Corporate Taxes, Profit Shifting and the Location of Intangibles within Multinational Firms

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Abstract

Intangible assets are one major source of profit shifting opportunities due to a highly intransparent transfer pricing process. Using a simple theoretical framework with multinational entities and transfer pricing, we show that multinational enterprises (MNEs) have an incentive to locate their shifting–relevant assets like intangibles at affiliates with a low statutory corporate tax rate within the MNE, since this optimizes their intra–group profit shifting opportunities. We test this hypothesis with panel data of European MNEs and by calculating for each affiliate the average tax rate difference to other affiliates of the corporate group. The smaller the statutory tax rate of a subsidiary relative to all other affiliates of the MNE, the larger is the probability of holding intangible assets and, furthermore, the larger is the share of intangible to total assets of this subsidiary. We employ various robustness checks to ensure that this result is indeed driven by profit shifting considerations.

JEL classification: H25, F23, H26, C33
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1 Introduction

In the last decades multinational enterprises (MNEs) have constantly expanded the functions of their foreign affiliates. Subsidiaries abroad are no longer used as production centers only, but also serve as research and development (R&D) units, product design centers or intellectual property and licensing departments. Several MNEs like Pfizer, Bristol–Myers Squibb and Microsoft have transferred a considerable part of their R&D investments from their home countries to Ireland. Others founded trademark holding companies abroad that own and administer the groups trademarks and licences. A famous example is Vodafone whose intangible properties are held by an Irish subsidiary.

All named examples have in common that intangible assets were relocated to Ireland, a country which is well–known to levy one of the lowest corporate tax rates in Europe. This development might reflect the MNEs' purpose to tax rents generated by the relocated intangible investment at a low statutory tax rate. Our paper, however, will provide an alternative explanation since we argue that the relocation of intangibles to low–tax affiliates is mainly motivated by the optimization of profit shifting strategies. The reason is that intangible assets are one major source of profit shifting opportunities due to a highly intransparent transfer pricing process.

We employ a simple theoretical model to derive hypotheses for the specification of our estimation equation. The model thereby assumes horizontally organized MNEs that produce a final output good using labor and an intangible factor as inputs. The intangible good is assumed to be a patent, royalty or trademark right and is produced at only one of the multinational affiliates and traded within the corporate group. Since we assume that tax authorities may not observe the true price for the intangible good, the MNE can distort the transfer price to shift profits between its locations. We investigate how corporate taxation affects the MNE's optimal location choice for its intangible asset production. We find that the MNE benefits most from locating its intangibles at the affiliate with the lowest tax rate within the multinational group since it may thus establish transfer pricing channels between this *tax haven affiliate* and all other affiliates located in countries with a higher corporate tax rate. In contrast, intangible location at one of the groups' high–tax affiliates opens up shifting possibilities solely between the *tax haven affiliate* and the intangible holding company, whereas other high–tax affiliates remain without shifting links to the *tax haven affiliate* via the intra–firm trade of intangibles. Henceforth, our model predicts that the probability to hold intangible assets increases, the lower an affiliate's statutory corporate tax rate compared to other group members.

We test this theoretical prediction using a panel of $6,800$ MNEs headquartered within the EU–25. Our data is drawn from the European micro database AMADEUS which contains detailed accounting information and enables a link between affiliates of a multinational corporate group. The data is available for the years 1995–2005.

Our purpose is to determine whether MNEs adjust their corporate structure to optimize profit shifting possibilities. Precisely, we determine whether the location of intangible assets is affected by the tax rate distribution of the different affiliate locations within the corporate group. Employing a conditional Logit model with fixed effects, we determine the effect of an affiliate's average statutory corporate tax rate difference to other affiliates of the multinational group on its probability to hold intangible assets. This calculated explainable variable of the *Average Tax Difference to Others* is the core element of our empirical analysis. Controlling for fixed firm effects, year effects and time–varying country characteristics, we find a significantly negative impact of this average tax differential on the probability of exhibiting intangibles. This means, in line with our theory, that the smaller a subsidiary's tax rate compared to all other affiliates of the MNE, the larger is its probability of holding intangible assets. Precisely, a decrease in the affiliate's statutory tax rate or an increase in the average tax rate of the other group members by 10 percentage points, respectively, raises the affiliate's probability of holding intangible assets by about 6% on average. We employ various robustness checks to ensure that this result is indeed driven by profit shifting considerations. The effect is robust against various specifications. To make sure that this effect does not only reflect a negative relation between corporate taxes and multinational investment in the sense that a low corporate tax rate raises the incentive to locate rent generating investments in a country, we rerun our regressions with an standard OLS fixed–effects model using the ratio of intangible assets over total assets as dependent variable. The qualitative results remain unchanged, now suggesting that a decrease in the tax rate of a subsidiary or an increase in the average tax rate of all other group affiliates by 10 percentage points, respectively, leads to a rise in the share of intangible to total assets at this location of nearly 14% on average.

We run several sensitivity checks on our results which equally confirm our hypothesis. Moreover, we test whether the estimate corporate tax effect on intangible asset location is indeed driven by profit shifting considerations. Thus, we show that an affiliate's profitability depends on its average tax difference to other affiliates, which suggests that profit shifting activities do not only take place between the headquarters and its subsidiaries (as suggested by previous papers) but within the whole multinational group. Moreover, in a companion paper (Dischinger and Riedel (2007)), we show that

profit shifting activities are indeed significantly larger if shifting–relevant assets (like e.g. intangibles) are located in low–tax countries within the multinational group.

The paper adds to a growing empirical literature that provides evidence for profit shifting activities. The first literature in this field were brought forward by Hines and Rice (1994) and Grubert and Mutti (1991) based on macro data for several countries. They find evidence in line with profit shifting activities. Follow–up studies by Collins, Kemsley, and Lang (1998) and Clausing (2003) support these qualitative results but rely on micro data that allow identification of the effect without imposing strong assumptions. Recent papers by Weichenrieder (2007), Dischinger (2007), Overesch (2006) and Huizinga and Laeven (2005) investigate shifting using European or German micro data, respectively. Our paper is most closely related to a work by Desai, Foley, and Hines (2006) who give evidence that large MNEs with high R&D intensities are most likely to locate in tax havens.[1] Our paper goes one step beyond this literature by showing that profit shifting opportunities within the multinational group depend on the location of profit shifting relevant assets like intangibles and by providing evidence that MNEs distort the location of these immaterial assets towards affiliates with a low tax rate relative to other affiliates of the corporate group.

The remainder of the paper is structured as follows. Section 2 presents a short theoretical motivation for our hypothesis, a detailed model can be found in the Appendix. In Section 3 we describe our data base and the sample construction. Section 4 states the basic estimation methodology. The estimation results are presented in Section 5. Finally, Section 6 concludes.

2   Short Theoretical Motivation

Our paper's main purpose is to investigate whether corporate taxation distorts the allocation of intangible assets within a corporate group to optimize profit shifting opportunities. In the following, we will shortly sketch the theoretical considerations which underly our empirical analysis. The corresponding formal model is presented in the Appendix.

Our model considers horizontal MNEs with production locations in several countries. The multinational affiliates produce an output good that is sold directly to local con-

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[1]In addition, Grubert (2003) provides evidence that subsidiaries in countries with a relatively low or high tax rate engage in a significantly larger volume of intercompany transactions which consist mainly of immaterial, R&D intensive goods like royalties or patents.

sumers. The final good production in turn requires an intermediate input good that is assumed to be produced by only *one* of the multinational affiliates.[2] Since the intermediate good is traded within the multinational group, it enables the MNE to shift profits between the intermediate producing affiliate and other affiliates of the group by distorting the goods' transfer prices from their arm's length price.

The intermediate good may be considered to be an intangible asset like a patent, royalty, trademark right or a management service. This refers to empirical evidence that indicates profit shifting activities to be strongly related to the existence of intangible assets within a MNE (e.g. Grubert (2003) and Desai, Foley, and Hines (2006)) since market prices for these firm–specific intangibles are in general hard to determine.

This model structure directly implies that the location of the intangible holding affiliate determines the MNE's profit shifting opportunities and henceforth the multinational after–tax profit. Our model will predict that the gains from profit shifting are maximized if the MNE's intangible assets are located in a country with a low corporate tax rate relative to other affiliates of the group. In the following, we will briefly present the intuition behind our model's results. For a more detailed discussion the reader is referred to the Appendix.

First and foremost, locating intangibles at the affiliate with the lowest tax rate generates a profit shifting link between this *tax haven affiliate* and *all* other group members which are located in countries with a higher tax rate. Thus, profit may be shifted from each high–tax affiliate to the intangible holding company in the low–tax country. In turn, 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 profit shifting links to this low–tax affiliate. Obviously, this provides a strong incentive to locate intangible assets at low–tax locations within the MNE.

However, for MNEs with both, a very asymmetric distribution of corporate earnings and a very asymmetric distribution of the corporate tax burden, it may become attractive to locate their intangibles at high–tax locations. Precisely, this situation might

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[2]There is an obvious asymmetry in the assumptions of final good production sites being located in every country and the intermediate good production being located in one country only. This may for example be justified by differing trade costs for intangible and tangible goods. If the MNE produces a tangible final good while the intermediate good is intangible in nature, the assumption may be motivated by prohibitively large trade costs for tangible goods whereas trade costs for intangibles are low and the MNE may thus exploit economies of scale by centralizing the intermediate good production at one location.

occur if all group affiliates are located in countries with a relatively low corporate tax rate and observe low earnings while one affiliate is located in a country with a very large tax rate and observes high earnings. Then, the MNE has an incentive to shift as much profit as possible from the high–tax affiliates to the low–tax members. In this situation, locating the intangible production at the high–tax affiliate may be profitable since this establishes a profit shifting link between this high–tax affiliate and all group members in low–tax countries. Thus, the MNE may benefit from shifting profit through several channels out of its high–tax location.

Taking into account tax auditing behavior of national tax offices, it nevertheless becomes obvious that even in this asymmetric setting, it is unlikely to be beneficial for the MNE to locate its intangibles at the high–tax affiliate.

First, the tax authorities' screening intensity depends on an affiliate's declared pre–tax profit in most OECD countries.[3] Formally, this is captured by tax evasion models in the tradition of Reinganum and Wilde (1985). If the pre–tax profit falls below a certain threshold, e.g. an industry average, the MNE's detection risk on shifting activities surges, in extreme cases may imply detection with probability of almost 1. Thus, it seems plausible to assume that the MNE's profit shifting gains are limited by these profit declaration thresholds. Therefore, at the high–tax affiliate, the MNE might not or only restrictively be able to make use of transfer pricing of intangibles and the implied enhanced shifting opportunities to other affiliates since its high–tax location's pre–tax profit would otherwise fall below the critical margin and induce increased screening activities by the national tax authority. Note, that this argument does not apply to intangibles that are located in low–tax countries as here profit is shifted *into* the country and, hence, the tax authority effectively does not control transfer prices in this situation.

Second, locating intangibles at high–tax affiliates may increase an MNE's shifting costs per unit shifted since the high–tax location's tax authority may use the additional information from controlling transfer pricing of intra–firm trade to *several* low–tax affiliates. Thus, if it detects irregularities in the pricing of one intermediate good it may well increase its screening effort on the pricing of other intermediates. This increases the MNE's detection risk and henceforth its expected profit shifting costs. Again, this

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[3]As the calculation of arm's length prices for transfer pricing auditing is difficult and sometimes impossible, tax authorities mostly apply the so called *Transaction Based Net Margin Method*, which compares the net margin of a respective affiliate with similar but non–affiliated firms of the same branch. For this, both sides, many transfer pricing consultants (e.g. Deloitte) as well as more and more tax authorities (e.g. Germany and France), use the AMADEUS database.

argument does not apply for intangibles located at low–tax locations since here profit is shifted into the country.

Consequently, the combination of the above three arguments leads us to the hypothesis that MNEs will tend to locate their intangible assets at affiliates with a low tax rate compared to other group members since this optimizes their profit shifting possibilities.

3   Data Set

We use 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. 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. Our criteria of being a multinational enterprise is the existence of a *foreign* corporate immediate shareholder (parent) with totally *at least 90%* ownership.[4] Therefore, the observational units of our analysis are multinational subsidiaries within the EU–25. Since we also require data from the parent company (e.g. the level of intangibles or the number and location of subsidiaries), the parent likewise has to be located within the EU–25. Nevertheless, our sample accounts for information on the *worldwide* structure of the corporate groups which is generally available with the AMADEUS data. Thus, we are able to calculate tax differences of our observational unit and all other subsidiaries of its parent irrespective if these subsidiaries are located within or outside of the EU–25.

We restrict our sample to subsidiaries whose foreign parent is an industrial corporation and which exhibit a minimum of *three* subsidiaries with the parent firm holding at least 90% of the ownership shares in each subsidiary. The restriction is supported by our theoretical hypotheses from Section 2, where we have shown that the strategical location of intangibles within the corporate group for the purpose of profit shifting is irrelevant for small MNEs with less than two foreign subsidiaries in different countries. In addition, we restrict the sample to multinational groups that actually own immaterial

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[4]The data restriction to firms with an ownership of 90% of the shares or more ensures that the potential location of profit and intangibles at this subsidiary is relevant for the multinational group. See Dischinger (2007) for an analysis on the influence of the parent's ownership share on the intensity of profit shifting.

assets, i.e. either the parent or at least one of its subsidiaries owns intangibles.

Our measure of intangibles is the balance sheet item *Immaterial Fixed Assets*.[5] Since many firms in the database report no information on this specific item, finally, our panel data sample consists of 44,190 observations from 6,800 MNE–subsidiaries for the years 1995 to 2005. Hence, we observe each affiliate for 6.5 years on average. With all above restrictions, our sample contains firms from all EU–25 countries despite Cyprus, the Baltic states, Malta and Slovenia. The country statistics are presented in Table 1 in the Appendix.

The AMADEUS data has the drawback that the information on the ownership structure is available for the last reported date only which is the year 2004 in most cases. Thus, by doing a panel study, there exists some scope for misclassifications of *parent–subsidiary–connections* that changed during the sample period. However, in line with previous studies, we are not too concerned about this issue since the described misclassifications introduce additional noise to our estimations that will bias our results towards zero (see e.g. Budd, Konings, and Slaughter (2005)).[6] We merge data on statutory corporate tax rates at the parent and subsidiary location, as well as basic country characteristics like GDP per capita and the population size.[7]

Table 2 in the Appendix displays basic sample statistics. We define a binary variable, named *Binary Intangible Assets Existence*, which takes on the value 1 if a subsidiary owns immaterial assets and 0 otherwise. The sample average is measured to be 0.524 and hence 52.4% of the subsidiaries in our sample hold intangibles. To quantify the amount of intangibles held relative to the affiliate's size we generate the *Share of Intangible to Total Assets* which exhibits a mean of 2.5% for the whole sample and 4.5% for the sub–sample of subsidiaries which actually own intangibles. The statutory corporate tax rate spreads from 10.0% to 56.8% whereas the mean is calculated with 33.6% on the subsidiary level and with 35.9% on the parent level. The average *Tax Difference to Parent*, which is the difference between the subsidiary's and the parent's

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[5]All balance sheet and profit & loss account items used in our analysis are exported from AMADEUS in unconsolidated values.

[6]Additionally, for the cross–section of the year 2004, we have compared our ownership data with that of the year 1998 and found that for 87% of our subsidiaries the country of the immediate shareholder (parent) is the same for both years. The country is the only relevant information for calculating tax differentials.

[7]The statutory tax rate data for the EU–25 is taken from the European Commission (2006), while the rates for affiliates outside the EU are based on data of the tax consultancy firm KPMG International (2006). Country data for GDP per capita and population are obtained from the OECD.

statutory corporate tax rates, is measured with -2.7%. The *Average Tax Difference to Other Affiliates*, which is the unweighted average corporate tax rate difference between a subsidiary and all other affiliates of the corporate group, spreads from -38.2% to 28.7% with a mean of -.77%.

Moreover, the mean of immaterial fixed assets is calculated with 3.1 million US dollars (but with a huge standard deviation of 110.4 million) at the subsidiary level and with 74.6 million (again with a huge standard deviation of 840.4 million) at the parent level. If we account solely for subsidiaries which are owned by at least 90% of the ownership shares, we find the average number of group subsidiaries to be 77.6. This estimate for the distribution's mean is partly driven by a few very large MNEs, as the median of the subsidiary number distribution is calculated with 24. On average, a subsidiary holds total assets amounting to 101.2 million US dollars.[8]

4   Econometric Approach

Our main purpose is to test the hypothesis of Section 2 which predicts that group affiliates with a low statutory corporate tax rate observe a high probability of holding intangible assets. We therefore estimate an equation of the following form

$$INTANG_{it} = \beta_0 + \beta_1 TAXDIFFOTHERS_{it} + \beta_2 X_{it} + \rho_t + \phi_i + \epsilon_{it} \qquad (1)$$

whereas $INTANG_{it}$ represents a binary variable that is equal to 1 if subsidiary i holds intangibles at time t and otherwise 0. X_{it} comprises time–varying country control characteristics like GDP per capita and the population size. Furthermore, year dummies ρ_t are included to capture shocks over time common to all subsidiaries. ϵ_{it} describes the error term. As our micro data is in a panel structure (6,800 subsidiaries, 1995–2005), we are able to add fixed effects of the subsidiaries to control for non-observable, time–constant firm specific characteristics ϕ_i. While the use of a fixed-effects model is suggestive while dealing with micro data, it is also preferred to a random-effects model suggested by a Hausman-Test. Equation (1) is estimated using a fixed–effects Logit model.

The explanatory variable of central interest is $TAXDIFFOTHERS_{it}$ which is defined as the difference between the statutory corporate tax rate of a subsidiary and the

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[8]For the evidence on profit shifting in Section 5.4, we apply additional accounting data of the firms. On average, the subsidiaries in these regressions earn a profit before taxation of 7.1 million and a turnover of 98.3 million US dollars, invest fixed assets of 54.8 million US dollars and employ 246.5 workers.

unweighted average tax rate of all other subsidiaries of its parent and of the parent itself.[9] This difference is calculated by subtracting the average tax rate of all other affiliates from the tax rate of the considered subsidiary. Our theory predicts that the more a subsidiary is located in a low–tax country within the corporate group, which is represented by a decrease in this *Average Tax Difference to Other Affiliates*, the larger is the affiliate's probability to hold intangible assets. Therefore, we expect $\beta_1 < 0$.

In an extension, we apply the ratio of intangible assets to total assets of a subsidiary as dependent variable to hedge against mixing up general tax effects on the overall investment at the subsidiary level with effects on the size of intangible assets and estimate Equation (1) using a OLS model with fixed effects.

As a robustness check, in Section 5.3, we focus on the subsidiary–parent channel and the distribution of intangibles between these two affiliates only. For this purpose, we apply the simple tax difference to the parent as explainable variable, again calculated by subtracting the parent tax rate from the tax rate of the considered subsidiary. To provide indirect evidence on profit shifting, in Section 5.4, our specifications substantially change. We then regress the unconsolidated profit before taxation of a subsidiary on various firm and country characteristics and additionally on the *Average Tax Difference to Other Affiliates*. By explaining variations in pre–tax profits, control variables on the firm level are the number of employees, as a proxy for the use of labor, and fixed assets as a proxy for the installed capital.

5 Empirical Results

This Section presents our empirical results. Throughout all regressions, the observational units of our panel analysis for the years 1995–2005 are the multinational subsidiaries as explained in Section 3. Additionally in all upcoming estimations, year dummy variables are included and heteroscedasticity robust standard errors adjusted for firm clusters are calculated and displayed in the tables in parentheses.

First, we dwell on our baseline estimation in Section 5.1 and on a small extension in Section 5.2. Subsequently, in Section 5.3, we run two simple robustness checks. Finally, we provide indirect evidence on profit shifting within MNEs in Section 5.4.

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[9]In the calculation of the average tax rate of all other affiliates we account for subsidiaries owned with at least 90% of the shares only.

5.1 Baseline Estimation

Regressions (1)–(4) of Table 3 in the Appendix present the basic Maximum–Likelihood estimations using a logit model with fixed effects. The dependent variable *Binary Intangible Assets Existence* is equal to 1 if a subsidiary generally holds immaterial fixed assets and is otherwise equal to 0. Controlling for fixed firm effects, many subsidiaries drop out of the estimation since they observe no variation in the status of intangible holding vs. non–intangible holding over the time period. Nevertheless, the estimations still consists of an adequate number of about $2,000$ firms for whom information is available for 7 years on average. In Specifications (1) and (2), we regress our binary intangible variable on the subsidiary's statutory tax rate. The coefficient estimate turns out to be negative and highly significant. Hence, the subsidiary's probability of holding intangibles decreases in the location's statutory tax rate. The effect increases in absolute size if we additionally control for the subsidiary country's characteristics.

However, the subsidiary's statutory tax rate is an imprecise measure since our theoretical hypotheses predicts intangibles to be located in countries with a low tax rate *relative to other affiliates* of the corporate group. This is captured in Specifications (3) and (4) of Table 3 by including the *Average Tax Difference to Other Affiliates* as explanatory variable. This variable is defined as the average tax differential between a subsidiary and all other group affiliates, as explained in the previous Section 4. In line with our hypotheses, the estimated coefficient is negative (-4.3) and significant at the 1% level. This suggests that the lower a subsidiary's statutory corporate tax rate compared to the tax rates of all other affiliates of the multinational group (including the parent), the higher is its probability of holding intangibles.[10]

In a second step, we reestimate the equation employing a linear OLS model with fixed firm effects in Specifications (5) and (6) of Table 3. The advantage of the OLS estimation model compared to the Logit model is that it makes use of all information in our data and does not preclude the sample to subsidiaries which observe a change over the time period in the status of intangible vs. non–intangible holding company. The estimation results are qualitatively equal to the Logit model. Ceteris paribus, a reduction of 10 percentage points in the statutory tax rate of a subsidiary or an increase of 10 percentage points in the average tax rate of the other affiliates, respectively, leads to a rise in the subsidiary's probability of holding intangibles of about 3.1 percentage

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[10]The coefficients of a Logit estimation cannot be interpreted quantitatively. Applying a Logit model with fixed effects makes the calculation of marginal effects impracticable as it requires specifying a distribution for the fixed effects.

points (cf. Column (6) of Table 3). As the mean of the probability of holding intangible assets is calculated with 52.4%, this is an increase of about 6% on average.

5.2 Extension

To ensure that our coefficient estimates for the *Average Tax Difference to Other Affiliates* do not reflect simple corporate tax effects on a subsidiary's asset investment, we additionally reestimate our specifications employing the subsidiarys share of intangible assets to total assets as the dependent variable. Methodologically, we refrain from a binary choice model and apply now a continuous OLS model with fixed effects. Estimation results are displayed in Table 4 in the Appendix. Overall, Table 4 shows qualitatively equal tax effects as Table 3. The subsidiary's ratio of intangibles seems to be explicitly distorted towards low–tax countries within the MNEs. The larger the *Average Tax Difference to Other Affiliates*, the higher is the subsidiary's tax rate compared to other affiliates in the group and, thus, the smaller should be its relative amount of intangible assets. This theoretical notion is confirmed by the data since the estimated coefficient of the tax differential is negative and statistically significant at the 1% and 5% level. Hence, a reduction of 10 percentage points in the statutory tax rate of a subsidiary or an increase of 10 percentage points in the average tax rate of the other affiliates, respectively, leads to a rise in the share of intangible to total assets of .35 percentage points (cf. Column (3) of Table 4) at this location, other things being equal. As the mean of the ratio of intangible to total assets is 2.5%, this is a substantial increase of nearly 14% on average. Controlling for fixed firm and year effects, we can explain about 70% of the variation in the shares of intangibles of about 6,500 subsidiaries which appear on average nearly 6.5 years in the regressions.

In Regressions (1) and (3) the whole sample of multinational subsidiaries is used which also includes 47.6% of firms with no intangibles. If, however, the regressions consists solely of subsidiaries that actually exhibit intangible assets, as displayed in Column (2) and (4) of Table 4, the effect of the tax rate and the tax differential, respectively, on the share of intangibles is substantially more pronounced, and, in addition, yields a higher adjusted R^2 value.

5.3 Robustness Checks

At first, we ran all specifications with the additional inclusion of 110 one–digit NACE code industry–year dummies. This add–on did not change any of our qualitative and

quantitativ results.

For a general sensitivity test, we now focus on the single subsidiary–parent channel and the distribution of intangibles between these two affiliates only. This is motivated by the stylized fact that parent firms still *rather hold* intangible assets than subsidiaries and that they on average hold *more* intangibles than their subsidiaries. The parent's probability of exhibiting intangibles is calculated with 65.6% compared to 52.4% for subsidiaries. The parent's share of intangibles to the sum of parent and subsidiary intangibles is 71.6 on average. Likewise, the probability of holding more intangibles than its subsidiary results to 72.0%.

The dependent variable in the first robustness check presented in Table 5 in the Appendix is the subsidiary's share of immaterial assets to the sum of immaterial assets of that subsidiary and its parent.[11] To analyze the distribution of intangibles between the subsidiary and its parent, we obviously have to apply the simple tax difference to the parent as explainable variable, which is again calculated by subtracting the parent tax rate from the tax rate of the considered subsidiary. The coefficient of the tax differential is negative and highly significant, indicating an increase in the subsidiary's share of intangibles relative to the sum of parent and subsidiary intangibles of about 11 percentage points, if the tax difference to its parent decreases by 10 percentage points (cf. Column (3) of Table 5).

In a second robustness check displayed in Table 6 in the Appendix, we replace the dependent variable by a binary variable that is equal to 1 if a subsidiary owns at least as much intangible assets as its parent and is equal to 0 otherwise.[12] The explainable variables stay the same. The Logit and the OLS estimations with fixed effects again show the same highly significant picture. The subsidiary's probability to hold a level of intangibles that is at least as high as the one of its parent substantially decreases with the tax differential.

In both robustness checks of Table 5 and 6, the coefficients of the tax differential increases by approximately 24% if the regressions are restricted to subsidiaries that hold intangible assets (Columns (2) and (4) of Table 5 and 6, respectively).

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[11]A subsidiary owns on average 28.4% of the sum of both levels of immaterial assets. This mean rises to 44.7% for the sub–sample of solely intangible holding subsidiaries.

[12]The probability of exhibiting at least as much intangibles as the parent is 28.0% for all subsidiaries and 43.7% for subsidiaries that own intangibles.

5.4 Profit Shifting Evidence

In a last step, we test the relevance of our variable *Average Tax Difference to Other Affiliates* in a standard approach to give indirect evidence of profit shifting. For this purpose, the specification substantially changes. In line with the empirical literature on profit shifting, we regress the unconsolidated pre–tax profit of a subsidiary on the number of employees (as a proxy for labor), on the level of fixed assets (as a proxy for capital), on country characteristics and additionally on the *Average Tax Difference to Other Affiliates*. The firm variables are calculated per operating revenue (sales) to control for economies of scale and are transformed in logarithmic form whereby the regressions consist solely of profit–making subsidiaries. Estimation results are shown in Table 7 in the Appendix.

The literature has so far applied the simple tax difference to the parent as the main variable in explaining variations in pre–tax profits of multinational affiliates to give indirect evidence of profit shifting (see Huizinga and Laeven (2005) or Dischinger (2007)). In this connection, the underlying assumption is that profit is shifted mainly between the parent firm and its subsidiaries, respectively, and, thus, that the tax differential to the parent gives the proper incentive to shift profits. However, in our paper, we presume that, to a significant volume, the shifting of profits also takes place between subsidiaries. Therefore, the more relevant tax differential in this indirect empirical approach might be a measure that capture a firm's tax rate *relative to all other* affiliates of the group to potentially give the more precise incentive to relocate profits. Such a measure is best represented by our variable *Average Tax Difference to Other Affiliates*.

The coefficients of all three tax measures of Table 7, the subsidiary's *Statutory Tax Rate* in Regressions (1) and (2), the *Tax Difference to Parent* in Regressions (3) and (4) and the *Average Tax Difference to Other Affiliates* in Regressions (5) and (6) have the correct negative sign and are significant at the 1% and 5% level. This indicates a higher pre–tax profitability for subsidiaries with a lower tax rate. For this indirect evidence of profit shifting, applying our preferred *Average Tax Difference to Other Affiliates* compared to the simple *Tax Difference to Parent*, yields a more than twofold larger coefficient and additionally a higher significance level.

As not only the allocation of intangibles within a MNE can be explained with the tax rate distribution of the different affiliate locations within the corporate group (*Average Tax Difference to Other Affiliates*), but also the allocation of pre–tax profits, we come to the conclusion that the optimization of profit shifting possibilities is one of the main purposes of locating intangibles strictly at or with a higher rate at low–tax subsidiaries

within the corporate group.

To give direct evidence that our main results from Section 5.1–5.3 are indeed driven by profit shifting considerations, is a complex analysis. We would like to show that low–tax affiliates which exhibit a high or above–average share of intangibles, shift more profits, and vice versa. However, the affiliate's endowment of intangibles is endogenous and correlated with the tax differentials. In a companion paper (Dischinger and Riedel (2007)), we show that profit shifting activities are indeed significantly larger if headquarters are located in low–tax countries within the multinational group. Headquarters still own a higher level of intangible assets than affiliates and the headquarters location is exogenous.

6   Conclusions

Although the economic literature has provided extensive evidence on profit shifting behavior of MNEs, the interaction between the organizational structure and the volume of profit shifting has been largely unexplored. Desai, Foley, and Hines (2006) and Grubert and Slemrod (1998) are notable exceptions that touch this question. They show that a MNE's presence in tax havens is related to the importance of intra–firm trade and intangible assets within a firm. Our paper goes one step further. We analyze where central multinational functions like patents or trademark rights have to be located within a corporate group to obtain the best profit shifting opportunities. Our theory suggests that MNEs have an incentive to distort the location of shifting–relevant assets like intangibles towards the affiliate with the lowest statutory corporate tax rate relative to other affiliates of the multinational group, since this optimizes the intra–firm profit shifting possibilities. Employing panel data of $6,800$ European MNEs for the years 1995–2005, we provide evidence in line with this hypothesis and show that MNEs in fact distort the location of immaterial assets towards low–tax countries within the corporate group. This result is in line with anecdotic evidence on recent relocation of central management units as well as R&D centers and brand holding affiliates of MNEs to tax havens.

To test our theoretical hypothesis, we estimate a fixed–effects Logit model with the dependent binary variable equal to unity if a multinational subsidiary exhibits any immaterial assets and, otherwise, equal to zero. We explain the existence of intangibles at a subsidiary with the difference between the tax rate of this subsidiary and the average tax rate of all other affiliates of the corporate group including the parent. This

calculated variable of the *Average Tax Difference to Others* is the core element of our empirical analysis. With this explainable variable, we additionally estimate an OLS model with fixed firm effects and apply as dependent variable the subsidiary's share of intangible assets to total assets. The empirical results confirm our theory that the smaller the statutory tax rate of a subsidiary compared to all other affiliates of the MNE, the larger is the probability of holding intangible assets and, furthermore, the larger is the share of intangible to total assets of this subsidiary.

Our theoretical and empirical model thus provides a rational and evidence that a relocation of intangibles, which are highly relevant for the shifting of profits, to low–tax countries may be attractive under profit shifting considerations. Given that immaterial assets are often related to skill–intensive corporate functions like R&D, management services and brand–holding and may comprise central decision units within the MNE, countries might desire to locate these parts of a MNE within their borders (see Bundesministerium für Finanzen (2007)), even beyond profit shifting considerations. This new mobility of intangibles holding central service units within the MNE may thus foster tax competition behavior between governments.

7 Appendix

7.1 Simple Theoretical Model

We consider a simple model with three countries a, b and c. Each country hosts an affiliate of a representative MNE that produces a homogeneous good for the local market. The price of the good is normalized to 1 in all countries. For simplicity reasons, the production of the good is assumed to use labor L as only input factor. The production function carries the standard properties $F(0) = 0$, $F'(L) > 0$ and $F''(L) < 0$. Wage costs are given by w and are considered to be fixed from the perspective of the MNE.

Our analysis considers the MNE to be horizontally organized in the sense that final production takes place in the local markets, i.e. at the local affiliates in countries a, b and c. Thus, trade costs for the tangible output good are assumed to be prohibitively high so that the MNE does not consider to serve markets from foreign productions sites. The production of the final good is assumed to require one unit of an intermediate good which is manufactured by the MNE. This intermediate good may be considered to be an intangible assets like a patent, royalty, trademark right or a management service. However, in contrast to the final output, the intangible intermediate is supposed to be provided by only *one* of the affiliates. This assumption may be justified by low trade costs for intangibles (in contrast to the final output goods). Hence, the MNE may profit from centralizing the intermediate good production at one location, e.g. by taking advantage of scale economies in the production process.

The intangibles holding affiliate produces the intermediate good at production costs of 1 and delivers one unit to each of the other multinational affiliates. We assume that the national tax authority may not observe the true price for the intermediate good correctly and therefore the intangibles producing affiliate i may deliver the intermediate good to the other group locations j at a transfer price p_j that differs from the true price of 1, with $i, j \in \{a, b, c\}$, $i \neq j$. This assumption is empirically motivated since profit shifting behavior is known to be strongly related to a MNE's ownership of immaterial assets, like patents, royalties or trademarks (see e.g. Desai, Foley, and Hines (2006) and Grubert (2003)). Intuitively, in contrast to tangible output, arm's length prices for firm specific intangibles are more difficult to observe for the tax authority and, hence, they are the more intransparent assets which open up a significantly higher scope for profit shifting.

In line with the previous literature, we assume that distorting the transfer price from the true price is associated with costs. These costs occur since the tax authority may

investigate the MNE's transfer pricing choice and may detect the price distortion with a certain probability that is assumed to depend on the absolute price deviation from the true price of 1. This corresponds to the perception that tax authorities are more likely to detect irregularities in transfer pricing behavior if the price strongly deviates from the good's true value. If the detection of shifting activities entails fine payments, expected shifting costs rise in the transfer price deviation.[13] Thus, we assume transfer pricing cost to take on a convex functional form

$$C_j = C_j(s_j, s_k \cdot \alpha), \quad C_j(0,0) = 0, \quad sign\left(\frac{\partial C_j}{\partial s_j}\right) = sign(s_j), \quad \frac{\partial^2 C_j}{\partial s_j^2} > 0, \qquad (2)$$

whereas $s_j = p_j - 1$ denotes the shifting volume between affiliate j and the intangibles holding affiliate i, with $i, j, k \in \{a, b, c\}$ and $i \neq j \neq k$. The parameter α is explained below. This implies that the shifting volume s_j takes on positive (negative) values if profit is shifted from affiliate j to affiliate i (from affiliate i to affiliate j). In contrast to previous work, we account for complex multinational structures in the sense that profit may not only be shifted between the intangibles holding company i and *one* of the other pure production affiliates j but also between i and the other pure production affiliate k. This raises the necessity to specify the interaction of profit shifting costs on these two channels.

It seems reasonable to assume that the national tax authority at the intangibles holding affiliate's host country makes use of the additional information from controlling *two* different affiliate–affiliate connections. This implies a positive correlation in detection risks in the sense that if the tax officials find that the transfer price p_k deviates from the true price, they increase their investigation intensity with respect to the other price p_j, with $j, k \in \{a, b, c\}$ and $j \neq k$. Thus, increased shifting activities between affiliate k and the intangibles holding affiliate i raise the detection risk on that channel and henceforth also enlarge the detection risk for profit shifting between affiliate j and i. Formally, this implies $\partial^2 C_j/(\partial s_j \partial(|s_k|)) > 0$ for $j, k \in \{a, b, c\}$ and $j \neq k$.

However, plausibly only tax authorities in high–tax countries have an incentive to stop profit relocation (see e.g. Peralta, Wauthy, and Ypersele (2003)). Therefore, the interaction between shifting costs applies only if profit is shifted *out* of the intangibles holding affiliate's host country. Formally, this is captured by the parameter α with $\alpha = 1$ if affiliate i observes the highest tax rate within the corporate group and $\alpha = 0$ otherwise. In contrast, MNEs with intangibles holding affiliates in low–tax countries are effectively controlled solely at the high–tax affiliates. Since international cooperation

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[13]See Haufler and Schjelderup (2000) and Huber (1997).

between tax authorities is still very small, these MNEs do not face increased shifting costs due to shifting activities via other affiliates.[14]

Thus, pre–tax profit at the intangibles holding affiliate i and the pure production affiliates j reads

$$\Pi_i = [F(L_i) - wL_i] + \sum_j (p_j - 1) - 1, \tag{3}$$

$$\Pi_j = [F(L_j) - wL_j] - p_j, \tag{4}$$

with $i, j \in \{a, b, c\}$, $i \neq j$. The MNE's overall after–tax profit is given by

$$\Pi = (1 - t_i)\Pi_i + \sum_j (1 - t_j)\Pi_j - \sum_j C_j(s_j, s_k \cdot \alpha), \tag{5}$$
$$\text{with} \quad i, j, k \in \{a, b, c\}, \ i \neq j \neq k,$$

and with t_i and t_j being the corporate statutory tax rates at the affiliates' locations. The MNE maximizes its after–tax profit by first choosing where to locate the intangible good production and by second deciding on the optimal transfer prices, i.e. the optimal shifting volume s_i^*.

2nd Stage: Transfer Prices and Labor Demand

At the second stage the MNE chooses its optimal transfer prices for the intangible intermediates. Maximizing after–tax profit in Equation (6) with respect to s_j gives

$$t_j - t_i = \frac{\partial C_j(s_j, s_k \cdot \alpha)}{\partial s_j}, \quad i, j, k \in \{a, b, c\}, \ i \neq j \neq k. \tag{6}$$

If $t_i < t_j$ ($t_i > t_j$), profit is shifted from affiliate j to the intangibles holding affiliate i (from the intangibles holding affiliate i to affiliate j) by choosing a transfer price p_j larger (smaller) than the true price 1.

Hence, the direction and volume of profit shifted is shown to depend on the difference in the statutory corporate tax rates between two countries. In the following, we will demonstrate that profit shifting reacts less sensitively to tax rate differentials if the intangibles holding affiliate is located in a high–tax country. There are two reasons for this. First, if the MNE's intangibles holding affiliate is located at a high–tax country ($\alpha = 1$), shifting costs are ceteris paribus larger than in case of intangible intermediates

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[14]Communication and information exchange between the national tax authorities in the OECD are restricted to individual examples (see e.g. interview with Jeffrey Owens, Head of Fiscal Affairs at OECD, OECD Observer (2000)).

location at the low–tax country as we clarified in the previous section. Second, in the tradition of the tax evasion model by Reinganum and Wilde (1985), one may presume that tax limitations restrict the MNE's profit shifting opportunities. Assume therefore that the tax authority's investigation effort is a function of an affiliate's profitability in the sense that the tax authority chooses a very high investigation effort if the affiliate profit falls below a certain threshold. In this case, profit shifting is detected almost with certainty. Thus, the MNE may reduce its profit at high–tax locations by a margin of only $\hat{\Pi}_i = \Pi_i - \overline{\overline{\Pi}}$ only, with $i \in \{a, b, c\}$. For $t_i > t_j$, an inner solution to Equation (6) is guaranteed only if $\hat{\Pi}_i > s_j^* + s_k^*$. Hence, if the intangibles producing affiliate was located in the high–tax country, then profit shifting is determined by Equation (6) only in the case that the profit at this location exceeds the optimal shifting volume to the affiliates, s_j^* and s_k^*. Otherwise, it holds that $\hat{\Pi}_i = s_j^* + s_k^*$, and profit shifting from the intangibles holding affiliate to the other affiliates is characterized by

$$\frac{t_j - t_i}{\partial C_j(s_j, s_k \cdot \alpha)/\partial s_j} = \frac{t_k - t_i}{\partial C_k(s_k, s_j \cdot \alpha)/\partial s_k} > 1, \quad i, j, k \in \{a, b, c\}, \ i \neq j \neq k. \tag{7}$$

Therefore, if the amount of profit generated at the intangibles holding affiliate is low and falls short of the optimal shifting volume, the MNE adjusts its profit shifting activities such that the ratio of marginal shifting gains to marginal shifting costs is equated across channels (Equation (7)).

Compare this with the case $t_i < t_j$. Then, we arrive at an inner solution only if Equation (6) holds, i.e. if $\hat{\Pi}_j > s_i^*$ for $j \in \{a, b, c\}$ and $j \neq i$. Hence, the optimal shifting volume determined in Equation (6) is chosen only if affiliate j's profit exceeds the desired shifting amount. Otherwise, it holds that $s_i^* = \hat{\Pi}_j$. Due to the symmetry in the modeling of the three affiliates, all pre–tax profits *before shifting* are equal across countries as can easily be seen from Equations (4) and (2). Thus, $[F(L_i) - wL_i] = [F(L_j) - wL_j]$ holds for $i, j \in \{a, b, c\}$ and $i \neq j$. It follows that the restriction of profit shifting through limited amounts of earnings is more likely to occur if the intangibles holding affiliate is located in the high–tax than in the low–tax country. The effects described above lead to the following Proposition.

Proposition 1. *The volume of profit shifted between the multinational affiliates will be more sensitive to tax rate differentials if the intangibles holding affiliate is located in the country with the lowest corporate tax rate than if it is located in the country with the highest tax rate.*

1st Stage: Location Choice of the Intermediates Producing Affiliate

At the first stage, the MNE decides where to locate the intangible intermediate good production. Thereby, again, its objective function is to maximize overall after–tax profits, in doing so, accounting for its optimal profit shifting strategies on the second stage. Hence, the MNE will locate its intermediate production in country c if the MNE's overall after–tax profit Π^c which corresponds to intermediate good production in country c is larger than profits Π^a and Π^b that correspond to intermediate production in country a and b, respectively. Since production in our model takes place at the affiliate locations irrespective of the location of the intermediates, the location choice is determined solely by profit shifting considerations. For the model to fit the data, we specify a non deterministic location choice and therefore make the additional assumption that the location decision of each MNE is also governed by a specific valuation parameter μ_i for each possible location $i \in \{a, b, c\}$. μ_i is taken to be a random variable with mean zero (and positive variance). Both aspects are reflected in

$$ S^i = \sum_j \left[(t_j - t_i)(p_j - 1) - C_j(s_j, s_k \cdot \alpha) \right] + \mu_i, \quad i, j, k \in \{a, b, c\}, \ i \neq j \neq k. \tag{8} $$

S^i thereby stands for the profit shifting gain if the MNE locates its intangible intermediates production in country i plus the firm specific location valuation. For example, the MNE will locate the intangibles holding affiliate at country c if $S^c > S^a$ and $S^c > S^b$. Let us first focus on potential shifting gains conditional on the intangible intermediates location. Consider for example the tax rate distribution $t_a > t_b > t_c$ with $t_b = (t_a + t_c)/2$. If we abstract from shifting costs for the moment, we know that the gross shifting gain is identical irrespective of whether the intangibles holding affiliate is located in country a (with the highest tax rate) or in country c (with the lowest tax rate). This is true because the tax rate differentials between the affiliate and, thus, the shifting gains are identical. However, from Equation (6) it follows that, for a given difference in corporate tax rates, the shifting costs are larger if the intangibles holding affiliate is located at the high–tax country. Therefore, since location at the high–tax country implies higher shifting costs as well as shifting caps caused by a limited pre–tax (and pre–shifting) profit, the MNE will always strictly prefer the low–tax country c as the location for the intangible intermediates production.

If the intangibles holding affiliate instead is located in country b, the MNE had an incentive to shift profit from the intangibles holding affiliate location b to the low–tax country c and from the high–tax country a to the intangible intermediates location.

Thus, profit is shifted out of country b only via one channel, and hence the detection risk of profit shifting through different channels is independent from each other. Therefore, the same amount of profit would be shifted from countries b to c irrespective of intangible intermediates location in country b or c. However, it holds that $t_a - t_c > t_a - t_b$ and hence the tax rate differential between countries a and c is larger by assumption than the differential between countries a and b (in absolute terms). Thus, the MNE will earn larger gains by shifting profit from country a to country c and taxing it there at the lowest available corporate tax rate. It follows from the reasoning above that the MNE prefers to locate the intangibles holding affiliate in the low–tax country c. Taking into account the intrinsic valuation μ_i for each location h, the tax rate distribution $t_a > t_b > t_c$ implies that $E(S^c) > E(S^b) > E(S^a)$. We arrive at the following proposition.

Proposition 2. *For a given symmetric distribution of corporate tax rates, the probability to attract the intangibles holding affiliate of a MNE is largest for the country with the lowest tax rate.*

Proposition 2 was derived under the assumption of a symmetric corporate tax distribution and equal pre–shifting profits at all affiliate locations. But our results still hold for asymmetric tax and profit distributions if the pre–tax profit of the affiliate with the highest corporate tax rate does not become very large compared to the pre–shifting profit of the affiliate with the medium sized tax rate, and if the tax rate distribution does not become very asymmetric in the sense that one high–tax affiliate faces two affiliates with very low tax rates.

7.2 Tables

Table 1: Country Statistics	
Country	*Subsidiaries*
Austria	89
Belgium	466
Czech Republic	221
Denmark	443
Finland	325
France	824
Germany	321
Great Britain	1,008
Greece	59
Hungary	99
Ireland	135
Italy	493
Luxembourg	33
Netherlands	590
Poland	396
Portugal	105
Slovakia	44
Spain	676
Sweden	473
Sum	6,800

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Table 2: Descriptive Statistics

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Variable	Observations	Mean	Std. Dev.
Subsidiary Level:			
Binary Intangible Assets Existence	44,190	.5238	.4994
Share Intangible Assets to Total Assets	44,189	.0254	.0837
(All Subsidiaries)			
Share Intangible Assets to Total Assets	23,146	.0486	.1107
(Solely Subsidiaries with Intangibles)			
Statutory (Corporate) Tax Rate	44,190	.3363	.0625
Tax Difference to Parent♦	31,582	-.0265	.0778
Average Tax Difference to Other Affiliates♦	42,518	-.00768	.0655
Immaterial Fixed Assets★	44,190	3,138	110,401
Total Assets★	44,189	101,229	862,612
Profit before Taxation★	24,446	7,062	48,353
Number of Employees	24,446	246.5	976.2
Fixed Assets★	24,446	54,781	599,432
Operating Revenue★	24,446	98,320	449,626
Parent Level:			
Statutory (Corporate) Tax Rate	31,582	.3586	.0636
Immaterial Fixed Assets★	31,582	74,623	840,448
Number of Subsidiaries▲	44,190	77.6	133.0
Country Level:			
GDP per Capita	44,190	24,491	5,622
Population	44,190	35,574	23,599

Notes:
★ In thousand US dollars, current prices.
▲ Subsidiaries owned with $\geq 90\%$ of the ownership shares. Median: 24, Min.: 3, Max.: 752.
♦ Calculated by: Subsidiary tax rate minus parent tax rate, or minus the average tax rate of all other parent's subsidiaries (owned with $\geq 90\%$) and the parent, respectively.

Table 3: Baseline Estimation, Logit & OLS Fixed–Effects, Panel 1995–2005						
Dependent Variable: Binary Intangible Assets Existence						

Variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Statutory Tax Rate	-3.550***	-5.563***			-.4212***	
	(1.127)	(1.289)			(.1202)	
Average Tax Difference to Other Affiliates			-2.929***	-4.267***		-.3092***
			(1.026)	(1.170)		(.1043)
GDP p. Capita (p. 100th)		19.68***		17.63***	1.073***	.9276***
		(6.083)		(6.040)	(.3487)	(.3495)
Population (p. 100th)		-25.71***		-27.28***	-1.658**	-1.734**
		(8.569)		(8.763)	(.7171)	(.7323)
Model	Logit	Logit	Logit	Logit	OLS	OLS
Number of Observations	17,202	14,807	16,613	14,283	44,190	42,518
Number of Firms	2,293	2,083	2,215	2,009	6,800	6,546
Pseudo R^2 or Adj. R^2	.0211	.0264	.0199	.0262	.7043	.7039

Notes: Heteroscedasticity robust standard errors adjusted for firm clusters in parentheses.
*, **, *** indicates significance at the 10%, 5%, 1% level. The observational units are multinational subsidiaries, i.e. they exhibit a foreign parent with at least 90% of the ownership shares. In Regressions (1) – (4), a Logit model with fixed firm effects is applied, in (5) – (6) a linear OLS model with fixed firm effects is estimated. The dependent binary variable is equal to 1 if a subsidiary generally owns immaterial fixed assets and is otherwise equal to 0. The variable *Average Tax Difference to Other Affiliates* is defined as the unweighted average tax difference between the considered subsidiary and each of the other affiliates of the corporate group including the parent, whereas each difference is calculated by subtracting the tax rate of the other affiliate from the tax rate of the considered subsidiary. All regressions include year dummy variables.

Table 4: Extension, OLS Fixed–Effects, Panel 1995–2005				
Dependent Variable: Share Intangible Assets to Total Assets				
Variable	*(1)*	*(2)*	*(3)*	*(4)*
Statutory Tax Rate	-.0426***	-.0613***		
	(.0148)	(.0207)		
Average Tax Difference to Other Affiliates			-.0351***	-.0430**
			(.0139)	(.0202)
GDP per Capita (per 100 thousand)	.0251	-.3711***	.0266	-.3801***
	(.0435)	(.1100)	(.0442)	(.1117)
Population (per 100 thousand)	.2173*	.4634**	.2178*	.4331**
	(.1284)	(.2131)	(.1309)	(.2183)
Solely Subsidiaries with Intangible Assets		$\checkmark$		$\checkmark$
Number of Observations	44,189	23,146	42,517	22,350
Number of Firms	6,800	4,512	6,546	4,357
Adjusted R^2	.6926	.7731	.6964	.7765

Notes: Heteroscedasticity robust standard errors adjusted for firm clusters in parentheses.
*, **, *** indicates significance at the 10%, 5%, 1% level. The observational units are multinational subsidiaries, i.e. they exhibit a foreign parent with at least 90% of the ownership shares. In Specifications (2) and (4), the regressions consists solely of subsidiaries that actually own immaterial assets, whereas in (1) and (3) the whole sample of multinational subsidiaries is used which also includes subsidiaries with no intangibles. The dependent variable is the subsidiary's share of immaterial assets to its total assets. The variable *Average Tax Difference to Other Affiliates* is defined as the unweighted average tax difference between the considered subsidiary and each of the other affiliates of the corporate group including the parent, whereas each difference is calculated by subtracting the tax rate of the other affiliate from the tax rate of the considered subsidiary. All regressions include year dummy variables.

Table 5: Robustness Check 1, OLS Fixed–Effects, Panel 1995–2005

Dep. Var.: Share Intangibles Subsidiary to Sum of Intangibles Parent & Subsidiary

Variable	(1)	(2)	(3)	(4)
Tax Difference to Parent	-.9742***	-1.240***	-1.135***	-1.381***
	(.0871)	(.1018)	(.0914)	(.1058)
GDP per Capita (per 100 thousand)			3.098***	1.293*
			(.5723)	(.7024)
Population (per 100 thousand)			.6578	3.264***
			(.9174)	(1.123)
Solely Subsidiaries with Intangible Assets		√		√
Number of Observations	31,582	20,071	28,859	18,488
Number of Firms	6,160	4,402	5,904	4,212
Adjusted R^2	.7232	.7165	.7240	.7148

Notes: Heteroscedasticity robust standard errors adjusted for firm clusters in parentheses.
*, **, *** indicates significance at the 10%, 5%, 1% level. The observational units are multi-national subsidiaries, i.e. they exhibit a foreign parent with at least 90% of the ownership shares. In Specifications (2), (4) and (6), the regressions consists solely of subsidiaries that actually own immaterial assets, whereas in (1), (3) and (5) the whole sample of multinational subsidiaries is used which also includes subsidiaries with no intangibles. The dependent variable is the subsidiary's share of immaterial assets to the sum of immaterial assets of that subsidiary and its parent. The variable *Tax Difference to Parent* is defined as the tax rate of the considered subsidiary minus the tax rate of the subsidiary's parent. All regressions include year dummy variables.

Table 6: Robustness Check 2, Logit & OLS Fixed–Effects, Panel 1995–2005

Dependent Variable: Binary Level Intangibles Subsidiary ≥ Level Intangibles Parent

Variable	(1)	(2)	(3)	(4)
Tax Difference to Parent	-9.449***	-9.007***	-1.142***	-1.406***
	(.9289)	(.9840)	(.0999)	(.1197)
GDP per Capita (per 100 thousand)	15.89*	-.0241	3.028***	1.056
	(8.458)	(8.086)	(.6226)	(.8924)
Population (per 100 thousand)	19.89*	35.72***	.6729	3.506***
	(12.05)	(13.52)	(1.001)	(1.254)
Solely Subsidiaries with Intangible Assets		√		√
Model	Logit	Logit	OLS	OLS
Number of Observations	8,359	6,887	28,856	18,485
Number of Firms	1,324	1,136	5,904	4,212
Pseudo R^2 or Adjusted R^2	.1574	.2132	.6729	.6598

Notes: Heteroscedasticity robust standard errors adjusted for firm clusters in parentheses.
*, **, *** indicates significance at the 10%, 5%, 1% level. The observational units are multi-national subsidiaries, i.e. they exhibit a foreign parent with at least 90% of the ownership shares. In Specifications (2), (4) and (6), the regressions consists solely of subsidiaries that actually own immaterial assets, whereas in (1), (3) and (5) the whole sample of multinational subsidiaries is used which also includes subsidiaries with no intangibles. In Specifications (1) and (2), a Logit model with fixed firm effects is applied, in (3) and (4) a linear OLS model with fixed firm effects is estimated. The dependent binary variable is equal to 1 if a subsidiary owns at least as much immaterial assets as its parent and is equal to 0 otherwise. The variable *Tax Difference to Parent* is defined as the tax rate of the considered subsidiary minus the tax rate of the subsidiary's parent. All regressions include year dummy variables.

Table 7: Profit Shifting Evidence, OLS Fixed–Effects, Panel 1995–2005

Dependent Variable: Log Profit before Taxation (per Sales)

Variable	(1)	(2)	(3)	(4)	(5)	(6)
Statutory Tax Rate	-1.511***	-1.576***				
	(.4038)	(.4335)				
Tax Difference to Parent			-.5410**	-.5225**		
			(.2471)	(.2609)		
Average Tax Difference to Other Affiliates					-1.292***	-1.419***
					(.3783)	(.4068)
Log Number Employees (per Sales)	.1275***	.1340***	.1285***	.1335***	.1278***	.1349***
	(.0358)	(.0384)	(.0358)	(.0384)	(.0367)	(.0394)
Log Fixed Assets (per Sales)	.0593***	.0683***	.0603***	.0700***	.0578***	.0653***
	(.0205)	(.0229)	(.0205)	(.0230)	(.0211)	(.0236)
Log GDP per Capita		.0285		-.1325		.0155
		(.4519)		(.4548)		(.4612)
Log Population		.6766		-.2989		.3754
		(1.336)		(1.305)		(1.360)
Number of Observations	24,446	21,877	24,446	21,877	23,497	21,003
Number of Firms	5,056	4,755	5,056	4,755	4,862	4,572
Adjusted R^2	.6090	.6147	.6086	.6143	.6101	.6154

<u>Notes:</u> Heteroscedasticity robust standard errors adjusted for firm clusters in parentheses. *, **, *** indicates significance at the 10%, 5%, 1% level. The observational units are multinational subsidiaries, i.e. they exhibit a foreign parent with at least 90% of the ownership shares. The dependent variable is the natural logarithm of the subsidiary's unconsolidated pre–tax profit calculated per operating revenue. The variable *Tax Difference to Parent* is defined as the tax rate of the considered subsidiary minus the tax rate of the subsidiary's parent. The variable *Average Tax Difference to Other Affiliates* is defined as the unweighted average tax difference between the considered subsidiary and each of the other affiliates including the parent, whereas each difference is calculated by subtracting the tax rate of the other affiliate from the tax rate of the considered subsidiary. *Log* means that the natural logarithm of the variable is taken. All regressions include year dummy variables.

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