authority as if the affiliate is wholly owned (same intensity of investigation).

[9] The relevance of the ownership share for the overall profit of the MNE is not modeled, i.e. the effect that a lower ownership share gives the incentive to shift profits from the partly owned affiliate to the (wholly owned) parent, and vice versa, is not incorporated as this *ownership effect* is independent of tax differences between these two affiliates. This analysis is focussing on profit shifting resulting solely from tax differentials. See Grubert (2003) for a similar procedure.

Thus, in the optimum, $s^* > 0$ if $t_p > t_s$, i.e. the MNE shifts profits from the parent to the subsidiary. Vice versa, $s^* < 0$ if $t_p < t_s$ and profits are shifted *to* the parent. The optimal level of shifting has the following comparative static properties:

$$\frac{\partial s^*}{\partial (t_p - t_s)} > 0 \tag{2.5}$$

$$\frac{\partial s^*}{\partial \delta} = \frac{(t_p - t_s)\, 2\, \delta}{\rho} \begin{array}{lll} > & 0 & \text{if } t_p > t_s \\ < & 0 & \text{if } t_p < t_s \end{array} \tag{2.6}$$

The optimal level of shifting increases with the tax differential (and decreases with the expected cost of shifting parameter ρ). A rise in the ownership share δ increases the optimal level of shifting s^* via the *management effect*, independent of the direction of shifting. I test this hypothesis from Equation (2.6) empirically in Section 2.4.4. If $t_p > t_s$, profits are shifted to the subsidiary and, thus, $s^* > 0$. Hence, an increase in δ leads to a higher level of shifting. The same results if $t_p < t_s$, as profits are shifted to the parent and $s^* < 0$.

Holding again all inputs fixed, I get the main theoretical hypothesis which will be tested throughout the econometric analysis to identify profit shifting:

$$\begin{aligned} \frac{\partial \pi_p^{gross}}{\partial (t_p - t_s)} &= \left(\frac{\partial \pi_p^{gross}}{\partial s^*} \right) \left(\frac{\partial s^*}{\partial (t_p - t_s)} \right) \\ &= -T(1 + t_p - t_s) \left(\frac{\partial s^*}{\partial (t_p - t_s)} \right) < 0 \end{aligned} \tag{2.7}$$

In the tax scenario $t_p > t_s$ (tax scenario $t_p < t_s$), a rise (decline, i.e. getting more negative) in the tax differential results in a higher level of shifting and yields a decrease (increase) in the gross profit of the parent (and finally, a rise in the overall net profit of the MNE). In addition, a rise in the ownership share δ leads to intensified shifting (Equation (2.6)) which further reduces (increases) the pre-tax profit of the parent.

Summarized, the simple model results in the following propositions which constitute the theoretical basis of the empirical analysis in Section 2.4.

Proposition 1.
A larger tax difference of the two affiliates leads to a higher optimal level of profit shifting. This reduces the pre-tax profit of the 'high-tax affiliate' and, vice versa, increases the pre-tax profit of the 'low-tax affiliate'.

Proposition 2.
A rise in the parent's ownership share of its subsidiary leads to a higher optimal level of profit shifting.

2.3 Data

I employ the European micro database AMADEUS provided by Bureau van Dijk which contains standardized unconsolidated and/or consolidated annual accounts for up to 1.5 million national and multinational, public and private companies in 38 European countries from 1993 to 2006. The database involves detailed descriptive information, numerous balance sheet and profit & loss account items, as well as information on the ownership structure, but is unbalanced in structure.

There is no legal commitment for firms to give out information for the database. However, usually the real source of the AMADEUS data is *Creditreform*. The purpose of this institution[10] insures a strong incentive for firms to participate and additionally insures an adequate quality of the data. As in reality the calculation of arm's length prices for transfer pricing auditing by national tax authorities is difficult, time intensive or even unfeasible, e.g. in case of specific patents, other methods are usually applied. Mostly, this is the so called *Transaction Based Net Margin Method*, which compares the net profit margin of the respective affiliate with similar but non-affiliated firms of the same branch with the help of a database. For this, both sides, transfer pricing consultants (e.g. *Deloitte* and *KPMG*) and also more and more tax authorities (e.g. in Germany and France), use the AMADEUS database.[11]

The sample contains firms from the EU–25 member states (except Cyprus and Malta) for the years 1995–2005 as these countries and years are sufficiently represented by the database. The country statistics are presented in Table 2.1. Furthermore, the analysis accounts only for non-public and for industrial MNEs. The observational units are multinational subsidiaries. Thereby, I consider a subsidiary to be *multinational* if there exists a corporate immediate shareholder with totally *at least 90%* of the ownership shares, i.e. the parent firm, which is located in a *foreign* country worldwide.[12] Finally, the baseline regression consists of 67,804 observations from 14,077 multinational sub-

[10] *Creditreform International* traces active commercial enterprises worldwide and checks their creditworthiness to provide credit reports and debt collection services to creditors.

[11] However, firms can self-select into the database or stay out. But by assuming that (more intransparent) firms which refuse the inclusion in the database are more willing to engage in (illegal) profit shifting activities, my estimation results should be biased downwards. Thus, with possibly underestimated but significant coefficient estimates, profit shifting inference is still feasible.

[12] The data restriction to subsidiaries which are owned by 90% or more ensures that the potential relocation of profit to this affiliate is actually relevant for the MNE. I analyze the effect of the parent's ownership share on the shifting intensity in Section 2.4.4.

Table 2.1: Country Statistics

Country	*Subsidiaries*	*Share*
Austria	146	1.04%
Belgium	1,058	7.52%
Czech Republic	396	2.81%
Denmark	844	6.00%
Estonia	206	1.46%
Finland	472	3.35%
France	1,731	12.30%
Germany	1,046	7.43%
Great Britain	2,610	18.54%
Greece	60	.43%
Hungary	30	.21%
Ireland	480	3.41%
Italy	877	6.23%
Latvia	6	.04%
Lithuania	33	.23%
Luxembourg	20	.14%
Netherlands	1,036	7.36%
Poland	643	4.57%
Portugal	84	.60%
Slovakia	60	.43%
Slovenia	7	.05%
Spain	1,390	9.87%
Sweden	842	5.98%
Sum	14,077	100.00%

sidiaries; hence, each subsidiary is observed for 4.8 years on average.[13] As the panel is not balanced, the number of observations per year is continuously increasing over the years. For the years 1997–2005, the percentage of observations per year in the baseline regression ranges between 7.5% (i.e. 5,050 observations, in 1997) and 13.7% (i.e. 9,305 observations, in 2004). Moreover, 30.5% of the subsidiaries in the sample are owned by a parent that is located outside of the EU–25, thus, for 69.5% of the cases there exists an immediate shareholder within the EU–25.

[13]For the econometric specification (explained in detail in the next section), balance sheet items have to be calculated in *unconsolidated* form. In addition, I have restricted the export from the AMADEUS database to MNEs that are currently active. Finally, this baseline sample consists of 22,991 relevant firms. Note, that no financial corporations are included in AMADEUS, and that only profitable subsidiaries are considered in the regressions. Furthermore, I dropped observations that exhibit implausible variable values, i.e. negative assets, cost or sales, or a financial leverage ratio of less than 0 or greater than 1.

Table 2.2: Descriptive Statistics

Variable	*Obs.*	*Mean*	*Std. Dev.*	*Min.*	*Max.*
Subsidiary Level:					
Profit before Taxation★	67,804	7,399	76,644	1	8,055,052
Fixed Assets★	67,804	41,933	473,442	1	3.76e+07
Cost of Employees★	67,804	9,540	42,387	1	2,746,471
Number of Employees	67,804	211.0	887.3	1	62,784
Sales★	64,904	93,403	466,587	1	2.10e+07
Financial Leverage Ratio♦	62,355	.6230	.2335	0	1
Statutory Corporate Tax Rate	67,804	.3337	.0549	.1	.5676
Tax Difference to Parent▲	66,045	-.018	.089	-.4676	.432
Parent Level:					
Statutory Corporate Tax Rate	66,045	.3519	.077	0	.5676
Country Level:					
GDP▼	67,634	1,016	692.9	5.54	2,792
GDP per Capita◄	67,634	108.0	17.37	35.4	222.4
Unemployment Rate	67,634	8.18	3.4	2.1	19.9
Corruption Index►	67,634	7.46	1.66	2.99	10

Notes: Firm data is exported from the AMADEUS database, TOP-1.5-Million-Version, October 2006.
★ Unconsolidated values, in thousand US dollars, current prices.
♦ = (total liabilities / total assets).
▲ = (subsidiary statutory corporate tax rate - parent statutory corporate tax rate).
▼ In billion US dollars, current prices.
◄ In Purchasing Power Standards (PPS), EU–25 = 100.
► Corruption Perceptions Index (CPI) from Transparency International (TI), ranges from 0 (extreme level of corruption) to 10 (free of corruption).

The AMADEUS data has the drawback that information on the ownership structure is only available for the last reported date which is the year 2004 in most cases of my database version. Therefore, in the context of my panel study, there exists some scope for misclassifications of *parent-subsidiary-connections* since the ownership structure may have changed over the sample period.[14] However, in line with previous studies, I am not too concerned about this issue since potential misclassifications would introduce noise to the estimations that would (again) bias the results towards zero (see e.g. Budd, Konings, and Slaughter, 2005). In addition, in Section 2.4.3.1, I regress the data for the cross-section of the year 2004 as a qualitative robustness check.

The descriptive sample statistics are shown in Table 2.2. The mean of profit before taxation is calculated with 7.4 million US dollars. On average, a subsidiary holds fixed assets amounting to 41.9 million US dollars, observes yearly cost of employees of 9.5

[14]However, I have compared my 2004 ownership data with that of the year 1998 and found that for 87% of my subsidiaries the country of the parent firm is the same for both years.

million US dollars and employs 211 workers. Furthermore, the mean of a subsidiary's sales amounts to 93.4 million US dollars, and the average subsidiary has 62.3% of its total assets financed through borrowing.

I merge data on the statutory corporate tax rate (including local taxes) at the subsidiary and parent location, as well as basic country characteristics like GDP, GDP per capita, the unemployment rate, and a corruption index.[15] On the subsidiary level, the statutory tax rate ranges from 10.0% to 56.8% with a mean of 33.4%, whereas, on the parent level, the tax rate spreads from 0% to 56.8% with a mean of 35.2%. The main tax measure, the *Tax Difference to Parent*, is defined as the statutory corporate tax rate of a subsidiary minus the tax rate of the parent. This tax differential ranges from −46.8% to 43.2% with a mean of −1.8% and a standard deviation of 8.9 percentage points.

2.4 Empirical Analysis

In this section, I first describe the econometric methodology to test Propositions 1 and 2 from Section 2.2. Then, Section 2.4.2 presents the baseline estimation results. In Section 2.4.3, two fundamental robustness checks are undertaken. Finally, in Section 2.4.4, the influence of the parent's ownership share on the level of profit shifting is empirically analyzed.

2.4.1 Methodology

The approach to identify profit shifting activities is the regression of the unconsolidated pre-tax profitability[16] of a profit-making multinational subsidiary on various firm and country characteristics and on the *statutory corporate tax rate difference to its parent firm*, controlling for fixed firm and year effects.[17] Taking tax differentials is

[15]The statutory tax rates are taken from the *European Commission (2006)*. Data on GDP comes from the *IMF*. Data on GDP per capita (in Purchasing Power Standards, EU–25 = 100) and on the unemployment rate is from the *European Statistical Office (Eurostat)*. The corruption index (Corruption Perceptions Index, CPI) is taken from *Transparency International* and ranges from 0 (extreme level of corruption) to 10 (free of corruption).

[16]Pre-tax profits are taken form the balance sheet item *Profit (Loss) before Taxation* which is net of all cost but before taxation.

[17]Note that 69% of the observational units own no further subsidiaries and 22% own solely *domestic* subsidiaries. Therefore, the vast majority of the subsidiary in the sample cannot engage in (down-

a more precise procedure in capturing the extent of the profit shifting incentive for a multinational affiliate than working with single tax rates. Quantitative interpretations of purely tax *rate* coefficients have to be taken with care. Calculated tax rate effects on pre-tax profits might not be confined solely to profit shifting activities, as the incentive to invest in a given country also decreases with the corporate tax rate.[18]

Based on the main hypothesis from Equation (2.7) of the theoretical model[19], the estimation equation takes on the following form

$$PBT_{it} = \beta_0 + \beta_1 DIFFSTR_{it} + \beta_2 X_{it} + \rho_t + \phi_i + \epsilon_{it} \tag{2.8}$$

with subscript i denoting the observational unit, i.e. a multinational subsidiary. Subscript t denotes the time period (year). The dependent variable PBT_{it} is the profit before taxation of a subsidiary. X_{it} stands for a vector of time-varying firm and country characteristics. These control variables on the micro level are the subsidiary's fixed assets as a proxy for the installed capital, the cost of employees as a proxy for the use of labor, and in a last specification also the financial leverage ratio (see e.g. Huizinga and Laeven, 2008, for a similar application of micro controls).[20] However, the debt-to-assets ratio is dependent on the tax rate and the tax differential as will be shown in Chapter 5 of this thesis, but its inclusion in the regressions does not really affect the coefficient estimates. Nevertheless, my most preferred specification is without the leverage ratio. All firm variables are calculated per employee to control for subsidiary size and to get a comparable profitability measure which is, however, neither qualitatively nor quantita-

ward) profit shifting activities with own foreign subsidiaries and, thus, the tax rate difference *to the parent* is an appropriate measure of the overall (upward) shifting incentive of the observational units.

[18] By constructing the tax differential, the *statutory* tax rate is the relevant tax measure for an analysis of profit shifting activities, in contrast to the effective (average or marginal) tax rate (see e.g. Devereux and Maffini (2007) for an extensive commentary). Furthermore, a MNE can define its own tax base by the shifting of profits. Thus, using effective tax rates instead of statutory rates would be misleading in this application.

[19] Note, to confer the theoretical model on the empirical specification, the status of the parent and of the subsidiary have to switch. Hence, from the perspective of the subsidiary, the cost of shifting term is irrelevant which further simplifies the derivative in Equation (2.7).

[20] In line with previous studies, I am not too concerned about potential endogeneity problems with the fixed assets and the cost of employees variables as I apply them as control variables whose inclusion does not significantly affect the coefficient estimate of the tax differential, i.e. qualitatively equal and quantitatively very similar tax effects are obtained if these micro controls are completely left out. Additionally, as a robustness check, I alternatively apply the *number* of employees instead of the cost of employees as a proxy for the labor input (cf. Section 2.4.3). Again, I find no change in any of my qualitative and quantitative results.

tively decisive for the results.[21] All variables besides the tax variables and the leverage ratio are transformed in logarithmic form to mitigate the potential effect of outliers.

The control variables on the macro level are GDP (as a proxy for the market size), GDP per capita (as a proxy for the productivity growth of a country), the unemployment rate (as a proxy for the economic situation), and an index for the degree of corruption (as a proxy for the overall risk of a country). The variables will also enter in logarithmic form which is again not crucial for the results. The explanatory variable of central interest is $DIFFSTR_{it}$ which stands for the main tax measure, i.e. the statutory tax rate difference of affiliate i to its foreign parent in year t. As this differential is calculated by subtracting the parent tax rate from the subsidiary tax rate, I expect β_1 to have a significantly negative sign to get (indirect) evidence of profit shifting. ϕ_i represent unobserved characteristics on the firm level and on the country level. The error term is denoted by ϵ_{it}. In the baseline panel regressions, I include year dummy variables ρ_t to control for shocks over time common to all affiliates. Instead, in the cross-section regressions of the robustness checks, I am able to additionally include (time-constant) industry dummies and, when leaving out the macro control variables, country dummies.

The panel structure of the sample allows the application of fixed-effects methods on the micro level. This considerably alleviates the endogeneity problem of unobservable, time-constant firm-specific factors ϕ_i in explaining variations in profits, e.g. management quality or product popularity. The fixed-effects model is also preferred to a random-effects approach as suggested by a Hausman-Test. Potentially unobserved, time-constant country characteristics are controlled for by the included fixed firm effects because together the firm-specific fixed effects of all affiliates in one country perfectly account also for all unobservable macro factors. Thus, I estimate Equation (2.8) by OLS with subsidiary fixed effects.

Huizinga and Laeven (2008) likewise use the AMADEUS database but undertake a cross-section analysis of the year 1999 without the possibility to control for fixed effects. In addition, compared to Huizinga and Laeven (2008), as dependent variable I use the balance sheet item *Profit (Loss) before Taxation*. Employing *EBIT*, which includes interest payments, as dependent variable could blur the effect of the tax differential as these payments may also serve as a profit shifting channel (see Chapter 5 of this thesis).

To analyze the effect of the parent's ownership share of its subsidiary on the shifting

[21] See the robustness checks in Section 2.4.3 for different normalization strategies. Note that also without any normalization of the firm variables the quantitative estimation results are almost equal.

intensity between these two affiliates, in a cross-section analysis of the year 2004 in Section 2.4.4, I interact $DIFFSTR_{i2004}$ with the parent's ownership share of the considered subsidiary i in 2004.[22] For this, in Section 2.4.4, I will reduce the initial sample requirement of the parent's minimum ownership share of 90% to 25%. Finally, I expect this interaction term to exhibit a negative coefficient estimate indicating an additional negative impact of the tax differential on pre-tax profitability for a higher ownership share, holding the tax differential fixed.

2.4.2 Baseline Estimation Results

The baseline results are shown in Table 2.3. I run panel estimations for the years 1995–2005 and for up to 14,077 subsidiaries applying OLS with fixed-effects. With at maximum 67,804 observations, the regressions thus comprise on average 4.8 observations per affiliate. All panel estimations include year dummy variables and heteroscedasticity robust standard errors adjusted for firm clusters which are displayed in the tables in parentheses.[23] Cross-section estimations partly include industry and country dummies and robust standard errors adjusted for country clusters.

Throughout all specifications of Table 2.3, the coefficient estimates of the firm controls (fixed assets and cost of employees calculated per employee respectively) are positive and significant at the 1%-level. They remain quite stable and sum up to .65. The contribution of labor to pre-tax profits is about four times higher than that of capital and an increase in the cost per employee of 1% leads to a rise in pre-tax profits per employee of .5%. The effect of the cost per employee variable can be better interpreted as that part of labor productivity which is reflected in pre-tax profits. Controlling for fixed firm effects, the estimations explain up to 75.4% of the variation in profits before taxation.

As a first indication for the tax effect on profitability and to compare the tax effect with the second robustness check in Section 2.4.3.2, I first regress each specification

[22] The advantage of the cross-section analysis for this issue is discussed in Section 2.4.3. The reason are the data restrictions on historical ownership (share) information addressed in the data section.

[23] Since the tax rate varies between country-year cells and supposing autocorrelation, I alternatively apply country-level clusters in the panel regressions as a sensitivity check (cf. Bertrand, Duflo, and Mullainathan, 2004). However, applying heteroscedasticity robust standard errors adjusted for country clusters does not change the significance levels of the firm and tax variable coefficients, but slightly reduces the significance of the country controls which results in an insignificant coefficient estimate of GDP.

Table 2.3: Baseline Estimations – Profit Shifting Evidence

OLS Firm–Fixed–Effects, Panel 1995–2005

Dependent Variable: Log (Profit before Taxation per Employee)

Explanatory Variables:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Statutory Tax Rate	-1.76***		-1.89***		-1.70***	
	(.267)		(.270)		(.271)	
Tax Difference to Parent		-.750***		-.735***		-.715***
		(.157)		(.157)		(.157)
Log (Fixed Assets per Employee)	.119***	.117***	.118***	.116***	.135***	.133***
	(.010)	(.011)	(.010)	(.011)	(.011)	(.011)
Log (Cost of Employees per Employee)	.508***	.505***	.511***	.509***	.519***	.517***
	(.021)	(.021)	(.021)	(.021)	(.022)	(.023)
Leverage Ratio					-1.35***	-1.36***
					(.050)	(.051)
Log GDP			-.506***	-.439***	-.688***	-.614***
			(.117)	(.119)	(.121)	(.123)
Log GDP per Capita			1.15***	.875***	.885***	.616***
			(.240)	(.245)	(.239)	(.243)
Log Unemployment Rate			.082	.150***	.084	.143***
			(.056)	(.056)	(.057)	(.058)
Log Corruption Index			.201***	.228***	.309***	.343***
			(.069)	(.070)	(.070)	(.071)
Year Dummies	√	√	√	√	√	√
# Observations	67,804	66,045	67,634	65,877	62,355	60,783
# Firms	14,077	13,741	14,067	13,731	13,515	13,198
Adjusted R^2	.7369	.7371	.7374	.7376	.7535	.7539

Notes: Heteroscedasticity robust standard errors adjusted for firm clusters in parentheses.
*, **, *** indicates significance at the 10%, 5%, 1% level. The observational units are profit-making multinational subsidiaries that exhibit a foreign parent which owns at least 90% of the ownership shares. The dependent variable is the natural logarithm (Log) of the subsidiary's unconsolidated pre-tax profit calculated per employee. An OLS model with fixed effects is estimated. *Tax Difference to Parent* is defined as the statutory corporate tax rate of the considered subsidiary minus the tax rate of the subsidiary's parent. All regressions include year dummies. Adjusted R^2 values are calculated from a dummy variables regression equivalent to the fixed-effects model.

with the single statutory tax rate separately. I find a strongly negative effect which is significant at the 1%-level. However, more important, the coefficient estimate of the statutory tax rate difference to the parent has the expected negative sign and is likewise highly significant, indicating that affiliates with a lower tax rate relative to the parent location observe a higher pre-tax profit per employee, and vice versa. This confirms the theoretical expectations from Equation (2.7) and, thus, gives indirect evidence for profit shifting activities. The size of the tax difference effect slightly decreases with the inclusion of the macro controls in Column (4). Quantitatively, my most preferred specification (Column (4) of Table 2.3) suggest an increase in pre-tax profits of 7.3%

if the tax difference to the parent decreases by 10 percentage points.

This point semi-elasticity of $-.73$ is by about one fourth smaller than the analogous one estimated in a recent study by Huizinga and Laeven (2008). They run cross-section estimations for the year 1999, likewise with the AMADEUS database, and, with their largest sample of $1,218$ observations, they find a coefficient estimate of the tax difference to the parent of $-.975$. However, the panel regressions yielding the smaller coefficient of $-.73$ simultaneously control for fixed effects at the firm level which is not feasible in a cross-section analysis. For example, if low-tax (high-tax) affiliates more often exhibit the more (less) efficient managers or engineers, resulting in higher (lower) profits, this unobservable affiliate characteristic would be captured by the fixed-effects approach, and thus a lower effect of the tax differential is estimated.

In Specification (5) and (6), the financial leverage ratio of a subsidiary is additionally included and enters with a significant and large coefficient of -1.4. This is not surprising as the balance sheet item *Profit (Loss) before Taxation* is minus all deductible costs which includes interest payments, in contrast to *EBIT* or *EBITDA*. The coefficients of all other explanatory variables show no significant change and, furthermore, stay statistically significant. But the effect of the tax difference to the parent slightly decreases with the inclusion of the leverage ratio. A smaller impact of the incentive to shift profits (e.g. via classical transfer pricing manipulations) is consistent if I assume larger leverage ratios in high-tax than in low-tax countries (for the purpose of legally biasing the MNE's different national tax bases, e.g. via larger debt financing of a high-tax affiliate). However, the debt-to-assets ratio is dependent on the tax rate and the tax differential, as is shown in Chapter 5 of this thesis, and may thus be a simultaneously determined variable. Therefore, Column (4) is the most preferred specification.

To account for time-varying country effects, I include the set of macro control variables. This inclusion raises the adjusted R^2 value only a little. The coefficient of GDP turns out significantly negative. An explanation could be that big markets are characterized by a high degree of competition which results in a lower profitability. The results further indicate that wealthier countries, measured by GDP per capita, which thus possess the more advanced technologies, yield a more profitable production. Moreover, a lower risk of a country, proxied by a higher level of the corruption index (i.e. a lower degree of corruption), seems to impact pre-tax profits per employee positively.

2.4.3 Robustness Checks

I first undertake some smaller sensitivity tests before I focus on two fundamental robustness checks in Sections 2.4.3.1 and 2.4.3.2. The results of these minor tests described in the following two paragraphs are not presented in the paper but are available from the author upon request.

At first, I check if the firm variables are robust against a variation in the method of normalization. Instead of dividing by the number of employees, I alternatively calculate the subsidiary variables in ratios of sales and additionally in ratios of total assets. Both of these modifications yield almost equal quantitative results but a slightly smaller coefficient of the tax differential. However, a firm's number of employees is likely to be less influenced by tax rates than monetary values which makes a division by the number of employees a more suitable way to control for subsidiary size.[24]

The possibility that some subsidiaries in the sample share the same parent firm could potentially bias the standard errors or overestimate the effect of the tax differential. To test the relevance of this problem, I randomly deleted observations with a duplicated *subsidiary-parent-connection* to exclusively keep firms with unique parents in the sample. Hence, the sample reduces to $6,925$ subsidiaries, i.e. almost the half of the affiliates are now dropped. However, with this reduced sample, all specifications of Table 2.3 yield very similar quantitative results. The coefficient estimate of the tax differential turns out to be only slightly larger ($-.75$) in my preferred Specification (4) of Table 2.3 and is again significant at the 1%-level. Furthermore, this quantitatively almost equal effect of the tax difference to the parent with this reduced sample, compered to the baseline estimations with the full sample, suggests that profits are shifted mainly between the affiliate and the parent firm and not between the affiliate and other subsidiaries of its parent.

2.4.3.1 Cross–section Analysis

Due to the data restrictions of the historical ownership information which is only available in a cross-section for the last reported year as described in Section 2.3, one fundamental qualitative sensitivity check of the results is thus to additionally run the

[24]Note that without any normalization the quantitative results again do not change significantly. Furthermore, instead of using the cost of employees as a proxy for the labor input, I alternatively apply the *number* of employees as an explanatory firm variable. Again, I find no significant change in any of the qualitative and quantitative results.

Table 2.4: Robustness Check I – Cross–section Analysis

OLS, Cross–section 2004

Dependent Variable: Log (Profit before Taxation per Employee)

Explanatory Variables:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Statutory Tax Rate	-3.32***		-2.71***		-2.28**	
	(.739)		(.969)		(1.06)	
Tax Difference to Parent		-2.11***		-1.55***		-1.21***
		(.417)		(.301)		(.276)
Log (Fixed Assets per Employee)	.284***	.283***	.286***	.286***	.270***	.269***
	(.035)	(.035)	(.035)	(.034)	(.030)	(.029)
Log (Cost of Employees per Employee)	.624***	.594***	.638***	.641***	.642***	.645***
	(.053)	(.051)	(.060)	(.063)	(.065)	(.069)
Leverage Ratio					-1.40***	-1.41***
					(.179)	(.170)
Log GDP			.041	.029	.041	.031
			(.028)	(.028)	(.031)	(.031)
Log GDP per Capita			-.444	-.807***	-.105	-.431*
			(.307)	(.218)	(.306)	(.233)
Log Unemployment Rate			-.130	-.225*	-.052	-.133
			(.119)	(.115)	(.123)	(.128)
Log Corruption Index			.054	.194	-.201	-.073
			(.162)	(.139)	(.196)	(.165)
Industry Dummies	√	√	√	√	√	√
# Observations	9,305	9,104	9,305	9,104	8,589	8,412
R^2	.2611	.2619	.2621	.2641	.3087	.3107

Notes: Heteroscedasticity robust standard errors adjusted for country clusters in parentheses. *, **, *** indicates significance at the 10%, 5%, 1% level. The observational units are profit-making multinational subsidiaries that exhibit a foreign parent which owns at least 90% of the ownership shares. The dependent variable is the natural logarithm (Log) of the subsidiary's unconsolidated pre-tax profit calculated per employee. An OLS model is estimated. *Tax Difference to Parent* is defined as the statutory corporate tax rate of the considered subsidiary minus the tax rate of the subsidiary's parent. All regressions include 59 industry dummies (NACE Rev.1 2-digit level).

regressions from Table 2.3 in a cross-section. I do this with OLS for the year 2004 as this is the last reported date in most cases of the database version. The results are presented in Table 2.4. In the cross-section regressions, it is now feasible to include 59 industry dummy variables (NACE Rev.1 2-digit level).

However, with the cross-section analysis I cannot control for fixed firm effects which consequently results in higher coefficient estimates and in a small R^2 value of about .31, which is less than half of the value from the fixed-effects panel regressions of Table 2.3. Though, all decisive coefficients still exhibit the expected sign and are highly significant. In particular, the tax difference to the parent has a significantly negative effect on a subsidiary's pre-tax profits (-1.55 in Column (4) of Table 2.4). This confirms the (indirect) evidence of profit shifting and states that the qualitative results are robust

to a cross-section analysis. This in turn mitigates the concerns about the restricted ownership information.

2.4.3.2 Domestic Individual Firms

Another fundamental robustness check to confirm the profit shifting inference is to compare the tax rate elasticities of MNEs with those of purely domestic companies (cf. Mintz and Smart, 2004). In such an analysis, I obviously have to revert to the statutory tax *rate* as differentials to a foreign parent do not exist for Non-MNEs. With the AMADEUS database, I construct a separate sample of at maximum 114,728 individual *domestic* firms with no shareholders and no subsidiaries to compare these regressions with those done with the initial MNE-sample. For the purpose of a qualitative robustness test, in this comparison, I focus on cross-section analysis for the year 2004 with OLS to get definite ownership information necessary for precisely separating a multinational from a domestic company.[25]

The results are shown in Table 2.5. With this sample of solely domestic firms, I cannot find any significantly negative effect of the statutory tax rate, in contrast to the regressions with the MNE-sample in Table 2.4. Moreover, although insignificant (besides a weak significance in Column (5)), the coefficient estimate of the tax rate in Table 2.5 is positive. This underlines the relevance of the statutory tax rate for companies with at least one connection to a foreign country via its parent firm (MNEs) in explaining variations in pre-tax profits. This in turn supports the prior profit shifting findings. In Specifications (2), (4) and (6), I leave out GDP because of a high correlation between the statutory tax rate and GDP (86%) which could result in upwards biased standard errors of the respective coefficients and thus in insignificance due to multicollinearity problems.

[25]See Section 2.3 for a discussion on the ownership data restrictions.

Table 2.5: Robustness Check II – Domestic Individual Firms

OLS, Cross–section 2004

Dependent Variable: Log (Profit before Taxation per Employee)

Explanatory Variables:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Statutory Tax Rate	1.19	.645	.866	.443	2.50*	1.76
	(1.10)	(.903)	(1.32)	(1.23)	(1.40)	(1.47)
Log (Fixed Assets	.329***	.330***	.289***	.289***	.259***	.260***
per Employee)	(.045)	(.045)	(.019)	(.019)	(.019)	(.019)
Log (Cost of Employees	.843***	.841***	.804***	.803***	.794***	.792***
per Employee)	(.039)	(.039)	(.033)	(.033)	(.042)	(.041)
Leverage Ratio					-1.61***	-1.61***
					(.223)	(.224)
Log GDP	-.060		-.047		-.080	
	(.052)		(.055)		(.063)	
Log GDP per Capita	-.996***	-1.30***	-.724*	-.961***	-.040	-.445
	(.314)	(.282)	(.373)	(.325)	(.508)	(.433)
Log Unemployment Rate	-.610***	-.746***	-.647***	-.754***	-.551**	-.732***
	(.146)	(.183)	(.147)	(.178)	(.207)	(.201)
Log Corruption Index	.352***	.427***	.153	.214	-.267	-.163
	(.119)	(.128)	(.197)	(.203)	(.212)	(.229)
Industry Dummies			√	√	√	√
# Observations	114,728	114,728	114,728	114,728	108,646	108,646
R^2	.2987	.2985	.3462	.3460	.3871	.3867

Notes: Heteroscedasticity robust standard errors adjusted for country clusters in parentheses. *, **, *** indicates significance at the 10%, 5%, 1% level. The observational units are profit-making domestic individual firms with no shareholders and no subsidiaries. The dependent variable is the natural logarithm (Log) of a firms's unconsolidated pre-tax profit calculated per employee. An OLS model is estimated. 59 industry dummies (NACE Rev.1 2-digit level) are includes where indicated. The correlation between *Statutory Tax Rate* and *Log GDP* is 86.2% which could result in larger standard errors and thus in an upwards biased P-value due to multicollinearity problems; therefore, in Specification (2), (4), and (6), *Log GDP* is left out.

2.4.4 Parent's Ownership Share and Profit Shifting

The positive effect of the parent's ownership share of its subsidiary on the level of shifting is described in the theory Section 2.2. An increase in the ownership share leads to a boost in profit shifting activities via lower shifting costs as the feasibility of implementing shifting strategies improves due to more management influence at the subsidiary in general, or more share voting rights in particular (*management effect*).[26]

To test this hypothesis from Equation (2.6), I reduce the initial MNE-sample requirement of the parent's minimum total ownership share of its foreign subsidiary of 90%

[26]See Mintz and Weichenrieder (2005) and Büttner and Wamser (2007) for evidence of the positive effect of the ownership share on the tax sensitivity of intra-company debt.

(cf. Section 2.3) to a minimum *direct* ownership share requirement of 25%.[27] All other criteria from the baseline MNE-sample stay the same. Now, the average direct ownership share is 92.9% with a standard deviation of 16.1 percentage points. To capture the additional effect of the ownership share, I generate an interaction term between the tax differential and the parent's direct ownership share. Based on the hypothesis from Equation (2.6) in combination with the indirect approach of profit shifting evidence from Equation (2.7), I expect a negative coefficient of this interaction term to represent *more* shifting via an additional impact of the tax differential on pre-tax profits for a higher ownership share.

The regression results of a cross-section analysis for the year 2004 with OLS are shown in Table 2.6.[28] Due to the large number of subsidiaries with a parent that fully owns the affiliate (71.9% of the subsidiaries), the tax differential and the interaction term between the tax differential and the parent's direct ownership share (*(TaxDiff.toParent)*×*(ParentShare)*) are highly correlated (98.9%). This multicollinearity is very likely to increase the standard errors of the estimated coefficients of the two collinear variables which can result in insignificance (cf. Columns (5) and (6) in Table 2.6). The interpretation of such an interaction effect is also not straightforward (cf. last paragraph of this section). For this reason, to get a more clear-cut interpretation, I calculate the interaction term by multiplying the tax differential with the *deviation of the ownership share from its mean* (*centering*). The correlation between this interaction term and the tax differential is at the moderate level of 13.0%. These results are displayed in Column (1)–(4) of Table 2.6.

Basically, the coefficient of the tax differential alone describes the effect of the tax difference on pre-tax profits for an *average ownership share of* 92.9%. For an ownership share above this mean, an increase in the tax differential has a stronger negative impact on pre-tax profits than for ownership shares below 92.9%.[29] Thus, an increase in the ownership share, holding the tax differential fixed, strengthens profit shifting in the sense that the sum of both coefficients decreases further. This qualitative result is in

[27] To precisely test the hypothesis from Equation (2.6), I apply the parent's direct ownership share instead of the total share which is the sum of directly and indirectly held shares. In doing so, I assure that no potentially opposed effects via the indirect holding of shares can emerge from other affiliates' management interests.

[28] The cross-section analysis for the year 2004 is again preferred to the fixed-effects panel study due to the data restrictions on historical ownership (share) information addressed in Section 2.3.

[29] This results as the coefficient of the interaction term multiplied with the respective (positive or negative) deviation from the mean ownership share has to be added to the original coefficient of the tax differential.

Table 2.6: Parent's Ownership Share & Profit Shifting

OLS, Cross–section 2004

Dependent Variable: Log (Profit before Taxation per Employee)

Explanatory Variables:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Tax Difference to Parent	-1.33***	-.848***	-1.52***	-1.11***	1.48	1.95
	(.378)	(.237)	(.322)	(.321)	(1.17)	(1.49)
(TaxDiff.toParent)×(Parent Share–MeanParentShare)	-3.03**	-3.57***	-3.05**	-3.31**		
	(1.25)	(1.26)	(1.16)	(1.52)		
(TaxDiff.toParent)× (ParentShare)					-3.03**	-3.31**
					(1.25)	(1.52)
Parent Share	.038	-.119	.054	.108	.038	.108
	(.102)	(.106)	(.105)	(.096)	(.102)	(.096)
Log (Fixed Assets per Employee)	.267***	.266***	.274***	.249***	.267***	.249***
	(.026)	(.026)	(.032)	(.026)	(.026)	(.026)
Log (Cost of Employees per Employee)	.793***	.809***	.659***	.654***	.793***	.654***
	(.069)	(.075)	(.065)	(.068)	(.069)	(.068)
Leverage Ratio				-1.48***		-1.48***
				(.184)		(.184)
Log GDP	.018		.030	.026	.018	.026
	(.040)		(.036)	(.038)	(.040)	(.038)
Log GDP per Capita	-.938***		-.698**	-.206	-.938***	-.206
	(.332)		(.312)	(.325)	(.332)	(.325)
Log Unemployment Rate	-.365**		-.364***	-.265*	-.365**	-.265*
	(.134)		(.118)	(.136)	(.134)	(.136)
Log Corruption Index	.088		-.071	-.384**	.088	-.384**
	(.175)		(.165)	(.182)	(.175)	(.182)
Industry Dummies			√	√		√
Country Dummies		√				
# Observations	8,815	8,815	8,815	8,107	8,815	8,107
R^2	.2254	.2326	.2674	.3176	.2254	.3176

Notes: Heteroscedasticity robust standard errors adjusted for country clusters in parentheses. *, **, *** indicates significance at the 10%, 5%, 1% level. The observational units are profit-making multinational subsidiaries that exhibit a foreign parent which owns at least 25% of the direct ownership shares. The dependent variable is the natural logarithm (Log) of the subsidiary's unconsolidated pre-tax profit calculated per employee. An OLS model is estimated. *Tax Difference to Parent* is defined as the statutory corporate tax rate of the considered subsidiary minus the tax rate of the subsidiary's parent. *(TaxDiff.toParent)×(ParentShare–MeanParentShare)* is the interaction term between the statutory corporate tax rate difference to the parent and the deviation of the parent's direct ownership share from its mean (correlation between this interaction term and the tax differential is 13.0%). *(TaxDiff.toParent)×(ParentShare)* is the interaction between the tax differential and the parent's direct ownership share (correlation between this term and the tax differential is 98.9%). *Parent Share* is the parent's direct ownership share in the considered subsidiary. 59 industry dummies (NACE Rev.1 2-digit level) are includes where indicated. In Specification (2), a full set of country dummies is included instead of the macro controls.

line with the expectations from Equations (2.6) and (2.7). In Specification (2), a full set of country dummy variables is included instead of the macro controls which results in an increased significance of the interaction term coefficient (1%-level). The inclusion

of country dummies is feasible as the tax differential varies across subsidiaries. To conclude, the results provide (indirect) evidence that firms which are owned by their parent with a higher ownership share are engaged in a higher level of profit shifting.

However, robust results can also be inferred without *centering* the ownership share in the interaction term (see Column (5) and (6) of Table 2.6). It is evident that with this little modification all coefficients of Regressions (5) and (6) are equal to the respective results in the similar Specifications (1) and (4), except for the tax differential. As mentioned above, multicollinearity leads here to higher standard errors of the tax differential's coefficient estimates which strongly reduces the significance but leaves the coefficients unbiased. Now, the coefficient of the tax differential alone generally represents the effect of the tax difference on pre-tax profits for an ownership share of *zero*. Thus, with an increasing ownership share the total effect of the tax differential (the sum of both coefficients) decreases, and gets negative at an ownership share of 49% (for Regression (5)). Above this share, the effect of the tax differential on pre-tax profits is negative. Focusing on this group, a further increase in the ownership share, holding the tax differential fixed, intensifies profit shifting in the sense that the sum of both coefficients decreases further.

Note that the result of this subsection can also be derived estimating separate samples with different ownership thresholds. In doing so, the absolute values of the coefficient estimates of the tax differential are continuously decreasing with a lower parent's ownership share in its subsidiary. The coefficient for wholly owned subsidiaries is estimated with -2.3. For example, for subsidiaries owned by the parent with less than 100%, less than 75% and less than 66.67%, the tax differential coefficient is estimated with -1.9, -1.6 and -1.2 respectively. Finally, for an ownership threshold of $<51\%$, the coefficient estimate of the tax rate difference to the parent is no longer significantly different from zero.

In the end, one might raise potential endogeneity concerns on the ownership share variable as the degree of ownership could be a choice parameter in the firm's set of strategic decisions and thus might not be exogenous to the profit shifting decision. To alleviate this possible problem, the ownership share information in the cross-section regressions could be lagged by one or two years, respectively. Alternatively, the ownership share variable could also be instrumented by lagged values while applying a first-difference approach as proposed by Anderson and Hsiao (1982). However, a proper analysis of such robustness checks require ownership information of past years and therefore has to be left for future research.

2.5 Conclusions

This paper provides indirect evidence of profit shifting activities by multinational enterprises (MNEs) within the EU–25 applying a panel analysis with the European micro database AMADEUS. In addition, the estimations show that a higher parent's ownership share of its subsidiary leads to an increase in the level of shifting activities between these two affiliates, and vice versa. Robust empirical evidence for this positive impact of the ownership share on the intensity of shifting is scarce in the existing literature. I incorporate this ownership effect of enhanced or reduced shifting possibilities, respectively, in a well-established simple theoretical model of profit shifting. The main hypotheses for the econometric specifications are derived from this stylized model.

For identifying profit shifting behavior, I explain variations in pre-tax profitability of profit-making multinational subsidiaries located in the EU–25 with the statutory tax rate difference of these affiliates to their respective foreign parent firms, while controlling for a range of firm and country variables. I apply a panel analysis for the years 1995 to 2005 with OLS fixed-effects estimations controlling for unobservable subsidiary characteristics. The regressions indicate a highly significant negative impact of the tax differential on profits before taxation which is consistent with profit shifting behavior. Quantitatively, the results suggest an increase in a subsidiary's pre-tax profitability of 7.3% if the statutory tax rate difference (between the subsidiary and its foreign parent firm) decreases by 10 percentage points. Several fundamental robustness checks confirm the profit shifting inference, e.g. a comparison of the tax rate effects of MNEs with those of domestic individual companies.

A precise comparison of semi-elasticities of different empirical studies is complicated in most cases as data structure and methodology, especially with respect to the tax measure for identifying shifting activities, varies in the literature. However, in comparison to the overall empirical literature using U.S. data, my results suggest that the supposition of more extensive profit shifting activities in Europe than in the U.S., due to large tax rate differences between many neighboring states and the predominating *tax exemption system* within the EU, cannot be confirmed. Even though e.g. Grubert and Mutti (1991) or Hines and Rice (1994) apply cross-section estimations without the feasibility to control for unobserved fixed firm effects which generally might yield overestimated tax effects, their calculated semi-elasticities of reported profits with respect to the statutory tax *rate* are still very large (-6.3 in the case of Hines and Rice, 1994; cf. my respective coefficient estimate of -1.9 in Column (3) of Table 2.3). Furthermore, my semi-elasticity with respect to the tax *differential* of $-.73$ is by about

one fourth smaller as the analogous one estimated in a recent study by Huizinga and Laeven (2008) who undertake a cross-section analysis for the year 1999 also with the AMADEUS database. If for instance better managers who yield higher profits are more often located in a low-tax country, my study would capture this unobservable affiliate characteristic by the fixed-effects approach and thus obtains smaller tax effects.

However, the robust empirical results of this paper indicate a statistically and also an economically significant effect of corporate taxes on the location of profit. More precisely, the allocation of gross profits is distorted by the statutory tax rate differential to the parent firm. Therefore, the shifting of profits from high-tax to low-tax countries seems to be relevant and can result in a substantial bias of national tax revenues in Europe. Hence, in the light of my results, concerning the advantage of abolishing transfer pricing problems, there is an argument for the European Commission's proposed changeover from the current EU corporate tax principle of *separate accounting* to a system of *formula apportionment* which substantially reduces the incentives for profit shifting activities.

With respect to the estimated positive ownership effect on the shifting intensity, under the principle of *separate accounting*, one policy implication for the tax audit by national fiscal authorities might be to condition the investigation intensity of MNEs' intra-company transactions with foreign affiliates on the level of the respective shareholding. Due to the time-intensive and complex assessment of transfer pricing documentations, this selection could improve the efficiency of the auditing.

Chapter 3

Corporate Taxes and the Location of Intangible Assets Within Multinational Firms

3.1 Introduction

In recent years, intangible assets have gained increasing importance in the corporate production process (e.g. Hall, 2001). Since access to financial capital has been substantially improved, key physical assets are less scarce (Zingales, 2000) and intangible factors related to product innovation and marketing are increasingly seen as the key to competitive success (Edmans, 2007). Hence, intangibles like patents, trademarks, customer lists and copyrights have become major determinants of firm value. This development is especially significant in multinational enterprises (MNEs).[1] While until the early 1990ies, MNEs commonly raised little or no fee from their corporate affiliates for the use of patents or trademarks, owners of these intangibles have - in line with updated legal regulations and accounting standards - started to charge for their immaterial goods and, thus, intangibles-related intra-firm trade has surged.

Since then, an increasing number of anecdotes has reported that MNEs transfer their valuable intangible property to low-tax jurisdictions. Famous examples are *Pfizer*, *Bristol-Myers Squibb* and *Microsoft* which have relocated a considerable part of their research and development (R&D) units and patents from their home countries to Ireland (see e.g. Simpson, 2005, on Microsoft's R&D transfer). Others founded trademark holding companies in tax havens that own and administer the group's brands and licenses. E.g. *Vodafone's* intangible properties are held by an Irish subsidiary, and *Shell's* central brand management is located at a Swiss affiliate from where it charges royalties to operating subsidiaries worldwide. Moreover, an increasing number of financial consultancies advocates multinational tax planning strategies that imply the relocation of intangible property to low-tax affiliates.[2]

Governments and tax authorities have raised increasing concerns about these relocation examples (Hejazi, 2006). They fear that the trend to fragment corporate production by locating value-driving intangible intermediate goods in low-tax economies diminishes the multinational corporate tax base in their countries. Moreover, arm's

[1] Empirical evidence links the presence of intangible property to the emergence of MNEs. Intangibles are perceived to foster FDI since they *"can be easily transferred back and forth and [...] enjoy a public good nature which makes them available to additional production facilities at relatively low costs"* (Markusen, 1995; see also Gattai, 2005).

[2] Examples are the British brand valuation consultancy *Brand Finance plc* whose client list includes world-wide operating MNEs like *British American Tabacco*, *Danone*, *Shell* or *Foster's* (Brand Finance plc, 2008) and the renowned U.S. law firm *Morgan, Lewis & Bockius LLP* (Morgan Lewis & Bockius LLP, 2007).

length prices for firm-specific intangibles are hard to determine (see e.g. Grubert, 2003; Desai, Foley, and Hines, 2006), which gives rise to the additional concern that MNEs may shift profits earned at production affiliates in high-tax countries to the intangibles-holding low-tax affiliate by overstating the true transfer price for royalties and license fees.

Surprisingly though, it has, to the best of our knowledge, not yet been clarified within an empirical framework whether these relocation examples are individual cases or represent a systematic multinational investment pattern. We investigate this question using panel data on European MNEs and find evidence for a statistically significant and quantitatively relevant bias of intangible property holdings towards affiliates with a low corporate tax rate relative to other group locations.

To receive guidance for the specification of our estimation approach, the paper starts out with a simple model of intangible asset location. We argue that MNEs have an incentive to relocate intangible property to low-tax countries for two reasons. First, intangible property is increasingly perceived to be the driver of (multinational) firm profit. As immaterial goods may easily be locally separated from other production units in the group, the MNE has an incentive to locate them at low-tax countries in order to tax the accruing rents at a low rate. Second, MNEs may have an incentive to locate their intangible property at a low-tax affiliate for profit shifting reasons. Conditional on the assumption that intra-firm trade of intellectual property rights establishes increased transfer pricing opportunities between the intangibles owner and the group's production affiliates, it pays to locate intangibles at a low-tax affiliate since this generates profit shifting channels between the intangibles-holding tax haven and *all* other affiliates located in countries with a higher corporate tax rate. In contrast, intangibles location at one of the group's high-tax affiliates generates shifting possibilities solely between the tax haven and the intangibles-holding firm whereas other high-tax affiliates remain without shifting link to a low-tax country. The paper argues that for both reasons, the location of intangible property becomes more attractive the lower the subsidiary's corporate tax rate *relative to other group locations*.

In the empirical section, we employ the firm's balance sheet item *intangible assets* and therefore first provide a short overview on European accounting practices with respect to intangible assets to obtain a clear identification strategy. For the regression analysis, we use a large panel dataset of multinational affiliates within the EU–25 which is available for the years 1995 to 2005. Our data is drawn from the micro database AMADEUS that provides detailed accounting information at the affiliate level and allows identification of a multinational group's ownership structure. Following our

theoretical considerations, we determine the effect of an affiliate's average statutory corporate tax rate difference to other group members on its level of intangible asset investment. Controlling for unobserved time-constant heterogeneity between subsidiaries, year effects, country characteristics and affiliate size, the results confirm our expectations and point to a robust inverse relation between the subsidiary's statutory tax rate relative to other group affiliates and its intangibles holdings. The effect is statistically and economically significant and appears across a range of specification and estimation choices that address endogeneity issues and the dynamic nature of the intangible asset investment. Quantitatively, the estimations suggest a semi-elasticity of around -1.4, meaning that a decrease in the average tax differential to other group affiliates by 10 percentage points raises a subsidiary's intangible property investment by around 14% on average. Finally, we provide evidence that suggests more extensive profit shifting activities of MNEs which possess a higher share of their intangible holdings at low-tax affiliates within the multinational group.

The paper adds to the literature on corporate taxation and multinational firm behavior. In the last years, research in this area has largely focused on the investigation of profit shifting activities. Various papers show that affiliate pre-tax profitability is inversely related to the statutory corporate tax rate and the tax rate differential to other group members, respectively (see Huizinga and Laeven, 2008, for a recent paper). These results are usually interpreted as indirect evidence for profit shifting activities through the distortion of multinational transfer prices and/or the group's equity-debt structure. Our paper suggests that this profitability pattern may be established by a third mechanism which is the relocation of profit-driving intangible property to low-tax affiliates. Although these relocations may also be induced by the desire to optimize transfer pricing opportunities (as described above), the relocation of value-driving assets itself generates the respective profitability pattern even in the absence of shifting activities.

Our paper moreover relates to existing work that connects the presence of intangible property holdings to multinational profit shifting behavior arguing that the true price for firm-specific intangible property is hard to control for national tax authorities and henceforth multinationals could easily engage in transfer pricing manipulations (e.g. Grubert, 2003). Moreover, there is some evidence that MNEs adjust their organization and investment structure to optimize profit shifting opportunities. For example, Grubert and Slemrod (1998) and Desai, Foley, and Hines (2006) find that parent firms with high intangible asset investments and henceforth good opportunities to engage in profit shifting activities are most likely to invest in tax havens. Analogously, Grubert (2003) shows that R&D intensive MNEs engage in significantly larger volumes of intra-group

transactions and thus create more opportunities for income shifting. However, none of these papers considers the location of intangible property within the multinational group to be a choice variable of the MNE. To the best of our knowledge, we are the first to show in a systematic econometric approach that MNEs distort the location of their value-driving and shifting-relevant intangibles towards low-tax affiliates in the multinational group. The only exception we are aware of is a recent paper by Grubert and Mutti (2007) who point out that U.S. parents' R&D investment has become a weak predictor for royalty payments from foreign subsidiaries to the U.S. parent but simultaneously strongly enlarges the earnings of group affiliates located in tax havens. They interpret their results to reflect the parents' incentive to found hybrid entities in tax havens and to reach favorable cost-sharing agreements on R&D investment with them. The hybrids then sell patent licenses to high-tax production affiliates and receive the corresponding royalty payments as earnings.

The remainder of the paper is structured as follows. Section 3.2 presents a simple model to derive the hypothesis tested in the empirical part. We provide an overview on European accounting rules for intangibles and our identification strategy in Section 3.3. In Section 3.4, we describe our data and the sample construction. Section 3.5 states the different estimation methodologies. The estimation results are presented in Section 3.6. Finally, Section 3.7 concludes.

3.2 A Simple Model of Intangible Asset Location

The aim of this paper is to empirically investigate if corporate taxes distort the location of intangible assets within MNEs as suggested by anecdotal evidence. In the following, we illustrate the underlying rationale for this distortion in a simple theoretical model. Precisely, we analyze the impact of corporate taxation on two multinational decision margins: firstly, on the MNE's choice at which of the multinational affiliates to create an intangible asset and secondly, on the decision whether to transfer ownership of the asset to another affiliate after creation.

We consider a MNE with $n > 2$ production affiliates. The MNE's output production requires an intangible input which is a common good created within the boundaries of the MNE (e.g. to avoid knowledge dissipation, see Ethier and Markusen, 1996; Fosfuri, 2000; Markusen, 2001; Gattai and Molteni, 2007).[3] For simplicity reasons, we assume

[3]Following previous papers, we consider the intangible to be a public good that is used as an intermediate input into production (see e.g. Eden, 1998). Pure public goods are both joint and non-excludable.

that it is only feasible to create and administer the intangible at two out of the n multinational affiliates which are located in countries ℓ and h.[4] The corporate profit earned at these affiliates is taxed at the rates t_ℓ and t_h whereas we assume without loss of generality that the host country of affiliate h imposes the higher statutory corporate tax rate than the host country of affiliate ℓ and consequently, $t_h > t_\ell$.

The creation of the intangible asset incurs costs C. Its development is risky in the sense that the gross value (before costs) P of the intangible capturing the sum of the discounted royalty payments is determined by a random process.[5] The intangible is created at affiliate $i \in \{\ell, h\}$. After creation, the MNE has the option to retain ownership of the asset at the production location or to transfer the asset to the other affiliate. The location of (final) ownership is denoted by $j \in \{\ell, h\}$. If the asset is transferred between the affiliates, a transfer price $T_{i,j}$ is paid from the acquiring firm j to the producer i.

We consider the true transfer price for this sale to be $\tilde{T} = \alpha(P - C) + C$, with $\alpha \in [0, 1]$. Hence, in a comparable unrelated party transaction the selling party would receive a share α of the asset return $P - C$. $\tilde{T}$ is assumed to be unobservable by the national tax authorities and thus the MNE may choose a transfer price $T_{i,j}$ that deviates from $\tilde{T}$ to shift profits to low-tax locations (see e.g. Haufler and Schjelderup, 2000, for a similar modeling strategy).[6] It is widely acknowledged that transfer prices for intangible goods are especially easy to distort as comparable unrelated party transactions often do not exist and the intangibles value is more volatile and thus more difficult to determine than the value of tangible goods. Nevertheless, deviations of the transfer price from $\tilde{T}$ plausibly incur costs which we denote by K. These costs can either be interpreted as concealment effort undertaken by the firm to hide the transfer price distortion from the tax authority or alternatively as expected fine payments if price deviations are detected by the officials. Both explanations suggest that the costs K convexly increase

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While jointness in consumption is decisive in our context (i.e. once produced, the intangible can be provided to an additional production affiliate at zero costs), non-excludability is less important.

[4]The other affiliates may, for example, lack access to the necessary human capital which is required to create and/or administer intangible property.

[5]In general, the value of an intangible asset can result from several sources: the intangible may for example reduce the plants' production costs, shift the demand curves upwards or make them less elastic, or create a new product different from the existing one.

[6]The OECD transfer pricing guidelines explicitly suggest to determine the transfer price for intangible assets according to comparable unrelated party transactions if this is feasible (see OECD, 2009). Consequently, the true transfer price $\tilde{T}$ depends on the bargaining power of the acquiring and selling parties in a comparable market transaction.

in the difference between $T_{i,j}$ and $\tilde{T}$. Formally, $K = K(T_{i,j} - \tilde{T})$, with $K(0) = 0$, $\text{sign}(K') = \text{sign}(T_{i,j} - \tilde{T})$ and $K'' > 0$.

The MNE's after-tax profit $\pi_{i,j}$ thus depends on its location choice for the intangible asset production (affiliate i) and the ultimate intangible ownership (affiliate j), with $i, j \in \{\ell, h\}$. The MNE chooses between four location options: creating the intangible at affiliate i and retaining ownership there ($i = j$) or creating it at affiliate i and selling it to the other affiliate afterwards ($i \neq j$). Apart from the considerations laid out so far, we assume that the MNE's after-tax profit in the four location scenarios is affected by a set of factors which are not explicitly modeled and which are subsumed in the variables μ_i and δ_j for the production location and the ownership location, respectively, with $i, j \in \{\ell, h\}$.[7] Factors that may determine an affiliate's suitability as production and ownership location of the intangible and thus its after-tax profits are for example differences in the access to technical equipment and human capital.

The MNE's expected after-tax-profit in the four location scenarios is given by

$$E(\pi_{i,j}) = (1 - t_i)(E(P) - C) + \mu_i + \delta_j \quad \text{if} \quad i = j \tag{3.1}$$

$$E(\pi_{i,j}) = (1 - t_j)(E(P) - T_{i,j}) + (1 - t_i)(T_{i,j} - C) - K + \mu_i + \delta_j \quad \text{if} \quad i \neq j \tag{3.2}$$

with $i, j \in \{\ell, h\}$. Equation (3.1) captures scenarios in which the intangible asset is created and owned at the same affiliate while Equation (3.2) depicts scenarios in which the intangible is created and owned by different affiliates. The MNE is assumed to organize its intangibles operation such that it maximizes its (expected) after-tax profit. We consider a sequential decision process in three stages. In the first stage, the MNE chooses at which of the affiliates to create the intangible. In the second stage, the realization of the random intangibles value becomes observable to the MNE and it decides whether to retain ownership with the affiliate which created the asset or whether to transfer the ownership to the other firm. If the asset is transferred, then the transfer price for the asset is chosen in the third stage. The model is solved by backward induction.

In the second and third stage, the value P is known to the firm and its after-tax profit functions henceforth become deterministic. Formally, this corresponds to Equations (3.1) and (3.2) with $E(\pi_{i,j}) = \pi_{i,j}$ and $E(P) = P$. If intangibles production and ownership are assigned to different affiliates in the first two stages, the MNE chooses the transfer price $T_{i,j}$ in the third stage by maximizing Equation (3.2) under consideration

[7] For simplicity reasons, we abstract from any tax-consequences of μ_i and δ_j. They may be considered to reflect additional or reduced volumes of equity finance and henceforth non-tax-deductible capital investments necessary to create and administer the intangible property.

of $E(\pi_{i,j}) = \pi_{i,j}$ and $E(P) = P$. The associated first order condition reads

$$t_j - t_i = K'(T_{i,j}), \quad i, j \in \{\ell, h\}, \; i \neq j. \tag{3.3}$$

If $i = h$ and $j = \ell$, the asset is sold from the high-tax producer to the low-tax affiliate. According to Equation (3.3), the MNE thus understates the transfer price $T_{i,j} < \tilde{T}$ in order to shift profits from h to ℓ. Analogously, if $i = \ell$ and $j = h$, the scenario is reversed and thus $T_{i,j} > \tilde{T}$.[8]

Conditional on the production location, the MNE decides in the second stage whether to retain ownership of the asset with the production affiliate or whether to relocate it. If the asset is produced in h, it is relocated after the creation to affiliate ℓ if $\phi_1 = \pi_{h,\ell} - \pi_{h,h} > 0$. Plugging in Equations (3.1) and (3.2) under consideration of $E(\pi_{i,j}) = \pi_{i,j}$ and $E(P) = P$ reads

$$\phi_1 = \pi_{h,\ell} - \pi_{h,h} = (t_h - t_\ell)(P - T_{h,\ell}) - K(T_{h,\ell}) + \delta_\ell - \delta_h. \tag{3.4}$$

The goal of our analysis is to determine whether corporate taxation exerts an impact on the ownership of the intangible property. Making use of the envelope theorem and Equation (3.3), comparative statics for Equation (3.4) derive $\partial\phi_1/\partial(t_h - t_\ell) = P - T_{h,\ell} \geq 0$ (see also Footnote 8). Intuitively, a rise in the corporate tax rate differential enhances the incentive to relocate the asset to the low-tax country as this ensures that a fraction of the asset's return is taxed at the low rate t_ℓ. Moreover, the incentive for relocation in response to tax changes rises in the realization of the asset value. To see this, assume that the MNE does not engage in profit shifting activities and thus, $T_{h,\ell} = \tilde{T} = C + \alpha(P - C)$. It then follows that $\partial^2\phi_1/(\partial(t_h - t_\ell)\partial P) = 1 - \alpha \geq 0$. Consequently, the higher the intangible value, the larger is the incentive to transfer the asset to the low-tax country. Furthermore, small marginal costs K' and hence a low transfer price $T_{h,\ell}$ enhance the attractiveness of asset relocations in response to tax rate differentials.

Analogously, if the asset is produced in ℓ, it is retained at affiliate ℓ if

$$\phi_2 = \pi_{\ell,\ell} - \pi_{\ell,h} = (t_h - t_\ell)(P - T_{\ell,h}) + K(T_{\ell,h}) + \delta_\ell - \delta_h > 0. \tag{3.5}$$

Comparative statics with respect to $t_h - t_\ell$ derive $\partial\phi_2/\partial(t_h - t_\ell) = (P - T_{\ell,h}) \geq 0$. Thus, the probability of asset relocation to h decreases in the tax rate differential whereas the marginal tax effect tends to be larger, the larger the asset value.[9] This leads to the following hypothesis.

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[8] For simplicity reasons, we assume $P \geq T_{i,j} \geq C$ with $i, j \in \{\ell, h\}$ as we consider this to reflect the dominating real-world scenario which is relevant for our empirical analysis.

[9] Note that the OECD's transfer pricing guidelines suggest to take the intangibles' costs as one reference

Hypothesis 1.
The probability that the intangible asset is owned by the affiliate in the low-tax country ℓ increases in the tax rate difference between h and ℓ.

In the first stage, the MNE chooses the production location, anticipating its optimal ownership location and transfer price set at later stages. With ownership in ℓ, the production is equally undertaken in ℓ if

$$\phi_3 = E(\pi_{\ell,\ell}) - E(\pi_{h,\ell}) = (t_h - t_\ell)(T_{h,\ell} - C) + K(T_{h,\ell}) + \mu_\ell - \mu_h > 0. \tag{3.6}$$

Accounting for Equation (3.3), comparative statics derive $\partial\phi_3/\partial(t_h - t_\ell) = T_{h,\ell} - C \geq 0$.[10] Intuitively, the larger the tax rate differential, the higher is the incentive to produce the asset in ℓ. This effect becomes larger, the larger the value $T_{h,\ell} - C$ tied to the asset creation. Consequently, increases in the tax differential enhance the probability that the asset is self-produced by the intangibles-owning affiliate ℓ. Note though that this effect decreases with falling transfer pricing costs as a small K implies a low transfer price $T_{h,\ell}$ which makes intangibles production in h less unattractive. Analogously, with ownership of the asset at affiliate h, it is produced at affiliate ℓ if

$$\phi_4 = E(\pi_{\ell,h}) - E(\pi_{h,h}) = (t_h - t_\ell)(T_{\ell,h} - C) - K(T_{\ell,h}) + \mu_\ell - \mu_h > 0. \tag{3.7}$$

Again, we find $\partial\phi_4/\partial(t_h - t_\ell) = (T_{\ell,h} - C) \geq 0$ and thus a rise in the tax rate differential enhances the probability of production at ℓ and hence lowers the probability of self-creation in this scenario. This is captured by the following hypothesis.

Hypothesis 2.
With intangibles ownership in the low-tax (high-tax) country, increases in the tax rate differential $t_h - t_\ell$ enhance (lower) the probability of self-creation.

Summing up, this section shows that MNEs have an incentive to bias the ownership of intangible assets within the group towards low-tax affiliates as this ensures that (part of) the asset return is taxed at a low rate. Moreover, it is shown that especially

value when determining the transfer price as they can be more easily determined than discounted profits which arise from the asset, in particular as the latter are commonly earned with a time-lag (see OECD, 2009). This would suggest that it is easier for an MNE to distort the transfer price downwards in the direction of the costs C than upwards in the direction of P which makes asset sales from high-tax to low-tax affiliates specially attractive. In this context also note that tax authorities in the EU commonly refrain from strategies which imply readjustments of the asset value at later points.

[10] Note that in our model the transfer price chosen is independent of the realized value of P but depends on $E(P)$, costs K and the tax rate differential $t_h - t_\ell$ only.

high-value intangibles are located in low-tax economies and that the probability of self-creation rises (falls) in the tax differential if the asset is held at the low-tax (high-tax) affiliate. Our empirical analysis will test Hypothesis 1 and determine the sensitivity of intangibles ownership to changes in the tax differential. Hypothesis 2 is important for our empirical analysis since the decision whether to self-create or acquire the asset may affect our estimation model as is described in the next section.

Note in this context that our model is stylized in the sense that we abstract from any profit shifting benefits which are attached to intangibles *ownership* at the low tax affiliate. Accounting for this enforces our model predictions. As laid out above, intangible assets are often used as inputs for the production and sales process and are commonly employed by several affiliates within the group. Thus, the intangibles-owning firm receives royalty payments for the use of the intangible from several of the n group members. As royalty prices or license fees for intangible property are perceived to be easily distorted this opens up profit shifting opportunities between the intangibles-owning affiliate and the other production affiliates in the corporate group.

Intuitively, holding intangibles at a low-tax affiliate generates a profit shifting link between the intangibles-holding tax haven affiliate and *all* other group members. Therefore, profit may be shifted from each high-tax affiliate to the intangibles-holding firm in the low-tax country. In contrast, if the intangibles were located at one of the high-tax affiliates, the MNE would gain only *one* profit shifting link to the tax haven affiliate while all other affiliates in high-tax countries would lack shifting opportunities to a low-tax country. This provides an additional incentive to locate the ownership of intangible assets at affiliates with a relatively low corporate tax rate.

3.3 Accounting for Intangible Assets and Identification Strategy

In the following sections, we will empirically test for Hypothesis 1 of Section 3.2 and determine whether MNEs have a tendency to locate intangible assets at low-tax countries in order to shift profits there. For this purpose, we employ information on corporate accounts for a large set of subsidiaries in Europe and use the unconsolidated intangible asset item on the firms' balance sheet as a proxy for the intangible property located at the affiliate.

As our identification strategy is affected by regulations of our European sample countries for the capitalization of intangibles on the balance sheet, this section shortly

describes the associated accounting rules.[11] The company accounts in our sample are filed on the basis of the local generally accepted accounting practices (local GAAP) in the European host countries and *International Financial Reporting Standards* (IFRS) do not play a role for our analysis.[12] These local GAAP regulations allow for the capitalization of various types of intangible assets on the balance sheet if three criteria are fulfilled: first, the intangible has to be an identifiable nonmonetary asset without physical substance, second, the asset has to be controlled by the enterprise as a result of past events (e.g. purchase or self-creation) and third, the asset has to be related to future economic benefits (inflow of cash or other assets).[13] For our sample countries, intangibles have to be capitalized irrespective of whether the asset is self-created by the considered firm or bought from another party. Exceptions to the latter regulation are the countries of Austria, Denmark and Germany which follow the U.S. in allowing only acquired intangible property to be recognized on the balance sheet.[14]

This difference in the accounting rules may thus affect the level of intangible assets captured on the balance sheet. However, it is unproblematic as our identification strategy determines the semi-elasticity of a firm's intangibles to *changes* in corporate tax measures. The identification is affected only if the decision whether to buy or self-create an intangible asset is dependent on corporate taxes. As shown in Hypothesis 2 of Section 3.2, an increase in the tax rate differential between high-tax and low-tax affiliates enhances (lowers) the probability of self-creation if the asset is held at the

[11] For detailed information see e.g. Alexander and Nobes (1994), Alexander and Archer (1995), Nexia International (1997), Jeny-Cazavan and Stolowy (2001), Alexander and Archer (2003), Alexander, Nobes, and Ullathorne (2007), and the books from the European Commission's series *European Financial Reporting* which are available for a large set of European countries, e.g. Lefebvre and Flower (1994) and Ghirri and Riccaboni (1995).

[12] In 1999, the European Union proposed that quoted firms within European borders should adopt IFRS (including IAS 38 for the capitalization of intangible property) for their consolidated accounts. The regulation became obligatory for quoted corporations in 2005. As our analysis however relies on *unconsolidated* accounting data for the years 1995–2005 and the balance sheet information is exclusively based on national accounting standards (local GAAP), IFRS accounting is not relevant for our study.

[13] Examples for intangible assets are patents, licenses, copyrights, brands/trademarks, marketing rights, computer software, customer lists, mortgage servicing rights, import quotas, franchises, customer and supplier relationships, or motion picture films.

[14] Within these broad categories, the precise regulations may differ between countries. For example, in Denmark development cost can as an exception be recognized on the balance sheet. In Ireland, Italy and the UK the capitalization of research costs is not allowed (only of development costs) in the contrary to other EU countries (apart from Austria, Denmark and Germany). In addition, France does not allow for the capitalization of self-created brands.

low-tax (high-tax) affiliate. This implies, that the decision margin whether to buy or self-create the intangible biases our results against zero if self-created assets are not capitalized on the balance sheet.[15] Thus, our results should be considered as a lower bound to the true effect.

Moreover, note that our theoretical model is stylized in the sense that we account for the cases of self-production and acquisition of an asset by the intangibles-administering affiliate only. In practice, MNEs are however also perceived to transfer profits related to intangibles to low-tax affiliates by subcontracting, engaging in cost-sharing agreements, or by sublicensing. First, subcontracting implies that a fraction of the R&D or marketing department has to be located in the low-tax country. These low-tax units then subcontract projects to affiliates in high-tax countries. The latter earn a fixed margin on their costs (*cost-plus method*) while the low-tax affiliate bears the risk of the project and consequently earns all residual profits. This scenario of 'contract research' is equivalent to our model case of self-production. Second, the MNE may engage in cost-sharing contracts in which the costs and benefits of the intangible are shared between the affiliates. Cost-sharing arrangements are particularly common in U.S.-parented groups, due to specific U.S. tax rules relating to cost-sharing which can make them advantageous from a U.S. federal tax perspective. In Europe, cost-sharing agreements are less employed and are mainly used to split the costs and benefits of administrative functions within MNEs (see e.g. Boone, Smits, and Verlinden, 2003). One particularity of cost-sharing agreements is that if the affiliate buys into a cost-sharing agreement after a part of the asset creation, then it has to make a buy-in payment which has to be capitalized on the balance sheet in all our sample countries. Last, the MNE may transfer profits by licensing the intangible to a low-tax affiliate which then sub-licenses the asset to other group affiliates. Again, in this scenario the license is recognized on the affiliate's balance sheet in all our sample countries.

Hence, intangible assets are capitalized in most of our sample countries irrespective of how the affiliate obtained intangibles ownership. We absorb any remaining heterogeneity in the local GAAP regulations by applying a firm fixed effects econometric approach. In Austria, Denmark and Germany, self-created intangibles (including sub-contracting) are not captured in the company accounts while acquired intangibles (including licenses which allow for sub-licensing, and buy-in payments into cost-sharing agreements) are

[15]Strictly speaking, a similar although less pronounced pattern is expected for the other sample countries besides Austria, Denmark and Germany, as bought intangibles are capitalized at the acquisition price while self-created intangibles are capitalized at costs.

capitalized.[16] Therefore, in a sensitivity test to our empirical analysis, we exclude firms located in these three countries and find no significant change in our quantitative results (see Table 3.6 in Section 3.6.4). In general, we consider the MNE's decision *how* to transfer intangible asset ownership to low-tax countries within the group to be strongly firm-specific.[17] As it affects the location choice of R&D and marketing units with core functions for the MNE, we do not consider this decision margin to be very tax-sensitive. However, if it is affected, it is likely to bias our results against zero as explained above, as increases in the tax differential enhance the attractiveness of self-creation (which may result in non-capitalization for some countries) at the low-tax affiliate opposed to acquisition or licensing from a high-tax firm because the latter imply less value to be transferred to the tax haven.[18]

Last, we have to account for the fact that the intangible asset item on the balance sheet may comprise goodwill defined as the price of a firm minus its book value. While self-created goodwill (so-called *original goodwill*), e.g. training costs and advertising/promotional costs, is not allowed to be capitalized and must be charged to expense, all countries included in our sample regulate goodwill to be included in the balance sheet only if it has been acquired through purchase (so-called *derivative goodwill*). To avoid that our analysis is affected by a firm's M&A activities, we drop all firms that took over another company via a M&A (identified through Bureau van Dijk's ZEPHYR database) and thus avoid problems related to the capitalization of goodwill.

[16]Note however that even with self-creation, some costs related to the intangible asset project may be capitalized on the balance sheets in these three countries, e.g. costs for law pursuits to secure a patent. This implies that irrespective of the way in which the intangible ownership was obtained, some costs may be recognized on the balance sheet. To exploit this possibility, we run some binary specifications which account for non-zero values of the intangibles item on the balance sheet.

[17]MNEs may, for example, have a set of traditional intangibles (owned by the firm for a longer period) that it may want to transfer to another affiliate which is possible by means of sale or licensing only. Moreover, self-creation in low-tax countries may be unattractive as it implies the relocation of the intangibles creating unit. This partly even applies if the project is launched by the low-tax affiliate and subcontracted to the creation center in the high-tax affiliate as the decision-making research and marketing management has to be located at the low-tax affiliate. In the latter case, the MNE may also be prone to agency problems caused by the geographic distance between the risk-bearing unit and the intangibles-creating unit (see e.g. Dischinger and Riedel, 2009, or Chapter 4 of this thesis, respectively).

[18]Licensing agreements imply only restricted profit-transfers to low-tax countries as with sub-licensing the low-tax affiliate can charge only a small mark-up on the original license fee (*cost-plus method*).

3.4 Data

Our empirical analysis employs the commercial database AMADEUS which is compiled by Bureau van Dijk. The version of the database available to us contains detailed information on firm structure and accounting of 1.6 million national and multinational corporations in 38 European countries from 1993 to 2006, but is unbalanced in structure.[19] We focus on the EU–25 and on the time period of 1995–2005 as these countries and years are sufficiently represented by the database. The observational units of our analysis are multinational subsidiaries within the EU–25.[20] Since our analysis also requires data on the subsidiary's parent company (e.g. the number and location of the parent's subsidiaries), we investigate only subsidiaries whose parents are likewise located within the EU–25 and on which information is available in the AMADEUS database.

Moreover, our analysis accounts only for industrial subsidiaries whose foreign parent is likewise an industrial corporation and owns at least *three* subsidiaries (by more than 90% of the ownership shares). The latter assumption ensures that the MNEs in our sample exhibit a sufficient size so that strategical allocation of intangibles may emerge. In addition, we restrict the sample to multinational groups that actually own immaterial assets, i.e. either the parent or at least one of its subsidiaries has to hold intangibles. Furthermore, we drop MNEs which observe a negative profit at *all* group affiliates throughout the sample period since they are then not subject to positive tax payments and profitability and/or profit shifting considerations are irrelevant. Last, we drop firms that took over another firm via a M&A using the ZEPHYR database which is equally provided by Bureau van Dijk. In doing this, we hedge against any effects resulting from the mandatory recognition of purchased goodwill in the balance sheet (as self-created goodwill is not allowed to activate in any country).

Our sample contains firms from all EU–25 countries except Cyprus and Malta. The country statistics are presented in Table 3.1.[21] The intangibles measure is the balance

[19] The AMADEUS database is also widely used outside the scientific community. For example, tax authorities (e.g. in Germany and France) are known to rely on AMADEUS for their monitoring activities. The same is true for tax consultancies (e.g. Deloitte Touche Tohmatsu and KPMG).

[20] Our criteria of being a MNE is the existence of a *foreign* immediate shareholder (parent) which holds at least 90% of the affiliate's ownership shares. The data restriction to firms which are owned by 90% or more ensures that the potential location of profit and intangibles at this subsidiary is relevant for the multinational group.

[21] Although it is a legal requirement for German and Austrian companies to file their accounts at the

Table 3.1: Country Statistics

Country	*Subsidiaries*
Austria	85
Belgium	456
Czech Republic	213
Denmark	400
Estonia	119
Finland	295
France	802
Germany	300
Great Britain	924
Greece	59
Hungary	97
Ireland	107
Italy	486
Latvia	54
Lithuania	32
Luxembourg	31
Netherlands	526
Poland	389
Portugal	105
Slovakia	45
Slovenia	6
Spain	650
Sweden	438
Sum	6,619

sheet item *intangible fixed assets*.[22] Since many firms in the database report no information on this variable, our panel data consists of 44,739 observations from 6,619 multinational subsidiaries for the years 1995–2005. Hence, we observe each affiliate for 6.8 years on average.

The AMADEUS data has the drawback that information on the ownership structure is available for the last reported date only which is the year 2004 for most observations in our sample. Thus, in the context of our panel study, there exists some scope for

government registries which is the main source of the AMADEUS data, not all companies comply. Consequently there are several German and Austrian companies on AMADEUS with limited or even no financial information.

[22] All balance sheet and profit & loss account items in our analysis are exported from the AMADEUS database in unconsolidated values. See Section 3.3 for an overview of European accounting rules for intangible assets.

Table 3.2: Descriptive Statistics

Variable	*Obs.*	*Mean*	*Median*	*Min.*	*Max.*
Subsidiary firms only:					
Statutory Corporate Tax Rate▲	44,739	.3334	.345	.1	.5676
Avg. Tax Difference to All Other Affiliates▼	42,994	-.0071	-.0030	-.3817	.2865
Intangible Fixed Assets★	44,739	3,303	3	0	1.03e+07
Dummy Intangible Assets♦	44,739	.5501	1	0	1
Sales★	37,112	76,107	13,076	1	1.58e+07
Ratio Intangible Assets to Sales	37,112	.022	.0006	0	.9284
Country R&D Expenditures (in % of GDP)►	42,215	1.767	1.833	.3637	4.251
Corruption Index◄	42,215	7.11	7.10	2.70	10
Population (in million)•	42,215	35.45	39.64	.4336	82.54
GDP per Capita (in thousand Euro)•	42,215	21.93	23.63	2.485	60.31
Growth Rate GDP per Capita (in %)►	42,215	2.391	2.178	-1.496	11.19
Parent firms only:					
Intangible Fixed Assets★	35,554	65,390	583	0	1.98e+07
Sales★	35,554	1,697,070	96,330	1	7.78e+07
Ratio Intangible Assets to Sales	35,554	.0775	.0086	0	3.467
Number of Subsidiaries■	35,554	80.4	29	3	752

Notes: Firm data is exported from the AMADEUS database, TOP-1.5-Million-Version, October 2006.
▲ Obtained from the European Commission (2006) and from KPMG International (2006).
▼ *Average Tax Difference to All Other Affiliates* calculated as: statutory corporate tax rate of the considered subsidiary minus the unweighted average statutory corporate tax rate of all other group members, comprising subsidiaries (owned with at least 90% of the ownership shares) and the parent firm.
★ Unconsolidated values, in thousand US dollars, current prices.
♦ Takes on the value 1 if a subsidiary owns intangible assets and 0 otherwise.
► Obtained from the *World Development Indicators* (June 2009) of the World Bank.
◄ From Transparency International (TI), ranks from 0 (extreme level of corruption) to 10 (free of corruption).
• Taken from the European Statistical Office (Eurostat).
■ Only subsidiaries owned with $\geq 90\%$ of the ownership shares.

misclassifications of *parent-subsidiary-connections* since the ownership structure may have changed over the sample period. However, in line with previous studies, we are not too concerned about this issue since the described misclassifications introduce noise to our estimations that will bias our results towards zero (see e.g. Budd, Konings, and Slaughter, 2005).

Table 3.2 displays the sample statistics. The mean of the intangible asset variable is calculated with 3.3 million US dollars at the subsidiary level (however with a median value of 3 thousand) and with 65.4 million at the parent level (again with a much smaller median of 583 thousand). To compare the intangible investment on the subsidiary and on the parent level in relative terms, we calculate the ratio of intangible assets to sales. The mean of this ratio is calculated with 2.2% for subsidiaries and with 7.8% for

parent firms. We moreover define a variable *Dummy Intangible Assets* which takes on the value 1 if a subsidiary owns intangible assets and 0 otherwise. The sample average is measured to be .5501 and hence 55% of the subsidiaries in our sample hold intangible property. In addition, the affiliates in our data belong to multinational groups with on average 80.4 subsidiaries that are owned by at least 90% of the ownership shares. This rather high mean value is driven by a few very large MNEs, as the median of the subsidiary number distribution is calculated with 29. Furthermore, on average, a subsidiary observes sales of 76.1 million US dollars.

We additionally merge data on the statutory corporate tax rate at the subsidiary and parent location, as well as basic country characteristics like GDP per capita (as a proxy for the degree of development), population (as a proxy for the market size), GDP per capita growth rate (as a proxy for the economic situation), R&D expenditures in percentage of GDP (as a proxy for the research potential), and a corruption index (as a proxy for the quality of the legal system or the intellectual property protection respectively).[23] For the subsidiaries in our sample, the statutory corporate tax rate spreads from 10.0% to 56.8% whereas the mean is calculated with 33.3%. Our theoretical considerations presuppose that the level of intangible assets may moreover be inversely related to an affiliate's corporate tax rate relative to other group members. We therefore define the *average tax difference to all other affiliates* which is the unweighted average statutory corporate tax rate difference between a subsidiary and all other affiliates of the corporate group (including the parent) that are owned by at least 90% of the ownership shares. This tax difference spreads from −38.2% to 28.7% with a mean of −.7%. Although our subsidiary sample comprises European firms only, the calculation of the *average tax difference to all other affiliates* accounts for information on the worldwide structure of the corporate group which is generally available with the AMADEUS data. However, for non-European subsidiaries, this information comprises only the subsidiaries' names, hosting countries and ownership shares but no accounting information. Therefore, an appropriate weighting procedure for our tax difference variable is not feasible and we employ an unweighted average tax measure.[24]

[23]The statutory tax rate data for the EU–25 is taken from the European Commission (2006). Our analysis will moreover rely on tax rates for group affiliates outside the EU as will be explained below. This data is obtained from KPMG International (2006). Country data for GDP per capita and population size are taken from the European Statistical Office (Eurostat), for GDP per capita growth rate and R&D expenditures in percentage of GDP are obtained from the *World Development Indicators* (June 2009) of the World Bank, and for the corruption index are from Transparency International.

[24]We experimented with size-weighted equivalents of this average tax difference variable for European

Figure 3.1: Parent Level Intangible Assets over Time
(Mean of all observations per year, in thousand US dollars, current prices)

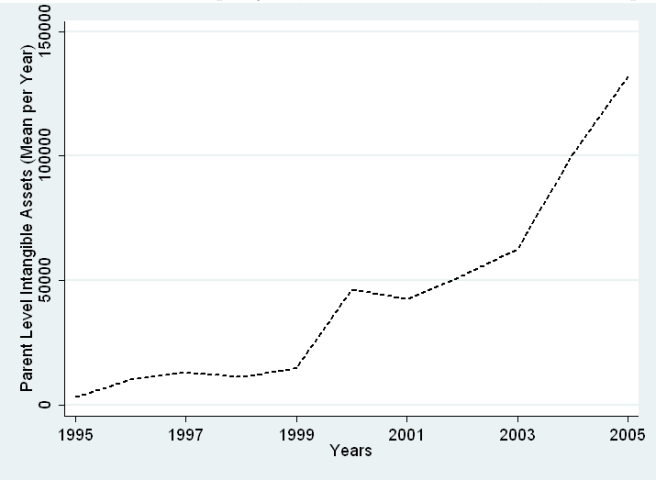
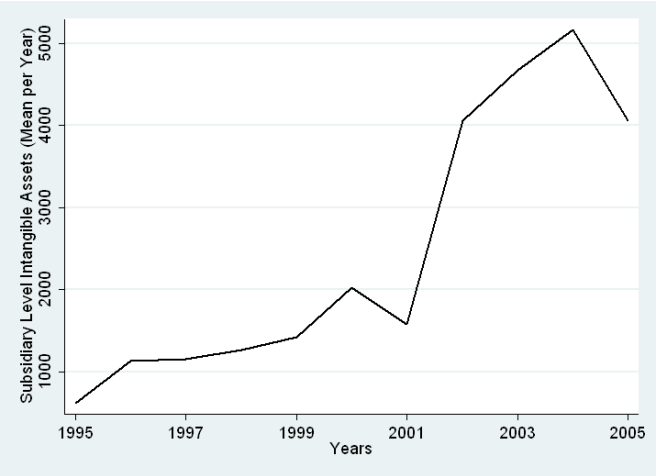


Figure 3.2: Subsidiary Level Intangible Assets over Time
(Mean of all observations per year, in thousand US dollars, current prices)



Last, the descriptive statistics strongly confirm the increasing importance of intangible property in corporate production over the last decade. Figures 3.1 and 3.2 report the average level of intangible asset investment at parents and subsidiaries in our sample between 1995 and 2005. While the average parent firm owns substantially more intangible property than the average subsidiary, the mean value steeply rises for both types over the years which is in line with previous findings in the literature (e.g. Hall, 2001). Figures 3.3 and 3.4 display on a yearly basis the average ratio of intangible assets to sales and to total assets, respectively. The picture of Figure 3.3, together with

affiliates. Since the application of a weighting scheme is only sensible if we observe information on the subsidiaries' size variable for all or at least the vast majority of the group affiliates, this leads to a drastic reduction in sample size as the information on affiliate accounts is often not available for a sufficient number of group subsidiaries. Nevertheless, we found the application of weighted tax measures to lead to qualitatively comparable results which are available from the authors upon request.

Figure 3.3: Ratio Intangible Assets to Sales over Time
(Mean of all observations per year)

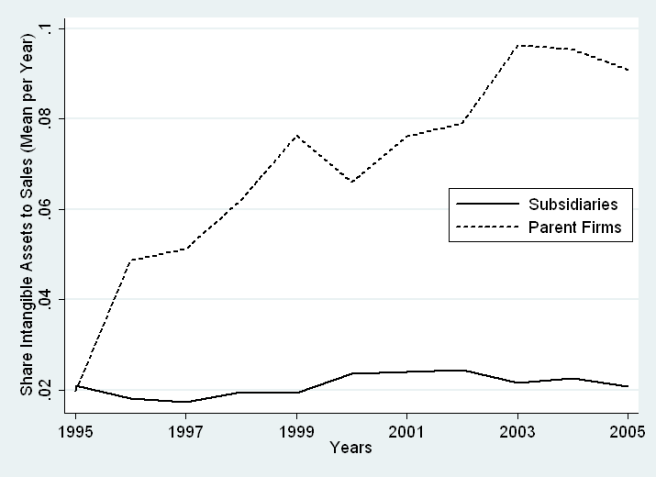
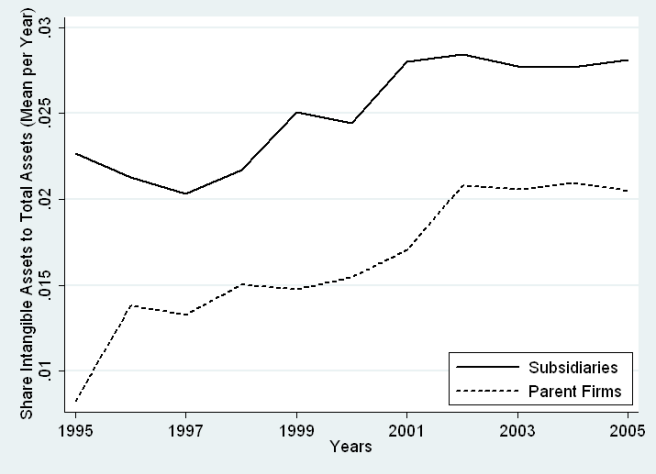


Figure 3.4: Ratio Intangible Assets to Total Assets over Time
(Mean of all observations per year)



Figures 3.1 and 3.2, suggests that sales at subsidiaries also significantly rises over the sample years while sales at parent firms decrease or stay constant. Figure 3.4 shows that intangibles relative to total assets likewise increase between 1995 and 2005 for parents as well as for subsidiaries in an almost equal magnitude.

3.5 Econometric Approach

We employ different methodological approaches to test Hypothesis 1 formulated in Section 3.2. The following subsections present our baseline estimation model and alternative model specifications that account for a binary dependent variable, endogeneity issues, and a dynamic estimation model of intangible asset investment.

3.5.1 Baseline Estimation Model

In our baseline regression, we estimate an OLS model of the following form

$$\log(y_{it}) = \beta_1 + \beta_2 \tau_{it} + \beta_3 X_{it} + \beta_4 log(a_{it}) + \rho_t + \phi_i + \epsilon_{it} \tag{3.8}$$

with y_{it} =(*intangible assets* +1). Since the distribution of intangible asset investment of subsidiary i at time t is considerably skewed, we employ a logarithmic transformation of the level of intangible assets as dependent variable. Furthermore, a substantial fraction (45%) of the subsidiaries in our dataset does not hold any intangible assets at all and thus, we follow previous studies (e.g. Plassmann and Tideman, 2001; Alesina, Barro, and Tenreyro, 2002; Hilary and Lennox, 2005; Weichenrieder, 2009) and add a small constant (= 1) to our intangibles variable to avoid that zero-observations are excluded from the estimation. The explanatory variable of central interest is τ_{it} which stands the subsidiary's statutory corporate tax rate difference to all other affiliates of the multinational group (that are owned with at least 90% of the ownership shares) including the parent. One might also consider to apply the effective marginal tax rate differences to identify the subsidiary's marginal intangibles investment (see also Devereux and Griffith, 1998). However, commonly available effective marginal (and average) tax rates usually refer to investment projects in the manufacturing industry and do not appropriately reflect intangibles related investments. Since deductibility rules may substantially differ between investment forms, we do not consider these effective tax measures to suit well in our regression context and employ the statutory tax rate as a proxy instead. Given the commonly reported high correlation between the effective marginal and the statutory corporate tax rates, we consider this approach to be valid.[25] Moreover, as suggested by the model in Section 3.2, the statutory corporate tax rate difference simultaneously captures the incentive to locate intangible property at low-tax countries for profit shifting purposes.

a_{it} stands for the total sales of subsidiary i at time t. Thereby, we condition intangible asset investments on affiliate size which may be decisive since otherwise our tax measure might reflect the widely-tested negative impact of corporate taxation on subsidiary size only. It is well-known that low corporate tax rates foster affiliate investment and vice versa. If large affiliates also tend to hold high investments in intangible property, an estimated corporate tax effect without controlling for firm size could be contaminated by the underlying negative relation between corporate taxes and affili-

[25] Nevertheless, we experimented with effective marginal corporate taxes and found qualitatively comparable effects on intangible asset investment.

ate size.[26] However, potential reverse causality problems may occur since intangibles may well determine an affiliate's volume of operating revenues as also argued by our profit shifting reasoning for the relocation of intangibles to low-tax countries. This endogeneity issue is addressed in Section 3.5.3 using instrumental variables techniques.

An alternative way to control for size is to apply the ratio of intangibles to sales as the dependent variable. We rerun our estimations with this regressand and find very similar results which are also shown in the result table. However, we choose to control for size with the sales variable as a separate regressor in the following, as thereby, we hedge against a possible complementary relationship between intangible assets and sales and thus are able to exploit the maximum variation in intangible investments.

Furthermore, X_{it} comprises a vector of time-varying country control characteristics like GDP per capita, population size, GDP per capita growth rate, R&D expenditures in percentage of GDP, and a corruption index. These macro controls are included to ensure that the results are not driven by an unobserved correlation between a country's wealth, market size, research potential, economic situation, and quality of intellectual property protection (as proxied by the above variables) with corporate taxes and intangible investment. Furthermore, a full set of year dummies ρ_t is included to capture shocks over time common to all subsidiaries. ϵ_{it} describes the error term. Since we apply panel data, we are able to add subsidiary fixed effects to control for non-observable, time-constant firm-specific characteristics ϕ_i. Using fixed-effects is reasonable and necessary in our analysis since a firm's level of intangible assets is likely to be driven by internal firm-specific factors which are impossible to be captured by observable control variables available in our data set. The fixed-effects model is also preferred to a random-effects approach by a Hausman-Test.

Starting from this baseline approach, we investigate the sensitivity of our results to alternative model specifications.

3.5.2 Binary Dependent Variable

In a first alternative approach, we take into account that 45% of the subsidiaries in our data do not exhibit any intangible property holdings at all. This data structure indicates it to be a relevant multinational choice whether or not to locate intangible property at an affiliate at all and that a binary choice model might fit the data well.

[26] Our results are robust against the use of alternative proxies for subsidiary size, e.g. the subsidiaries' total assets.

Thus, the sensitivity check comprises a model of the following form

$$b_{it} = \gamma_1 + \gamma_2 \tau_{it} + \gamma_3 X_{it} + \gamma_4 log(a_{it}) + \rho_t + \phi_i + v_{it} \tag{3.9}$$

where b_{it} represents the binary intangible assets variable that takes on the value 1 if a subsidiary owns intangible property and the value 0 otherwise. The explanatory variables are specified analogously to Equation (3.8). Again the regression includes time-constant affiliate fixed effects and year dummies. In a first step, we determine the coefficient estimates for Equation (3.9) based on maximum-likelihood techniques by estimating a fixed-effect logit model. The model thereby critically relies on the assumption that the error term v_{it} follows a logistic distribution. As a sensitivity check to our results, we thus re-estimate Equation (3.9) in a linear probability framework based on the standard OLS assumptions.[27]

3.5.3 Instrumental Variables Approach

Since the level of intangible investment could well determine an affiliate's volume of operating revenues, in a second alternative model specification, we address this potential reverse causality problem with instrumental variables techniques. We therefore employ the levels estimator proposed by Anderson and Hsiao (1982) which suggests to control for time constant affiliate effects by taking the first differences of the estimation equation and to instrument for the difference in the endogenous variable (here: *sales*) by employing lagged *levels* of this variable.[28] Thus, we use a two-stage instrumental variables approach (2SLS) to estimate the following model

$$\Delta \log(y_{it}) = \beta_2 \Delta \tau_{it} + \beta_3 \Delta X_{it} + \beta_4 \Delta log(a_{it}) + \Delta \rho_t + \Delta \epsilon_{it} \tag{3.10}$$

where all variables correspond to the variables defined in Section 3.5.1 and Δ indicates the first difference operator. Our result tables will report the F-statistic for the relevance

[27] The data structure suggests the estimation of a truncated regression model. However, truncated models like tobit are not feasible with affiliate fixed effects. Since subsidiary fixed effect turn out to be decisive in our empirical analysis, we consider the application of a binary fixed-effect logit and an OLS model respectively to be an appropriate alternative.

[28] With panel data on more than two time periods, it is not equivalent to apply a fixed-effect and first-differencing approach respectively. Both models give unbiased and consistent estimates although the relative efficiency of the estimators may differ, depending on the model structure. Precisely, the fixed-effect estimator is less sensitive against the violation of strict exogeneity of the regressors while the first-differencing estimator is less sensitive against the violation of serially uncorrelated error terms. In the result section, we will discuss the relation between the fixed-effects and first-differencing results.

of the instruments at the first stage of the regression model and a Sargan/Hansen-Test of overidentifying restrictions which tests for the validity of the instruments employed, i.e. for their exogeneity with respect to the error term $\Delta\epsilon_{it}$.

3.5.4 Dynamic Estimation Model

Last, our estimation approach so far did not take into account that relocating intangible property within the MNE might be associated with considerable positive adjustment costs. For example, relocating corporate R&D units and/or the associated patent rights from one affiliate to another is associated with a move of workers and tangible assets and henceforth implies relocation costs. Thus, we expect a subsidiary's intangibles holdings in previous periods to be a predictor for intangible assets investment today and include the first lag of a subsidiary's intangible asset investment $y_{i,t-1}$ as an additional explanatory variable in our estimation equation.

The well-known *dynamic panel bias* implies that including the first lag of the dependent variable as additional control in a fixed-effects framework leads to biased coefficient estimates because the lagged dependent variable is endogenous to the fixed effects in the error term. Thus, we follow Arellano and Bond (1991) who build on the Anderson and Hsiao (1982) framework applied in Section 3.5.3 and suggest to estimate a first-difference generalized method of moments (GMM) model and instrument for the first difference in the lagged dependent variable by deeper lags of the *level* of the dependent variable.[29] The estimation equation then takes on the following form

$$\Delta \log(y_{it}) = \beta_1 \Delta \log(y_{i,t-1}) + \beta_2 \Delta\tau_{it} + \beta_3 \Delta X_{it} + \beta_4 \Delta log(a_{it}) + \Delta\rho_t + \Delta\epsilon_{it}. \quad (3.11)$$

The variable definitions correspond to the ones in the previous subsections. Because the model is estimated in first-differences, the equation will be characterized by the presence of first-order serial correlation. However, the validity of the GMM estimator relies on the absence of second-order serial correlation. The Arellano/Bond-Test for second-order serial correlation will be reported at the bottom of the result table. Again, we check for the exogeneity of the instrument set by employing a Sargan/Hansen-Test.

[29] Note that the difference in the lagged dependent variable correlates with the differenced error term. However, deeper lags (starting from the second lag) of the dependent variable (in levels) are available as valid instruments as they are orthogonal to the error term.

3.6 Estimation Results

This section presents our empirical results. Throughout all regressions, the observational units of our analysis are the multinational subsidiaries as explained in Sections 3.4 and 3.5. Additionally, in all upcoming estimations, a full set of year dummy variables is included and heteroscedasticity robust standard errors adjusted for firm clusters are calculated and displayed in the tables in parentheses. Section 3.6.1 presents the baseline findings, Section 3.6.2 estimates a binary choice model, Section 3.6.3 displays the results of an instrumental variables estimation, Section 3.6.4 comprises the dynamic estimations, Section 3.6.5 describes undertaken robustness checks, and finally Section 3.6.6 presents evidence for more extensive profit shifting activities of MNEs that have located their intangibles at low-tax affiliates within the corporate group.

3.6.1 Baseline Estimations

Table 3.3 presents our baseline estimation. Following the methodology described in Section 3.5.1, Specification (1) regresses the logarithm of subsidiary intangible asset investment on the firm's statutory corporate tax rate, while controlling for fixed firm and year effects. In line with our theoretical considerations, we find a statistically significant negative influence that suggests high corporate tax rates at an affiliate to be associated with low intangible asset investment and vice versa. The effect is robust against the inclusion of time-varying country control characteristics in Specification (3) and sales as a firm size control in Specification (5).

However, the subsidiaries' statutory tax rate may be an imprecise measure for tax incentives on intangible asset location since our hypothesis predicts intangibles to be located in countries with a low tax rate *relative to all other affiliates* of the corporate group. This is accounted for in Specifications (2), (4), and (6) which regress the level of intangible assets on the *average tax difference to all other affiliates*. Confirming our theoretical expectations of Section 3.2, the results indicate that the average statutory corporate tax rate difference between a subsidiary and other group members exerts a highly significant negative impact on the subsidiary's intangibles holdings. Quantitatively, the estimations suggest that a decrease in the *average tax difference to all other affiliates* by 1 percentage point raises the subsidiary's level of intangible assets by 2.1% (cf. Column (6) of Table 3.3).

In Columns (5) and (6), we additionally control for the subsidiary size by including

Table 3.3: Baseline Estimations

OLS Firm–Fixed–Effects, Panel 1995–2005

Depend. Variable	**Log Intangible Assets**						**Log Int./Sales**	
Explanat. Variables:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Statutory Tax Rate	-2.44***		-2.38***		-2.50***		-2.54***	
	(.631)		(.663)		(.690)		(.717)	
Av.TaxDiff.toOthers		-2.08***		-2.01***		-2.08***		-2.27***
		(.559)		(.584)		(.606)		(.627)
Log Sales					.447***	.453***		
					(.026)	(.026)		
Country R&D Exp.			.385***	.325***	.247*	.178	.094	.041
			(.132)	(.132)	(.140)	(.139)	(.144)	(.143)
Corruption Index			.007	-.001	.019	.008	.030	.019
			(.029)	(.029)	(.029)	(.029)	(.030)	(.030)
Population			.013	.010	-.013	-.020	-.025	-.029
			(.038)	(.039)	(.038)	(.038)	(.038)	(.039)
GDP per Capita			-.028**	-.028**	-.025*	-.023	-.021	-.017
			(.013)	(.014)	(.015)	(.016)	(.016)	(.016)
Growth GDPp.Cap.			.018	.017	-.000	-.003	-.020*	-.021*
			(.011)	(.012)	(.011)	(.011)	(.012)	(.012)
Year Dummies	√	√	√	√	√	√	√	√
# Observations	44,739	42,994	42,215	40,574	37,112	35,666	37,112	35,666
# Firms	6,619	6,363	6,617	6,361	6,017	5,788	6,017	5,788
Adjusted R^2	.7218	.7207	.7274	.7262	.7538	.7531	.7195	.7194

Notes: Heteroscedasticity robust standard errors adjusted for firm clusters in parentheses.
*, **, *** indicates significance at the 10%, 5%, 1% level. Observational units are multinational subsidiaries, i.e. firms that exhibit a foreign parent which owns at least 90% of the ownership shares. Additionally, to be included in the sample, at least one affiliate of the corporate group has to own intangible assets and at least one has to make positive profits. In (1)–(6), the dependent variable is the natural logarithm (Log) of the level of intangible assets. In (7)–(8), the dependent variable is the log of the ratio intangible assets to sales (*Log (Int./Sales)*). In both cases, we add a small constant to the initial level of intangible assets to avoid losing observations with zero intangibles by taking the log. An OLS model with fixed firm effects is estimated. *Av.TaxDiff.toOthers* is defined as the unweighted average statutory tax rate difference between the considered subsidiary and all other affiliates of the corporate group including the parent. Adjusted R^2 values are calculated from a dummy variables regression equivalent to the fixed-effects model.

the affiliate's sales as a regressor. The coefficient estimate suggests that size positively affects the reported intangible assets where the tax effect on the intangibles variable remains largely unchanged. In Columns (7) and (8), we moreover rerun our baseline model using the ratio of intangible assets to sales as regressand and find comparable results.

3.6.2 Binary Dependent Variable

In this section, we estimate Equation (3.9) and thus focus on the binary multinational choice whether to locate intangible property at a certain affiliate or not. The results are displayed in Table 3.4. Specifications (1) to (4) thereby present maximum-likelihood estimations of a fixed-effect logit model. The dependent variable is the *Dummy Intangible Assets* which is set to 1 if a subsidiary owns intangible assets and 0 otherwise. Since the logit estimation controls for subsidiary fixed effects, many subsidiaries drop out of the estimation since they observe no variation in the status of intangibles-holding vs. non-holding during the observation period. Nevertheless, the estimations still comprises an adequate number of about 2,000 firms for which information is available for 7.3 years on average.

In Specifications (1) and (3), we regress the binary dependent variable on the subsidiary's *statutory tax rate*. The coefficient estimate is negative and highly significant and thus confirms the presumption that a subsidiary's probability of holding intangible property decreases in the location's statutory tax rate. Moreover, Specifications (2) and (4) estimate the relation using the *average tax difference to all other affiliates* as explanatory tax variable. Again, we find a negative effect on intangibles holdings which is statistically significant at the 1% level. Thus, conditioning on country characteristics and firm size, the lower a subsidiary's statutory corporate tax rate compared to all other affiliates of the same multinational group (including the parent), the higher is its probability of holding intangible assets.[30]

Nevertheless, the estimation of the fixed-effect logit model critically depends on the assumption of a logistic distribution of the error term. Thus, as a sensitivity check, we moreover estimate a linear probability model with subsidiary fixed effects. The application of an OLS framework thereby has the additional advantage that we make use of all information in our dataset and do not confine the sample to subsidiaries which observe a change over the sample period in the status of intangibles-holding vs. non-holding. The results are displayed in Specifications (5) to (8) of Table 3.4 and are qualitatively equal to the results of the logit model. Ceteris paribus, a reduction of the *average tax difference to all other affiliates* by 10 percentage points is suggested to raise the subsidiary's probability of holding intangible assets by 2.1 percentage points on average (cf. Column (8)). As the mean probability of holding intangibles is 55.0%,

[30]The coefficient estimates of a logit estimation cannot be interpreted quantitatively. Moreover, applying a logit model with fixed effects makes the calculation of marginal effects impracticable as it requires specifying a distribution for the fixed effects.

Table 3.4: Binary Dependent Variable								
Logit & OLS Firm–Fixed–Effects, Panel 1995–2005								
Dependent Variable: Dummy Intangible Assets								
Model	**Logit Fixed-Effects**				**OLS Fixed-Effects**			
Explanat. Variables:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Statutory Tax Rate	-3.36***		-4.31***		-.271***		-.309***	
	(1.14)		(1.26)		(.102)		(.117)	
Av.TaxDiff.toOthers		-2.71***		-2.82***		-.218**		-.208**
		(1.04)		(1.14)				(.104)
Log Sales			.583***	.575***			.053***	.054***
			(.048)	(.048)			(.004)	(.004)
Country R&D Exp.			.323	.122			.051**	.039
			(.298)	(.298)			(.025)	(.024)
Corruption Index			.085	.047			.006	.004
			(.067)	(.068)			(.005)	(.005)
Population			-.259***	-.287***			-.016***	-.017***
			(.082)	(.083)			(.007)	(.007)
GDP per Capita			-.008	-.015			-.001	-.001
			(.039)	(.038)			(.002)	(.003)
Growth GDPp.Cap.			-.001	-.009			.002	.001
			(.029)	(.029)			(.002)	(.002)
Year Dummies	√	√	√	√	√	√	√	√
# Observations	16,734	16,151	13,164	12,726	44,719	42,974	37,102	35,656
# Firms	2,227	2,150	1,884	1,822	6,619	6,363	6,017	5,788
Pseudo or Adj. R^2	.0198	.0197	.0596	.0584	.6724	.6709	.6786	.6763

Notes: Heteroscedasticity robust standard errors adjusted for firm clusters in parentheses. *, **, *** indicates significance at the 10%, 5%, 1% level. Observational units are multinational subsidiaries, i.e. firms that exhibit a foreign parent which owns at least 90% of the ownership shares. Additionally, to be included in the sample, at least one affiliate of the corporate group has to own intangible assets and at least one has to make positive profits. Dependent variable (*Dummy Intangible Assets*) is set to 1 if a subsidiary owns intangible assets and is 0 if not. In (1)–(4), a logit model with fixed firm effects is estimated while in (5)–(8) a linear OLS model with fixed firm effects is applied. *Av.TaxDiff.toOthers* is defined as the unweighted average statutory tax rate difference between the considered subsidiary and all other affiliates of the corporate group including the parent. Adjusted R^2 values are calculated from a dummy variables regression equivalent to the fixed-effects model.

this corresponds to an average increase of 3.8%.

3.6.3 Instrumental Variables Estimations

In this section, we account for potential reverse causality with respect to sales and intangible investment levels as described in Section 3.5.3. Accordingly, we estimate the equation in first differences and employ the lagged *levels* of sales as instruments for the first differences in sales (Anderson and Hsiao, 1982).

Table 3.5: Instrumental Variables Estimations

OLS & IV First–Differences, Panel 1995–2005

Dependent Variable: Log Intangible Assets

Model	**OLS First Differences**				**IV First Differences**			
Explanat. Variables:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Statutory Tax Rate	-1.23***		-1.14***		-3.15***		-3.00***	
	(.419)		(.446)		(.994)		(1.03)	
Av.TaxDiff.toOthers		-.972***		-.961**		-2.31***		-2.33***
		(.390)		(.411)		(.844)		(.880)
Log Sales	.318***	.320***	.333***	.337***	-.338	-.361	-.233	-.266
	(.025)	(.025)	(.027)	(.027)	(.256)	(.265)	(.232)	(.245)
Country R&D Exp.			.109	.090			.472***	.421**
			(.122)	(.124)			(.192)	(.195)
Corruption Index			.019	.010			-.007	-.017
			(.018)	(.018)			(.038)	(.039)
Population			-.021	-.024			-.106**	-.121***
			(.036)	(.036)			(.046)	(.047)
GDP per Capita			-.019*	-.017			.014	.016
			(.012)	(.012)			(.020)	(.020)
Growth GDPp.Cap.			-.018***	-.019***			-.012	-.013
			(.007)	(.007)			(.016)	(.016)
Year Dummies	√	√	√	√	√	√	√	√
# Observations	32,187	30,917	29,204	28,049	16,424	15,752	15,553	14,912
# Firms	5,709	5,491	5,656	5,439	4,080	3,920	4,048	3,888
1st-stage F-Test of excl. instr. (F-stat.)					24.28	22.49	25.35	22.70
Hansen J-Test (P-value)					.7108	.5267	.5933	.3864

Notes: Heteroscedasticity robust standard errors adjusted for firm clusters in parentheses.
*, **, *** indicates significance at the 10%, 5%, 1% level. Observational units are multinational subsidiaries, i.e. firms that exhibit a foreign parent which owns at least 90% of the ownership shares. Additionally, to be included in the sample, at least one affiliate of the corporate group has to own intangible assets and at least one has to make positive profits. Dependent variable is the natural logarithm (Log) of the level of intangible assets; we add a small constant to the initial level of intangible assets to avoid losing observations with zero intangibles by taking the log. In (1)–(4), an OLS model in first differences is estimated. In (5)–(8), a first-differenced instrumental variables (IV) approach in two stages (2SLS) is applied, with the 1st difference of *Log Sales* being instrumented with the 2nd–4th lag of the level of *Log Sales* (cf. Anderson and Hsiao, 1982). *Av.TaxDiff.toOthers* is defined as the unweighted average statutory tax rate difference between the considered subsidiary and all other affiliates of the corporate group including the parent. Note, unobserved time-constant heterogeneity between subsidiaries is controlled for by first-differencing.

To do so, we first compare the results of a first-differencing approach to the fixed-effects model and re-estimate our specifications of Table 3.3 using first differences instead of fixed effects. The comparable coefficient estimates are displayed in Columns (3) and (4) of Table 3.5. While the qualitative effect of both, the *statutory tax rate* and the *average tax difference to all other affiliates*, on the level of intangible asset in-

vestment remains unchanged, the point estimates are substantially smaller than for the fixed-effect regressions (−1.14 and −.96, respectively) although they do not statistically differ from each other. Since we consider unobserved heterogeneity in the subsidiary characteristics to be a major issue in our regression context, we generally presume the fixed-effects approach to deliver the more efficient estimates. Nevertheless, since the qualitative results are independent of the model employed and first-differencing delivers *smaller* coefficient estimates than the fixed-effect approach, we feel confident that a qualitative and a quantitative interpretation of the first-differencing model's coefficient estimates (as a *lower* bound) is valid. The coefficient estimate of *sales* is positive and statistically significant suggesting that larger affiliates tend to hold more intangible property. However, since the specifications in Column (1) to (4) do not control for potential reverse causality, the coefficient estimates may be biased.

In Specifications (5) to (8) of Table 3.5, we address this endogeneity problem and instrument the first difference of *sales* with lagged levels of the variable.[31] This modification of the estimation model increases the coefficient estimates of our tax measures which remain statistically significant. Interestingly though, instrumenting for sales erases the positive effect of affiliate size on intangible asset holdings now suggesting that intangible asset investment is independent of affiliate size. Moreover, the usual test statistics claim our specification to be valid since the F-test for the instruments at the first stage is highly significant indicating our instruments to be relevant. Furthermore, the null-hypothesis of the Hansen J-Test is accepted stating that the instruments are uncorrelated with the error term and henceforth valid.

3.6.4 Dynamic Estimations

Last, we determine the relation between corporate taxes and intangible asset investment in a *dynamic* model which additionally accounts for positive adjustment and relocation costs of intangible property. We follow Arellano and Bond (1991) and employ a one-step linear GMM estimator in first differences which implies that the endogenous differenced lag of intangible assets investments is instrumented with the second and all deeper lags

[31] Precisely, we employ the second to fourth lag of the logarithm of sales as instruments. We consider this to be an appropriate model specification since with the Anderson and Hsiao (1982) estimator, the gained information from including additional lags as instruments has to be weighted against the loss in sample size due to missing values implied by including additional lags.

of the *level* of intangible asset investments as explained in Section 3.5.4.[32] The results are presented in Table 3.6 and point to a dynamic nature of intangible asset investment since lagged intangible property holdings indeed show a significant and quantitatively relevant impact on current intangibles investments.

Our corporate tax effects on intangible asset investment are largely unaffected by the inclusion of the lagged dependent variable and are quantitatively smaller compared to the estimations in the non-dynamic case presented in Table 3.5. Specifications (1) to (4) of Table 3.6 document a negative and significant effect of the subsidiary's statutory tax rate and of the tax differential variable on intangible asset investment. In Specifications (5) and (6), we again include subsidiary sales as size control whereas we treat the variable as endogenous and instrument it with the second and all deeper lags of its level. The results show a similar picture as in the previous subsection. While the coefficient estimates for the corporate tax measures are unaffected by the inclusion of the size control and remain statistically significant and of quantitatively relevant size, the sales variable itself does not exert any statistically significant effect on intangible asset holdings. Moreover, the test statistics confirm our dynamic specifications to be valid. The Arellano/Bond-Test accepts the null-hypothesis that there is no second-order autocorrelation in the error term and likewise the Sargan/Hansen-Test of overidentifying restrictions accepts the null-hypothesis that the set of instruments is exogenous to the error term.

As a sensitivity check, in Specifications (7) and (8), we exclude subsidiaries located in Austria (AT), Denmark (DK) and Germany (DE). These countries do not allow for capitalization of self-created intangibles on the balance sheet as described in Section 3.3. Since our quantitative tax results show no major change without the three countries, this suggests that the difference in national accounting standards does not play an important role for our study.

[32]Note that with the Arellano and Bond (1991) estimator, we do not face the trade-off of the Anderson and Hsiao (1982) estimator that the gained information from including additional lags as instruments has to be weighted against the loss in sample size due to missing values. This applies since the Arellano and Bond (1991) methodology sets missing values to 0 and still derives a meaningful set of moments conditions. Nevertheless, we additionally reestimated all specifications of Table 3.6 in an Anderson and Hsiao (1982) framework and found qualitative and quantitative comparable results. Here, the F-statistic of the first-stage regression also indicates a strong relevance of the instrument set used.

Table 3.6: Dynamic Estimations

Difference GMM, Panel 1995–2005

Dependent Variable: Log Intangible Assets

Sample	**Full Sample**						**No AT,DE,DK**	
Explanat. Variables:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
1st Lag Log Int.As.	.889***	.873***	.870***	.866***	.871***	.867***	.895***	.889***
	(.036)	(.036)	(.032)	(.033)	(.026)	(.027)	(.029)	(.029)
Statutory Tax Rate	-1.08**		-1.23**		-1.51**		-1.56***	
	(.547)		(.584)		(.639)		(.626)	
Av.TaxDiff.toOthers		-1.37***		-1.47***		-1.38**		-1.18**
		(.559)		(.581)		(.611)		(.583)
Log Sales					-.031	-.001	-.422**	-.351
					(.220)	(.232)	(.210)	(.221)
Country R&D Exp.			.501***	.464***	.551***	.506***	.511***	.462**
			(.181)	(.185)	(.195)	(.199)	(.201)	(.204)
Corruption Index			-.002	-.007	-.014	-.021	.004	-.004
			(.031)	(.032)	(.032)	(.033)	(.034)	(.035)
Population			-.122***	-.116***	-.139***	-.142***	-.076*	-.090**
			(.035)	(.035)	(.040)	(.041)	(.040)	(.040)
GDP per Capita			.007	.014	.005	.014	.018	.026
			(.010)	(.009)	(.014)	(.016)	(.015)	(.016)
Growth GDPp.Cap.			.003	.004	.001	.002	.005	.004
			(.011)	(.011)	(.012)	(.012)	(.013)	(.013)
Year Dummies	√	√	√	√	√	√	√	√
# Observations	29,730	28,556	27,950	26,832	24,792	23,792	23,729	22,759
# Firms	5,790	5,570	5,745	5,527	5,128	4,932	4,721	4,535
# Instruments	18	18	23	23	32	32	32	32
Arellano-Bond-Test AR(2) (P-value)	.213	.180	.222	.194	.342	.327	.364	.366
Hansen-Test (P-value)	.480	.624	.438	.533	.448	.448	.604	.569

Notes: Standard errors robust against heteroscedasticity and autocorrelation within firms are reported in parentheses. *, **, *** indicates significance at the 10%, 5%, 1% level. Observational units are multinational subsidiaries, i.e. firms that exhibit a foreign parent which owns at least 90% of the ownership shares. Additionally, to be included in the sample, at least one affiliate of the corporate group has to own intangible assets and at least one has to make positive profits. Dependent variable is the natural logarithm (Log) of the level of intangible assets; we add a small constant to the initial level of intangible assets to avoid losing observations with zero intangibles by taking the log. A one-step linear GMM dynamic panel-data estimation in first differences is applied. Following Arellano and Bond (1991), we instrument the 1st difference of the *1st Lag of Log Intangible Assets* with the 2nd and all deeper lags of the level of *Log Intangible Assets*. In (5)–(8), we additionally instrument the 1st difference of *Log Sales* with the 2nd and all deeper lags of *Log Sales* levels. In (7)–(8), subsidiaries located in Austria (AT), Germany (DE) and Denmark (DK) are excluded. *Av.TaxDiff.toOthers* is defined as the unweighted average statutory tax rate difference between the considered subsidiary and all other affiliates of the corporate group including the parent. Note, unobserved time-constant heterogeneity between subsidiaries is controlled for by first-differencing.

3.6.5 Robustness Checks

First, we rerun all our specifications with the additional inclusion of a full set of 110 one-digit NACE code industry-year dummies (not reported). This add-on does not change any of our qualitative and quantitative results. In addition, we checked if our results are driven by a pure Eastern European effect. We thus defined a dummy variable that takes on the value 1 if a subsidiary is located in one of the Eastern European countries (comprising the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia) and generated interaction terms of the East European dummy with the set of year effects. Including these in our regression analysis does not alter any of the qualitative and quantitative results.

Furthermore, we re-estimate our regressions employing the statutory corporate tax rate difference between a subsidiary and *its parent firm* as explanatory variable (instead of the average tax difference to all other group affiliates, including the parent). This model specification accounts for the fact that a large fraction of intangible property is traditionally held by the multinational parent firms (see Figures 3.1 and 3.2) and parents are perceived to be the *natural* and *classic* owners and administrators of intangible property since they host the MNEs' relevant management and administration departments. Regressing intangible asset investment on the tax difference to the parent captures the incentive to relocate intangibles from the parent to the considered subsidiary for tax purposes. We hence re-estimate all specifications presented in this paper (including the alternative model specifications) using the tax difference to the parent as the relevant tax measure. This modification leads to the same qualitative results (not reported) as the models accounting for the tax structure of the whole MNE and supports the notion that taxes impact on the location of intangibles within a MNE.[33]

Summing up, we present empirical evidence that the lower the corporate tax rate of a subsidiary relative to all other affiliates of the multinational group the higher is its level of intangible assets. This result turns out to be robust against a set of alternative model specifications and robustness checks.

[33]The results of these robustness checks are available from the authors upon request.

3.6.6 Location of Intangible Assets and Profit Shifting

The previous subsections presented evidence that the location of intangible assets is distorted towards affiliates with a relatively low corporate tax rate. Our theoretical motivation predicts that this distortion roots in the incentive to transfer profits to the low-tax affiliate, for example by distorting the transfer price for royalty payments and thus to shift profits from worldwide production affiliates to the low-tax economy. This implies that profitability rates observed at multinational low-tax affiliates are predicted to exceed the profitability at high-tax affiliates.

A series of previous papers brought forward empirical evidence for a negative relationship between corporate taxes and firm profitability which is in line with this prediction.[34] In our analysis, we apply this indirect approach of providing evidence of profit shifting (which is well established in the empirical literature, see e.g. Devereux and Maffini, 2007, for an overview) by regressing affiliate pre-tax profits on various firm and country control variables and additionally on corporate tax rate differentials.[35] Provided our previous analysis, it is of interest to understand whether a relevant fraction of profit relocations in the wake of tax rate differentials is related to intangibles.

In line with the argumentation above, we presume that the average statutory corporate tax rate difference between a considered subsidiary and all other affiliates of the corporate group including the parent (*Av.TaxDiff.toOthers*) exerts a negative effect on the company's reported (unconsolidated) pre-tax profits while controlling for input factors and firm fixed effects, and that this effect is especially strong if intangible assets play a prominent role in the firm. In Specifications (1) and (2) of Table 3.7, we run the regression separately for subsidiaries which belong to MNEs with a below average intangibles intensity (sub-sample *LowIA*) and for subsidiaries with an above average intensity (sub-sample *HighIA*). The intangibles intensity is determined as the mean over all years of the intangible assets to sales ratio of all group affiliates on which information is available. Both specifications suggest a negative effect of the tax differential on pre-tax profits whereas the effect is quantitatively almost twice as large

[34] Collins, Kemsley, and Lang (1998) and Dischinger (2008) (or Chapter 2 of this thesis) present evidence that the statutory corporate tax rate difference between a subsidiary and its *parent firm* negatively affects the subsidiary's productivity. Analogously, Hines and Rice (1994) or Huizinga and Laeven (2008) provide evidence that affiliate productivity falls in the average tax rate difference to *all other affiliates* of the multinational group.

[35] See Section 2.4.1 of Chapter 2 for the estimation equation and a more detailed description of the econometric approach.

Table 3.7: Location of Intangible Assets and Profit Shifting

OLS Firm–Fixed–Effects, Panel 1995–2005

Dependent Variable: Log (Profit before Taxation)

Sample	LowIA	HighIA	IAHighTax	IALowTax	All Subsidiaries	
Explanat. Variables:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Av.TaxDiff.toOthers	-2.078***	-3.970***	-1.958***	-3.777***	-1.894***	1.327
	(.445)	(.887)	(.632)	(.744)	(.612)	(1.800)
Av.TaxDiff.toOthers ×D.IALowTax					-1.985***	
					(.897)	
Av.TaxDiff.toOthers ×IntensityDifference						-28.573**
						(12.530)
Log FixedAssets	.017	.088***	.075***	.008	.047**	.047**
	(.021)	(.033)	(.026)	(.033)	(.020)	(.021)
Log CostEmployees	.523***	.564***	.498***	.561***	.524***	.525***
	(.048)	(.062)	(.057)	(.065)	(.043)	(.044)
Country R&D Exp.	.279***	.396*	.432***	.032	.256***	.255***
	(.110)	(.209)	(.156)	(.160)	(.112)	(.112)
Corruption Index	.056***	.074*	.052*	.086**	.071***	.070***
	(.024)	(.043)	(.030)	(.036)	(.023)	(.023)
Population	.415*	.775	.934**	.562	.749***	.749***
	(.287)	(.536)	(.040)	(.424)	(.291)	(.291)
GDP per Capita	.254***	.498***	.229***	.285***	.251***	.025***
	(.074)	(.147)	(.010)	(.113)	(.074)	(.007)
Growth GDPp.Cap.	.062***	.078***	.071***	.069***	.070***	.070***
	(.012)	(.024)	(.015)	(.020)	(.012)	(.012)
Year Dummies	√	√	√	√	√	√
# Observations	15,034	4,634	7,847	6,348	14,195	14,195
# Firms	3,269	1,079	1,653	1,284	2,937	2,937
Adjusted R^2	.7762	.7861	.7604	.7954	.7793	.7790

Notes: Heteroscedasticity robust standard errors adjusted for firm clusters in parentheses.
*, **, *** indicates significance at the 10%, 5%, 1% level. Observational units are multinational subsidiaries, i.e. firms that exhibit a foreign parent which owns at least 90% of the ownership shares. Additionally, to be included in the sample, at least one affiliate of the group has to own intangibles and at least one has to make profits. Dependent variable is the logarithm (Log) of subsidiary's pre-tax profits. *Av.TaxDiff.toOthers* is defined as the unweighted average statutory corporate tax rate difference between the considered subsidiary and all other affiliates of the corporate group including the parent. In (1), the sample is restricted to groups which exhibit *below* average levels of intangible assets per sales while in (2), the sample is restricted to groups which exhibit *above* average levels of intangibles per sales. In (3), the sample is restricted to subsidiaries of MNEs which observe a larger intangible intensity (measured as intangibles over sales) at *high-tax* affiliates than at low-tax affiliates while in the contrary, in (4) the sample is restricted to subsidiaries of MNEs which observe a larger intangible intensity at *low-tax* than at high-tax affiliates. In (5)–(6), the full sample of all subsidiaries is applied. In (5), we interact *Av.TaxDiff.toOthers* with the dummy *D.IALowTax* that is set to 1 if the intangible intensity at *low-tax* affiliates in the group is larger than at high-tax affiliates in the group, and 0 otherwise. In (6), we interact *Av.TaxDiff.toOthers* with the variable *IntensityDifference* which captures the difference between the intangibles intensity at low-tax affiliates within the group and high-tax affiliates within the group and which is transformed to exhibit only positive values.

for the sub-sample of intangibles intensive groups (Column (2)).[36] This is in line with results reported by Grubert (2003) who equally finds that the reported pre-tax profits of MNEs whose parent firm reports high R&D expenditures react more sensitive to changes in the corporate tax rate.

However, our theoretical presumptions even more precisely suggest that multinational groups whose intangible assets are biased towards low-tax economies should engage in larger profit shifting activities as they can distort transfer prices for royalty payments between the intangibles owner and other group affiliates located in countries with a higher tax rate and henceforth shift profits from a large number of intangibles users to the intangibles-holding low-tax affiliate. Moreover, if the MNE already observes a bias in favor of low-tax economies, it is equally more likely to react according to the pattern proposed in this paper and relocate intangibles in the wake of tax rate differentials. To investigate this, we split our original subsidiary dataset in two subgroups: first, a group of subsidiaries of MNEs in which the intangibles intensity (i.e. intangible assets per sales) is larger for affiliates in *high-tax* countries than for affiliates in low-tax countries (sub-sample *IAHighTax*), and a second group of subsidiaries of MNEs for which the intangibles intensity at *low-tax* affiliates is larger than at high-tax affiliates (sub-sample *IALowTax*).[37] The results are reported in Specifications (3) and (4) of Table 3.7 and indicate that profit shifting activities prevail in both groups but that they are quantitatively twice as large in MNEs with an over-proportional fraction of their intangible assets located at low-tax affiliates (Column (4)).

Specification (5) reruns the same estimation in the full sample, interacting the tax differential with a dummy variable which takes on the value 1 if the low-tax affiliates in the multinational group on average observe a larger intangibles intensity than the high-tax affiliates (analogue to the definition of the sub-sample *IALowTax* in Column (4)). This derives quantitatively comparable results. In Specification (6) of Table 3.7, we define the variable *IntensityDifference* which measures the difference between the intangibles intensities of the low-tax affiliates and the high-tax affiliates within the MNE. We define this variable to be positive by moving the distribution of the variable upwards so that the smallest value is just above zero (to avoid complications when interacting the variable with the tax differential that can take on positive and negative values). Interacting *IntensityDifference* with *Av.TaxDiff.toOthers* indicates that the

[36] Note that the respective coefficient estimates of the tax differential just fail to be statistically different from each other on the 15% significance level.

[37] High-tax (low-tax) affiliates are affiliates with a statutory corporate tax rate which is larger (smaller) than the average tax rate of all other group affiliates.

sensitivity of pre-tax profits to the tax differential is larger the stronger the MNE's intangible assets distribution is biased in favor of low-tax affiliates.[38]

Summarizing, this section provides evidence that suggests a link between intangible assets and their location within the multinational group and profit shifting opportunities. Note, however, that all the above specifications have to be understood as suggestive evidence as we face some important data restrictions. The main issue here is that we do not necessarily observe detailed accounting data on *all* (majority-owned) affiliates within MNEs (see also Section 3.4 on data description) and henceforth cannot clearly determine the entire intangible asset distribution across the MNE.

3.7 Conclusions

The last years have witnessed an increasing importance of intangible assets (patents, copyrights, brand names, etc.) in the corporate production process of MNEs (see Figures 3.1 – 3.4 in Section 3.4). Anecdotal evidence thereby suggests that these intangibles are often located at low-tax affiliates. For example, *Nestle*, *Vodafone* and *British American Tabacco* have created brand management units in countries with a relatively low corporate tax rate that charge royalties to operating subsidiaries worldwide. Our paper argues that these relocation tendencies are driven by two motivations. Firstly, by the incentive to save taxes through the relocation of highly profitable intangible assets to low-tax countries. Secondly, by the incentive to optimize profit shifting strategies through the distortion of transfer prices for intangible property traded within the firm. Intangibles are usually firm-specific goods for which arm's length prices can hardly be determined by tax authorities. Hence, MNEs may overstate the transfer price for the intermediate immaterial good at relatively low expected costs and thus shift profits from high-tax production affiliates to the intangibles-holding affiliate in the low-tax country.

To the best of our knowledge, our paper provides the first systematic empirical evidence that the location of intangible assets within MNEs is indeed distorted towards low-tax affiliates. Based on a rich data set of European MNEs during the years 1995 to 2005, we show that the lower the statutory corporate tax rate of a subsidiary relative to all other affiliates of the multinational group, the higher is the level of intangible

[38]Note that the average of the *IntensityDifference* variable is calculated with .174. Consequently, evaluated at the sample mean the semi-elasticity of pre-tax profit with respect to the tax differential is determined with -4.97.

assets at this location. This result turns out to be robust against various specifications and robustness checks. Thus, the evidence suggests that MNEs exploit the enhanced importance of intellectual property in the production process by distorting its location within the corporate group to minimize their overall tax liabilities. Quantitatively, we find a semi-elasticity of around -1.4, meaning that a decrease in the average tax difference to all other group affiliates by 10 percentage points raises a subsidiary's stock of intangibles by around 14% on average.

These behavioral adjustments have profound consequences for international corporate tax competition. First, the relocation of intangible assets to tax havens facilitates income shifting and enlarges the streams of multinational profit transferred to countries with a low tax rate. This increases the governmental incentive to lower its corporate tax rate and aggravates the race-to-the-bottom in corporate taxes. Second, it is important to stress that the creation and administration of intangible assets is related to *real* corporate activity. To relocate patents and trademark rights to low-tax countries, MNEs have to transfer part of their R&D departments and their administration and marketing units with them. Obviously, these multinational service units comprise high-skilled workers who represent part of the decisive corporate human capital (see e.g. Bresnahan, Brynjolfsson, and Hitt, 2002). Thus, countries which attract intangible investment by lowering their corporate tax rate do not only gain higher pre-tax profits but may also win additional jobs and knowledge capital that may spill over and increase the productivity of local firms. According to this, the gains from lowering the corporate tax rate surge along a second line and enforce tax competition behavior.

Currently, the regulations on intangibles relocation within MNEs are rather lax in many OECD countries. For example, rules with respect to cost sharing agreements between multinational affiliates are loose in the U.S. and other OECD countries (see also Grubert and Mutti, 2007) and thus tend to foster the shift of patent rights from parent R&D departments to R&D units at low-tax affiliates. Additionally, in most OECD countries (part of) the intangible property can be relocated across borders at rather low costs. For example, if an MNE moves a production center from a high-tax country to a tax-haven, it usually has to calculate transfer prices for all tangible assets transferred while intangible goods like e.g. production plans and knowledge capital is not accounted for.

Many governments have identified these hidden intangible asset relocations from their countries as one major source of corporate tax revenue losses. For example, Germany has recently come forward with an unilateral attempt to restrict the relocation of (intellectual property owning) production units from its borders. In January 2008,

a new legislation was introduced that regulates transfer prices to be charged on the whole relocated multinational affiliate. This implies that MNEs must calculate transfer prices not only on their *tangible* production units but equally have to account for the *intangible* value, the *profit potential*, of the firm. Other countries are expected to follow the German advance with the introduction of similar regulations. In the light of our paper, this tightening on relocation possibilities of intangible assets across borders should be appreciated as it reduces the potential for tax competition behavior.

Chapter 4

There's No Place Like Home: The Profitability Gap between Headquarters and their Foreign Subsidiaries

4.1 Introduction

The purpose of this paper is to compare the profitability of corporate activities at multinational headquarters and their foreign subsidiaries. Although the emergence and investment behavior of multinational enterprises (MNEs) are well studied (see e.g. Barba-Navaretti and Venables, 2006; Brakman and Garretsen, 2008), the literature has so far largely neglected to investigate the *profit* distribution within multinational groups. Exceptions are recent public finance papers which suggest that multinational profits tend to be distorted towards affiliates with a low corporate tax rate as MNEs shift paper profits from high-tax to low-tax entities and tend to bias the location of profitable investment projects in favor of low-tax affiliates (e.g. Devereux and Maffini, 2007; Huizinga and Laeven, 2008; Dischinger and Riedel, 2008 or Chapter 3 of this thesis, respectively; Becker, Fuest, and Riedel, 2009).

Our paper adds to this literature by testing whether the profitability of headquarters activities statistically differs from activities undertaken at foreign subsidiaries. To the best of our knowledge, we are the first study to empirically investigate this question although a set of existing theoretical papers (implicitly) suggests that headquarters activities exhibit a higher profitability than operations located at multinational subsidiaries. One strand of papers which is related to the notion of "vertical" foreign direct investment (FDI) proposes that this pattern arises due to agency costs faced by the headquarters management if valuable assets and functions are located with geographically separated subsidiaries (see e.g. Chang and Taylor, 1999; Hamilton and Kashlak, 1999; O'Donnell, 2000). An alternative explanation for the headquarters bias is brought forward by the theoretical literature on "horizontal" FDI which suggests that investments at the parent location may exhibit a higher profitability because MNEs have advantages when operating in their home market as they know the language, culture and customs better than foreign competitors (see e.g. Dunning, 1977; Brakman and Garretsen, 2008).

To test for the profitability gap between headquarters and their foreign subsidiaries, we exploit a large European firm data set which is available for the years 1999 to 2006. Our results indicate that the profitability of headquarters investments indeed largely outweighs the profitability of investments at foreign subsidiaries. Our most conservative estimates quantify the profitability gap with around 30%. The results turn out to be robust against the use of different profitability measures and the inclusion of a large set of control variables: multinational group fixed effects (to account for unobserved heterogeneity between MNEs), country fixed effects (to control for productivity differences

between countries), industry fixed effects, the size of the input factors, the corporate leverage and firm age (to account for set up costs faced by young corporations).

Moreover, we test how the profit gap has evolved over time. If profitability differences between headquarters and their foreign subsidiaries were driven by agency costs, one would presume that the profitability gap has declined in the last decade as new technological developments, like the invention of the internet and mobile phone, have led to reductions in communication and monitoring costs. Although the predictions for the home market effect are less clear cut, a similar pattern might arise. Interestingly, our data indeed suggests a significant drop in the parent bias by at least 1.5 percentage points per year, implying that the profitability gap has closed by at least 15% over our sample period (1999–2006) whereas some specifications point to a closure of the gap by more than 30%.

Following these baseline estimates, we additionally assess whether and to what extent agency costs and the home market effect contribute to the profitability gap. To do so, we distinguish between "vertical" and "horizontal" FDI as the agency costs argument is mainly tied to the former while the home market advantage argument is largely tied to the latter. Thus, we divide the sample in two subgroups, the first comprising multinationals where the parent firm and the observed subsidiary operate in the same 4-digit NACE industry (proxying for horizontal FDI) and the second comprising multinationals where the parent firm and the observed subsidiary operate in different 4-digit NACE industries (proxying for vertical FDI). The profitability gap between parents and subsidiaries prevails in both groups suggesting that agency costs and the home market effect play a role in driving the results. Moreover, we find that the profitability gap closes over time in the vertical FDI group (in line with the notion of falling communication and agency costs) while the effect remains constant in the horizontal FDI-group.

Furthermore, we run a large set of robustness checks. Most importantly, we assess whether the profitability gap derived in this paper is unique to the international context or whether it prevails in national groups. Our estimations indicate a statistically significant profitability gap between headquarters and their *domestic* subsidiaries that is measured to be around one third of the gap derived in our baseline specifications. In additional sensitivity checks, the paper among others shows that the derived profitability pattern is not driven by mergers & acquisitions (M&A) and does not reflect avoidance of dividend withholding taxes.

In a last step, we discuss potential implications of the presented parent bias for economic welfare and public economic policy. Profitability is expected to affect a country's

welfare along several lines. It for example determines the size of the firm's corporate tax payments and thus, our analysis suggests that parent firms pay higher taxes on their corporate activity than subsidiaries. This presumption is confirmed in our data. Conditioning on affiliate size and the host country's corporate tax rate, tax payments at multinational headquarters are found to be 60% larger than the tax payment at their multinational subsidiaries. Additionally, affiliate profitability is well known to positively affect local wage bargaining outcomes and consequently, workers at the headquarters firm are predicted to earn higher wages than their colleagues at the subsidiary level (see e.g. Budd, Konings, and Slaughter, 2005).

In addition, we present empirical evidence that profit shifting activities of MNEs critically depend on the groups' organizational structure, precisely on the multinational headquarters location. Particularly, we show that, on the one hand, MNEs are reluctant to shift profits away from high-tax headquarters to low-tax subsidiaries and, vice versa, that MNEs are eager to shift profits from high-tax subsidiaries to low-tax headquarters. Although the economic literature has brought forward comprehensive empirical evidence for quantitatively relevant shifting behavior (see e.g. Chapter 2 of this thesis, or Clausing, 2003; Huizinga and Laeven, 2008; for a comprehensive survey, see Devereux and Maffini, 2007), not much is known about which type of firm engages in shifting activities. A few papers link a R&D intensive production process and the ownership of intangible assets to enhanced profit shifting activities (see Chapter 3 of this thesis, and Grubert, 2003; Desai, Foley, and Hines, 2006). However, the existing literature neglects the heterogeneity in MNEs' organizational structure and its impact on the location of profits across affiliates. To the best of our knowledge, our paper is thereby the first to provide evidence that the profit distribution within a MNE is biased towards the parent company and that, correspondingly, the bulk of profit shifting activities between parent firms and their subsidiaries takes place if the multinational headquarters are located at a low-tax economy.

Thus, our paper suggests that countries tend to profit more from hosting a multinational headquarters firm than from hosting a multinational subsidiary. This may, for example, rationalize government policies to create national champions by intervening in international M&A activities. But our results also in a broader sense suggest that it is in the national interest of economic policy to strengthen the domestic parent firms rather than trying to attract subsidiaries from abroad.

The paper is structured as follows. In Section 4.2, we provide a theoretical motivation for our analysis, Section 4.3 describes our data set. In Section 4.4, we present our estimation methodology and in Section 4.5 the estimation results. Section 4.6 discusses

relevant implications of our findings for public economics and Section 4.7 concludes.

4.2 Theoretical Considerations

The purpose of this paper is to test whether the profit distribution of multinational firms is skewed in favor of the headquarters location. There are two strings of the literature which suggest a positive profitability gap between parent firms and their subsidiaries: the first proposes agency costs to give rise to a higher profitability of headquarters investment, while the second suggests that the same pattern is induced by home market advantages.

The agency cost theory is related to the notion of "vertical" FDI, i.e. the presumption that value chains comprising various functions like manufacturing, logistics, marketing and R&D are geographically separated across borders. Recent contributions brought forward empirical evidence for this kind of vertical fragmentation (see Campa and Goldberg, 1997; Hummels, Rapoport, and Yi, 1998; Hummels, Ishii, and Yi, 2001; Hanson, R. J. Mataloni, and Slaughter, 2001; Hanson, R. J. Mataloni, and Slaughter, 2005). Assuming that the profitability of functions within the value chain differs, the MNE may strategically choose the location of profit-driving operations.[1] Several papers in the business economics literature suggest that MNEs have a tendency to keep valuable functions with the head office as physical distance hampers communication and the headquarters management thus faces agency and information costs if these operations are run abroad (see e.g. Chang and Taylor, 1999; Hamilton and Kashlak, 1999; O'Donnell, 2000).[2] Nevertheless, the last decade was also characterized by the development of new technologies like the internet and the mobile phone which have lowered communication costs and might henceforth have dampened agency problems caused by geographic separation (see e.g. Freund and Weinhold, 2002, Blinder, 2006). This suggests that the profitability gap is not constant over time but might have declined in recent years.

A second literature strand proposes that the profitability gap between headquarters and their foreign subsidiaries may be induced by a different mechanism which is related to the notion of "horizontal" FDI. Precisely, the papers suggest that exporting the

[1]Some contributions suggest that the functions which drive the corporate profit are knowledge and marketing related, like R&D and advertisement (see e.g. Zingales, 2000).

[2]Furthermore, La Porta, de Silanes, and Shleifer (1999), analyze the widespread organizational form of *corporate pyramids* which are strongly associated with agency problems.

MNE's business model and products to foreign countries by setting up production and sales units there may result in lower profitability rates since these units may for example have less knowledge about language, customs and consumer behavior than their domestic competitors or since the MNE's products might have been developed to fit domestic not foreign consumer preferences (e.g. Dunning, 1977; Brakman and Garretsen, 2008).[3]

In the following, we will bring these hypotheses to the data and test whether operations located at the headquarters firm are indeed more profitable than operations located at foreign subsidiaries. Moreover, we will assess the role of agency costs and the home market effect in generating this profitability pattern.

4.3 Data

Our empirical analysis relies on the commercial database AMADEUS which is compiled by Bureau van Dijk. The version of the database available to us contains detailed information on firm structure and accounting of national and multinational corporations in Europe. We focus on 27 European countries[4] and on the time period of 1999 to 2006 as these countries and years are sufficiently represented by the database. One major advantage of AMADEUS is that it allows to link accounting information for parent firms and their corporate subsidiaries which makes the data set ideal for our purpose.

For an observation to be included in the sample, it has to belong to an MNE. The parent firms in our sample are the global ultimate owner of a multinational group and own at least one subsidiary in a foreign country with an ownership share of 100%. The

[3]Note that two other mechanisms may give rise to a profitability bias in favor of the parent firm. Firstly, Betrand, Mehta, and Mullainathan (2002) show that business groups expropriate minority shareholders by tunneling profits from firms where they have low cash flow rights (e.g. subsidiaries owned by less than 100% of the ownership shares) to firms where they have high cash flow rights (e.g. the headquarters firm). However, as our empirical analysis compares parent firms and their *wholly-owned* subsidiaries, this motive is not considered in our empirical analysis. Secondly, MNEs may have an incentive to bias the location of profits towards the parent firm in order to save withholding taxes on dividend payments which become due upon repatriation. As withholding taxes on dividends are however low within the European Union, we consider this to be unlikely which is empirically confirmed in a robustness check.

[4]Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Great Britain, Hungary, Ireland, Italy, Latvia, Luxembourg, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Spain, Sweden, Switzerland, Ukraine.

Table 4.1: Country Statistics

Country	*All Affiliates*	*Parent Firms*	*Subsidiaries*
Austria	271	135	136
Belgium	2,092	1,123	969
Bulgaria	78	5	73
Croatia	186	57	129
Czech Republic	519	77	442
Denmark	1,724	828	896
Estonia	240	24	216
Finland	537	14	523
France	2,838	1,283	1,555
Germany	1,395	731	664
Great Britain	3,175	960	2,215
Hungary	34	9	25
Ireland	30	30	0
Italy	2,339	1,418	921
Latvia	10	0	10
Luxembourg	23	14	9
Netherlands	2,068	1,404	664
Norway	1,112	365	747
Poland	738	44	694
Portugal	273	82	191
Romania	512	12	500
Serbia	69	2	67
Slovakia	82	5	77
Spain	2,644	1,231	1,413
Sweden	2,226	1,392	834
Switzerland	138	138	0
Ukraine	40	2	38
Sum	25,393	11,385	14,008

subsidiaries in our sample likewise belong to a multinational group in the sense that they are wholly owned by a parent corporation in a foreign country. The subsidiaries may own (further) subsidiaries themselves but this is not decisive for our qualitative results. The country statistics for the parent and subsidiary sample are presented in Table 4.1.

Moreover, in our baseline regressions we restrict the sample to firms which earn a positive pre-tax profit since our theoretical considerations apply particularly well to firms with a positive profit and this allows us to abstract from loss-offset regulations. Additionally, it enables us to take the logarithm of the pre-tax profitability as the dependent variable which is suggested since the variable exhibits a rather skewed dis-

Table 4.2: Descriptive Statistics

Variable	*Obs.*	*Mean*	*Median*	*Min.*	*Max.*
Dummy Parent Firm	107,930	.4912	0	0	1
Profit before Tax (PBT)★	107,930	18,623	884	1	1.67e+07
Earnings before Interest & Tax (EBIT)★	107,930	14,857	850	1	1.52e+07
Gross Profit Margin (PBT per Sales)	100,181	2.32	.0585	1.73e-05	26,393
EBIT Margin (EBIT per Sales)	100,181	.1024	.0576	1.73e-05	295
Sales★	100,181	191,893	16,151	1	1.46e+08
Fixed Assets★	107,930	154,263	2,486	1	1.04e+08
Cost of Employees	107,930	26,530	2,183	1	2.26e+07
Number of Employees	107,930	565	44	1	99,837
Financial Leverage Ratio♦	102,227	.5937	.6209	0	1
GDP▲	107,864	932.1	610.7	5.63	2,915
GDP per Capita◄	107,864	28,778	27,892	633	74,471
Corruption Index►	107,864	7.34	7.4	1.5	10
Statutory Corporate Tax Rate	107,864	.3251	.3399	.1	.523
Parent firms only:					
Profit before Tax (PBT)★	53,011	32,967	1,683	1	1.67e+07
Earnings before Interest & Tax (EBIT)★	53,011	26,711	1,538	1	1.52e+07
Gross Profit Margin (PBT per Sales)	48,650	3.53	.0639	1.73e-05	26,393
EBIT Margin (EBIT per Sales)	48,650	.1214	.0605	3.22e-05	295
Fixed Assets★	53,011	285,419	8,612	1	1.04e+08
Cost of Employees	53,011	46,423	3,921	1	2.26e+07
Number of Employees	53,011	990	83	1	99,837
Subsidiary firms only:					
Profit before Tax (PBT)★	54,919	4,778	520	1	8.06e+06
Earnings before Interest & Tax (EBIT)★	54,919	3,878	528	1	2.64e+06
Gross Profit Margin (PBT per Sales)	51,531	1.18	.0543	2.71e-05	23,304
EBIT Margin (EBIT per Sales)	51,531	.0852	.0549	1.73e-05	64.7
Fixed Assets★	54,919	27,664	599	1	3.76e+07
Cost of Employees	54,919	7,328	1,391	1	6.33e+06
Number of Employees	54,919	156	29	1	80,146

Notes: Firm data is exported from the AMADEUS database, full version, October 2008.
★ Unconsolidated values, in thousand US dollars, current prices.
♦ = (total liabilities / total assets).
▲ In billion US dollars, current prices, data from IMF WEO Database October 2008.
◄ In US dollars, current prices, data from IMF WEO Database October 2008.
► Corruption Perceptions Index (CPI) from Transparency International (TI), ranks from 0 (extreme level of corruption) to 10 (free of corruption).

tribution. However, in robustness checks we reran our regressions including firms with negative pre-tax profits and did not find qualitatively different results.

The observational unit in our analysis is the multinational affiliate, i.e. the parent or subsidiary firm per year. In total, our baseline sample comprises 107,930 observations from 25,393 affiliates for the years 1999 to 2006 belonging to 18,531 multinational groups. 49.1% of the observations are parent firms. This number may seem surprisingly

high but simply reflects the fact that our data does not only comprise corporate groups for which both, the parent firm and at least one corporate subsidiary, are available but also MNEs for which either one or the other is observed. Since many firms in our data are parents with subsidiaries outside of Europe (which then are not covered by AMADEUS), the fraction of parent firms in our sample is quite large.

As our analysis will include fixed effects for the multinational group, the parent bias is identified via the former set of groups only which accounts for $57,261$ observations. The rationale for equally keeping the other firms in the sample is that the coefficient estimates of all other control variables are predicted to be econometrically more precise. However, as a robustness check, we reran our regressions on the sub-sample of firms for which parent and subsidiary information is available and found our qualitative and quantitative results to be confirmed. Note moreover that in this sub-sample of multinational groups the fraction of parent firms is estimated to be a moderate 23.5%. Furthermore, to control for country characteristics, we merge data on GDP, GDP per capita, a corruption index and the statutory corporate tax rate to the firm accounting data.[5] Table 4.2 displays basic descriptive sample statistics.

On average, the affiliates in our sample observe a pre-tax profit of 18.6 million US dollars, fixed asset investments of 154.3 million and sales of 191.9 million US dollars. The average firm employs 565 workers. The median of the distributions is substantially smaller for all three variables. The median for the profitability measures *gross profit margin* (i.e. pre-tax profit over sales) and *EBIT margin* (i.e. earnings before interest and tax over sales) is estimated with 5.85% and 5.76% respectively. Note, moreover that the sample characteristics substantially differ between parent firms and subsidiaries. First, parent firms tend to be larger than their subsidiaries with an average fixed assets stock of 285.4 million US dollars and a median of 8.61 million versus an average fixed asset stock of 27.7 million and a median of 0.60 million US dollars at the subsidiary level. Additionally, the descriptive statistics already suggest a profitability gap between parents and their subsidiaries as the median of the gross profit margin and EBIT margin at the parent level is 6.39% and 6.05% respectively, while the median of these ratios at the subsidiary level is calculated with 5.43% and 5.49% respectively. The next section will investigate whether these descriptive patterns prevail in an econometric framework.

[5]The statutory tax rate data is taken from the European Commission. Country data for GDP and GDP per capita are obtained from the IMF World Economic Outlook Database October 2008. The Corruption Perceptions Index is taken from Transparency International and ranks from 0 (extreme level of corruption) to 10 (free of corruption).

4.4 Econometric Approach

Following our theoretical considerations in Section 4.2, we estimate an empirical model of the following form

$$\log \pi_{ijt} = \beta_0 + \beta_1 PARENT_{ijt} + \beta_2 X_{ijt} + \phi_j + \rho_t + \epsilon_{ijt} \tag{4.1}$$

where π_{ijt} represents the profitability measure of affiliate i belonging to multinational group j at time t. We employ two profit variables which are taken from the firms' unconsolidated balance sheet information: profit before tax (PBT) and earning before interest and tax (EBIT). While PBT captures the overall affiliate profit (comprising operating and financial profits), the EBIT measure depicts the firm's operating profit. In the following, we will determine the profitability gap between parents and their subsidiaries in terms of both variables. Moreover, since the profit variables exhibit a rather skewed distribution (cf. e.g. the divergence of mean and median in Table 4.2), we employ a logarithmic transformation.

The explanatory variable of central interest is $PARENT_{ijt}$ which depicts a dummy that takes on the value 1 if the considered affiliate is an independent parent firm and the value 0 if it is a dependent subsidiary. Our theoretical considerations suggest that the profitability of assets at the parent firm exceeds the profitability of assets at the subsidiary and henceforth, $\beta_1 > 0$. In the contrary, if neither agency costs nor the home market effect play a decisive role, we expect $\beta_1 = 0$. Our regressions moreover control for a set of subsidiary and country characteristics depicted by the vector X_{ijt}. Precisely, we condition on the size of the multinational affiliate by including the entity's capital investment and payroll costs[6] and furthermore account for affiliate age to acknowledge that young firms entering a market may face additional costs.

Moreover, we include a full set of fixed effects for the multinational group to control for non-observable, MNE specific characteristics ϕ_j which may determine the profitability of all affiliates within the group. While the use of a group fixed-effects model is generally suggestive in our context, it is also preferred to a random effects model by a Hausman-Test. Furthermore, year dummies ρ_t are included to capture shocks over time which are common to all affiliates. Additionally, we account for a full set of country

[6]Note that including the affiliate's payroll bill as an explanatory variable controls for both differences in the wage rate as well as differences in the skill level and productivity of the affiliates' workers. Note moreover that we also re-estimate Equation (4.1) accounting for an additional size control by normalizing on a sales factor, i.e. by employing the affiliate's gross profit margin (=PBT per sales) and EBIT margin (=EBIT per sales) as dependent variables.

dummies. These absorb time-constant country characteristics, for example, differences in the education and skill level or differences in accounting laws which may translate into differing reported profitability levels. Apart from that, we also include different time-varying macro controls which may exert an impact on affiliate profitability (GDP as a proxy for the market size, GDP per capita as a proxy for the degree of development of a country, an index of corruption as a proxy for the overall risk of a country and the statutory corporate tax rate as a proxy for the corporate tax burden). ϵ_{ijt} describes the error term.

4.5 Estimation Results

The following section presents the results for the estimation model specified above. Section 4.5.1 discusses our baseline regressions. Section 4.5.2 investigates the development of the profitability gap over time. Section 4.5.3 assesses the role of agency costs and the home market effect in driving the results and Section 4.5.4 discusses various robustness checks. Throughout the analysis, the observational unit is the multinational affiliate per year. All regressions include a full set of group fixed effects and year fixed effects. The result tables display the coefficient estimates and, in parentheses, heteroscedasticity robust standard errors which are adjusted for clustering at the level of the multinational group.

4.5.1 Baseline Estimations

Tables 4.3 and 4.4 present our baseline estimations. In Table 4.3, we estimate Equation (4.1) employing the affiliate's pre-tax profit and EBIT measure as dependent variable. In Specification (1), we regress the affiliate's pre-tax profit on a parent dummy and control variables for the input factors, a full set of group fixed effects and year fixed effects. As predicted by our theoretical considerations, the coefficient estimate for the parent dummy exhibits a positive sign and is statistically significant at the 1% level. Quantitatively, multinational parent firms are suggested to observe a level of pre-tax profits which is by 88% larger than the pre-tax profits of their subsidiaries. This qualitative result is robust against the inclusion of a full set of country fixed effects and time-varying country characteristics (GDP, GDP per capita, corruption index and statutory corporate tax rate) in Specification (2), the affiliate's debt-to-assets ratio in Specification (3) and a set of two-digit NACE code industry dummy variables in Specification

Table 4.3: Baseline Estimations I – Higher Parent Profits

OLS Group–Fixed–Effects, Panel 1999–2006

Dep. Variable	**Log (Profit before Tax)**				**Log EBIT**			
Expl. Variables:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Parent Dummy	.877***	.858***	.697***	.650***	.547***	.497***	.398***	.429***
	(.044)	(.046)	(.046)	(.046)	(.043)	(.044)	(.045)	(.045)
Log FixedAssets	.231***	.227***	.216***	.214***	.148***	.141***	.136***	.137***
	(.008)	(.008)	(.008)	(.008)	(.008)	(.008)	(.008)	(.007)
Log CostEmpl.	.464***	.454***	.488***	.505***	.606***	.167***	.634***	.633***
	(.011)	(.012)	(.012)	(.012)	(.011)	(.012)	(.012)	(.012)
Leverage Ratio			-1.26***	-1.26***			-.720***	-.726***
			(.043)	(.043)			(.040)	(.039)
Log GDP		-.238	-.222	-.172		-.209***	-.199***	-.189**
		(.148)	(.143)	(.184)		(.066)	(.061)	(.079)
Log GDPp.Cap.		.609***	.414***	.339*		.315***	.212**	.203*
		(.169)	(.165)	(.201)		(.101)	(.098)	(.110)
Log Corruption		.231***	.303***	.296***		.138**	.177***	.166**
		(.079)	(.079)	(.079)		(.068)	(.069)	(.069)
Corp. Tax Rate		-.962***	-.754***	-.784***		-.609***	-.407*	-.418*
		(.239)	(.235)	(.236)		(.215)	(.220)	(.220)
Year Dummies	√	√	√	√	√	√	√	√
Country Dumm.		√	√	√		√	√	√
Industry Dumm.				√				√
# Observations	107,930	107,864	102,227	101,828	107,106	107,046	100,973	100,567
# MNE-Groups	18,531	18,531	18,007	17,923	18,067	18,066	17,514	17,433
Adjusted R^2	.7928	.7940	.8033	.8041	.8117	.8140	.8192	.8204

Notes: Heteroscedasticity robust standard errors adjusted for group clusters in parentheses. *, **, *** indicates significance at the 10%, 5%, 1% level. The observational units are profit-making *multinational parent firms* and *multinational subsidiaries*. A group-fixed-effect is set for belonging to a MNE-group. *Parent Dummy* is a dummy variable set to 1 if an observational unit is a *parent firm* and set to 0 if it is a *subsidiary*. *Log CostEmpl.* is the natural logarithm (Log) of the cost of employees. 56 industry dummies (NACE Rev.1 2-digit level) and 27 country dummies are included where indicated. Adjusted R^2 values are calculated from a dummy variables regression equivalent to the fixed-effects model.

(4). Adding these additional control variables reduces the size of the coefficient estimates for the parent dummy. Specification (4) suggests that (conditioning on the input factors and the other control variables) parent firms observe pre-tax profits which are by 65% larger than profits at their corporate subsidiaries.[7]

In a second step, we re-estimate the regressions presented in Columns (1) to (4) using EBIT as the dependent variable and thus determining differences in the operating profitability between parents and their subsidiaries. The results are presented in

[7]Note moreover that the adjusted R^2 in all specifications is high, between 79.3% and 80.4%, increasing with the set of additional control variables.

Columns (5) to (8) and qualitatively resemble the results for the pre-tax profit measure although the point estimates of the parent effect are quantitatively smaller. Column (8) suggests that (conditioning on the input factors and all other control variables) operating profits at the parent firm are on average by 43% larger than operating profits at its subsidiaries.

Note that in all specifications the coefficient estimates for the control variables exhibit the expected sign. The corporate input factors, fixed assets investments and cost of employees, enter positively and are statistically significant suggesting that the production displays decreasing returns to scale as the coefficient estimates add up to less than 1. The leverage ratio has a significant and negative effect on the affiliate's profit level which reflects that highly leveraged firms are more dependent on creditors and are therefore restricted with respect to the riskiness of their projects which results in lower expected profitability rates. Moreover, the host country's GDP per capita impacts positively on firm profits as does a low level of corruption (note that a high corruption index stands for a low level of corruption). The coefficient estimate for the statutory corporate tax rate exhibits a negative sign which is commonly interpreted to reflect profit shifting activities from high-tax to low-tax locations. A country's GDP exerts a significantly negative impact in the EBIT specifications which may reflect that a higher degree of competition in larger consumer markets depresses operating profits.

In Table 4.4, we re-estimate the specifications presented in Table 4.3 adding another size control by normalizing the specifications on affiliate sales. Thus, we regress the gross profit margin (= pre-tax-profit/sales) and the EBIT margin(=EBIT/sales) on a set of control variables comprising the input factors per sales and a size control. The results are depicted in Table 4.4 and confirm our previous findings as they indicate a large and statistically significant parent bias. Column (4) suggests that after controlling for input factors, the firm leverage, macro characteristics and fixed year, country, industry and MNE-group effects, parent firms are by 65% more profitable than their subsidiaries in terms of the gross profit margin. Column (5) to (8) re-estimate the specifications using the EBIT margin as the dependent variable and find comparable, although somewhat smaller, coefficient estimates. The most conservative estimate in Column (8) suggests a profitability gap of about 30%.

Note that we additionally experimented with other profitability measures which imply the normalization of the estimation Equation (4.1) on an affiliate's total assets (PBT/TotalAssets, EBIT/TotalAssets) and its number of employees (PBT/NumberEmplyees, EBIT/NumberEmployees), respectively. These regressions show comparable results which are available from the authors upon request.

Table 4.4: Baseline Estimations II – Higher Parent Profitability

OLS Group–Fixed–Effects, Panel 1999–2006

Dep. Variable	**Log (Profit b. Tax per Sales)**				**Log (EBIT per Sales)**			
Expl. Variables:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Parent Dummy	.930***	.927***	.746***	.648***	.471***	.443***	.299***	.291***
	(.046)	(.048)	(.048)	(.047)	(.038)	(.039)	(.039)	(.039)
Log (FixedAssets per Sales)	.444***	.454***	.407***	.369***	.193***	.183***	.145***	.137***
	(.015)	(.015)	(.015)	(.014)	(.010)	(.010)	(.010)	(.010)
Log (CostEmpl. per Sales)	.043***	.032*	.014	.016	-.054***	-.039**	-.061***	-.068***
	(.017)	(.018)	(.018)	(.018)	(.018)	(.019)	(.019)	(.019)
Log FixedAssets	-.243***	-.255***	-.222***	-.200***	-.120***	-.112***	-.087***	-.089***
	(.009)	(.010)	(.010)	(.010)	(.007)	(.008)	(.008)	(.008)
Leverage Ratio			-1.57***	-1.58***			-1.14***	-1.13***
			(.044)	(.043)			(.035)	(.035)
Log GDP		-.217	-.193	-.141		-.182***	-.165***	-.148**
		(.148)	(.143)	(.183)		(.064)	(.061)	(.071)
Log GDPp.Cap.		.568***	.322**	.231		.169*	-.012	-.025
		(.167)	(.162)	(.198)		(.093)	(.090)	(.097)
Log Corruption		.170**	.274***	.275***		.105*	.190***	.186***
		(.079)	(.077)	(.077)		(.065)	(.064)	(.064)
Corp. Tax Rate		-.652***	-.351	-.362		-.311	.033	.016
		(.231)	(.226)	(.227)		(.197)	(.199)	(.200)
Year Dummies	√	√	√	√	√	√	√	√
Country Dumm.		√	√	√		√	√	√
Industry Dumm.				√				√
# Observations	100,181	100,117	94,893	94,525	99,846	99,786	94,143	93,766
# MNE-Groups	17,191	17,191	16,702	16,624	16,846	16,845	16,337	16,261
Adjusted R^2	.5987	.6003	.6303	.6340	.4662	.4698	.4976	.5010

Notes: Heteroscedasticity robust standard errors adjusted for group clusters in parentheses. *, **, *** indicates significance at the 10%, 5%, 1% level. The observational units are profit-making *multinational parent firms* and *multinational subsidiaries*. A group-fixed-effect is set for belonging to a MNE-group. *Parent Dummy* is a dummy variable set to 1 if an observational unit is a *parent firm* and set to 0 if it is a *subsidiary*. *Log (CostEmpl. per Sales)* is the natural logarithm (Log) of the cost of employees per sales. 56 industry dummies (NACE Rev.1 2-digit level) and 27 country dummies are included where indicated. Adjusted R^2 values are calculated from a dummy variables regression equivalent to the fixed-effects model.

4.5.2 Development over Time

Thus, our baseline analysis provides evidence for a significant and quantitatively relevant parent bias in the location of profitable operations across multinational affiliates. As discussed above, this effect is however not necessarily constant over time. If agency costs contribute to the profitability gap between parents and their corporate subsidiaries, one might presume that the profitability gap has declined in the past

Table 4.5: Extension I – Development over Time

OLS Group–Fixed–Effects, Panel 1999–2006

Dep. Variable	**Log PBT**		**Log EBIT**		**Log(PBT/Sales)**		**Log(EBIT/Sales)**	
Expl. Variables:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Parent Dummy	.968***	.714***	.635***	.503***	1.02***	.702***	.560***	.360***
	(.047)	(.049)	(.045)	(.047)	(.049)	(.049)	(.040)	(.041)
Parent×Time	-.024***	-.017***	-.024***	-.020***	-.025***	-.015***	-.024***	-.019***
	(.004)	(.004)	(.004)	(.004)	(.004)	(.004)	(.003)	(.003)
Time	.062***	.033***	.036***	.028***	.059***	.031***	.026***	.027***
	(.003)	(.007)	(.003)	(.006)	(.003)	(.007)	(.003)	(.006)
Log FixedAss.	.233***	.216***	.151***	.140***	-.243***	-.199***	-.119***	-.088***
	(.008)	(.008)	(.008)	(.008)	(.009)	(.010)	(.007)	(.008)
Log CostEmpl.	.463***	.504***	.604***	.632***				
	(.011)	(.012)	(.011)	(.012)				
Log (FixedAss. per Sales)					.446***	.370***	.196***	.138***
					(.015)	(.014)	(.010)	(.010)
Log (CostEmpl. per Sales)					.041**	.015	-.056***	-.069***
					(.017)	(.018)	(.018)	(.019)
Leverage Ratio		-1.26***		-.722***		-1.58***		-1.12***
		(.042)		(.039)		(.043)		(.035)
Log GDP		-.163		-.171**		-.134		-.133**
		(.181)		(.073)		(.181)		(.066)
Log GDPp.Cap.		.263		.106		.167		-.113
		(.199)		(.107)		(.198)		(.095)
Log Corruption		.296***		.166**		.273***		.183***
		(.079)		(.069)		(.077)		(.064)
Corp. Tax Rate		-.781***		-.414*		-.350		.033
		(.236)		(.220)		(.227)		(.200)
Year Dummies	√	√	√	√	√	√	√	√
Country Dumm.		√		√		√		√
Industry Dumm.		√		√		√		√
# Observations	107,930	101,828	107,106	100,567	100,181	94,525	99,846	93,766
# MNE-Groups	18,531	17,923	18,067	17,433	17,191	16,624	16,846	16,261
Adjusted R^2	.7930	.8042	.8119	.8205	.5990	.6341	.4668	.5013

Notes: Heteroscedasticity robust standard errors adjusted for group clusters in parentheses.
*, **, *** indicates significance at the 10%, 5%, 1% level. The observational units are profit-making *multinational parent firms* and *multinational subsidiaries*. A group-fixed-effect is set for belonging to a MNE-group. The abbreviation *PBT* stands for *Profit before Tax*. *Parent Dummy* is a dummy variable set to 1 if an observational unit is a *parent firm* and set to 0 if it is a *subsidiary*. *Time* is set to 0 for the year 1999, 1 for 2000, 2 for 2001,... and 7 for 2006, with a mean of 3.5. *Parent× Time* is the interaction term between *Parent Dummy* and *Time*. *Log (Cost Employees per Sales)* is the natural logarithm (Log) of the cost of employees per sales. 56 industry dummies (NACE Rev.1 2-digit level) and 27 country dummies are included where indicated. Adjusted R^2 values are calculated from a dummy variables regression equivalent to the fixed-effects model.

decade since the rise of new technologies has facilitated communication and information exchange and has consequently lowered agency costs for monitoring operations at geographically separated affiliates. The same pattern might to some extent also prevail if the home market effect drives the profitability gap since markets in the EU have become more open and a proceeding integration may have enlarged the knowledge of local customs and consumption behavior.

To empirically assess this hypothesis, we interact our parent dummy variable with a linear time trend.[8] The results are presented in Table 4.5. In Column (1), we regress the pre-tax profit measure on the parent dummy and the time trend interaction. In line with our presumption, the coefficient estimate for the parent dummy exhibits a positive sign and is statistically significant while the coefficient estimate for the interaction term between the parent dummy and the time trend exhibits a significantly negative sign. Consequently, while in our first sample year 1999 parents observe a pre-tax profit (conditioned on the input factors) which is about twice as large as the pre-tax profit at their subsidiaries, this profitability gap closes by around 2.4 percentage points in each of the successive years. This corresponds to a closure of the profitability gap by 17% in our 7-year sample period. This result is confirmed when we account for additional control variables in Specification (2) or alternative profitability measures in Specifications (3) to (8). Note that in terms of the EBIT margin (Column (7) and (8)), the decline in the profitability gap is reported to be quantitatively even more pronounced since the profitability gap between the parent and the subsidiary closes by 37% or 13.3 percentage points from its initial level of 36%.[9]

4.5.3 A Closer Look: Agency Costs and Home Market Effect

As described in Section 4.2, we presume that the profitability gap between headquarters and their subsidiaries may be driven by agency costs or home market advantages. The aim of the following section is to get an idea whether and to what extent the two mechanisms contribute to the profitability gap.

To disentangle the role of agency costs and the home market effect, we split the sam-

[8] The linear time trend variable takes on the value 0 for our first sample year 1999, the value 1 for the second sample year and so on.

[9] As a sensitivity check, we interacted the parent dummy variable with a dummy for each sample year. All coefficient estimates exhibit a negative sign and smoothly grow in absolute size over time which suggests a steady decline of the profitability gap in our sample period. The results are available from the authors upon request.

ple in "horizontal" and "vertical" foreign direct investments. As explained in Section 4.2, the agency costs theory largely relates to the notion of "vertical" FDI as the argument refers to the location choice of different operations in the multinational value chain that may vary in their corporate profitability. In the contrary, the home market effect largely relates to the notion of "horizontal" FDI as it discusses potential profitability differences in selling the same product on different markets. To identify "horizontal" and "vertical" investment in our sample, we exploit four-digit NACE industry information on the parent and its corporate subsidiaries. Precisely, if the subsidiary operates in the same four-digit NACE industry as the parent firm, it is classified as "horizontal" FDI whereas it is considered "vertical" FDI if it operates in a different four-digit industry. Consequently, we run two sets of regressions: one, in which we include only subsidiaries that observe the same four-digit NACE industry as their parent, and a second, in which we include only subsidiaries that observe a different four-digit industry than their parent. The results are presented in Table 4.6. Specifications (1) and (2) re-estimate our baseline regressions for the two sub-groups employing the profit before taxation (PBT) measure as dependent variable. The coefficient estimate for the parent dummy variable is positive and statistically significant in both samples indicating that the profitability gap between headquarters firms and their subsidiaries prevails in horizontal investment settings as well as in vertical investment settings. Thus, we may conclude that our sample indicates that both, home market advantages and agency costs drive a wedge between the profitability of headquarters and subsidiaries (where the impact of the former appears to be quantitatively larger).

In Specifications (3) and (4) of Table 4.6, we interact the parent dummy with a linear time trend following our analysis in the previous section. Interestingly, we find that the size of the profitability gap between headquarters and subsidiaries remains constant over time in the sample accounting for horizontal subsidiaries (and the home market effect respectively) while it significantly declines in the sample accounting for vertical subsidiaries (and the agency costs theory respectively). In the context of our theoretical presumptions, this suggests that technological advances have indeed induced a fall in agency costs over the last decade while advantages of operating in home markets have remained largely unchanged.[10] Finally, we re-estimate the presented PBT-regressions

[10] A third mechanism which may drive the profitability gap between parents and their subsidiaries and has not yet been discussed in the paper is that MNEs potentially bias the distribution of their profits in favor of the headquarters firm to save withholding taxes on dividend payments from subsidiaries to their parent. However, as the withholding taxes on dividends have been low between EU countries over the last decades and were abolished through the EU's Parent-Subsidiary Directive in 2004, we consider this to be an unlikely scenario. Nevertheless, as a robustness check we reran our regressions

Table 4.6: Extension II – Vertical & Horizontal FDI

OLS Group–Fixed–Effects, Panel 1999–2006

Dep. Variable	**Log PBT**		**Log PBT**		**Log EBIT**		**Log EBIT**	
Expl. Variables:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Parent Dummy	.917***	.608***	.917***	.677***	.630***	.368***	.686***	.437***
	(.092)	(.060)	(.119)	(.066)	(.097)	(.059)	(.118)	(.064)
Parent×Time			-.000	-.018***			-.014	-.018***
			(.016)	(.007)			(.016)	(.006)
Time			.038***	.024***			.045**	.025***
			(.020)	(.012)			(.019)	(.011)
Log FixedAssets	.164***	.240***	.164***	.241***	.130***	.158***	.131***	.160***
	(.012)	(.011)	(.012)	(.011)	(.012)	(.010)	(.012)	(.010)
Log CostEmpl.	.466***	.472***	.466***	.471***	.560***	.611***	.560***	.610***
	(.018)	(.016)	(.018)	(.016)	(.020)	(.017)	(.020)	(.017)
Leverage Ratio	-1.172***	-1.311***	-1.172***	-1.311***	-.607***	-.656***	-.607***	-.655***
	(.061)	(.062)	(.061)	(.062)	(.058)	(.054)	(.058)	(.054)
Log GDP	-.238*	-.251*	-.238*	-.244*	-.108**	-.157**	-.106**	-.148**
	(.137)	(.137)	(.137)	(.136)	(.052)	(.066)	(.052)	(.063)
Log GDPp.Cap.	.166	.514***	.166	.453**	-.125	.161	-.142	.094
	(.213)	(.196)	(.214)	(.195)	(.155)	(.140)	(.156)	(.138)
Log Corruption	.431***	.399***	.431***	.387**	.260***	.226***	.260***	.215***
	(.112)	(.102)	(.112)	(.102)	(.098)	(.087)	(.098)	(.088)
Corp. Tax Rate	-.425	-.800***	-.425	-.767**	-.000	-.541*	.006	-.505*
	(.338)	(.318)	(.338)	(.317)	(.326)	(.299)	(.327)	(.298)
Investment Type	H	V	H	V	H	V	H	V
Year Dummies	√	√	√	√	√	√	√	√
Country Dumm.	√	√	√	√	√	√	√	√
Industry Dumm.	√	√	√	√	√	√	√	√
# Observations	53,071	62,441	53,071	62,441	51,437	60,854	51,437	60,854
# MNE-Groups	11,187	17,923	11,187	17,923	10,652	10,854	10,652	10,854
Adjusted R^2	.6037	.6416	.6037	.6419	.6637	.6762	.6644	.6766

Notes: Heteroscedasticity robust standard errors adjusted for group clusters in parentheses.
*, **, *** indicates significance at the 10%, 5%, 1% level. The observational units are profit-making *multinational parent firms* and *multinational subsidiaries*. A group-fixed-effect is set for belonging to a MNE-group. The abbreviation *PBT* stands for *Profit before Tax*. *Parent Dummy* is a dummy variable set to 1 if an observational unit is a *parent firm* and set to 0 if it is a *subsidiary*. *Time* is set to 0 for the year 1999, 1 for 2000, 2 for 2001,..., and 7 for 2006, with a mean of 3.5. *Parent× Time* is the interaction term between *Parent Dummy* and *Time*. *Log CostEmpl.* is the natural logarithm (Log) of the cost of employees. 56 industry dummies (NACE Rev.1 2-digit level) and 27 country dummies are included in all regressions. Moreover, the investment type "H" indicates horizontal FDI, i.e. the corresponding regressions in Column (1), (3), (5) and (7) include only subsidiaries for which the subsidiary observes the same four-digit NACE code industry as the parent firm. Analogously, the investment type "V" indicates vertical FDI, i.e. the corresponding regressions in Column (2), (4), (6) and (8) include only subsidiaries for which the subsidiary operates in a different four-digit NACE code industry than the parent firm. Adjusted R^2 values are calculated from a dummy variables regression equivalent to the fixed-effects model.

excluding all subsidiary-year combinations from our sample which face a non-zero withholding tax rate on dividends. As this sample restriction does neither qualitatively nor quantitatively change our findings, we are confident that withholding taxes are not a major driver of our results.

using EBIT as the dependent variable and find comparable results (see Specifications (5) to (8) of Table 4.6).

4.5.4 Robustness Checks

Last, we ran a set of sensitivity checks. Due to space restrictions, many of the robustness checks are only sketched in the text whereas the detailed results are available from the authors upon request.

First, we hedge against the possibility that our parent dummy estimate picks up a firm age effect. Younger corporations are often perceived to be less profitable than more established firms since they e.g. still have to engage in upfront investments. As parent firms are commonly older than their subsidiaries, the observed profitability gap may simply reflect this age difference. Thus, we rerun our baseline specifications and additionally include the firm age as a control variable. The results are presented in Table 4.7 and indicate that the profitability gap is robust against controlling for firm age.[11] The coefficient estimates for the parent dummy is almost unchanged in size compared to the specifications without the age control variable. Moreover, the coefficient estimate for the age variable exhibits the expected positive sign, suggesting that more established firms earn higher returns on their input factors. Since the information on the date of incorporation is not available for all firms in the database, the number of observations drops by around 20%.

In a second step, we furthermore investigate whether our results are unique to the international context or whether the profitability gap prevails on a domestic scale. To assess the profitability gap within *national* groups, we use a sample of domestic enterprises, i.e. parent firms and their *domestic* subsidiaries, drawn from the AMADEUS data base for the same countries and years as our baseline sample.[12] The regressions include around $450,000$ observations from about $80,000$ affiliates. The results are presented in Table 4.8 and show qualitatively the same picture as our baseline regressions

[11] The specifications presented in Table 4.7 use the logarithm of firm age as explanatory variable since the firm age distribution is considerably skewed. Alternatively, taking no logarithmic transformation of the age variable and additionally including the quadratic transformation yields the same estimations results. Then, the coefficient estimate for the age variable turns out to be positive while the coefficient estimate for the age-squared variable is significantly negative.

[12] The parents in this new sample are domestic ultimate owners of their subsidiaries, i.e. some of the parent firms may observe a foreign shareholder implying that they operate on an international scale. In a sensitivity check, we restricted the sample to purely national groups without any international ownership connections and found comparable results.

Table 4.7: Robustness Check I – Control for Firm Age

OLS Group–Fixed–Effects, Panel 1999–2006

Dep. Variable	**Log PBT**		**Log EBIT**		**Log(PBT/Sales)**		**Log(EBIT/Sales)**	
Expl. Variables:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Parent Dummy	.923***	.729***	.560***	.467***	.963***	.740***	.446***	.295***
	(.058)	(.061)	(.058)	(.060)	(.063)	(.062)	(.055)	(.054)
Log Age	.117***	.067***	.059***	.046**	.097***	.045**	.025	.012
	(.020)	(.021)	(.019)	(.020)	(.022)	(.021)	(.016)	(.016)
Log FixedAssets	.214***	.196***	.140***	.130***	-.286***	-.235***	-.119***	-.087***
	(.011)	(.010)	(.010)	(.009)	(.013)	(.014)	(.011)	(.011)
Log CostEmpl.	.427***	.478***	.577***	.607***				
	(.015)	(.017)	(.015)	(.016)				
Log (FixedAss. per Sales)					.471***	.392***	.172***	.121***
					(.019)	(.019)	(.013)	(.013)
Log (CostEmpl. per Sales)					.017	.008	-.116***	-.115***
					(.020)	(.021)	(.019)	(.020)
Leverage Ratio		-1.22***		-.642***		-1.51***		-1.01***
		(.053)		(.048)		(.054)		(.042)
Log GDP		-.130		-.135**		-.109		-.116*
		(.170)		(.060)		(.176)		(.062)
Log GDPp.Cap.		.201		.006		.206		-.079
		(.206)		(.116)		(.208)		(.106)
Log Corruption		.312***		.199**		.272***		.185**
		(.093)		(.082)		(.092)		(.076)
Corp. Tax Rate		-.842***		-.298		-.487*		.037
		(.281)		(.265)		(.275)		(.243)
Year Dummies	√	√	√	√	√	√	√	√
Country Dumm.		√		√		√		√
Industry Dumm.		√		√		√		√
# Observations	78,012	74,272	76,706	72,696	72,121	68,707	71,242	67,564
# MNE-Groups	14,785	14,368	14,303	13,855	13,607	13,239	13,240	12,843
Adjusted R^2	.8161	.8248	.8359	.8422	.6596	.6858	.5182	.5442

Notes: Heteroscedasticity robust standard errors adjusted for group clusters in parentheses.
*, **, *** indicates significance at the 10%, 5%, 1% level. The observational units are profit-making *multinational parent firms* and *multinational subsidiaries*. A group-fixed-effect is set for belonging to a MNE-group. The abbreviation *PBT* stands for *Profit before Tax*. *Parent Dummy* is a dummy variable set to 1 if an observational unit is a *parent firm* and set to 0 if it is a *subsidiary*. *Log Age* is the natural logarithm (Log) of the firm age in years. *Log (CostEmpl. per Sales)* is the natural logarithm of the cost of employees per sales. 56 industry dummies (NACE Rev.1 2-digit level) and 27 country dummies are included where indicated. Adjusted R^2 values are calculated from a dummy variables regression equivalent to the fixed-effects model.

for MNEs whereas the estimated profitability gap is however - as expected - quantitatively smaller (roughly one third of the profitability gap in the baseline specifications).[13]

[13]Note that the coefficient estimates for the parent dummy in the *multinational* baseline and the

Table 4.8: Robustness Check II – Parents vs. Domestic Subsidiaries

OLS Group–Fixed–Effects, Panel 1999–2006

Dep. Variable	**Log PBT**		**Log EBIT**		**Log(PBT/Sales)**		**Log(EBIT/Sales)**	
Expl. Variables:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Parent Dummy	.360***	.303***	.084***	.252***	.463***	.229***	.189***	.128***
	(.011)	(.023)	(.012)	(.022)	(.011)	(.022)	(.010)	(.019)
Log FixedAss.	.253***	.250***	.222***	.220***	-.290***	-.229***	-.172***	-.136***
	(.004)	(.004)	(.004)	(.004)	(.005)	(.005)	(.004)	(.004)
Log CostEmpl.	.362***	.376***	.460***	.443***				
	(.004)	(.005)	(.005)	(.005)				
Log (FixedAss. per Sales)					.488***	.408***	.295***	.242***
					(.005)	(.006)	(.004)	(.005)
Log (CostEmpl. per Sales)					-.042***	-.055***	-.161***	-.168***
					(.006)	(.007)	(.006)	(.006)
Leverage Ratio		-1.19***		-.499***		-1.60***		-.961***
		(.022)		(.021)		(.021)		(.019)
Log Age		.074***		.064***		.015**		-.019***
		(.006)		(.006)		(.006)		(.005)
Log GDP		-.075***		-.065***		-.058**		-.040*
		(.025)		(.024)		(.025)		(.023)
Log GDPp.Cap.		-.026		-.095		.004		-.061
		(.065)		(.059)		(.061)		(.052)
Log Corruption		-.196***		-.192***		-.265***		-.253***
		(.052)		(.047)		(.051)		(.043)
Corp. Tax Rate		-.607***		-.439***		-.281*		-.265**
		(.159)		(.145)		(.156)		(.131)
Year Dummies	√	√	√	√	√	√	√	√
Industry Dumm.		√		√		√		√
# Observations	519,915	466,129	508,344	453,835	454,167	405,509	453,271	403,135
# Firm-Groups	89,241	84,105	85,856	80,617	74,266	69,995	72,938	68,526
Adjusted R^2	.7729	.7838	.7931	.8012	.6013	.6357	.5136	.5405

Notes: Heteroscedasticity robust standard errors adjusted for group clusters in parentheses.
*, **, *** indicates significance at the 10%, 5%, 1% level. The observational units are profit-making *domestic parent firms* and *domestic subsidiaries*. A group-fixed-effect is set for belonging to a firm-group. The abbreviation *PBT* stands for *Profit before Tax*. *Parent Dummy* is a dummy variable set to 1 if an observational unit is a *parent firm* and set to 0 if it is a *subsidiary*. *Log Age* is the natural logarithm (Log) of the firm age in years. *Log (CostEmpl. per Sales)* is the natural logarithm of the cost of employees per sales. 88 industry dummies (NACE Rev.1 2-digit level) are included where indicated. Country dummies are not included due to no variation in the country of a parent and their subsidiary(ies) which is a condition in a fixed-effects model. Adjusted R^2 values are calculated from a dummy variables regression equivalent to the fixed-effects model.

domestic sensitivity regression are statistically different at the 99% confidence level. Moreover, in the latter regressions the corruption index enters negatively suggesting a risk premium required by *domestic* corporations doing business (that mostly have no international location opportunity like MNEs) if corruption is high and property rights are less protected (represented by a low index).

Moreover, we hedge against potential reverse causality problems which may arise if highly profitable firms are more likely to be a multinational parent. This might be problematic, especially as in mergers & acquisition the more profitable firm is perceived to commonly take over the less profitable one. To account for this possibility, we run a robustness check identifying corporate affiliates which were either acquired by a corporate group in the past or which took over a foreign subsidiary through an M&A by using Bureau van Dijk's ZEPHYR database which contains M&A back until 1997. Excluding these affiliates from the data does neither qualitatively nor quantitatively change our results.[14]

In further robustness checks, we reran our regressions including only subsidiaries that do not own any further subsidiaries themselves which slightly increased the quantitative coefficient estimates of the parent dummy. Moreover, we excluded holding companies from our baseline MNE-sample which likewise strengthened the profitability bias. Additionally, we repeated the regression analysis including affiliates with negative profits which leaves our qualitative results unaffected. Last, we split our baseline MNE-sample into ten industry groups (at the NACE 1-digit level) and found the profitability gap between parent firms and their foreign subsidiaries to be rather homogeneous across the industries.

4.6 Implications for Public Economics

Our analysis finds robust evidence for a profitability bias in the location of valuable operations and projects in favor of the parent firm. Although the documented profitability gap between parent and subsidiary firms has declined over the recent years, we still find it to be sizable. Our results have implications for several areas of public economics and policy making.

Firstly, several papers in the literature have suggested that the wages bargained for workers at a multinational affiliate are strongly dependent on the affiliate's profitability

[14]Note, however, that the data indeed indicates that in M&A more profitable firms on average take over less profitable ones. Moreover, since there is some (weak) positive correlation between the parent dummy variable and the size of the input factors, we account for potential reverse causality between the profitability measure and the input factors by rerunning our equations and instrumenting for the input factor variables fixed assets (per sales) and cost of employees (per sales) and for the leverage ratio through lagged values of these variables. The regressions show neither a qualitative nor a quantitative change in our parent dummy effect and thus suggest no serious endogeneity problems with these firm variables.

(see e.g. Budd, Konings, and Slaughter, 2005). In the context of our paper, this would suggest that workers at multinational headquarters firms earn higher wages than comparable workers at the subsidiary level. Our data is unfortunately not well suited to investigate this question as we do not observe information on the employees' skill level. Thus, although preliminary estimates show a positive correlation between the parent dummy and workers' wages, we cannot exclude that this correlation is driven by an unobservable variable bias. Thus, we have to delegate this question to future research.

4.6.1 Higher Parent Tax Payments

Furthermore, our results imply that headquarters firms pay higher taxes on their corporate activity than subsidiaries, simply because headquarters activities are more profitable. To test this implication empirically, we use our baseline sample and regress an affiliate's unconsolidated (actual) tax payments on the parent dummy and on a set of control variables (size controls, a full set of group fixed effects, country fixed effects, industry fixed effects and time-varying country characteristics). The results are depicted in Table 4.9. While the specifications presented in Columns (1) to (4) use the level of an affiliate's tax payments as the dependent variable, the specifications in Columns (5) to (8) are normalized on the affiliate's sales variable and thus the regressand is tax payments per sales. In all specifications, the coefficient estimate for the parent dummy exhibits a positive sign and is statistically significant at the 1% level. Quantitatively, parent firms pay by 61% higher tax payments on their corporate activity compared to their subsidiaries (cf. Column (8) of Table 4.9).

There may be concerns that the gap in tax payments between headquarters and their subsidiaries is driven by residence based taxation in the MNE's home country which may enhance the MNE's tax bill at the headquarters location. As this argument refers to a relatively small number of European countries with residence based taxation according to a credit system (Bulgaria, Czech Republic, Estonia, Great Britain, Greece, Ireland, Poland, Romania), we reran our regressions excluding all groups that are headquartered in a country with a credit system and found our results qualitatively and quantitatively unchanged. The results are available from the authors upon request. Note furthermore that we observe the same qualitative results of the parent dummy on tax payments for our sample of parent firms and their *domestic* subsidiaries. However, to a lesser extent as also the profitability gap is smaller for this sample.

Table 4.9: Implication I – Higher Parent Tax Payments

OLS Group–Fixed–Effects, Panel 1999–2006

Depend. Variable	**Log (Tax Payments)**				**Log (Tax Payments per Sales)**			
Explanat. Variables:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Parent Dummy	.874***	.802***	.656***	.648***	.875***	.812***	.637***	.614***
	(.081)	(.081)	(.082)	(.083)	(.087)	(.088)	(.088)	(.085)
Log FixedAssets	.119***	.120***	.107***	.109***	-.242***	-.253***	-.230***	-.228***
	(.013)	(.012)	(.012)	(.013)	(.016)	(.017)	(.017)	(.018)
Log CostEmployees	.562***	.553***	.581***	.577***				
	(.019)	(.020)	(.021)	(.022)				
Log (FixedAssets per Sales)					.325**	.341***	.301***	.291***
					(.022)	(.023)	(.024)	(.023)
Log (CostEmployees per Sales)					.061***	.070***	.055**	.048*
					(.025)	(.027)	(.027)	(.029)
Leverage Ratio			-1.08***	-1.07***			-1.41***	-1.39***
			(.067)	(.068)			(.064)	(.065)
Log Age				.119***				.096***
				(.026)				(.026)
Log GDP		-2.30***	-2.13***	-1.89**		-2.16***	-1.99***	-1.79**
		(.822)	(.823)	(.833)		(.799)	(.790)	(.800)
Log GDPp.Cap.		2.52***	2.19***	1.81**		2.45***	2.07***	1.78**
		(.844)	(.841)	(.857)		(.817)	(.804)	(.819)
Log Corruption		.079	.122	.122		.034	.090	.107
		(.128)	(.127)	(.127)		(.129)	(.126)	(.127)
Corp. Tax Rate		2.14***	2.40***	2.40***		2.33***	2.72***	2.64***
		(.431)	(.430)	(.432)		(.433)	(.429)	(.433)
Year Dummies	√	√	√	√	√	√	√	√
Country Dummies		√	√	√		√	√	√
Industry Dummies				√				√
# Observations	51,878	51,851	48,949	47,640	48,262	48,235	45,516	44,291
# MNE-Groups	9,406	9,405	9,118	8,923	8,698	8,697	8,439	8,269
Adjusted R^2	.7692	.7758	.7831	.7839	.5392	.5500	.5676	.5749

Notes: Heteroscedasticity robust standard errors adjusted for group clusters in parentheses.
*, **, *** indicates significance at the 10%, 5%, 1% level. The observational units are profit-making *multinational parent firms* and *multinational subsidiaries*. A group-fixed-effect is set for belonging to a MNE-group. *Parent Dummy* is a dummy variable set to 1 if an observational unit is a *parent firm* and set to 0 if it is a *subsidiary*. *Log Age* is the natural logarithm (Log) of the firm age in years. *Log (CostEmployees per Sales)* is the natural logarithm of the cost of employees per sales. 53 industry dummies (NACE Rev.1 2-digit level) and 27 country dummies are included where indicated. Adjusted R^2 values are calculated from a dummy variables regression equivalent to the fixed-effects model.

4.6.2 Effect on Profit Shifting Behavior

Along the same lines, the documented profitability bias between parents and subsidiaries might well influence multinational profit shifting behavior in response to corporate tax rate differentials.[15] Chapter 2 and 3 of this thesis, as well as a large literature (e.g. Clausing, 2003, or Huizinga and Laeven, 2008) show that MNEs engage in profit shifting activities from high-tax to low-tax countries in order to reduce their corporate tax burden. If MNEs are however reluctant to relocate profitable operations and profitable assets away from the headquarters firm then they might as well respond less to tax rate differentials between the headquarters and the corporate subsidiaries if the head office is located in a high-tax country. In the contrary, if the headquarters firm is located in a low-tax country and consequently profit shifting activities run from the subsidiaries towards the headquarters location, profit shifting is expected to be strongly responsive to tax rate differentials. We will investigate this notion in the following.

As argued by our theoretical considerations in Section 4.2, the location of profitable functions and projects away from the headquarters firm may be costly for the central management since this involves to monitor functions across physical distances. Moreover, the central management may have an incentive to locate profits at the parent firm to exert direct control over their use. For example, a comprehensive literature on the funding of corporate investment activities documents a pecking order with respect to financing modes for new investment projects which is led by funding via retained earnings (see Majluf and Myers, 1984). Last, several papers report a positive causal effect of affiliate profitability on the wage level of workers. Consequently, the central management may have an incentive to locate a high fraction of profits at the headquarters to justify high wages for themselves and their co-workers. These arguments predict that the profit shifting activities are not homogeneous across multinational affiliates but decisively depend on the location of the headquarters.

Table 4.10 displays the results of our OLS regression analysis including subsidiary firm fixed effects. In line with Chapter 2 and 3, as well as with previous studies, we give indirect evidence for profit shifting behavior by regressing subsidiary pre-tax profits on various firm and country control variables and additionally on the tax rate differential between the subsidiary and the headquarters.[16] This tax measure captures the direct

[15] This subsection is based on a companion paper (Dischinger and Riedel, 2010) and is not included in the working paper version of Dischinger and Riedel (2009).

[16] See Section 2.4.1 of Chapter 2 for the estimation equation and a detailed description of the econometric approach.

incentive to relocate profits between the two affiliates. However, in contrast to existing work, we account for a potential heterogeneity in profit shifting activities between parent and subsidiary firms depending on the shifting direction and hence on whether the parent is located in a country with a higher or lower corporate tax rate than the subsidiary. To investigate this effect, we focus solely on the *sub-sample of subsidiaries* and define the dummy variable *High-Tax-Subs* which takes on the value 1 if a subsidiary is located in a country with a higher statutory corporate tax rate than its parent and the value 0 otherwise. Interacting this dummy with the tax rate difference between the subsidiary and the parent should capture the potential heterogeneity in the effect.

The results are presented in Column (1) and (2) of Table 4.10. In line with our theoretical considerations, we find that the coefficient estimate for the tax difference to the parent is negative but small and not statistically significant while the coefficient of the interaction term *(TaxDiff)*×*(High-Tax-Subs)* suggests a large and significantly negative effect. The regression result thus shows that profits before taxation are very sensitive to tax rate differences if profit is shifted from the subsidiary towards the headquarters location but are not sensitive to tax differentials if profit shifting flows away from the headquarters. This effect is in line with our observed parent bias of profitability in Section 4.5. The effect turns out to be robust against the inclusion of industry-year dummy variables and the financial leverage ratio in Specification (2) of Table 4.10.

For a more rigorous econometric identification of this asymmetric profit shifting behavior, we split the sample of subsidiaries into the two subgroups of subsidiaries that exhibit a larger (*High–Tax–Subs*) and a smaller corporate tax rate (*Low–Tax–Subs*) than the parent. In addition, this allows for differing coefficient estimates for the control variables in the two subgroups and should improve our estimates. The results are presented in Columns (3) to (6) of Table 4.10. In line with the pooled specifications, we again find evidence for substantial profit shifting activities from subsidiaries in high-tax countries towards the (low-tax) headquarters location (cf. Columns (3) and (4)) while no shifting seems to take place in the other direction from high-tax parents towards their low-tax subsidiaries (cf. Columns (5) and (6)). Note that the respective coefficient estimates of the tax differential for these two subgroups are statistically different from each other at the 5% significance level.

As a test of robustness, we additionally analyze the other endpoint of the profit shifting linkage and therefore focus solely on the *sub-sample of parents* undertaking a corresponding estimation method.[17] In this analysis, we expect inverse effects compared

[17]Note that in this parent firm sub-sample, we only account for parents with at least 100 employees

Table 4.10: Implication IIa – Effect on Profit Shifting – Subsidiary Sample

OLS Firm–Fixed–Effects, Panel 1999–2006

Dependent Variable: Log (Profit before Taxation)

Sub–sample	**All Subsidiaries**		**High–Tax–Subs**		**Low–Tax–Subs**	
Explanatory Variables:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Tax Difference to Parent	-.036	-.168	-1.23**	-1.31**	.208	.149
	(.186)	(.190)	(.583)	(.588)	(.210)	(.219)
(TaxDiff)×(High-Tax-Subs)	-.905*	-.885*				
	(.538)	(.542)				
High-Tax-Subs Dummy	.061**	.049**				
	(.025)	(.025)				
Log FixedAssets	.098***	.115***	.091***	.100***	.106***	.130***
	(.009)	(.009)	(.019)	(.019)	(.011)	(.012)
Log Employees	.375***	.396***	.355***	.371***	.366***	.388***
	(.016)	(.017)	(.035)	(.036)	(.020)	(.021)
Leverage Ratio		-1.09***		-.872***		-1.16***
		(.045)		(.095)		(.055)
Log GDP	-3.73***	-3.84***	-3.54***	-3.59***	-5.96***	-6.21***
	(.680)	(.717)	(1.29)	(1.32)	(.969)	(1.04)
Log GDP per Capita	3.83***	3.72***	4.04***	4.03***	5.86***	5.84***
	(.643)	(.681)	(1.29)	(1.32)	(.913)	(.982)
Log Corruption	-.142	-.122	.144	.111	-.262*	-.195
	(.099)	(.103)	(.179)	(.183)	(.147)	(.155)
Year Dummies	√	√	√	√	√	√
Industry-Year Dummies		√		√		√
# Observations	61,535	55,254	17,682	16,280	39,608	35,024
# Subsidiary Firms	17,482	15,979	5,963	5,533	12,664	11,472
Adjusted R^2	.8177	.8278	.7964	.8042	.8295	.8411

Notes: Heteroscedasticity robust standard errors adjusted for firm clusters in parentheses. *, **, *** indicates significance at the 10%, 5%, 1% level. Observational units are profit-making *multinational subsidiaries* that have no further subsidiaries. A fixed-effect is set for each observational unit. Sub-sample *High(Low)–Tax–Subs* consists solely of subsidiaries that exhibit a higher (lower) statutory corporate tax rate than their parent firm. *Tax Difference to Parent* equals the subsidiary tax rate minus the parent tax rate. *High-Tax-Subs Dummy* is set to 1 if an observational unit exhibit a higher tax rate than the parent and set to 0 otherwise. *(TaxDiff)×(High-Tax-Subs)* is the interaction term between *Tax Difference to Parent* and *High-Tax-Subs Dummy*. *Log Employees* is the natural logarithm (Log) of the number of employees. 130 industry-year dummies (NACE Rev.1 1-digit level) are included where indicated.

to the results of Table 4.10, meaning that in the subgroup of *High–Tax–Parents*, pre-tax profits should show no sensitivity to tax differentials while in the subgroup of *Low–Tax–Parents* we should find a significant effect. The regression results are displayed in Table 4.11.

The sub-sample of *High(Low)–Tax–Parents* consists solely of parents that have at

as small parent firms seems not to be engaged in such tax planning strategies.

Table 4.11: Implication IIb – Effect on Profit Shifting – Parent Sample

OLS Firm–Fixed–Effects, Panel 1999–2006

Dependent Variable: Log (Profit before Taxation)

Sub–sample	**High–Tax–Parents**			**Low–Tax–Parents**		
Explanatory Variables:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Av.TaxDiff to All Subs	-.137	-.078	-.364	-1.03**	-1.03**	-1.18***
	(.479)	(.503)	(.499)	(.477)	(.476)	(.479)
Log FixedAssets	.097**	.096**	.106**	.142***	.133***	.144***
	(.046)	(.046)	(.046)	(.032)	(.031)	(.032)
Log Employees	.281***	.285***	.274***	.339***	.348***	.385***
	(.046)	(.046)	(.047)	(.066)	(.065)	(.067)
Leverage Ratio			-1.39***			-1.27***
			(.164)			(.145)
Log GDP		-2.30	-2.67*		-.091	-.104
		(1.63)	(1.57)		(.095)	(.103)
Log GDP per Capita		2.48	3.04*		.562*	.428
		(1.83)	(1.76)		(.323)	(.325)
Log Corruption		.122	.131		-.028	-.184
		(.211)	(.214)		(.331)	(.344)
Year Dummies	√	√	√	√	√	√
Industry-Year Dummies			√			√
# Observations	10,957	10,957	10,795	9,864	9,864	9,678
# Parent Firms	3,162	3,162	3,123	2,784	2,784	2,741
Adjusted R^2	.8313	.8314	.8380	.8495	.8495	.8538

Notes: Heteroscedasticity robust standard errors adjusted for firm clusters in parentheses. *, **, *** indicates significance at the 10%, 5%, 1% level. Observational units are profit-making *multinational parent firms* with at least 100 employees. A fixed-effect is set for each observational unit. Sub-sample *High(Low)–Tax–Parents* consists of solely parents that have at least 2/3 of their wholly owned foreign subsidiaries in low(high)-tax countries, relative to the parent tax rate. *Av.TaxDiff to All Subs* is the average statutory corporate tax rate difference of the parent to all its wholly owned foreign subsidiaries, i.e. the parent tax rate minus the unweighted average tax rate of all wholly owned foreign subsidiaries. *Log Employees* is the natural logarithm (Log) of the number of employees. 130 industry-year dummies (NACE Rev.1 1-digit level) are included where indicated.

least 2/3 of their wholly owned foreign subsidiaries located in a country with a lower (higher) tax rate than the parent. To capture the precise incentive to relocate profits between the parent and all its subsidiaries, the proper tax measure in this parent firm analysis is the average statutory corporate tax rate difference of the parent to all its wholly owned foreign subsidiaries (*Av.TaxDiff to All Subs*), which is calculated as the parent tax rate minus the (unweighted) average tax rate of all wholly owned foreign subsidiaries. Finally, the estimations in Table 4.11 suggest that pre-tax profits of parents that have the bulk of their subsidiaries located in a *low-tax* country do not react sensitive to the average tax differential to all subsidiaries (cf. Columns (1)–(3)). On the contrary, the average tax differential obtains a significantly negative effects on

pre-tax profits of parents that exhibit the bulk of their subsidiaries in a *high-tax* country (cf. Columns (4)–(6)). Thus, for these low-tax parents, a lower tax rate relative to their subsidiaries leads to a higher level of profits before taxation, all else kept equal. Summing up, we find evidence that low-tax parents receive shifted profits from their (high-tax) subsidiaries but we find no evidence for high-tax parents shifting profits to their (low-tax) subsidiaries. This result is in line with the observed profit shifting pattern of the corresponding subsidiary firm analysis in Table 4.10. Finally, both findings are consistent with our main analysis of a profitability gap between headquarters and their foreign subsidiaries.

4.7 Conclusions

This paper provides evidence that the location of profits within multinational enterprises is biased toward the headquarters firm. Using a large panel of European MNEs and conditioning on input factors employed, our most conservative estimates suggest that headquarters exhibit a 30% higher profitability than their foreign subsidiaries. In line with previous theoretical contributions, the paper discusses that this pattern might be driven by two effects: firstly, MNEs may prefer to keep their value-driving functions at the headquarters location as physical distance to foreign subsidiaries gives rise to agency problems; and secondly, MNEs may have advantages from operating in home markets as they commonly know local customs and consumer behavior better than foreign competitors. We present suggestive evidence which proposes a role for both mechanisms in driving the profitability gap.

However, our results also indicate some cracks in the notion and status of the parent company as profit center of the multinational group. Precisely, we find that the profitability gap between parents and their subsidiaries decreases over time. Quantitatively, the decrease is sizable, pointing to a decline of the gap by up to around 30% in seven years. This result is in line with the widespread perception of an increased fragmentation of the production process across international borders which today does not only comprise of standard operating functions like manufacturing and sales but equally includes value-driving units like R&D and licensing departments (see Dischinger and Riedel, 2008 or Chapter 3 of this thesis, respectively). This especially applies as our results suggest that the closure of the profitability gap is related to the agency cost argument and not to the home market effect.

The results have various implications for public economic policy. Our analysis for

example shows that headquarters firms pay higher taxes on their corporate activity than subsidiaries. Moreover, we find that MNEs are reluctant to shift profits away from corporate headquarters in response to tax rate differentials but, vice versa, are eager to shift profits from high-tax subsidiaries to low-tax headquarters. Additionally, higher profitability rates at the multinational headquarters firms are expected to translate into a wage premium for the parent firm's workers. Consequently, our findings suggests that countries experience larger welfare gains from hosting a multinational parent firm than from hosting a multinational subsidiary. This implies that governments in general have a higher incentive to support and develop their multinational headquarters firms than to attract foreign subsidiaries. In this context, the profitability gap between headquarters and subsidiaries may also rationalize recent government actions to avoid the take-over of national firms by foreign companies and the associated attempt to create national champions.

Chapter 5

Leverage, Corporate Taxes and Debt Shifting of Multinationals: The Impact of Firm-specific Risk

5.1 Introduction

The deduction of interest expenses from the corporate tax base is allowed by the majority of current corporate tax systems. However, the equity returns to investors are not tax-deductible. Because of this asymmetric treatment of alternative means of financing investment corporations exhibit a fundamental incentive to raise their reliance on debt finance. Therefore, firms will trade-off the tax gain of debt against its costs. These costs arise mainly from a higher risk of financial distress and the resulting agency costs due to potentially opposed interests between debt and equity owners (cf. Myers, 2001).

Only in recent years, the straightforward hypothesis that higher corporate statutory tax rates lead firms to adopt higher financial debt ratios could be confirmed by robust empirical evidence. For example, Gordon and Lee (2001) provide quantitative results for domestically organized corporations. Furthermore, concerning multinational enterprises (MNEs), Desai, Foley, and Hines (2004b) show for U.S.-based MNEs that a 10% higher corporate tax rate in the host country of a foreign subsidiary is related to a raise in the total debt-to-assets ratio of this affiliate by about 4.5%. Mintz and Weichenrieder (2005) and Büttner, Overesch, Schreiber, and Wamser (2006) provide quantitatively similar results for German owned MNEs. Over and above, Huizinga, Laeven, and Nicodème (2008) show that the capital structure of European MNEs is systematically installed in a tax-minimizing way to international differences in statutory corporate tax rates and tax systems.

Thus, MNEs can reduce their tax liability abroad by granting internal loans to their foreign subsidiaries. Furthermore, Mintz and Smart (2004) argue that a strategic allocation of debt and equity within the multinational group by borrowing from low-tax affiliates and lending to high-tax affiliates allow the latter to deduct interest payments from the tax base and, consequently, overall the MNE saves taxes. Ramb and Weichenrieder (2005), Overesch and Wamser (2006), and Büttner and Wamser (2007) provide evidence that this behavior of tax-minimizing debt shifting is done by German MNEs to shift profits from high-tax to low-tax countries.

By the intra-company shifting of debt to locations with a relatively high tax rate, these countries observe lower levels of corporate tax revenues as more interest expenses are deducted from the tax bases of MNEs than without such tax avoidance strategies. In contrast, multinational affiliates at locations with a relatively low tax rate exhibit lower debt levels. Hence, these countries benefit from international debt shifting activities of MNEs by receiving higher tax revenue from multinational corporate profits. In addition,

MNEs have to bear costs of implementing debt shifting strategies and also efficiency costs with respect to deviations from the optimal financial structure that would be installed without any tax saving opportunities of debt shifting.

In a first step, this paper provides evidence for the positive effect of statutory corporate tax rates on a multinational affiliate's debt-to-assets ratio using a large panel database (AMADEUS) of European MNEs. Thereby, we focus on 30 European countries and on the time period of 1998 to 2006. At maximum, our regressions include 248,859 observations of 44,875 affiliates. Furthermore, we show that multinational subsidiaries use external debt to react on tax rate changes and additionally are engaged in internal debt shifting with the parent. We conclude this from our indirect econometric identification strategy by finding a significantly positive impact of the tax rate as well as of the asset weighted tax rate difference to the parent on the debt-to-assets ratio of a subsidiary, while controlling for firm size, profitability, age, various country characteristics, time fixed effects and subsidiary fixed effects. Profit shifting by means of internal debt shifting should not be sensitive to the corporate tax rate but to the tax rate difference between the lending and the borrowing multinational affiliate (cf. Mintz and Smart, 2004). Thus, if the tax differential is included in the regressions, changes in the statutory corporate tax rate capture the incentive for adjusting external debt.

In a second step, we apply two firm-specific risk proxy variables and provide (indirect) evidence that subsidiaries with an above average risk are more involved in debt shifting than subsidiaries with a below average risk. Vice-versa, our estimations suggest that low-risk subsidiaries use external debt significantly more to get advantage of the depreciation tax shield than high-risk subsidiaries. We explain this with a higher probability for high-risk firms of obtaining no external debt (because of a larger default risk) or of achieving external debt only at too high costs. In addition, the parent firm can charge lower interest rates for internal loans to its subsidiary as external creditors demand because the parent faces a lower information asymmetry as compared to these external creditors and thus can claim a lower risk premium.[1] In this analysis, as a proxy for firm-specific risk of financial distress, we first employ the standard deviation of the affiliate's EBIT margin, i.e. the ratio of earnings before interest and taxes to sales, over the sample period 1998–2006. Alternatively, we use the affiliate's ratio of intangible assets to sales as a risk proxy variable. Due to endogeneity and misidentification concerns on the two risk proxies, in a robustness test, we apply an exogenous

[1]These considerations are supported by evidence of Desai, Foley, and Hines (2004b) and Büttner, Overesch, Schreiber, and Wamser (2006) who show that external and internal debt financing of multinational affiliates are substitutes.

proxy variable that measures R&D expenditures relative to sales in German industries resulting from a large survey analysis. Thereby, we do a sectoral analysis comparing high-risk with low-risk industries and find a similar, even more extreme pattern. In high-risk sectors like the electronics or the consultancy industry, we find a significant impact of the tax differential on the debt ratio but no effect of the tax rate. In contrast, in low-risk sectors like the transport or the trade industry we observe a significant and also large impact of the tax rate but no effect of the tax differential. This confirms our theoretical considerations.

To the best of our knowledge, there is no paper so far that analyzes the response of MNEs' debt ratios to tax incentives depending on the firm-specific risk and likewise on the industry sector. In addition, in contrast to Büttner and Wamser (2007) or Huizinga, Laeven, and Nicodème (2008) who apply fixed effects on the multinational group level, we use affiliate fixed effects and are thus able to control for any time-constant unobservable characteristic of the affiliate that might affect its leverage.[2] Thereby, we additionally can control for institutional heterogeneity of countries with respect to deduction allowances of interest expenses which is not possible with group fixed effects. Accordingly, our coefficient estimates of the tax differential are smaller compared to the existing literature, suggesting an about 1% increase in the subsidiary's debt-to-assets ratio if the tax rate difference to the parent rises by 10 percentage points. Referring to the tax rate, controlling for internal debt shifting incentives, a 10 percentage points rise in the tax rate increases the subsidiary's leverage ratio by 5%, everything else being equal.

The paper is structured as follows. In Section 5.2, we present a literature review on debt shifting including a systematic comparison of selected empirical papers and their quantitative results. In Section 5.3, we discuss theoretical considerations and formulate hypotheses for the empirical analysis. Section 5.4 describes the dataset and our firm-specific risk proxies. The estimation method and identification strategy is documented in Section 5.5. Section 5.6 presents the empirical results and a robustness check with an industry analysis. Section 5.7 concludes.

[2]In general, an affiliate faces different and complex incentives for financial decisions that are likely to be to a significant extent unobserved which makes the application of a fixed effects approach essential.

5.2 Literature Review on Debt Shifting

While the theoretical literature on the impact of taxes on debt financing is comprehensive and well established (see e.g. Auerbach, 2002, for a review) the empirical literature is less extensive and still developing. With respect to the quality of identifying debt shifting the recent empirical literature can be classified in five categories (see Table 5.1). The studies in the first category of Table 5.1 estimate the effect of corporate tax *rates* on a firm's *total* debt-to-assets ratio.[3] However, while explaining the variation in leverage ratios of multinational affiliates, tax rate changes represent the incentive for external debt, for internal debt and for debt shifting adjustments together. Thus, working with tax rates cannot identify debt shifting directly.

The only paper treating foreign plant ownership as endogenous when analyzing tax rate effects on MNE's leverage is Egger, Eggert, Keuschnigg, and Winner (2010). They use domestic firms as a reference group applying propensity score matching techniques and provide evidence that foreign-owned firms have on average 1.7 percentage points higher debt-to-assets ratios than domestically-owned firms. In addition, they show that debt finance of *multinational* subsidiaries react more elastic to corporate tax rate changes than debt finance of *domestic* subsidiaries. They interpret this as a hint for the important role of debt shifting for MNEs.[4]

The empirical literature that *explicitly* deals with debt shifting is scarce. The second and third categories of Table 5.1 display the different effects of the tax rate on the ratio of *external* vs. *internal* debt, estimated separately. Overall, internal debt seems to react more elastically to tax rate changes than external debt (average semi-elasticity of about 8% vs. 6%) which is an indirect hint for debt shifting activities. However, the econometric strategy still lacks in a distinction of the proper tax incentive for *shifting* debt within the multinational group. For example, in response to a tax rate increase an affiliate can raise internal borrowing from the parent without any shifting activities of debt (and finally of profit), i.e. without symmetrically lowering debt at the parent

[3]Note that specially the first category of Table 5.1 is of course not a complete list. Earlier empirical studies using U.S. data are undertaken e.g. by Collins and Shackelford (1992), and Froot and Hines (1995).

[4]However, this larger elasticity for MNEs could likewise be a result of the more intensive use of solely *external* debt finance without any debt shifting activities. Multinational subsidiaries exhibit on average larger and more profitable parents than domestic subsidiaries and thus have better access to collateral, which results in lower interest rates. Over and above, our dataset shows that the larger the debt-to-assets ratio of a firm the more pronounced are tax effects in general.

Table 5.1: Comparison of Existing Literature

Corporate Tax Effects on Firms' Leverage
– selected empirical papers –

Estimated Effect	%-points change of dep. var. if tax var. rises by 10%-points	% change of dep. var. if tax var. rises by 10%-points **(Semi-Elasticity)**
1. Effect of corporate tax rate on total debt-to-assets ratio:		
Gordon and Lee (2001)	3.6	3.5
Jog and Tang (2001)	5.3	-
Altshuler and Grubert (2003)	3.9	7.3
Desai et. al (2004)	2.5	4.5
Mintz and Weichenrieder (2005)	3.0	5.4
Büttner et. al (2006)	3.4	5.6
Overesch and Schreiber (2008)	2.4	3.9
This study	1.1▲ / 3.1▼	1.8▲ / 5.0▼
2. Effect of corporate tax rate on external debt-to-assets ratio:		
Altshuler and Grubert (2003)	3.3	7.6
Desai et. al (2004)	2.3	5.2
Büttner et. al (2006)	1.9	5.1
(This study, indirectly)	(2.6)	
3. Effect of corporate tax rate on internal debt-to-assets ratio:		
Altshuler and Grubert (2003)	.65	5.9
Desai et. al (2004)	.83	10.4
Mintz and Weichenrieder (2005)	1.5	-
Ramb and Weichenrieder (2005)	1.4	7.0
Büttner et. al (2006)	1.5	6.2
Büttner and Wamser (2007)	.65	6.1
Büttner et. al (2008)	2.0	7.9
Overesch and Schreiber (2008)	2.9	11.3
4. Effect of corporate tax rate differential on total debt-to-assets ratio:		
Jog and Tang (2001)	3.5	-
Huizinga et. al (2008)	1.2	1.9
This study	.55	.88
5. Effect of corporate tax rate differential on internal debt-to-assets ratio:		
Ramb and Weichenrieder (2005)	.21★	3.2★
Overesch and Wamser (2006)	1.9	6.8
Büttner and Wamser (2007)	.68	6.4
(This study, indirectly)	(.55)	

Notes: Most semi-elasticities based on own calculations, however, a dash indicates that the value could not be calculated due to missing descriptive statistics in the respective paper.
▲ The tax rate effect of 1.1 (or 1.8, respectively) is estimated with the sample of multinational parent firms *and* subsidiaries (Table 5.4) *without controlling for debt shifting incentives* with the tax differential (cf. Column (3) of Table 5.4). Note that if we estimate this effect for subsidiary firms only the tax effect rises to 1.5 and the semi-elasticity to 2.4. These regressions are not shown in the paper but are available from the authors upon request.

▼ The tax rate effect of 3.1 (or 5.0, respectively) is estimated with the sample of solely subsidiary firms (Table 5.5) *controlling additionally for internal debt shifting incentives* with the asset weighted tax rate difference to the parent (cf. Column (3) of Table 5.5). The effect results adding up the coefficient estimates of the tax rate and the tax differential.
★ Note that the coefficient estimate of the tax differential in Ramb and Weichenrieder (2005) relates only to indirectly held German affiliates of foreign MNEs, i.e. a German subsidiary is held by a German company that in turn is owned by a foreign parent firm, whereas they find no effect for directly held affiliates, i.e. the German subsidiary is directly owned by a foreign parent.

location or adjusting the equity allocation of the MNE.

Only a few papers directly capture the incentive for shifting one monetary unit of debt from a low-tax to a high-tax location by applying tax rate *differentials* (see fourth and fifth category of Table 5.1). But, the tax differentials are calculated differently which, in addition to deviating country coverages, further handicaps the comparability of the coefficient estimates. For example, Jog and Tang (2001) apply the difference of the average industry corporate tax rates between Canada and the U.S. by analyzing multinational affiliates located in these two counties. Furthermore, Büttner and Wamser (2007) calculate the unweighted tax rate difference of German-owned foreign subsidiaries relative to the lowest tax rate observed among all affiliates of the MNE. Overesch and Wamser (2006) however use the unweighted tax rate difference between a foreign-owned German subsidiary and its foreign parent.[5] In contrast, Huizinga, Laeven, and Nicodème (2008) construct for European MNEs the sum of tax differences to all other majority owned affiliates of the group, weighted by total asset shares, taking withholding taxes and the international tax system into account.

But, overall, tax differential effects on *internal* leverage seems to be almost as large as tax rate effects indicating that shifting of debt is a relevant strategy for MNEs. Note that the papers in the fifth category of Table 5.1 provide the most direct empirical identification of debt shifting by analyzing the impact of tax differentials on intercompany loans. However, the datasets of these papers (MiDi database of the German Bundesbank) include either German MNEs and their foreign subsidiaries or German subsidiaries of foreign MNEs, which limits the transferability of the quantitative results to other countries.

In general, a proper comparison of the estimated tax effects even within a category of Table 5.1 is difficult. Although most studies use micro-level panel data, the papers deviate in almost all other dimensions: the ownership share threshold to define a firm as an affiliate of the group,[6] the country coverage, the calculation of tax rates (additionally

[5]For the reason of different firm samples and calculations of the tax differential the coefficient estimates of Overesch and Wamser (2006) and Büttner and Wamser (2007) deviate much (1.9 vs. .68). However, the semi-elasticities are almost equal (6.8 vs. 6.4).

[6]Note that the results of Mintz and Weichenrieder (2005) suggest that partly-owned multinational

accounting for dividend taxes, withholding taxes, depreciation allowances and/or the international tax system) and tax differentials (difference to the parent and/or to other affiliates, unweighted or weighted), and the estimation method (affiliate vs. group fixed effects, set of control variables). Therefore, a comparison of different tax effects in the empirical literature has to be taken with care.

5.3 Theoretical Considerations

Corporate taxation affects a firm's optimal mix of debt and equity independent if the firm is multinational or solely domestically structured. Basically, the higher the statutory corporate tax rate a firm has to bear the larger the incentive for debt financing, as the value of the interest deduction from the tax base increases with the tax rate and thus the amount of tax savings is larger. Initially, we will empirically test this baseline mechanism (cf. Section 5.6, Table 5.4).

Hypothesis 1.
The debt-to-assets ratio of a firm is increasing in the statutory corporate tax rate.

The existing literature hardly describes the exact mechanism of international debt shifting or detailed strategies of applying it by MNEs. Moreover, the literature likewise lacks in a common and clear-cut definition of debt shifting. Therefore, we want to define debt shifting by a tax-minimizing strategy of a MNE in which a low-tax affiliate act as a lender to a high-tax affiliate to shift profits from a high-tax to a low-tax location. Thereby, as interest paid to an *internal* lender of a corporate group is also deductible from the tax base, the MNE benefits from the enhanced deduction of interest at the location where profits are subject to the higher tax rate and, thus, the MNE's global tax liability is reduced. In this debt shifting process, the lender simultaneously reduces its own external debt by the same magnitude as the credit he gives out, so that the global debt-to-asset ratio of the MNE stays constant but the respective ratios of the two affiliates are changed inversely, everything else being equal. Note that equity might

subsidiaries show significantly smaller tax effects on borrowing than wholly-owned affiliates. One explanation is that partly-owned firms may suffer from ambiguous strategies for the financial structure due to potentially opposed tax incentives from other management parties involved. Likewise, Dischinger (2008) or Chapter 2 of this thesis, respectively, provide evidence that profit shifting activities of subsidiaries are reduced with a decreasing ownership share of the parent. Therefore, differently constructed samples of multinational affiliates with respect to the ownership share threshold (e.g. $\geq$ 51% vs. 100% ownership to be considered as a foreign subsidiary) might as well affect the difference in the results of empirical studies and thus additionally complicate their comparability.

not be rearranged so that equity levels at the two affiliates can stay unchanged and total assets at the borrower location can be increased.[7] We are aware that there exists a range of more complex strategies, e.g. debt shifting chains between several affiliates of a MNE or the simultaneous use of equity rearrangements.[8]

For our theoretical considerations, we assume a MNE that consists of a parent firm and one wholly-owned foreign subsidiary. With respect to the subsidiary's debt financing, the MNE has the choice between *external* debt, i.e. outside capital coming from a bank or lender that does not belong to the corporate group, and *internal debt shifting*, i.e. outside capital received from the parent. The use of external debt leads to the trade-off between generating new capital and the price of increasing the indebtedness of the whole corporate group which results in a higher overall probability of financial distress. Vice-versa, the use of internal debt shifting, on the one hand, leads to the trade-off between the advantage of keeping the overall leverage and thus the bankruptcy risk of the group unchanged and the disadvantage of generating no additional capital.[9] On the other hand, statutory corporate tax rate differences between the subsidiary and the parent are relevant. If the subsidiary exhibits a higher (lower) tax rate than the parent, the MNE faces an *additional gain (loss)* by the internal shifting of debt from the parent to the subsidiary via a shift of income from the high-tax (low-tax) subsidiary to the low-tax (high-tax) parent.[10] Finally, a potential tax gain from the shifting of debt must be traded-off against agency costs that might arise because tax authorities try to curb profit shifting and thus MNEs have to spend effort to rationalize the use of internal borrowing. In addition, efficiency cost of deviating from the optimal finan-

[7] However, if e.g. a low-tax subsidiary acts as a lender to a high-tax parent solely for debt shifting purposes, equity (to the same magnitude as the reduced debt) could be transformed from the parent to the subsidiary so that total assets can stay constant at both affiliates.

[8] See Mintz (2004) for a theoretical analysis of different debt shifting strategies considering institutional aspects like conduit entities of MNEs.

[9] We disregard the fact that internal debt is much more restricted than external debt due to thin capitalization rules by assuming that the subsidiary has not reached this quota yet.

[10] In general, higher debt cost of a firm also reduce its dividends. However, since most MNEs to a large extent defer the repatriation of dividends to retain profits at the subsidiary location for tax reasons or for investments (see e.g. Altshuler and Grubert, 2003, for an analysis how MNEs can use various strategies to avoid home country repatriation taxes), we abstract from dividend taxes and withholding taxes on dividend payments which become due upon repatriation. Grubert (2001) and Grubert and Mutti (2001) provide evidence for the U.S. that taxes on dividend repatriations are very modest, even from low-tax countries. Moreover, withholding taxes on dividends are relatively low within the EU and thus play a minor role.

cial structure may occur, e.g. with respect to manager incentives.[11] Finally, we assume that multinational subsidiaries find an optimal mix of external debt and internal debt shifting resulting in the following testable hypothesis (cf. Section 5.6, Table 5.5).

Hypothesis 2.
A multinational subsidiary uses external debt as well as internal debt shifting with the parent firm to get advantage of the depreciation tax shield.

For including firm-specific risk in these considerations, we make two assumptions. First, we assume that the parent firm can charge a lower interest rate for the internal credit to its subsidiary than external creditors charge because the parent faces a lower information asymmetry with its (wholly-owned) subsidiary and thus can claim a lower risk premium.[12] Second, we assume that subsidiaries with a higher firm-specific risk exhibit a higher probability of obtaining no external debt (because of a larger default risk) or of achieving external debt only at a very high interest rate that is too costly. Hence, as external debt is more restricted for high-risk subsidiaries, they rely more often on internal debt as a substitute.[13] We conclude with our final hypothesis (cf. Section 5.6, Table 5.6 and 5.7).

Hypothesis 3.
It is more likely that a multinational subsidiary with a high firm-specific risk uses internal debt and thus debt shifting with the parent than a low-risk subsidiary and, vice-versa, it is more likely that a low-risk subsidiary uses external debt than a high-risk subsidiary to minimize taxes.

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[11] See Mintz and Smart (2004), Büttner and Wamser (2007), Huizinga, Laeven, and Nicodème (2008) or Egger, Eggert, Keuschnigg, and Winner (2010) for a theoretical analysis of MNEs' capital structure choice that explicitly account for internal borrowing and lending for profit shifting purposes.

[12] In addition, we assume that the parent exhibits a lower firm-specific risk than the subsidiary (e.g. due to a bigger size) and thus also pays a lower interest rate for its external debt so that, in the case of a low-tax parent, the debt shifting strategy really results for the MNE in overall lower tax payments and hence a shift of income to the low-tax location.

[13] This is supported by Büttner, Overesch, Schreiber, and Wamser (2006) who provide evidence that external and internal debt financing of multinational affiliates are substitutes. Likewise, Desai, Foley, and Hines (2004b) show that internal debt is employed by MNEs to overcome imperfections in external capital markets.

5.4 Data

We use the commercial database AMADEUS (full version, October 2008) which is provided by Bureau van Dijk and includes detailed information on firm structure and accounting of about 11 million domestic and multinational corporations in 41 European countries from 1993 to 2007, but is unbalanced in structure. We focus on 30 European countries (see Table 5.2 for country statistics) and on the time period of 1998 to 2006 as these countries and years are sufficiently represented by the database. The observational units of our panel analysis are, on a yearly basis, *multinational parents* (i.e. a firm that exhibits at least one wholly-owned foreign subsidiary) and *multinational subsidiaries* (i.e. a firm that is owned by a foreign immediate shareholder with 100%[14] of the ownership shares).[15] Although our sample is restricted to firms located in 30 European countries, we observe basic information on worldwide parents of these firms (country, total assets, ownership share) which is of importance for the calculation of the tax differential (see Section 5.5). As they are not subject to positive tax payments, we drop affiliates with losses during the whole sample period.

5.4.1 Summary Statistics

Table 5.3 displays descriptive sample statistics, separately for the large sample of parent firms and subsidiaries (applied in the tax rate estimations of Table 5.4) and for the sample of only subsidiaries (applied in the estimations with the tax differential to the parent of Table 5.5–5.7). All firm data is exported from AMADEUS in unconsolidated values and current prices. In total, our data comprises 248,859 observations from 44,875 multinational affiliates, hence, on average, we observe each affiliate 5.5 times. We obtain an almost equal mean value if we consider only subsidiaries as our regressions then include 78,337 observations from 14,332 multinational subsidiaries.

The debt-to-assets ratio is defined as the sum of total current and total non-current

[14] By considering only wholly-owned subsidiaries we hedge against potential opposed interests of other management parties involved concerning debt shifting strategies. In contrast, Huizinga, Laeven, and Nicodème (2008) define a firm to be a multinational subsidiary if at least 50% of the shares are owned by another, foreign firm.

[15] If both criteria apply, the firm is nevertheless labeled as a subsidiary. However, the inclusion of these intermediate parents do not affect our results, if anything it would bias the estimated tax effects downwards. Furthermore, our descriptive statistics show that the median firm in our subsidiary sample exhibit no further own subsidiaries.

Table 5.2: Country Statistics

Country	*Parent Firms & Subsidiaries*	*Subsidiary Firms only*
Austria	487	157
Belgium	2,577	952
Bulgaria	854	66
Croatia	475	104
Czech Republic	595	378
Denmark	1,680	529
Estonia	550	254
Finland	1,096	614
France	5,124	1,580
Germany	3,064	966
Great Britain	7,843	2,093
Greece	202	85
Hungary	124	79
Iceland	42	7
Ireland	627	263
Italy	3,265	943
Latvia	161	113
Lithuania	109	71
Luxembourg	260	55
Netherlands	2,547	707
Norway	1,545	864
Poland	1,241	773
Portugal	437	263
Russia	1,636	89
Serbia	108	59
Slovakia	95	80
Spain	3,802	1,286
Sweden	3,997	876
Switzerland	212	2
Ukraine	120	24
Sum	44,875★	14,332★

★ The high number of parents & subsidiaries relative to including solely subsidiaries in our regressions (cf. Column (1) of Table 5.4 with (1) of Table 5.5) results because, in the regressions of Table 5.4, we just control for the tax rate, whereby, in the regressions of Table 5.5, we additionally apply the asset weighted tax rate difference to the parent. For about half of the subsidiaries this variable cannot be calculated due to missing values in the database mostly of the parent's total assets.

liabilities to total assets. Its mean is calculated with 60.5% for the sample of parents and subsidiaries, and with 62.5% for the subsidiary sample. Not surprisingly, sales are on average much smaller in the subsidiary sample compared to the large sample with parent firms (99.2 vs. 225.3 million US dollars). However, the substantially smaller median values show a rather skewed distribution of the sales variable, thus, we apply

Table 5.3: Descriptive Statistics

Variable:	*Obs.*	*Mean*	*Median*	*Min.*	*Max.*
Parent Firms & Subsidiaries:					
Debt-to-Assets Ratio	248,859	.6045	.6396	0	1
Sales★	248,859	225,328	12,888	1	3.2e+08
Total Assets★	248,859	340,882	14,251	1	3.7e+08
EBIT per Total Assets♦	248,859	.1227	.0518	-529	4,096
EBIT Margin (EBIT per Sales)	111,206	.0689	.0463	-1	1
Age◊	109,054	21.7	14	1	321
Statutory Corporate Tax Rate▲	248,859	.3238	.3383	.1	.566
GDP◄	248,433	992	689	5.57	2,915
GDP per Capita◄	248,433	27,810	27,219	633	89,923
Corruption Index►	248,433	.7284	.74	.15	1
Lending Rate▷	205,105	.0609	.0564	.0211	.5495
Subsidiary Firms only:					
Debt-to-Assets Ratio	78,337	.6245	.6658	0	1
Sales★	78,337	99,219	9,328	1	9.8e+07
Total Assets★	78,337	117,643	6,892	1	1.3e+08
EBIT per Total Assets♦	78,337	.1066	.06	-21	1,961
EBIT Margin (EBIT per Sales)	34,615	.0573	.0413	-1	1
Age◊	34,231	17.4	12	1	250
Statutory Corporate Tax Rate▲	78,337	.3184	.31	.1	.566
Tax Rate Differential▼	78,337	-.0142	-.0051	-.466	.4166
Firm-specific Risk Proxy Variables:■					
Volatility of Profitability□	140,614	.102	.0502	0	1.41
Intangible Assets per Sales	118,510	.0342	.0008	0	1.57

Notes: Firm data is exported from the AMADEUS database, full version, October 2008.
▲ Statutory corporate tax rates obtained from the European Commission (2006) and from KPMG International (2006).
★ Unconsolidated values, in thousand US dollars, current prices.
♦ Earnings before interest and taxes (EBIT) per total assets, unconsolidated values.
◊ In years since establishing.
◄ GDP in billion US dollars, current prices; GDP per Capita in US dollars, current prices; data from the IMF WEO Database October 2008.
► *Corruption Perceptions Index (CPI)* (divided by 10) from *Transparency International (TI)*, ranks from 0.00 (extreme level of corruption) to 1.00 (free of corruption).
▷ Average interest rate for loans in the private sector of a country, obtained from the IMF International Financial Statistics Yearbook (2006).
▼ Statutory corporate tax rate of the subsidiary minus the tax rate of the parent.
■ Based on all available observations in the whole dataset of multinational parent firms and subsidiaries exported from AMADEUS.
□ Standard deviation of the affiliate's EBIT margin, i.e. the ratio of earnings before interest and taxes to sales, over the sample period 1998–2006.

a logarithmic transformation. For the sample of subsidiaries, the profitability measure earnings before interest and taxes (EBIT) per total assets exhibits a mean of 10.7%, again with a lower median of 6.0%. Of course, the average firm age is higher in the large sample than in the subsidiary sample (21.7 vs. 17.4 years). However, this information is missing for more than half of the observations. For the large sample, the average

statutory corporate tax rate is calculated with 32.4%, the minimum with 10% and the maximum with 56.6%. The average statutory corporate tax rate difference to the parent (only available in the subsidiary sample) is −1.4% indicating a higher tax rate for parent than for subsidiary firms on average.

5.4.2 Firm-specific Risk Proxy Variables

We use two different proxy variables for the firm-specific risk of financial distress. First, for every firm, we calculate the volatility of profitability which is the standard deviation of the affiliate's EBIT margin, i.e. the ratio of earnings before interest and taxes to sales, over the sample period 1998–2006.[16] This measure spreads from 0 to 141 percentage points with a mean value of 10.2 percentage points. The proxy properties of this variable for firm-specific risk are quite intuitive, with a larger volatility indicating a higher risk, and vice-versa. However, the measure suffers from disadvantages. On the one hand, for many ranges of profitability the measure misidentifies firm-specific risk: e.g. if a firm's EBIT margin spreads between 10% and 40% which would be interpreted as an above-average risky firm (high volatility), or, vice-versa, e.g. in the range of -8% and -6% which would be interpreted as a below-average risk (low volatility). On the other hand, a firm's EBIT margin might be endogenous as its level could be a result of profit shifting behavior (e.g. via transfer pricing of intermediate goods) due to international tax differentials. In addition, the volatility of profitability measure by construction assumes implicitly that the firm-specific risk is constant over time, at least over our sample period within the standard deviation of the affiliate's EBIT margin is calculated.

Therefore, second, we alternatively apply the affiliate's yearly ratio of intangible assets to sales as a proxy for firm-specific risk.[17] Firms with high R&D activities and/or little operational revenue are more likely to fail with the business strategy and to generate lower as planned (or even no) sales and profits in the future which ex-ante yields a higher probability of bankruptcy or insolvency, respectively. The mean of the intangibles ratio is calculated with 3.42%. To dampen the potential impact of outliers, we drop values above the 99% percentile of the distribution. The endogeneity concerns on this measure are less pronounced, however, the variable has the disadvantage that like-

[16] See Huizinga, Laeven, and Nicodème (2008) who apply a very similar proxy variable for firm-specific risk.

[17] See e.g. Myers (2001) who also links firm-specific business risk to the holding of an above average level of intangible assets.

wise the successful outcome of R&D (like patents, royalties, etc.) could be capitalized in the balance sheet item "intangible fixed assets".

See Section 5.6.3 for our classification of affiliates in high-risk vs. low-risk firms and hence divergent estimation results. However, there exists endogeneity and misidentification concerns of both risk proxies, as stated above. Therefore, in a robustness test in Section 5.6.4, we apply an exogenous risk proxy variable that measures R&D expenditures relative to sales in German industries resulting from a large survey analysis.

5.5 Econometric Approach

Our estimation strategy of indirectly identifying external debt and internal debt shifting has the following form

$$(DEBT/ASSETS)_{it} = \beta_0 + \beta_1 STR_{it} + \beta_2 TAXDIFF_{it} + \beta_3 X_{it} + \rho_t + \phi_i + \epsilon_{it} \quad (5.1)$$

with subscript i denoting the observational unit (affiliate) and t the time period (year). The dependent variable is the sum of total current and total non-current liabilities to total assets. The explanatory variables of central interest are the statutory corporate tax rate (STR_{it}) and the statutory corporate tax rate difference to the parent firm weighted by total asset shares ($TAXDIFF_{it}$). We assume debt shifting to be mainly relevant in the parent-subsidiary relationship, therefore, we do not apply tax rate differences to all other subsidiaries of the parent. For a subsidiary, the most unambiguous profit shifting incentive exists with the immediate shareholder that holds 100% of the ownership shares which in our case is the parent firm. Furthermore, controlling for the size of a subsidiary *relative* to its parent by weighting the tax differential by total assets is important for capturing the precise benefit of shifting debt.[18]

The vector X_{it} stands for a range of time-varying affiliate and country control characteristics. On the micro level, this is the firm size represented by the logarithm of sales and the profitability represented by EBIT per total assets. We additionally control for firm age with the logarithm of years since establishing and for firm-specific risk with the proxy variable intangible assets per sales described in the previous section. On the

[18]For example, a loan of 1 Mio. US dollars may have a different value for the lender than for the borrower due to size differences. Of course, for equal tax rates of the subsidiary and the parent there exists no incentive for debt shifting and the tax differential is zero. See Huizinga, Laeven, and Nicodème (2008) for a similar weighting of the tax incentive. Alternatively, the total asset shares could also be included in the estimations as a regressor leaving the tax differential unweighted which yields very similar coefficient estimates.

macro level, we control for GDP (as a proxy for the market size), for GDP per capita (as a proxy for the productivity growth of a country), for an index of corruption (as a proxy for creditor rights or the quality of the legal system respectively) and for the average interest rate for loans in the private sector (as a proxy for credit costs). Moreover, we include year dummy variables (ρ_t) and affiliate fixed effects (ϕ_i). ϵ_{it} denotes the error term. We estimate an OLS model. Applying fixed-effects estimation techniques is generally suggestive when analyzing micro data to control for unobservable, firm-specific factors while explaining variations in leverage ratios.[19] Furthermore, the affiliate fixed effects additionally control for institutional heterogeneity of countries with respect to deduction allowances of interest expenses.

Finally, if the tax differential is included in the regressions, we assume that changes in the statutory corporate tax rate capture the incentive for adjusting external debt (cf. Mintz and Smart, 2004). For a theoretical analysis see Huizinga, Laeven, and Nicodème (2008) who call this the *domestic effect*, in contrast to the *international* or *debt shifting effect* which is represented by the weighted tax differential. Therefore, and suggested by our theoretical considerations of Section 5.3, we expect $\beta_1 > 0$ to provide indirect evidence for the use of *external debt* (if the tax differential is included in the regressions), and we expect $\beta_2 > 0$ to provide indirect evidence for the use of *internal debt shifting*.

Profit shifting by means of internal debt shifting should not be sensitive to the corporate tax rate but to the tax rate difference between the lending and the borrowing multinational affiliate (cf. Mintz and Smart, 2004). Thus, if the tax differential is included in the regressions, changes in the statutory corporate tax rate capture the incentive for adjusting external debt.

[19] The fixed-effects model is also preferred to a random-effects approach as suggested by a Hausman-Test. Note that, in contrast to our approach, Büttner and Wamser (2007) and Huizinga, Laeven, and Nicodème (2008) apply fixed effects for the multinationals group. Thus, they control for MNE-specific, time-constant unobservable effects. However, we suppose that an unobservable characteristic that potentially influences the affiliate's financial structure is affiliate-specific and not equal for all affiliates of the group.

5.6 Estimation Results

This section comprises our empirical results and additionally a robustness check comparing firms in high-risk vs. low-risk industries. All regressions include a full set of year dummy variables and affiliate fixed effects. In parentheses below the coefficient estimates, the result tables display heteroscedasticity robust standard errors which are adjusted for clustering at the affiliate level. Note that the (adjusted) R^2 values are at relatively high levels around 70% due to the inclusion of affiliate fixed effects.[20]

5.6.1 Tax Rate Effect on Firm's Leverage

First, Table 5.4 presents baseline estimations of the tax rate effect on a multinational affiliate's debt-to-assets ratio. As we do not yet analyze debt shifting in theses regressions, the sample consists of multinational parent firms and subsidiaries (as defined in Section 5.4). In Column (1) to (3), we include additional control variables besides firm size (Log Sales), i.e. our set of time-varying macro controls (GDP, GDP per capita, corruption index) and the affiliate's profitability (EBIT per Total Assets). As expected (cf. Hypothesis 1 in Section 5.3) and widely documented in the literature, throughout the coefficient estimates of the statutory corporate tax rate are positive and significant at the 1% level. Accordingly, a rise in the tax rate by 10 percentage points yields an increase in the debt-to-assets ratio of multinational affiliates of 1.1 percentage points (cf. Column (3) of Table 5.4). Note that this rather small effect results with the sample of multinational parent firms and subsidiaries *without* controlling for debt shifting incentives with the tax differential.[21] We achieve a much larger tax rate effect of .31 (cf. Column (3) of Table 5.5, adding up the coefficient estimates of the tax rate and the tax differential) with the sample of solely subsidiary firms while controlling additionally for internal debt shifting incentives with the tax rate difference to the parent.

With respect to the control variables in Table 5.4, larger firms exhibit significantly more leverage indicating a better access to outside capital with a larger size. Furthermore, our estimations suggest that more profitable firms use less debt finance as they are more able to finance investments with retained earnings, but this effect is very

[20]The adjusted R^2 values are calculated from a dummy variables regression equivalent to the fixed-effects model.

[21]If we estimate this effect for subsidiary firms only, the respective coefficient rises to .15. These regressions are not shown but are available from the authors upon request.

Table 5.4: Tax Rate Effect on Firm's Leverage

OLS Firm–Fixed–Effects, Panel 1998–2006
Sample of Multinational Parent Firms & Subsidiaries
Dependent Variable: Debt–to–Assets Ratio

Explanatory Variables:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Stat. Corp. Tax Rate	.117***	.107***	.109***	.111***	.142***	.129***
	(.024)	(.023)	(.024)	(.024)	(.035)	(.036)
Log Sales	.028***	.029***	.029***	.028***	.031***	.029***
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)
EBIT p. Total Assets			-2e-4**	-2e-4**	-1e-4***	-.004
			(8e-5)	(9e-5)	(1e-5)	(.003)
Log Age					-.050***	
					(.003)	
Intangibles per Sales						.019*
						(.012)
Log GDP		.001	.001	-4e-6	.001	5e-5
		(.002)	(.002)	(.002)	(.004)	(.004)
Log GDP per Capita		-.101***	-.102***	-.090***	-.069***	-.095***
		(.010)	(.010)	(.012)	(.016)	(.015)
Corruption Index		.046***	.049***	.068***	.002	.010
		(.013)	(.013)	(.014)	(.019)	(.019)
Log Lending Rate				.008**		
				(.003)		
Year Dummies	√	√	√	√	√	√
# Observations	248,859	248,433	245,094	205,105	109,054	105,871
# Firms	44,875	44,874	44,451	40,451	21,113	20,586
Adjusted R^2	.7223	.7232	.7228	.7346	.7513	.7425

Notes: Heteroscedasticity robust standard errors adjusted for firm clusters in parentheses. *, **, *** indicates significance at the 10%, 5%, 1% level. Observational units are multinational parent firms (i.e. firms that hold at least one foreign wholly-owned subsidiary) and multinational subsidiaries (i.e. firms that exhibit a foreign parent holding 100% of the ownership shares). Firms with losses during the whole sample period were dropped. Dependent variable is the sum of current and non-current liabilities to total assets. *EBIT p. Total Assets* is earnings before interest and taxes per total assets. *Log Age* is the natural logarithm (Log) of years since establishing. Lending rate is the average interest rate for loans in the private sector of a country. Adjusted R^2 values calculated from a dummy variables regression equivalent to the fixed-effects model.

small. GDP (as a proxy for the market size of a country) shows no effect on firm's leverage. However, firms in more developed countries (proxied by GDP per capita) seem to be characterized by lower debt-to-assets ratios as these firms can generate equity more easily. Finally, better creditor rights or a better quality of the legal system, respectively, proxied by a larger corruption index (which stands for less corruption) affects the leverage of multinational affiliates positively.

In Column (4) to (6) of Table 5.4, we include further control variables to test the sensitivity of the tax rate effect. First, we additionally include the average interest

rate for loans in the private sector of a country (Log Lending Rate) which surprisingly exhibits a significantly positive but very small effect. This could be explained by the substitutive relationship between external and internal debt financing if capital market conditions worsen (cf. Büttner, Overesch, Schreiber, and Wamser, 2006). In Column (5), we add the firm age as an explanatory variable and observe that older firms are less leveraged suggesting that younger firms are more restricted in raising equity.[22] However, the information on a firm's date of incorporation is missing in the database for more than half of the firms. In Column (6), we control for our preferred proxy variable for firm-specific risk, the share of intangible assets over sales (see Section 5.4.2 for a description), which enters positive with a significance at the 10% level. Thus, riskier firms relate more to debt financing as generating equity is more difficult with a higher risk of financial distress. However, most importantly, the inclusions of these additional controls do not alter our qualitative tax rate effect and just slightly increases the coefficient estimates.

5.6.2 External Debt and Internal Debt Shifting

In a second step, in Table 5.5, we analyze tax effects on external debt and internal debt shifting by regressing the same specifications of Table 5.4 but with the additional inclusion of the asset weighted tax rate difference to the parent. This differential captures the MNE's incentive for debt shifting between the subsidiary and the parent firm. Therefore, now the sample comprises only multinational subsidiaries. Throughout all regressions, the tax differential exhibits a positive and highly significant effect on the debt-to-assets ratio which provides indirect evidence that MNEs are involved in the intra-company shifting of debt. Quantitatively, if the statutory corporate tax rate difference to the parent rises by 10 percentage points, the subsidiary's leverage ratio increases by .55 percentage points (cf. Column (3) of Table 5.5), which is .88% of the sample mean. As we additionally obtain a positive and highly significant effect of the tax rate while controlling for the debt shifting incentive, we interpret this as indirect evidence that multinational subsidiaries simultaneously use external debt to react on tax rate changes in a tax-minimizing way. This confirms our theoretical considerations (cf. Hypothesis 2 in Section 5.3). A reason for the much larger effect of the tax rate compared to the tax differential could be that debt shifting cost, i.e. cost of

[22] We apply the logarithm of firm age since the distribution of this variable is considerably skewed. Alternatively, taking no logarithmic transformation and additionally include the quadratic transformation of the age variable yields almost equal quantitative results.

Table 5.5: External Debt & Internal Debt Shifting

OLS Firm–Fixed–Effects, Panel 1998–2006
Sample of Multinational Subsidiary Firms
Dependent Variable: Debt–to–Assets Ratio

Explanatory Variables:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Stat. Corp. Tax Rate	.258***	.260***	.258***	.210***	.325***	.366***
	(.044)	(.043)	(.043)	(.044)	(.065)	(.066)
Tax Rate Differential	.058***	.055***	.055***	.045***	.046**	.044**
	(.016)	(.016)	(.016)	(.016)	(.022)	(.023)
(Tax Rate Differential)×						.237*
(Intangibles per Sales)						(.138)
Log Sales	.035***	.036***	.036***	.035***	.041***	.038***
	(.002)	(.002)	(.002)	(.002)	(.003)	(.003)
EBIT p. Total Assets			-.001***	-.001***	-.065***	-.118***
			(1e-4)	(1e-4)	(.025)	(.022)
Log Age					-.067***	
					(.006)	
Intangibles per Sales						.100**
						(.043)
Log GDP		-.003	-.003	-.003	.005	.005
		(.007)	(.007)	(.007)	(.009)	(.009)
Log GDP per Capita		-.153***	-.154***	-.157***	-.129**	-.175***
		(.018)	(.018)	(.020)	(.028)	(.027)
Corruption Index		.084***	.084***	.119*	-.003	.027
		(.024)	(.024)	(.026)	(.036)	(.036)
Log Lending Rate				.005		
				(.006)		
Year Dummies	√	√	√	√	√	√
# Observations	78,337	78,200	78,148	65,276	34,231	33,379
# Firms	14,332	14,332	14,326	13,044	6,837	6,697
Adjusted R^2	.6883	.6905	.6907	.7048	.7208	.7181

Notes: Heteroscedasticity robust standard errors adjusted for firm clusters in parentheses. *, **, *** indicates significance at the 10%, 5%, 1% level. Observational units are multinational subsidiaries that exhibit a foreign parent holding 100% of the ownership shares. Firms with losses during the whole sample period were dropped. Dependent variable is the sum of current and non-current liabilities to total assets. *Tax Rate Differential* is the statutory corporate tax rate difference to the parent firm, i.e. the tax rate of the considered subsidiary minus the parent tax rate, weighted by total asset shares. *(Tax Rate Differential)×(Intangibles per Sales)* is the interaction term of the tax differential with the intangibles per sales variable. *EBIT p. Total Assets* is earnings before interest and taxes per total assets. *Log Age* is the natural logarithm (Log) of years since establishing. Lending rate is the average interest rate for loans in the private sector. Adjusted R^2 values calculated from a dummy variables regression equivalent to the fixed-effects model.

changing the capital structure of two affiliates just for profit shifting purposes, might be significant and large (see Büttner and Wamser, 2007, for a similar conclusion).

Again, the tax effects of Table 5.5 are robust to the inclusion of our set of control

variables already applied in the regressions of Table 5.4. Thereby, the qualitative effects of the controls are unchanged but the respective coefficient estimates are slightly larger (besides for Log Sales). However, now the lending rate is no longer significant which potentially points to its asymmetric effect on external debt (negative) and internal debt (positive) while explicitly controlling for debt shifting (cf. Desai, Foley, and Hines, 2004b; Büttner, Overesch, Schreiber, and Wamser, 2006). As a new element, in Column (6) of Table 5.5, additionally to the firm-specific risk proxy (Intangibles per Sales) we include an interaction term of the tax rate differential and this risk proxy. We observe a weakly significant positive impact of the interaction variable on leverage suggesting that the debt-to-assets ratio of riskier subsidiaries reacts more elastic on changes in the tax rate difference to the parent. Thus, the higher the risk of a firm the more debt shifting with the parent is undertaken. This preliminary result supports our theoretical considerations (cf. Hypothesis 3 in Section 5.3), however, this issue will be further analyzed in a more rigorous way with sub-samples of high-risk and low-risk firms in the next two subsections.

5.6.3 High-risk vs. Low-risk Firms

We now test Hypothesis 3 of Section 5.3 in a more straightforward econometric approach. Hypothesis 3 says that it is more likely for subsidiaries with a high firm-specific risk to use debt shifting than for low-risk subsidiaries and, vice-versa, that it is more likely for low-risk affiliates to use external debt than for high-risk affiliates to get advantage of the depreciation tax shield. Therefore, we divide our sample of multinational subsidiaries into sub-samples of high-risk and low-risk firms. Thereby, we apply the two proxy variables for firm-specific risk introduced in Section 5.4.2. First, a subsidiary is labeled as a high-risk (low-risk) firm if it exhibits an *above (below)* average *Volatility of Profitability* which is the subsidiary's standard deviation of its EBIT margin, i.e. the ratio of earnings before interest and taxes to sales, over the sample period 1998–2006. This threshold mean is calculated with .102, i.e. 10.2 percentage points is the average standard deviation of a subsidiary's EBIT margin during the years 1998–2006.[23] In addition, as an alternative proxy for firm-specific risk that is less suspicious to be

[23]To gain a threshold mean that is at maximum representative for an average multinational affiliate, the calculations of the mean values are based on all available observations in the whole dataset of multinational parent firms and subsidiaries exported from AMADEUS. However, choosing the threshold mean based just on the subsidiary sample results in slightly lower mean values and does not change the resulting pattern of the asymmetric tax effects in the high-risk vs. low-risk firm sample.

Table 5.6: High–Risk vs. Low–Risk Firms

OLS Firm–Fixed–Effects, Panel 1998–2006
Sample of Multinational Subsidiary Firms
Dependent Variable: Debt–to–Assets Ratio

Sub–Sample	**High–Risk Firms**				**Low–Risk Firms**			
Risk Measure	Volatility of Profitability > Average		Intangibles per Sales > Average		Volatility of Profitability < Average		Intangibles per Sales < Average	
Explanat. Variables:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Stat. Corp. Tax Rate	.192***	.196***	.185***	.186***	.377***	.377***	.417***	.394***
	(.057)	(.056)	(.058)	(.056)	(.068)	(.067)	(.070)	(.068)
Tax Rate Differential	.078***	.073***	.064***	.060***	.023	.023	.044*	.047**
	(.021)	(.021)	(.021)	(.021)	(.023)	(.023)	(.025)	(.024)
Log Sales	.034***	.037***	.035***	.037***	.036***	.038***	.032***	.039***
	(.002)	(.002)	(.002)	(.002)	(.003)	(.003)	(.003)	(.003)
EBIT p. Total Assets		-.016*		-4e-4***		-4e-4***		-.114***
		(.009)		(9e-5)		(3e-5)		(.024)
Log GDP		-.010		-.010		.005		.005
		(.009)		(.009)		(.009)		(.009)
Log GDP per Capita		-.156***		-.134***		-.152***		-.186***
		(.023)		(.023)		(.028)		(.028)
Corruption Index		.131***		.115***		.017		.008
		(.032)		(.032)		(.037)		(.038)
Year Dummies	√	√	√	√	√	√	√	√
# Observations	8,333	8,288	4,273	4,272	28,976	28,924	29,164	29,107
# Firms	1,607	1,607	1,404	1,404	4,867	4,867	6,272	6,271
Adjusted R^2	.6789	.6831	.6889	.6913	.7037	.7056	.7160	.7254

Notes: Heteroscedasticity robust standard errors adjusted for firm clusters in parentheses.
*, **, *** indicates significance at the 10%, 5%, 1% level. Observational units are multinational subsidiaries that exhibit a foreign parent holding 100% of the ownership shares. Firms with losses during the whole sample period were dropped. Dependent variable is the sum of current and non-current liabilities to total assets. *Tax Rate Differential* is the statutory corporate tax rate difference to the parent firm, i.e. the tax rate of the considered subsidiary minus the parent tax rate, weighted by total asset shares. *EBIT p. Total Assets* is earnings before interest and taxes per total assets. Regressions (1) and (2) (Regressions (5) and (6)) include solely subsidiaries that exhibit an *above (below)* average *Volatility of Profitability* which is the standard deviation over the sample period 1998–2006 of the subsidiary's EBIT margin, i.e. the ratio of earnings before interest and taxes to sales. The threshold mean is calculated with .102. Regressions (3) and (4) (Regressions (7) and (8)) include solely subsidiaries that exhibit *above (below)* average *Intangible Assets per Sales*. This mean is calculated with .0342. Tax rate coefficients of Column (3) vs. (7) and of (4) vs. (8) are different at the 90% confidence interval, respectively. Adjusted R^2 values calculated from a dummy variables regression equivalent to the fixed-effects model.

endogenous and/or to misidentify firm-specific risk, we mark a subsidiary as a high-risk (low-risk) firm if it exhibits *above (below)* average *Intangible Assets per Sales*. The sample mean of this ratio is calculated with 3.42%.

The estimation results are presented in Table 5.6. For high-risk firms (Columns (1)–

(4) of Table 5.6), throughout, the coefficient of the tax differential is highly significant and around .07 which is larger than in the regressions with the whole subsidiary sample (Table 5.5). Whereas for low-risk firms (Columns (5)–(8) of Table 5.6), we observe no or just a weakly significant impact of the tax differential on the debt-to-assets ratio. On the contrary, the tax rate effect is much larger for low-risk than for high-risk firms (.39 vs. .19, on average). Note that the coefficient estimates of the tax rate in Column (3) vs. (7) and in (4) vs. (8) are each statistically different at the 90% confidence interval.[24] Thus, this pattern confirms our theoretical considerations and provides indirect evidence that high-risk firms use external debt less intensive (to adjust leverage due to tax rate changes to minimize tax payments) but are more involved in internal debt shifting than low-risk firms. Our set of control variables show the same effects than in the estimations with the whole subsidiary sample (Table 5.5). However, interestingly, the coefficient of the corruption index is no more significant in the sub-sample of low-risk firms suggesting that the quality of creditor rights in a country is only relevant for lenders of companies with a high firm-specific risk.

5.6.4 Robustness Check: High-risk vs. Low-risk Industries

We are aware of potential endogeneity concerns on our firm-specific risk proxies. The volatility of profitability variable and the intangibles per sales variable are obtained from the firm's balance sheet and might also be influenced by tax differentials, either indirectly via profit shifting activities (transfer pricing for intermediate goods) or directly via the location of profitable assets (see Dischinger and Riedel, 2008, or Chapter 3 of this thesis, respectively). Therefore, as a test of robustness, we apply an exogenous risk proxy which is the ratio of overall R&D expenditures to overall sales in German industries in the year 2005 based on a comprehensive survey of the Stifterverband für die Deutsche Wissenschaft (2007).[25] Analogue to the ratio of intangibles per sales, we interpret a high R&D-intensity in an industry as a high firm-specific risk, while assuming the German industry structure to be representative for European countries and additionally assuming the distribution of these R&D-intensities over the industries to be stable during our sample period. This ratio of R&D expenditures to sales has the

[24] Furthermore, taking solely subsidiaries in these regressions that actually own intangible assets yields more pronounced effects, i.e. the coefficient of the tax rate for the low-risk firm sample rises to .61 and is different from the coefficient in the high-risk firm sample on the 99% confidence interval. The mean of the ratio of intangibles to sales for this sub-sample is calculated with 5.94%.

[25] See Overesch and Schreiber (2008) for an empirical analysis of enhanced profit shifting activities due to higher R&D-intensities that likewise uses this survey data.

additional advantage of being solely based on R&D expenditures (the real risky characteristic of a firm) and not on patents, trademarks, royalties, etc. that are likely to be enclosed (if activated) in the balance sheet item intangible assets. Note that the share of capitalized patents or brands could be interpreted inversely with respect to the firm-specific risk as they might be used as collateral for debt and likewise may strengthen the market position against competitors. In the survey analysis of the Stifterverband für die Deutsche Wissenschaft (2007), the mean R&D-intensity of all industries is 4.0%.

Thus, we define the *Electronics Industry* and the *Consultancy Industry* to be *High–Risk Industries* as they exhibit an *above* average ratio of overall R&D expenditures to overall sales of 7.3% and 16.1%, respectively, referring to the survey. Our *Electronics Industry* sub-sample consists of subsidiaries with NACE codes 30–33 (=Subsection DL of the NACE systematic: Manufacture of electrical and optical equipment), and our *Consultancy Industry* sub-sample comprises subsidiaries with NACE codes 72–74 (=Computer and related activities; R&D; Other business activities). In contrast, we define the *Transport Industry* and the *Trade Industry* to be *Low–Risk Industries* as they exhibit a *below* average R&D-intensity of .5% and .6%, respectively. The *Transport Industry* sub-sample consists of subsidiaries with NACE codes 60–63 (=Land/water/air/pipeline transport; Supporting/auxiliary transport activities, activities of travel agencies), and the *Trade Industry* sub-sample comprises subsidiaries with NACE codes 51–52 (=Wholesale/retail/commission trade except of motor vehicles/cycles, repair of personal/household goods).[26]

The results are presented in Table 5.7. We observe an even more extreme pattern compared to Table 5.4: The tax rate is almost never significant for subsidiaries in high-risk industries (Columns (1)–(4) of Table 5.7), whereas the significant coefficients of the tax rate for subsidiaries in low-risk industries (Columns (5)–(8) of Table 5.7) are on a high level of .44, on average. On the other hand, the estimations show no effect of the tax differential for firms in low-risk industries, however, there is a significant and very large impact of the tax differential on the debt-to-assets ratio for firms in

[26]Note that adding the industries *Real estate activities* (NACE code 70) and *Renting of machinery and equipment without operator and of personal and household goods* (NACE code 71) to our *Consultancy Industry* sub-sample to represent the whole Section K of the NACE systematic does not change our results neither qualitatively nor quantitatively. Furthermore, adding the industry *Post and telecommunications* (NACE code 64) to our *Transport Industry* sub-sample to represent the whole Section I does not change our results qualitatively. In addition, adding the industry *Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel* (NACE code 50) to our *Trade Industry* sub-sample to represent the whole Section G again does not change our results qualitatively nor quantitatively.

Table 5.7: High–Risk vs. Low–Risk Industries

OLS Firm–Fixed–Effects, Panel 1998–2006
Sample of Multinational Subsidiary Firms
Dependent Variable: Debt–to–Assets Ratio

Sub–Sample	**High–Risk Industries**				**Low–Risk Industries**			
Industry	Electronics Industry		Consultancy Industry		Transport Industry		Trade Industry	
Explanat. Variables:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Stat. Corp. Tax Rate	.289*	.262	.105	.092	.612***	.466*	.325***	.369***
	(.168)	(.181)	(.128)	(.125)	(.250)	(.260)	(.069)	(.065)
Tax Rate Differential	.239***	.231***	.093**	.092**	.056	.067	.030	.021
	(.082)	(.082)	(.046)	(.046)	(.080)	(.076)	(.023)	(.022)
Log Sales	.020***	.027***	.030***	.031***	.054***	.059***	.048***	.059***
	(.007)	(.008)	(.003)	(.003)	(.008)	(.009)	(.003)	(.003)
EBIT p. Total Assets		-.112***		-4e-4***		-.038**		-.163***
		(.039)		(2e-5)		(.019)		(.028)
Log GDP		.063		-.024*		1.06**		.009**
		(.404)		(.014)		(.450)		(.004)
Log GDP per Capita		-.136		-.099*		-1.18***		-.228***
		(.405)		(.053)		(.449)		(.027)
Corruption Index		.064		.066		-.119		.027
		(.118)		(.066)		(.128)		(.040)
Year Dummies	√	√	√	√	√	√	√	√
# Observations	3,853	3,840	13,529	13,502	2,996	2,988	28,495	28,429
# Firms	656	656	2,953	2,949	551	551	4,917	4,916
Adjusted R^2	.6704	.6766	.6704	.6716	.6769	.6829	.6791	.6961

Notes: Heteroscedasticity robust standard errors adjusted for firm clusters in parentheses.
*, **, *** indicates significance at the 10%, 5%, 1% level. Observational units are multinational subsidiaries that exhibit a foreign parent holding 100% of the ownership shares. Firms with losses during the whole sample period were dropped. Dependent variable is the sum of current and non-current liabilities to total assets. *Tax Rate Differential* is the statutory corporate tax rate difference to the parent firm, i.e. the tax rate of the considered subsidiary minus the parent tax rate, weighted by total asset shares. *EBIT p. Total Assets* is earnings before interest and taxes per total assets. *High–Risk (Low–Risk) Industries* exhibit an *above (below)* average ratio of overall R&D expenditures to overall sales referring to a survey of the Stifterverband für die Deutsche Wissenschaft (2007) for German firms in the year 2005. In this study, the mean ratio is 4.0%. The *Electronics Industry* results in R&D expenditures per sales of 7.3% and consists of subsidiaries with NACE codes 30–33 (=Subsection DL: Manufacture of electrical and optical equipment). The *Consultancy Industry* results in R&D expenditures per sales of 16.1% and consists of subsidiaries with NACE codes 72–74 (=Computer and related activities; R&D; Other business activities). In contrast, the *Transport Industry* results in R&D expenditures per sales of .5% and consists of subsidiaries with NACE codes 60–63 (=Land transport, transport via pipelines; Water transport; Air transport; Supporting and auxiliary transport activities, activities of travel agencies). The *Trade Industry* results in R&D expenditures per sales of .6% and consists of subsidiaries with NACE codes 51–52 (=Wholesale trade and commission trade, except of motor vehicles and motorcycles; Retail trade, except of motor vehicles and motorcycles, repair of personal and household goods). Adjusted R^2 values calculated from a dummy variables regression equivalent to the fixed-effects model.

high-risk industries (coefficient of .16, on average).[27] These results confirm our original analysis of high-risk vs. low-risk firms in the previous subsection (Table 5.6) and likewise support our theoretical considerations. High-risk firms seems to use more internal debt shifting whereas low-risk firms relate more on external debt to adjust leverage in a tax-minimizing way. Note that now GDP enters significantly positive for the low-risk industry sub-sample suggesting that larger markets are characterized by a higher degree of competition (likewise for equity) which leads to a greater use of debt financing for low-risk firms.

We did further more general robustness checks on all of our regressions. First, we included in the estimations only observations with positive profits, second, only observations that exhibit any debt financing, and third, only observations with a debt-to-assets ratio larger than the 10% percentile of the distribution. Furthermore, we employed EBIT per sales instead of EBIT per total assets as the profitability measure. All these alternative estimations, respectively, did not alter our results either qualitatively or quantitatively.

5.7 Conclusions

First, our empirical analysis finds a significant and robust effect of the corporate tax differential on a multinational subsidiary's total leverage which indirectly provides evidence that intra-company debt shifting is used by MNEs to shift profits from high-tax to low-tax locations. Quantitatively, the subsidiary's debt-to-assets ratio increases by about 1% if the statutory corporate tax rate difference to the parent firm rises by 10 percentage points. With respect to the statutory corporate tax rate, while controlling for debt shifting incentives with the asset weighted tax differential, a 10 percentage points rise in the tax rate increases the subsidiary's leverage ratio by 5%, everything else being equal. The results are comparable with the existing literature. Obtaining additionally a positive effect of the tax rate while controlling for debt shifting is interpreted as indirect evidence that multinational subsidiaries simultaneously use external debt to react on tax rate changes in a tax-minimizing way. Second, our paper is the first showing that subsidiaries with an above average firm-specific risk are more involved

[27] Note that the same pattern of asymmetric tax effects also results taking other industries than the ones applied here. For example, using the industry *Manufacture of medical, precision and optical instruments, watches and clocks* (NACE code 33) as a high-risk industry (R&D-intensity of 8.9%, referring to the survey) or the industry *Manufacture of pulp, paper and paper products; Publishing and printing* (Subsection DE = NACE codes 21–22) as a low-risk industry (R&D-intensity of 1.2%).

in debt shifting activities than subsidiaries with a below average risk. However, low-risk subsidiaries use external debt more intensive to get advantage of the depreciation tax shield. Our large panel estimations with data on European MNEs control for firm size, profitability, age, various country characteristics, as well as time and affiliate fixed effects.

The adverse effects of MNEs' debt shifting activities for high-tax countries are broadly discussed in the existing literature. In general, even in the absence of any debt shifting, countries with a relatively high corporate tax rate exhibit lower tax bases of MNEs and of domestic firms, compared to low-tax countries. Over and above, with the use of internal debt shifting strategies by MNEs, corporate tax bases in high-tax countries are even more reduced as profits are shifted out of these countries to locations with a relatively low tax rate. Thus, by allocating debt over all possible locations, MNEs minimize their global tax payments. Most countries in the EU have already reacted to this with thin capitalization rules. Overesch and Wamser (2006), for example, provide evidence that debt shifting can be effectively limited by such regulations. They show that the German thin capitalization rule induces lower internal debt shares of multinational subsidiaries located in Germany. Büttner, Overesch, Schreiber, and Wamser (2008) can confirm this result, however, they also find that investment is adversely affected. In contrast, with the same database (MiDi), Weichenrieder and Windischbauer (2008) find only weak effects of the regulation tightening in Germany in 2001 and no evidence of reduced real investments. They presume that reorganizations within the MNE to circumvent the regulation could be a reason for this limited impact, e.g. the creation of ownership chains with intermediate holding companies.

Moreover, two alternative policies could be effective in fighting debt shifting and consequently profit shifting, but at the same time are politically difficult or very complex, respectively, and therefore far away from implementing. First, introducing a *Common Consolidated Corporate Tax Base (CCCTB)* would generally make shifting of profits within the EU pointless (see European Commission, 2001, and European Commission, 2008; or Fuest, 2008, for a review on the current state of the proposal). Second, limiting interest deduction allowances by complex tracing rules such that at the margin the MNE faces the same marginal corporate tax rate on every incremental monetary unit of debt (cf. Jog and Tang, 2001) would theoretically be an effective policy to dampen debt shifting.

With respect to the asymmetric use of external debt and internal debt shifting of high-risk versus low-risk firms, our results suggest that tax authorities should intensify tax audit at multinational affiliates with a high firm-specific risk. These are affiliates

that exhibit a relatively high R&D-intensity, that hold a large share of intangible assets, or that are characterized by a relatively volatile profitability. In addition, reducing imperfections in capital markets that results in lower interest rates, for example lowering the information asymmetry between creditor and debtor, might help to increase the high-risk affiliate's incentive for using external debt while simultaneously decreasing the incentive for using internal debt.

Interestingly, an alternative strategy to shift profits via internal borrowing and lending has not been analyzed in the literature yet: MNEs could significantly deviate intra-company interest rates from the market rates for income shifting purposes. Of course, similar to the regulation of transfer prices for intra-company traded goods, such a practice is forbidden by the arm's length principle. However, in general, a MNE can additionally shift income if e.g. the borrowing affiliate in a high-tax country pays a higher interest rate (than the market rate) to the lending affiliate in a low-tax country. An empirical analysis of internal interest rates or interest payments within MNEs might be possible e.g. with the MiDi database of the German Bundesbank or with the UK Annual Foreign Direct Investment register (AFDI). Furthermore, the comparability of credit agreements can be difficult for tax authorities due to heterogeneities for example with respect to dynamic interest rates, maturity, premature and unscheduled repayments, or special agreements. Hence, this opens up a scope to MNEs for further strategies of tax avoidance.

Chapter 6

Conclusions

This doctoral thesis empirically assessed corporate tax effects on the location decision of multinational enterprises' (MNEs) assets, profits and debt. The fundamental conclusion of this thesis is the observation that corporate activity of MNEs is significantly influenced by corporate taxation. The location of investments and the location of profits are affected by corporate tax rates as well as by tax rate differences within the multinational group. More precisely, on the one hand, MNEs minimize their global corporate tax liability by relocating profitable assets and functions to countries with a relatively low corporate tax rate, while on the other hand, MNEs use strategies to avoid corporate taxes by shifting income from high-tax to low-tax affiliates. This is inferred from numerous estimations using a large micro database of European MNEs for the years 1995 to 2006 and applying different specifications and econometric methods. The various panel regressions show an impact of corporate tax rates, as well as a robust impact of international tax differentials on multinational affiliates' level of intangible asset investment, rate of profitability, and degree of leverage.

If the results with respect to profit shifting activities are compared to the existing empirical literature using U.S. data, it has to be concluded that the amount of profits shifted by European MNEs seems not to be more pronounced than the volume shifted by U.S. MNEs. This is inferred from the smaller coefficient estimates. The supposition of a more extensive shifting behavior in Europe than in the U.S. could be justified due to larger tax rate differences between many neighboring states and the predominating *tax exemption system* within the European Union (EU). However, this cannot be confirmed by the study of Chapter 2. But, this thesis provides evidence of different strategies of European MNEs for shifting corporate income to low-tax locations. Hence, specific channels for profit shifting are empirically analyzed: first, the channel via research and development (R&D) or intangible assets respectively is studied. Intangibles are shown to be located at affiliates with a low corporate tax rate relative to all other affiliates of the multinational group (Chapter 3). Second, the channel via intra-company financial transactions is identified by providing evidence of debt shifting activities by MNEs to bias the allocation of pre-tax profits in favor of low-tax affiliates (Chapter 5).

The results of Chapter 4 are in line with the observations in Chapter 3. On the one hand, Chapter 4 provides evidence that the profitability gap between parent firms and their foreign subsidiaries (which indicates a much higher profitability of the multinational headquarters) significantly decreases over time. On the other hand, Chapter 3 finds a negative effect of a multinational subsidiary's corporate tax rate (relative to other affiliates) on the level of intangible asset investment at this subsidiary. These days are characterized by an increased fragmentation of the production process across

international borders which does not only comprise of standard operating functions like manufacturing and sales but more and more equally includes value-driving units like R&D and licensing departments. Thus, the evidence of intangible asset relocations to low-tax affiliates is consistent with an increasing mobility of profitable assets within MNEs in the last decade, which consequently results in a growing profitability of foreign subsidiaries, or vice-versa in a shrinking parent firm profitability. This in turn reduces the observed profitability gap.

One overall conclusion of the empirical analyzes in this thesis is a purely methodical one. In general, the research of corporate micro data is complex and difficult as firm behavior is to a high degree influenced by unobservable characteristics. For example, a firm's profitability level or the amount of intangible asset investments are likely to be driven by internal firm-specific factors like management quality, degree of product innovation or quality of the engineers. However, these factors are impossible to be captured by variables available in standard corporate accounting databases. Hence, the application of panel data in combination with econometric models that explicitly control for such unobserved heterogeneity by fixed-effects techniques is inevitable in providing unbiased estimations and thus leads to more reliable results of firm behavior. For example, in the analysis of Chapter 2, the coefficient estimates of the tax differential are considerably smaller in the panel estimations applying firm fixed effects (Table 2.3) than in the cross-section regressions where the inclusion of fixed firm effects is technically impossible (Table 2.4). Likewise, the study in Chapter 5 shows much smaller effects of the tax differential while controlling for *affiliate* fixed effects than comparable papers using fixed effects on the level of the multinational group (see Table 5.1).

Finally, with regard to conclusions for political consulting, the robust empirical evidence of profit shifting activities by European MNEs presented in this thesis yields a significant argument for the European Commission's proposed changeover from the current EU corporate tax principle of *separate accounting* to a system of *formula apportionment* (Common Consolidated Corporate Tax Base, CCCTB). The CCCTB system should in principle abolish the incentives for intra-European income shifting. Moreover, the more detailed results of this doctoral thesis provide the following more specific policy implications within the current EU tax system of *separate accounting*. Referring to the estimated positive effect of the parent firm's ownership shares of its foreign subsidiary on the profit shifting magnitude between the two affiliates, one policy advice for tax authorities in high-tax countries may be to condition the investigation intensity of MNEs' intra-company transactions with foreign affiliates on the level of the respective shareholding. Due to the time-intensive and complex assessment of transfer

pricing documentations, this selection could improve the efficiency of the tax auditing. In addition, relating to the observed more intensive use of debt shifting for high-risk versus low-risk firms, tax authorities should tighten tax examinations at multinational affiliates with a high firm-specific risk. Such high-risk affiliates may be characterized by relatively high R&D expenditures to sales, by a large share of intangible assets, or by a relatively volatile profitability, respectively. Furthermore, tax authorities in high-tax countries could likewise concentrate their inspections at affiliates of MNEs that exhibit clustered intangible asset holdings at low-tax locations within the multinational group, in particular with respect to patents, copyrights, and trademark rights.

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Eidesstattliche Versicherung

Ich versichere hiermit eidesstattlich, dass ich die vorliegende Arbeit selbständig und ohne fremde Hilfe verfasst habe. Die aus fremden Quellen direkt oder indirekt übernommenen Gedanken sowie mir gegebene Anregungen sind als solche kenntlich gemacht. Die Arbeit wurde bisher keiner anderen Prüfungsbehörde vorgelegt und auch noch nicht veröffentlicht.

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