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

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Abstract

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 multinationals, the shifting of internal debt opens up additional tax saving opportunities. Using a large database of European multinationals for the years 1998–2006, first, we 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 as well as external debt to get advantage of the depreciation tax shield. Third, we provide evidence that 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. 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.

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Keywords: multinational enterprise, corporate taxation, debt financing, profit shifting, firm-specific risk proxy variables

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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 (2004) 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. A small literature analyzes this more detailed theoretical prediction for MNEs which moreover includes a strategy of profit shifting. 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 as well as 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

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

intangible assets to sales as a risk proxy variable. This is done because intangible assets can serve as a proxy for the level of research and development (R&D) of a firm which in turn is an indicator for risky business activities. Due to endogeneity and misidentification concerns on the two risk proxies, in a robustness test, we apply an exogenous 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, the degree of a potential overestimation of the true effect is much more alleviated in our study. This also results in smaller coefficient estimates of the tax differential 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 2, we present a literature review on debt shifting including a systematic comparison of selected empirical papers and their quantitative results. In Section 3, we discuss theoretical considerations and formulate hypotheses for the empirical analysis. Section 4 describes the dataset and our firm-specific risk proxies. The estimation method and identification strategy is documented in Section 5. Section 6 presents the empirical results and a robustness check with an

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

industry analysis. Section 7 concludes.

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 1). The studies in the first category of Table 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 as well as 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 (2009). 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 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

[3]Note that specially the first category of Table 1 is of course not a complete list. Earlier empirical studies using U.S. data are undertake 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 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 4) *without controlling for debt shifting incentives* with the tax differential (cf. Column (3) of Table 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) *controlling additionally for internal debt shifting incentives* with the asset weighted tax rate difference to the parent (cf. Column (3) of Table 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.

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 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 1). However, 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. Büttner and Wamser (2007), e.g., calculate the unweighted tax rate difference of German-owned foreign subsidiaries relative to the lowest tax rate observed among all affiliates of the MNE. However, Overesch and Wamser (2006) 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 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 1 is difficult. Although most studies use micro-level panel data, the papers

[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).

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 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.

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 6, Table 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

[6]Note that the results of Mintz and Weichenrieder (2005) suggest that partly-owned multinational 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 (2010) 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.

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 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

[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 extend 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.

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 financial 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 6, Table 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 6, Table 6 and 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 (2009) 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 (2004) show that internal debt is employed by MNEs to overcome imperfections in external capital markets.

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 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). As they are not subject to positive tax payments, we drop affiliates with losses during the whole sample period.

4.1 Summary Statistics

Table 3 displays descriptive sample statistics, separately for the large sample of parent firms and subsidiaries (applied in the tax rate estimations of Table 4) and for the sample of only subsidiaries (applied in the estimations with the tax differential to the parent of Table 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, then, our regressions 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 liabilities to total assets. Its mean is calculated with 60.5% for the sample of parents

[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 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
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
United Kingdom	7,843	2,093
Sum	44,875★	14,332★

★ The high number of parents & subsidiaries relative to including solely subsidiaries in our regressions (cf. Column (1) of Table 4 with (1) of Table 5) results because, in the regressions of Table 4, we just control for the tax rate, whereby, in the regressions of Table 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.

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 a logarithmic transformation. For the sample of subsidiaries, the profitability measure

Table 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	0.15	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.

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.

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 likewise the successful outcome of R&D (like patents, royalties, etc.) could be capitalized

[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.

in the balance sheet item "intangible fixed assets".

See Section 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 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 Econometric Approach

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

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

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 macro level, we control for GDP (as a proxy for the market size), for GDP per capita

[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.

(as a proxy for the degree of development 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 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.

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

[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.

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]

6.1 Tax Rate Effect on Firm's Leverage

First, Table 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 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 (Hypothesis 1 in Section 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 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, 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 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 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 4, we include further control variables to test the

[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 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.

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 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.

6.2 External Debt and Internal Debt Shifting

In a second step, in Table 5, we analyze tax effects on external debt and internal debt shifting by regressing the same specifications of Table 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 relatively small but 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), 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 (Hypothesis 2). 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 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 are robust to the inclusion of our set of control variables already applied in the regressions of Table 4. Thereby, the qualitative effects of the controls are unchanged but the respective coefficient estimates are slightly larger

[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: 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.

(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, 2004;

Büttner, Overesch, Schreiber, and Wamser, 2006). As a new element, in Column (6) of Table 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 (Hypothesis 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.

6.3 High-risk vs. Low-risk Firms

We now test Hypothesis 3 of Section 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 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 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 6. For high-risk firms (Column (1)–(4) of Table 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

[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 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.

(Table 5). Whereas for low-risk firms (Column (5)–(8) of Table 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). 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 right in a country is only relevant for lenders of companies with a high firm-specific risk.

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, 2010). 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 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),

[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.

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 7. We observe an even more extreme pattern compared to Table 4: The tax rate is almost never significant for subsidiaries in high-risk industries (Column (1)–(4) of Table 7), whereas the significant coefficients of the tax rate for subsidiaries in low-risk industries (Column (5)–(8) of Table 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 high-risk industries (coefficient of .16, on average).[27] These results confirm our original

[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.

[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%).

Table 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.

analysis of high-risk vs. low-risk firms in the previous subsection (Table 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.

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 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 as well as 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)* that generally would 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.

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