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Do multinational firms invest more? On the impact of internal debt financing on capital accumulation

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Abstract

This study provides evidence on the causal impact of debt shifting activities of multinational companies (MNC) on their capital accumulation. The identification strategy exploits the corporate tax rate cut of 10%-points in Germany 2008 as a quasi-natural experiment. This reform reduced substantially the incentive of multinational firms to engage in debt shifting. Using a difference-in-differences matching strategy (DiD), the results suggest firstly that MNC decreased their fraction of internal borrowing and thus reduced or even stopped shifting profits abroad. Secondly they decreased their capital stock compared to purely domestic firms. Combined, the results suggest that if MNC shift profits abroad, their capital accumulation is less depressed by the national tax rate and thus benefits less from a tax rate reduction. The DiD results are confirmed by a structural approach, which focus on the tax incentive to shift profits to the headquarter for the identification. The findings are particularly strong for firms with a low ratio of profits before interest to their capital stock which suggests that only debt shifting but not transfer pricing fosters capital accumulation. Moreover, it is shown that more generous depreciation allowances decrease the difference in capital accumulation between domestic and multinational firms.

Keywords: internal debt shifting, capital accumulation, corporate income taxation, depreciation allowances

JEL Classification: H25, F23, G31, G32

1 Introduction

A growing body of literature documents that multinational corporations use intra-firm transaction to reduce their tax payments.[1] These activities cause a loss in tax revenue, forcing governments either to engage in tax competition by decreasing their tax rates[2] and/or to limit profit shifting activities by introducing anti-abuse regulations[3]. However, in the light of research showing that a higher tax burden reduces capital accumulation[4], profit shifting activities of multinational firms may, to some extent, even be beneficial by fostering capital accumulation (Hong and Smart, 2010). Although this relationship seems to be common wisdom in the theoretical literature (e.g. Desai et al., 2006; Schindler and Schjelderup, 2012), empirical evidence is mixed and faces identification problems, e.g. complementarity of production function within one multinational group or finding suitable control group firms. The aim of this paper is to address these challenges by using a new identification strategy in order to present causal evidence on the impact of debt shifting as a particular form of profit shifting on capital accumulation.[5]

The identification strategy used in this study employs a difference-in-differences approach to compare how the investment and financing behavior of purely domestic and multinational firms in a high tax country differ in response to a strong tax rate reduction. Following prior literature (e.g. Egger et al., 2010) a propensity score matching approach is used to account for potential differences between the two groups. Compared to prior studies, the applied design has several advantages: Firstly, using the high tax countries ensures that almost all subsidiaries had before the reform an incentive to

[1] E.g. Grubert and Mutti (1991), Hines and Rice (1994), Clausing (2003), Bartelsman and Beetsma (2003), Huizinga and Laeven (2008), Huizinga et al. (2008), Egger et al.(2010).

[2] See Zodrow and Mieskowski (1986) for a theoretical and Devereux et al.(2008) for an empirical analysis

[3] See Fuest and Hemmelgarn (2005) and Haufler and Runkel (2012) for a theoretical and Buettner et al.(2012) and Buslei and Simmler (2013) for an empirical analysis.

[4] E.g. Chirinko et al. (1999), Bond and Xing (2011), Dwenger (2014).

[5] The paper deals solely with the impact of debt shifting activities on the intensive margin of capital accumulation. For the impact of taxation on the extensive margin, i.e. the location decision of multinational firms, see De Mooij and Ederveen (2003), Devereux and Griffith (2003) or Barrios et al.(2013).

engage in debt financing to shift profits out of the country. This is similar to the design by Overesch (2009), but contrasts with Egger et al. (2014), who uses a sample of foreign subsidiaries to show that only for a subset of multinational subsidiaries capital accumulation is unaffected by the tax rate of the subsidiary country. Based on the their research design, the authors implicatively assume, however, that in- and outward shifting of profits affects capital accumulation in the same way. Secondly, the focus on a tax rate reduction in the subsidiary country rules out that a complementarity or substitutability of production function within the multinational firm are driving the results. This could be the case in Overesch (2009), who exploits international variation in the tax rate of parent companies and reports that the difference between the tax rate of the subsidiary and the parent company affects subsidiaries' investment spending. As shown by Becker and Riedel (2012), however, the parent tax rate affects subsidiaries' investment spending in case of a common input located at the parent company as well. Since the impact of the subsidiary's production on to the overall group production is likely to be small, the focus on the reduction of the subsidiaries' tax rate in this paper ensures that a potential link between production functions does not affect the results. Thirdly, by comparing purely domestic firms and multinational firms, the control group clearly does not have the advantage of debt shifting and is thus unlikely to be affected as multinational firms. This is similar to the design by Mintz and Smart (2004), who compare firms with income shifting possibilities to firms without, but in contrast to studies using only one specific type. For example, Buettner et al. (2012; 2014) study the impact of thin capitalization rules on debt financing and capital accumulation using a sample of multinational subsidiaries for the identification. Comparing multinational subsidiaries that are directly affected by thin capitalization rules with subsidiaries that are not directly affected may, however, be misleading, given the results by Bloiun et al. (2014). They highlight that all subsidiaries within one multinational group are affected if in one of the subsidiaries' countries a thin capitalization rules is introduced. Finally, the focus on the strong tax rate reduction in this paper ensures that the incentive to engage in debt shifting is substantially reduced and thus adjustment costs

are unlikely to refrain firms from reacting.

To link the results to the investment literature and to allow a comparison with the prior literature on profit shifting, a second identification strategy is implemented as well. This exploits the change in the tax incentive to engage in debt financing to the headquarter for the identification. Compared to the first approach, which avoids assuming a functional form and extrapolation, the second approach is sensitive to the modeling of the tax incentive but allows for directly linking multinational firms' tax savings to investment spending. Since the studied tax reform followed the principle *tax rate cut cum base broadening*, the role of depreciation allowances is investigated as well.

Both applied methods provide consistent results and confirm the theoretical predictions. The findings suggest that multinational firms, for which the incentive to shift profits via debt financing was reduced or even abolished, firstly decreased their (internal) debt ratio and secondly decreased their capital stock compared to domestic firms. This highlights that debt shifting introduces a tax-advantage for multinational firms that allows them to invest more than domestic firms (Overesch, 2009; Simmler and Buslei, 2013; Buettner et al., 2014; Egger et al., 2014). Further, the analysis presents evidence that only debt shifting activities foster capital accumulation, but not transfer pricing as suggested by Schjelderup and Schindler (2013). Moreover, the analysis shows that restricting depreciation allowances and, thusly, enlarging the tax burden on capital increases the tax advantage of multinational firms compared to domestic firms. Thus, recent tax reforms, which followed the principle *tax rate cut cum base broadening*, might have decreased the number of firms shifting (simply) profits (to the headquarter) but simultaneously increased at the same time the tax advantage for firms that still engage in debt shifting.

The remainder of this paper is as follow. In section two the 2008 corporate tax reform in Germany, the high tax country used in this study, is described. The expected behavioral responses with respect to the adjustments in internal debt financing and capital accumulation for purely domestic and multinational firms are illustrated in section three. After introducing the data in

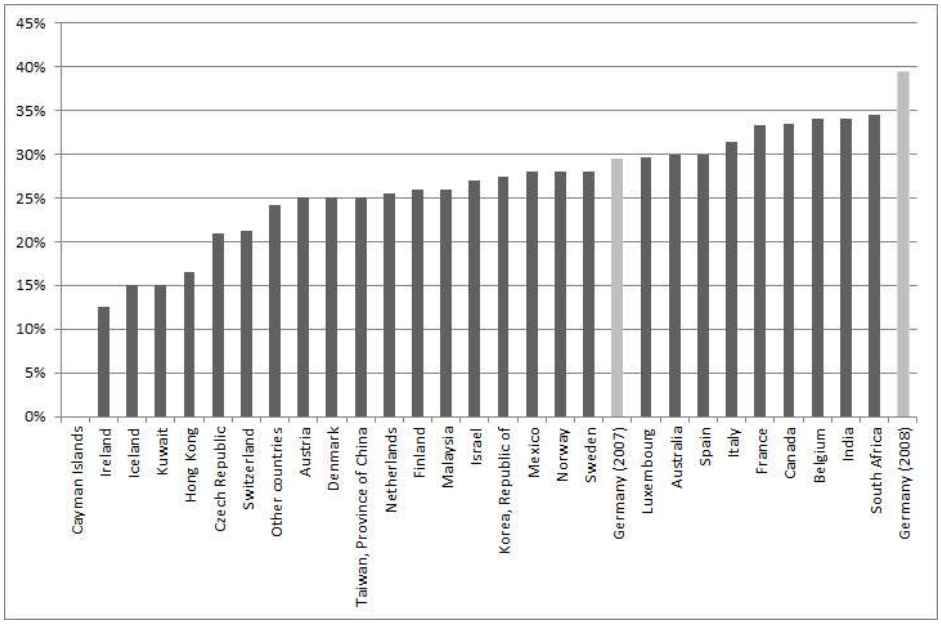
section four, the methodology and the results of the difference-in-differences matching strategy are presented in section five, and for the structural approach in section six. After comparing the results of the two approaches in section seven, section eight concludes.

2 Institutional Background: The German Corporate Tax Reform 2008

The high tax country used in this study to compare the finance and investment behavior of multinational and domestic firms in response to the large tax rate cut is Germany. Prior to 2008, Germany had one of the highest corporate income tax rates in Europe and the world. Thus, almost every foreign owned subsidiary in Germany had an incentive to shift part of the profits abroad, e.g. to its headquarter (see Figure 1 for a distribution of the tax rates faced by parent companies owning German firms). Most of the subsidiaries also seemed to follow this incentive as empirical evidence suggests that profit shifting activities came, to a large extent, at Germany's cost (Huizinga and Laeven, 2008). To discourage firms from shifting profits abroad, the German government implemented, through the corporate tax reform 2008, two principle measures: First, a strong reduction of the tax rate on profits from 40 to 30%, which was accompanied by the introduction of less generous depreciation allowances. And secondly, the introduction of anti-abuse regulations as the new interest barrier (see e.g. Buslei and Simmler, 2013). A minor change relates to the adding back regulations of the local business tax. Due to these tax base adjustment, which apply in particular to finance expenses, the tax rate on profits does not necessarily equal the tax rate to which interest expenses are deductible in Germany.[6] Before 2008, interest expenses on long term debt (with a maturity exceeding one year) had to be added back to 50%. In order to treat interest expenses for short and long term debt in the same way, this applies beginning in 2008 to all

[6]The origin of these regulations go back to the 1990s, when the local business taxes, set and collected by German municipalities, were designed to be a tax on infrastructure use.

Figure 1: Corporate tax rates for selected parent companies of German subsidiaries in 2008



Notes: Corporate income tax rates in 2008 for countries with at least 50 parent firm - year observations in the database are shown. Tax rates are obtained from the Corporate Tax Guide by Ernest & Young 2008.
Source: DAFNE firm data base, 2008.

interest payments but only to 25%. The share of the local business tax of the overall tax rate is around 50%.[7]

[7]Before 2008, the local business tax rate was calculated as local business tax multiplier, set by the municipality, times the *Gewerbesteuermesszahl*, which was 5.5% for all municipalities. Further, the local business tax was deductible from its own and from the corporate income tax base. The effective local business tax amounts before the reform to roughly 18% for the average multiplier of 400. Since local business tax payments reduce the corporate income tax base, the average overall tax rate amounts to 39% (18%+(1-18%)*26.38%). Due to the corporate tax reform, the *Gewerbesteuermesszahl* was reduced to 3.5% and the deductibility of the local business tax abolished. The average overall tax rate on profits amounts thus after 2007 to 29% (14% local business tax and 15.8% corporate income tax, including solidarity surcharge). The difference between the tax rate on profits and to which interest payments are deductible decreased. On average, before the reform it amounted to 6%; after to 3.5%.

3 Theoretical Background

To illustrate the impact of debt shifting activities on real investment and how both are affected by the German corporate tax reform 2008, the cost of capital approach dating back to both Jorgenson (1963) and Hall and Jorgenson (1967) is extended by allowing for internal debt financing.[8]

To consider the role of internal debt financing in the multinational context, the starting point of the approach is a shareholder who owns two representative firms in two different countries (G and A) and wants to maximize the value of the two firms ($V_{G,t}$ and $V_{A,t}$). The value of a firm can be expressed as the present value of its future cash flows (equation (1)), which is the sum of cash flow out to real activity (π_r) and cash flow out to financial activity (π_f) (equation (2)). The real activity cash flow in period s for each firm is calculated as sales (price p_s multiplied with output $F(K_{s-1})$) minus investment costs and taxes, determined by the tax rate on profits (u) and depreciation allowances (ϕ) (see equation (3) for the firm in country G).

The cash flow out to financial activity captures internal debt financing and, thus, the borrowing and lending between the two firms of the shareholder. It is determined by three terms and exemplary shown for the firm in country G.[9] The first term in equation (4) reflects the case that part of the capital stock in country G ($\beta_{G,t-1} * K_{G,t-1}$) can be financed with internal debt. In this case, interest payments are deducted from the tax base in country G.[10] The tax rate to which interest payments are deductible ($u_{G,mod,t}$) may however differ from the tax rate on profits ($u_{G,t}$) due to, for instance, adding back regulations or thin capitalization rules. Noteworthy, β is bounded as it cannot exceed one.[11] The second term determining firms' financial cash flow is the impact of internal debt financing of the capital stock in A on

[8] For an overview and extensions of the approach see Devereux (2004).

[9] In the following I ignore that cash flow changes due to the received respectively paid back, nominal value of debt and focus only on interest payments.

[10] In principle, multinational firms might manipulate interest rates as well. However, this strategy would conflict with the arm's-length principle and is thus not considered in this study.

[11] In principle β might exceed one but in this case capital would earn only the interest rate. Thus, it would be beneficial to receive this income in the low tax country.

profits in G, thus the opposite case. In this case, the tax base in country G is broadened by the received interest income.

$$
\begin{aligned}
V_t &= V_{G,t} + V_{A,t} && (1)\\
V_{t,G} &= E_t \sum_{s=t} (1+r)^{-s} [\pi_{r,t,G} + \pi_{f,t,G}] && (2)\\
\pi_{r,t,G} &= (1-u_{G,s}) p_{G,s} F(K_{G,s-1}) - q_s I_{G,s} + u_s \phi (q_s I_{G,s} + K^T_{G,s-1}) && (3)\\
\pi_{f,t,G} &= -(1-u_{G,mod,s}) r \beta_{G,s-1} K_{G,s-1} + (1-u_{G,s}) r \beta_{A,s-1} K_{A,s-1} \\
&\quad + c(\beta_{G,s-1}) && (4)\\
c(\beta_G) &= c_{fix} + c_{var}(\beta_G) = c_G \pi^T_{r,t,G} (u_{G,mod} - u_A) + c_{var}(\beta_G) && (5)\\
\pi^T_{r,t,G} &= (1-u_{G,s}) p_{G,s} F(K_{G,s-1}) + u_s \phi (q_s I_{G,s} + K^T_{G,s-1}) && (6)\\
K_t &= I_t + (1-\delta) K_{t-1} && (7)\\
K^T_t &= (1-\phi) K^T_{t-1} + (1-\phi) q_{t-1} I_t && (8)
\end{aligned}
$$

Further, debt shifting comes at costs ($c(\beta)$), which reduce the cash flow (equation (5)). They consist of a fixed (c_{fix}) and variable part ($c_{var}(\beta)$). The fixed cost component is assumed to be a fraction (c_a) of firms' maximal tax savings ($\pi^T_{r,t,G}(u_{G,mod} - u_A)$) and accounts for the fact that multinational firms have different ways to shift profits abroad, e.g. debt financing and transfer pricing. Thus, they use the way that allows them to shift more (which is the way with lower overall costs). The main advantage of using a fixed cost component for internal debt financing is that transfer pricing and it related costs does not have to be explicitly modeled but are still included in the model. The variable cost part is assumed to be convex in the fraction of internal debt financing.[12] It relates to tax engineering expenses incurred in order to avoid or relax regulations such as thin capitalization rules and/or

[12]Further, prior literature assumes that the cost of shifting increases in the capital stock (e.g. Schindler and Schjelderup, 2012). The results are not sensitive to this choice. The only difference is that the impact of internal debt financing on capital accumulation would in this case be reduced by the costs of shifting. Since I am not able to account for the cost of internal debt financing in the empirical analysis, I have to leave the question for future research and assume the simpler case in my model. The impact I estimate is the net effect.

controlled-foreign-company rules.[13]

The shareholder maximizes the present value of the future cash flows by choosing the state variables for the two firms, firms' capital stock and the fraction of internal borrowing in period $t+1$ (K_{t+1} and β_{t+1}), subject to a capital accumulation constraint (equation (7)) and the valuation of the capital stock for tax purposes (equation (8)).

Optimal Internal Debt Financing

Out of the model, three insights regarding the optimal fraction of internal debt financing (β_G^*) in country G can be derived (equations (9) and (10)). One insight relates to the first order condition for the internal solution, the two other deal with the corner solutions. In one case the firm can shift as much as it wants, ultimately facing zero tax burden (third line equation (10)). The maximum fraction that has to be shifted is given by equation (9) as for $\beta_{G,t-1}^{max}$ taxable profits in country G are zero in period t.[14] This maximum fraction increases with the ratio of profits before interest payments to the capital stock (first term within the brackets) and decreases with the share of depreciation allowances to the capital stock (second term within the brackets). Since β cannot exceed one, this means that firms with a high ratio of profits before interest to their capital stock and/or low depreciation allowances are not able to reduce their tax payments to a large extent by using internal debt financing. Finally, the maximum share increases with the ratio between the tax rate on profits and the tax rate to which interest payments are deductible.

The other corner solution (first line, equation (10)) and thus the second insight relates to the question whether a firm engages in internal debt financing or not. This depends on the fixed costs. If tax savings exceed the costs, the firm engages in internal debt financing. Since the fixed costs are a fraction of firms' potential overall tax savings, a firm will only engage in

[13]It is assumed that the costs of debt shifting are not tax-deductible. The assumption is not crucial for the results. If the costs are deductible, then the firm has an incentive to deduct them in the high tax country.

[14]One has to derive an expression for firms tax payments in period t, set it to zero and solve it for β.

internal debt financing if it can substantially reduce its tax payment. Thus, drawing from the insights before, firms with a high ratio of profits to the capital stock are less likely to engage in debt financing as these firms are not able to reduce their tax burden to a large extent using debt financing. The amount of depreciation allowances in contrast does not matter as it does not affect the relative advantage (or disadvantage) of debt shifting (to transfer pricing).

Finally, the last insight relates to the question how much internal financing is used if the firm engages in debt financing and cannot shift as much as it want. It is given by the first order condition for the interior solution (second line, equation (10)) and states that for the optimal amount of internal debt the benefit of debt shifting, expressed by the tax savings, equals the marginal costs of debt shifting, a common result in the literature (e.g. Schindler and Schjelderup, 2012).

$$\begin{aligned} \beta_{G,t-1}^{max} &= \frac{u_{G,t}}{u_{G,mod,t}} \frac{\pi_{r,t,G}^{T}}{rK_{G,t-1}} \\ &= \frac{u_{G,t}}{u_{G,mod,t}} [\frac{p_{G,t}F(.)}{rK_{G,t-1}} - \frac{\phi(q_{G,t}I_{G,t} + K_{G,t-1}^{T})}{rK_{G,t-1}}] \end{aligned} \tag{9}$$

$$\beta_{G,t-1}^{opt} = \begin{cases} 0 & \text{if } a \leq \frac{\pi_{G}^{T} c_{G,a}}{rK_{G,t-1}} \\ K_{G,t} r(u_{G,mod,t} - u_{A,t}) = c_{\beta_{G,t-1}}(\beta_{G,t-1}^{*}) & \text{if } a > \frac{\pi_{r,G}^{T} c_{G,a}}{rK_{G,t-1}} \\ & \text{and } \beta_{G,t-1}^{*} \leq \beta_{G,t-1}^{max} \\ min(1, \beta_{G,t-1}^{max}) & \text{if } \beta_{G,t-1}^{*} > \beta_{G,t-1}^{max} \end{cases}$$

with

$$a = \frac{\frac{\delta u_{G,t,mod}}{\delta u_{G,t}} \beta_{G,t-1}^{*} rK_{G,t-1} - c_{var}(\beta_{G}^{*})}{rK_{G,t-1}} \tag{10}$$

Optimal capital stock with debt shifting

The first order condition for the optimal capital stock of the representative

firms in county G is given by equation (11).[15] In the optimum the marginal productivity of capital (left hand side) has to equal marginal costs (right hand side), whereas the latter consist of two parts for multinational firms. The first is the usual expression for the user costs of capital using retained earnings (e.g. Chirinko et al., 1999). They depend on the present value of depreciation allowances ($(1-A)$[16], the finance costs r, the economic depreciation rate δ, and the business tax rate u_t. The second term captures the impact of internal debt financing. It is obvious that if the capital stock of the representative firm in country G is (partly) financed with internal debt ($\beta_G > 0$), the user costs of capital are lower than without shifting (equation (12)). Further, since only $\beta_{G,t}$ affects the return of capital in country G, there will be no difference in the user costs of capital in country G, if profits are shifted from A to G.

$$F_{K_{G,t}} = \frac{(1-A_{G,t+1})(r+\delta)) - r\beta_{G,t}(u_{G,mod,t+1} - u_{A,t+1})}{p_{G,t+1}(1-u_{G,t+1})} \tag{11}$$

$$= UCC^{RE}_{G,t} - \frac{r\beta_{G,t}(u_{G,mod,t+1} - u_{A,t+1})}{p_{G,t+1}(1-u_{G,t+1})} \tag{12}$$

$$A = \frac{u_t\phi(1+r)}{\phi+r} \tag{13}$$

Before summing up the hypothesis derived from the neoclassical investment model, two simplifying assumption are discussed. The first concerns the fact that only two companies are considered in the analysis above, the second the role of external financing.

More than two countries

To understand the incentive in a more general setting, the case with three firms is briefly described. The shareholder owns in the following a firm in T as well. Profits from G can now not only be shifted to A but also to T. The costs of shifting depend on the overall fraction that is shifted abroad

[15] The expression is derived by taking the first order condition for the optimal capital stock, then setting inflation and expected real change in the price of capital to zero.

[16] Present value of depreciation allowances is shown for declining-balance method.

$(\beta_{G,A,t} + \beta_{G,T,t})$. Further, one may assume that the shareholder prefers (or dislikes) profits to be located in country A (ω). The first order condition for the interior solution for the optimal fraction of internal debt financing are for the three country case given by equation (14) and (15).

$$
\begin{aligned}
c_{\beta_{G,A,t}} &= K_{G,t} r(u_{G,mod,t+1} - u_{A,t+1}) + \omega_{\beta_{G,A,t}}(\beta_{G,A,t}) && (14)\\
c_{\beta_{G,T,t}} &= K_{G,t} r(u_{G,mod,t+1} - u_{T,t+1}) && (15)\\
F_{K_{G,t}} &= UCC^{RE}_{G,t} - \frac{r\beta_{G,A,t}(u_{G,mod,t+1} - u_{A,t+1})}{p_{G,t+1}(1 - u_{G,t+1})} && (16)\\
&= -\frac{r\beta_{G,T,t}(u_{G,mod,t+1} - u_{T,t+1})}{p_{G,t+1}(1 - u_{G,t+1})}
\end{aligned}
$$

Depending on the preference parameter (ω) and the tax rates, two different cases may arise out of this setting. Firstly, the shareholder shifts all profits to one location, which is then not different from the two country case. Secondly, it may be optimal to shift part of the profits to one place and the rest to the other place. The capital stock in G for the latter case is given by equation (16). It depends now on the tax rates in all three countries, but the implications are the same as in the two country case. If multinational firms shift profits abroad via internal debt financing, they face lower investment costs and thus invest more than domestic firms.

External Debt Financing

Compared to retained earnings, external debt financing is tax favored as interest payments are deductible from the tax base. In contrast to internal debt financing however, domestic and multinational firms are able to use external debt financing. Following the trade-off-theory, the use of external debt financing causes bankruptcy costs (Kraus and Litzenberger, 1973). In case bankruptcy costs equal the tax advantage of external debt on the firm level, both type of firms would use - if otherwise identical - the same amount of external debt and thus react to the same extend to a change in the tax advantage. Further, their investment would be equally affected. The implications stated above would thus be the same.

If marginal costs and benefits are, however, not balanced on the firm but rather the group level, the picture would change. In this case, external and internal debt are to some extend substitutes as multinational firms have an incentive to load firms in high tax countries with a larger amount of debt (see Moen et al., 2011). Multinational firms are in this case likely to react differently to changes in the tax advantage as the group level weighted tax advantage of external debt financing is reduced to a smaller extent than for the domestic firms. Given however that prior research could so far not identify the impact of external debt financing on capital accumulation (e.g. Bond and Xing, 2011), which is likely to be due to the balance of costs and benefits at the margin, the different impact of the tax rate reduction on the use of external financing is not likely to bias my results.

Summing up, the following hypothesis can be derived out of the model, suggesting the following behavioral adjustments in response to Germany's large tax rate cut in 2008.

Hypothesis 1a: If the tax rate on profits in country A is lower than the tax rate to which interest expenses are deductible in country G, then the shareholder of the firms in G and A shift profits from G to A. The larger the difference is, the higher the share of internal debt financing.

Hypothesis 1b: Firms with a high ratio of profits before interest to their capital stock do not engage in debt shifting due to fixed costs. Further, internal borrowing of firms with generous depreciation allowances depends less on the tax rate difference as these firms are able to shift as much income as they want and are, therefore, not constrained by marginal costs.

For the 2008 corporate tax rate cut, this means that multinational firms should reduce their internal debt financing as the tax advantage to engage in debt financing shrink. Further, I expect that firms with a low ratio of profits to their capital stock will reduce their internal debt financing more than firms with a high ratio of profits. Since firms facing more generous depreciation allowances have to shift less, their fraction of internal borrowing is lower and

thus their reduction in the debt ratio should be lower in response to the tax rate cut as well.

Hypothesis 2a: If profits are shifted from country G to A, the capital stock in G is larger than without profit shifting.

Hypothesis 2b: The relative advantage of the profit shifting firm with respect to investment increases with the share of overall taxable profits that is shifted abroad. Thus, the positive impact on investment is larger for firms with a low ratio of profits before interest payments to the capital stock and for firms with less generous depreciation allowances.

If multinational firms shifted profits prior to the tax rate reduction, their investment was less affected by the tax rate meaning that their capital stock benefit less from the rate reduction, and thus it decreases relative to purely domestic firms. I further expect that the reduction in the capital stock is larger for firms that were more actively engaged in debt shifting before the reform, e.g. firms with a low share of profits to the capital stock. Moreover, the reduction is less strong if firms benefit from generous depreciation allowances as they reduce the amount that can be shifted abroad.

4 Data

To test the hypothesis outlined in the section three, two different methods are used. The first method is a difference-in-differences propensity score estimation; the second a more structural approach. Since for both methods the same dataset is used, although using different subsample, I start by describing the data and then introduce in the next two sections the methods in detail and their results.

The database of this study are unconsolidated financial statements, ownership and subsidiary information for German incorporated firms between 2004 and 2010 from the database DAFNE. This data has two main advantages compared to other data sets used to study the behavior of multinational

firms. Firstly, beginning in 2006 it covers almost 85% of all German firms with limited liability. Thus, the database allows to compare multinational firms with a broad set of domestic firms instead of exploiting differences between multinational firms. Secondly, at least for a subsample of firms income statements are observed. This allows, firstly, to explore the heterogeneity following the theoretical predictions and, secondly, to complement the main analysis, which uses only balance sheet information, with additional regression results using interest payments and profits.

Two main selections are made to derive the final samples. Firstly, I require that all firms in the sample are owned by another non natural person. The main reason is to exclude stand-alone companies from the control group in order to compare only firms belonging to a domestic group with firms belonging to a multinational group. Secondly, I require that the firms included in the final sample are observed before and after the reform as the identification is based on the changed incentive due to the specific reform. A minor selection concerns the exclusion of subsidiaries owned by parent companies located in countries that apply the worldwide principle for corporate taxation (in my sample US, UK, and Japan). Their investment decision depends independently of debt shifting on the parent tax rate. Further, firms with changes in the ownership structure are excluded as these could be driven by taxes as well.

The data is complemented by a collection of foreign tax rates to capture the tax incentive to engage in debt financing to the headquarter.[17] Further, to exploit variation in the tax rate on profits in Germany, which varies across the 12,000 municipalities, municipality specific local business tax rates are merged to the data using firms' postal code.[18]

[17]The data stems from the Ernst & Young tax guides.

[18]The local business tax rates are provided by the Federal Statistical Office. Since I have firm level data and not plant level data, I cannot account for the fact that plants of the same firm located in different municipality may pay different local business tax rates.

5 Difference-in-Differences Propensity Score Estimation

5.1 Methodology & Descriptive Statistics

The first approach used to provide evidence on the causal impact of debt shifting on capital accumulation compares the financing and investment behavior of purely domestic to multinational firms, before and after the reform. Thus, a difference-in-differences specification of the form given in equation (17) is estimated. The main advantage of this approach is that I do not have to model the tax incentive to engage in debt shifting, which is almost impossible given the complex structures of multinational companies and the missing information on finance flows.

$$Y_{i,t} = \alpha_i + \beta_0 Treatment_i + \beta_1 Treatment_i * Reform + \beta_2 Reform + e_{i,t} \quad (17)$$

As shown in Table 1, multinational and domestic firms are different with respect to their observable characteristics. Domestic firms seems to be smaller than multinational firms, and have a lower debt ratio, although their capital stock is larger. Further, they operate in different industries. To account for these difference, I combine the difference-in-differences with a propensity score matching approach. This approach stems from the evaluation literature and can be used to make treatment and control group more comparable (Heckman et al., 1997).[19] It is used in a similar context by Egger et al. (2010). The main idea of the approach is to use only treated and control companies that are sufficiently similar to each other for the comparison. Treatment and control group observations are thus matched on a set of variables X such that the conditional mean independence assumption is fulfilled, which states that both group would behave similar in the absence of treatment.

Crucial assumption for the matching approach is the inclusion of all rel-

[19] Stuart (2010), Caliendo and Kopeinig (2008) and Caliendo and Kuenn (2011) provide comprehensive overviews and an application of matching methods.

Table 1: Descriptive statistics for treatment and control group up to 2006

	Mean		p-value
	Control Group	Treatment Group	t-test (two-sided)
firm size (log(total assets))	8.29	8.87	0.00
debt ratio	0.45	0.50	0.00
log(capital stock in thd. EURO)	6.14	5.54	0.00
d.debt ratio	-0.01	-0.01	0.57
d.log(capital stock)	0.05	0.02	0.21
Industry dummies			
agriculture, forestry and fishing	0.01	0.00	0.00
mining and quarrying	0.00	0.00	0.56
manufacturing	0.05	0.25	0.00
electricity and gas supply	0.11	0.03	0.00
water supply	0.02	0.03	0.00
construction	0.04	0.23	0.00
wholesale and retail trade	0.01	0.00	0.00
transportation and storage	0.07	0.07	0.81
information and communication	0.01	0.02	0.34
accommodation and food service activities	0.42	0.33	0.00
real estate activities	0.05	0.00	0.00
professional, scientific and technical activities	0.09	0.01	0.00
administrative and support service activities	0.11	0.03	0.00

Notes: Control group consists of purely domestic firms, that are observed between 2005 and 2009. Treatment group includes firms that had before the reform an incentive to engage in debt financing to the headquarter, which was abolished due to the reform.
Source: DAFNE firm data base 2004 - 2006.

evant characteristics X in the analysis. The broadest set of variables, on which I match the two groups are: industry classification, debt ratio 2005, firm size 2005 (measured as natural logarithm of total assets), and (natural logarithm of the) capital stock in 2005 as well as the change in the capital stock and the debt ratio between 2005 and 2006.[20] I use the 2005 and 2006 characteristics as the reform was announced in 2007. Although one might argue that matching on capital stock and finance structure does not increase the similarity of treatment and control group since multinational firms that shift profits have a higher debt ratio and invest more, the null hypothesis is that both firms behave in the same way. To check the sensitivity of the results, I exclude these variables in a robustness check.

Since I match on multiple variables, proximity between observations is based on the estimated one-dimensional propensity score, which is the probability of receiving treatment, conditional on the matching variables X. It is

[20]In a robustness specification, I also matched on changes between 2004 and 2005. The results are qualitatively and quantitatively unchanged and are available upon request.

estimated by running a logistic regression of the treatment indicator on X.[21] As distance measure, I use the linear propensity score, which improves the balance between the treatment and control groups (Rosenbaum and Rubin 1985). Finally, the observations are matched using kernel and, in a sensitivity check, 5-to-1 nearest neighbor matching as well, both with replacement. To evaluate the matching quality I report standardized bias before and after matching.[22] Noteworthy, since the combination of DiD and propensity score estimation requires a balanced sample as otherwise the estimation would suffer from sample attrition, I include only firms in the sample that are observed in every year between 2005 and 2009.

The control group in my setting consists of 6,083 purely domestic firms, observed between 2005 and 2009. These are firms that are ultimately owned by another German corporation, and that do not own foreign subsidiaries, neither directly nor indirectly (via the parent company or subsidiaries). The treatment group in contrast consist of 1,081 foreign owned firms, observed between 2005 and 2009. To account for the fact that not every multinational firm has a tax haven, only around 30% (Gumpert et al., 2011; Buettner et al., 2013), and, secondly, that there seems to be a home bias in multinational firms' profit shifting activities (Dischinger et al., 2014), I exclude foreign owned firms with a parent company facing a higher tax rate on profits than in Germany. Further, I exclude foreign owned firms that had both before and after the reform an incentive to shift profits to the headquarters, as their reaction is likely to attenuate the impact on multinational firms for which the incentive was abolished. The treatment group consists thus only of firms, that could easily avoid tax payments in Germany by shifting profits to the headquarter before the reform but not after. These are firms owned by parent companies located, for example, in France or Sweden (see Table A.1 in the Appendix). The sensitivity of the exclusion of other multinational firms is assessed in a robustness check.

[21] Rosenbaum and Rubin (1985) show that conditioning on X is equivalent to conditioning on the propensity score.

[22] The standardized bias is calculated as the difference between the mean characteristic of the treated and matched control firms, standardized by the square root of the average of the variances in the two groups.

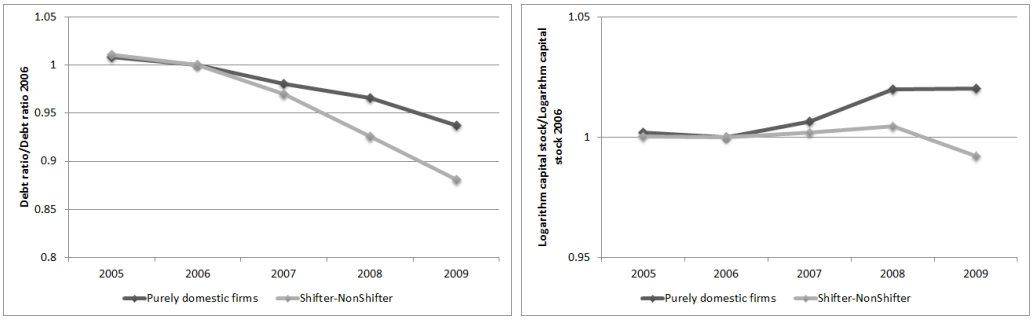
The two outcome variables of interest are (the natural logarithm of) firms' capital stock and firms' debt ratio (defined as total liabilities to total assets). The latter is used since internal liabilities are not observed for all firms in the sample. To explore the heterogeneity with regard to the incentive to engage in debt financing and its impact on investment, following the theoretical prediction, I split the sample according to firms' ratio of profits before interest payments to total assets and reapply the propensity score matching approach. Since profits are not observed for each company in the data, two-digit industry averages based on all available firms in the database are used. The mean ratio of profits before interest to total assets is around 30%. To uncover the impact of the generosity of depreciation allowances on internal debt financing and the related impact on the capital stock, I interact the ratio of depreciation allowances to total assets with the Treatment*After variable. As for profits, I use the two-digit industry averages, the mean is around 5.4%.

5.2 Results

Before presenting the graphical and regression results based on the matched sample, information on the propensity score estimation is provided. The results from the logistic regression used to estimate the propensity score reflect the differences between foreign owned firms and purely domestic firms (Table A.2 in the Appendix). After estimating the propensity score, I apply kernel matching to identify suitable control observations for every firm in the treatment group. The standardized bias indicates a successful matching as for all variables, I match on, the bias is below 5% (Table A.3 in the Appendix.)

The evolution of the debt ratio for purely domestic firms and multinational firms that are *Shifter-NonShifter* and thus had before the reform an incentive to engage in debt shifting to the headquarter that was abolished due to the reform, based on the matched sample are presented on the left hand side of Figure 2. The debt ratio is normalized by groups' mean debt ratio in 2006. The common trend assumption seems to be fulfilled as between 2005

Figure 2: Evolution debt ratio and capital stock for purely domestic firms and Shifter-NonShifter based on the matched sample



Notes: The debt ratio is defined as total liabilities to total assets. Groups and sample as described in the text.
Source: DAFNE firm data base, 2005 - 2009.

and 2006 both groups exhibit a similar trend. In line with the theoretical expectations, both the treatment (*Shifter-NonShifter*) and control (purely domestic firms) group decreased their debt ratios after 2007 since the reform reduced the tax advantage of debt by lowering the tax rate on profits (e.g. Modigliani and Miller 1963, Feld et al. 2013). Further, in line with the derived hypothesis in section 3, the debt ratio of the *Shifter-NonShifter* decreased stronger.

The evolution of the capital stock for both type of firms is shown on the right hand side of Figure 2. Depicted is the natural logarithm of the capital stock, normalized by the groups' mean in 2006. Purely domestic firms increased their capital stock after 2007, which is consistent with the literature on taxes and investment spending (e.g. Chirinko et al., 1999). Firms for which the incentive to engage in debt shifting was abolished, however, (*Shifter-NonShifter*) did not increase their capital stock. This suggest that these firms were already less affected by the high tax rate in Germany such that the reduction in 2008 did not foster their capital accumulation.

The clear picture of the graphical analysis is confirmed by the difference-in-differences regression analysis, which accounts for firm specific effects. Column (1) and (2) of Table 2 show the results for the debt ratio and the natural logarithm of the capital stock as dependent variable based on the sample using kernel, and (3) and (4) using 5-to-1 nearest neighbor matching. In all specification, there is a statistically significant, negative impact for the treat-

ment group due to the corporate income tax reduction in 2008. The results suggest that on average the treatment group reduced their debt ratio by 2.2 (kernel matching) to 2.3%-points (5-to-1 nearest neighbor) compared to domestic firms. This is in line with the hypothesis that these firms reduced or even stopped using internal debt financing to lower their taxable income. With regard to the capital stock, the results show that firms which stopped shifting profits abroad via internal debt financing decreased their capital stock by around 7 (5-to-1 nearest neighbor) to 11%-points (kernel matching) compared to domestic firms. The basic hypothesis of the model can thus not be rejected.

Table 2: Results difference-in-differences (DiD) specification

Matching Method	Kernel		Nearest Neighbor		Kernel	
Matching Variables	with debt variables				without debt variables change capital stock	
Dep. Var	Debt Ratio	Capital Stock	Debt Ratio	Capital Stock	Debt Ratio	Capital Stock
	(1)	(2)	(3)	(4)	(5)	(6)
D(> 2007)	-0.016***	0.120***	-0.019***	0.124***	-0.020***	0.080***
	(0.002)	(0.009)	(0.002)	(0.008)	(0.001)	(0.011)
D(Treatment)*	-0.022***	-0.107**	-0.023***	-0.070*	-0.023***	-0.125***
D(> 2007)	(0.005)	(0.040)	(0.005)	(0.040)	(0.005)	(0.043)
Observations	35,615	35,615	17,025	17,025	35,615	35,615

Notes: Robust standard errors in parenthesis. Each regression includes a full set of firm and time dummies (not reported). Stars *, **, *** indicate significant at the 10/5/1% level.
Source: DAFNE firm database, 2004 to 2010, own calculations.

Before turning to the heterogeneity analysis, the sensitivity of the results is assessed. I firstly excluded the finance structure variables as well as the growth rate for the capital stock from the matching variables. The main argument is that due to the fact that multinational firms use debt financing and thus have a higher debt ratio than domestic firms, matching treatment and control group on their finance structure does not increase their similarity but rather their dissimilarity. The results are reported in Table 2, column (5) and (6). The result for the debt ratio is almost unchanged, while the impact for the capital stock increases to 12.5%. Overall, however, the results are not statistically different from the baseline specification. The second sensitivity check concerns the focus on firms, that had, before the reform, an incentive to shift profits to the headquarter, but not after. Table 3 reports the

results where all multinational, respectively only *Shifter-Shifter* (firms with an incentive before and after the reform to engage in debt financing to the headquarter) and *NonShifter-NonShifter* (firms that had neither before nor after the reform an incentive to engage in debt financing to the headquarter) form the treatment group. Neither for *Shifter-Shifter* nor for *NonShifter-NonShifter* are significant results found. When using all multinationals as treated firms, only the negative impact on investment is significant. These results suggest that it seems to be, in particular, *Shifter-NonShifter* that drive the results, as only these firms had to adjust their debt financing due to the changed tax incentive.

Table 3: Sensitivity analysis: Difference-in-differences (DiD) specification

Matching Method			Kernel			
Treatment Group (TR)	All multinational firms		Shifter-Shifter		NonShifter-NonShifter	
Dep. Var	Debt Ratio	Capital Stock	Debt Ratio	Capital Stock	Debt Ratio	Capital Stock
	(1)	(2)	(3)	(4)	(5)	(6)
D(> 2007)	-0.009***	0.102***	-0.015***	0.092***	-0.025***	0.050
	(0.002)	(0.015)	(0.004)	(0.014)	(0.004)	(0.054)
D(TR) * D(> 2007)	-0.009	-0.099***	0.002	-0.060	0.003	-0.117
	(0.006)	(0.030)	(0.011)	(0.045)	(0.006)	(0.100)
Observations	40,455	40,455	33,900	33,900	27,270	27,270

Notes: Robust standard errors in parenthesis. Each regression includes a full set of firm and time dummies (not reported). Stars *, **, *** indicate significant at the 10/5/1% level.
Source: DAFNE firm database, 2004 to 2010, own calculations.

Heterogeneity Analysis

The results for firm heterogeneity with firms' debt ratio as dependent variable are presented in Table 4. There is only weak evidence that firms with a low ratio of profits to total assets (Table 4, column (1)) decreased their debt ratio more compared to firms with a high ratio (Table 4, column (3)). Further, the difference is not statistically significant. One reason could be that the hypothesis are derived for the internal debt ratio and that the external debt ratio changes differently for multinational firms. With respect to the role of depreciation allowance, the results are also not fully convincing as the interaction term is not significant. However, for the group that is likely to engage in debt financing the main effect increases in absolute terms and the interaction term is positive, which is in line with a lower reduction

in firms' debt ratio the more generous the depreciation allowances are.

Table 4: Heterogeneity debt ratio DiD specification

Dependent variable: Change in liabilities to shareholders				
Sample	$\frac{pF(.)-wL}{K}$ < Mean		$\frac{pF(.)-wL}{K}$ > Mean	
	(1)	(2)	(3)	(4)
D(> 2007)	-0.018***	-0.020***	-0.017***	-0.030***
	(0.006)	(0.007)	(0.003)	(0.003)
D(Shifter-NonShifter) * D(year > 2007)	-0.024**	-0.068	-0.022***	0.010
	(0.009)	(0.063)	(0.006)	(0.024)
D(> 2007) * $\frac{Depr.A}{K}$		0.072***		0.280***
		(0.008)		(0.000)
D(Shifter-NonShifter) * D(> 2007) * $\frac{Depr.A}{K}$		1.319		-0.664
		(1.601)		(0.400)
Observations	16,693	16,693	16,917	16,917

Notes: Robust standard errors in parenthesis. Each regression includes a full set of time dummies (not reported). Stars *, **, *** indicate significant at the 10/5/1% level.
Source: DAFNE firm database, 2004 to 2010, own calculations.

The results for the capital stock as dependent variable are in line with the theoretical expectation. They show that firms, which are not active in internal debt financing (Table 5, column (3)) due to fixed costs, decrease their capital stock less than firms with a low ratio of profits to total assets (Table 5, column (1)) compared to domestic firms. Further, firms likely to engage in internal debt financing but benefiting from generous depreciation allowances, experienced a lower reduction in the capital stock. This suggest that their capital accumulation benefit less from internal debt financing due to a lower tax burden on capital. In contrast are the results for firms that are less likely to engage in debt financing. For these firms depreciation allowances affect capital accumulation only by changing the investment costs. Nevertheless, for these firms profit shifting also seems to impact capital accumulation although to a much smaller extent. Overall the results are similar to Egger et al. (2014), who find that around 11% of all multinational firms (which are, in particular, the large ones) in their sample are tax avoiders and thus their investment is unaffected by changes in the tax rate. The main difference, however, is that my results suggest that firms that engage in debt shifting (which are firms with a low ratio of profits to assets) are, in particular, unaffected by tax rate changes. Thus, if multinational firms use either transfer pricing or debt shifting, the results suggest that both means of profit shifting

have a different impact on capital accumulation, which is also suggested by Schindler and Schjelderup (2013).

Table 5: Heterogeneity capital stock DiD specification

Dependent variable: Growth rate of the capital stock				
Sample	$\frac{pF(.)-wL}{K}$ < Mean		$\frac{pF(.)-wL}{K}$ > Mean	
	(1)	(2)	(3)	(4)
D(> 2007)	0.114***	0.080***	0.141***	0.136***
	(0.016)	(0.016)	(0.013)	(0.013)
D(Shifter-NonShifter) * D(year > 2007)	-0.189**	-0.776***	-0.094**	-0.114**
	(0.086)	(0.235)	(0.043)	(0.041)
D(> 2007) * $\frac{Depr.A}{K}$		1.019***		0.101***
		(0.076)		(0.001)
D(Shifter-NonShifter) * D(> 2007) * $\frac{Depr.A}{K}$		16.969***		0.412
		(5.584)		(0.669)
Observations	16,693	16,693	16,917	16,917

Notes: Robust standard errors in parenthesis. Each regression includes a full set of time dummies (not reported). Stars *, **, *** indicate significant at the 10/5/1% level.
Source: DAFNE firm database, 2004 to 2010, own calculations.

6 Second Approach: Structural Approach

6.1 Methodology & Descriptive Statistics

As an additional test of the hypothesis and to allow to link the results to the investment literature a second more structural approach is applied. Compared to the first approach, it has, on the one hand, the advantage that the estimated coefficients are related to the potential tax savings of shifting profits abroad, on the other hand, it explicitly relates the profit shifting to the investment literature. The costs are that the tax incentive of multinational firms must be explicitly modeled. Since multinational groups are complex and the construction of the relevant tax incentive, therefore, almost impossible, I restrict the analysis to a particular channel, which is the incentive to shift profits to the headquarter. Three reasons support the use of this channel. Firstly, the results of the difference-in-differences approach are, in particular, strong for multinational subsidiaries that had an incentive to engage in debt shifting to the headquarter before the reform, but not after. Secondly, there seems to be a home bias in internal debt financing (Dischinger et al.,

2014) and, thirdly, only 20 to 30% of all multinational firms have subsidiaries in tax havens (Gumpert et al., 2011; Buettner et al., 2013). A further advantage is that liabilities to the parent company are directly observed in the data in contrast to liabilities to other subsidiaries, which are only available as sum of all liabilities to other subsidiaries. Moreover, since the reform abolished the incentive to shift profits to the headquarter completely for some firms, a potential omitted variables bias is of minor importance.[23]

To test the hypothesis, I estimate two equations. The first refers to the amount of internal debt financing to the parent company (equation 16). Thus, the dependent variable is the share of liabilities against the parent company to total assets ($\frac{LS_{i,t}}{TA_{i,t}}$). The main variable of interest is the tax rate differential (TRD), i.e. the difference between the tax rate to which interest payments are deductible, and the tax rate on profits of the parent company (see equation (18)). Since the TRD is, after the 2008 corporate tax reform, negative for some firms and should not affect the internal debt ratio, as it includes no receivables, I interact the TRD variable with a dummy that is one if a company has no tax incentive to shift profits (D(NITS)). The coefficient of the TRD (α_1) should be positive since a positive TRD allows firms to save taxes by using internal debt financing. The TRD should, however, not influence internal liabilities if a company has no tax incentive to shift profits. Thus, the sum of α_1 and α_2 should be zero. Besides the TRD and the interaction term in the regression I control for the business tax rate in Germany, which is identified due to variation in the local business tax rate, as well as for firm size (measured as the natural logarithm of total assets) and the business cycle (by including time dummies). These control variables are captured in the matrix $X_{i,t}$. Since the fraction of internal borrowing may depend on a firm specific effect ($\eta_{1,i}$), estimation is done in first differences. Robust standard errors, clustered for the location of the parent company are

[23]The omitted variable bias depends on the correlation between the omitted variable, which is for example the tax incentive to shift to a tax haven, and the variable of interest, which is the tax rate differential to the headquarter. Since I interact the latter with a dummy that is one if the company has no tax incentive to shift to the headquarter, the bias is reduced as the interaction term between the dummy and the tax rate differential to the headquarter is less correlated with the tax rate differential to the tax haven.

reported.

$$\frac{LS_{i,t}}{TA_{i,t}} = \eta_{1,i} + \alpha_1 TRD + \alpha_2 D(NITS) * TRD + \theta_1 X_{i,t} + \epsilon_{i,t} \quad (18)$$

The impact of internal debt financing on capital accumulation, i.e. the second hypothesis, is tested using a neoclassical investment equation. The estimation equation (equation (20)) is derived by taking the natural logarithm of the first order condition with respect to the capital stock derived in the model (equation (12)) and assuming a simple production (equation (19)) function. It states that the natural logarithm of the capital stock depends on the natural logarithm of the user costs of capital using retained earnings less the tax advantage of the multinational due to debt shifting. To identify the main variable of interest, the impact of the tax advantage (γ), I re-arrange equation (20). Following the argumentation for the debt shifting equation, I interact the tax advantage of the multinational with a dummy that is one if a firm has no tax incentive to shift profits (equation (21)). I expect that the sum of the coefficient b_2 and b_3 should be zero, since a multinational firm should behave as a domestic firm if it does not engage in internal debt financing to save taxes. If, however, the firm has a tax incentive to shift, it should invest more. From a theoretical point I expect further that the coefficient for the user costs of capital (b_1) is -1.

$$S_{i,t} = K_{i,t}^{\sigma} \quad (19)$$

$$\begin{aligned} log(K_{i,t}) &= \eta_{2,i} - b_1 * log[UCC_{G,t} - \gamma \frac{(u_{G,mod,t} - u_{A,t})}{(1 - u_{G,t})}] \\ &\quad + \theta_2 log[S_{i,t}] + w_{i,t} \end{aligned} \quad (20)$$

$$\begin{aligned} log(K_{i,t}) &= \eta_{2,i} - b_1 * logUCC_{G,t} + b_2 \frac{(u_{G,mod,t} - u_{A,t})}{(1 - u_{G,t})UCC_{G,t}} \\ &\quad - b_3 \frac{(u_{G,mod,t} - u_{A,t})}{(1 - u_{G,t})UCC_{G,t}} D(NITS) + \theta_2 log[S_{i,t}] + w_{i,t} \end{aligned} \quad (21)$$

The key variable in the neoclassical investment equation (20) is the user cost of capital (UCC). I construct them based upon the work by both Jorgenson (1963) as well as Hall and Jorgenson (1967). For the case without internal debt financing, the $UCC_{i,j,t}$ for firm i in industry j at time t is the

weighted average of its asset a specific user costs $UCC_{i,a,j,t}$:

$$UCC_{i,j,t} = \sum_a \kappa_{i,t}^a UCC_{i,a,j,t} = \sum_a \kappa_{i,t}^a \frac{p_t^I}{p_t^S} \frac{((1-u_{i,t}z_{a,t})(r_t+\delta_{a,j,t})}{1-u_{i,t}} \quad (22)$$

where $\kappa_{i,t}^a$ is the firm-specific share of asset a to total assets; p_t^I is a price deflater for investment goods and p_t^S the industry j-specific output price at time t[24]; $\delta_{j,a,t}$ is the asset a, industry j-specific economic depreciation rate[25], and $z_{a,t}$ are asset a-specific depreciation allowances by the tax system[26], weighted by the tax rate $u_{i,t}$ that consists of the corporate income and the local business tax in Germany. The financial costs are r_t.[27] Two types of assets are considered, property with buildings and fixed tangible assets.

The investment equation is estimated in first differences to account for firm-specific effects ($\eta_{2,i}$). Robust standard errors clustered for the location of the parent company are reported. Due to the short length of my panel, I am not able to instrument the UCC to account for measurement error (Goolsbee, 2000), attenuation bias (Goolsbee, 1998; 2004), and endogeneity due to the asset specific weighting. Since attenuation bias and measurement error bias the coefficient downwards, the coefficient for the UCC would present a lower bound. Since this however does not hold for the bias in case of endogeneity, the sensitivity of the results is assessed using firms' twice lagged

[24]The index p_t^I (*Investitionsgueterpreisindex*) is constructed at the country level and the price index p_t^S *(Erzeugerpreisindex)* on a disaggregated level for manufactures by the German Statistical Office. I use this information at the four digit industry level.

[25]The rate of economic depreciation $\delta_{a,j,t}$ can be derived from the national accounts capital stock *(Kapitalstockrechnung)*, provided by the German Statistical Office. The rate is asset (fixed assets and structures), industry (four-digit-level) and time-specific. The rate of economic depreciation is calculated in prices of 2000.

[26]In Germany, allowances for fixed assets and structures follow different methods. Structures are depreciated on a straight line basis, whereas fixed assets could also be depreciated according to the declining-balance method until 2007. The rates of depreciation are set by the Federal Ministry of Finance. Due to data restrictions, only regular depreciation allowances are considered. The relevant lifetime of structures for tax purposes is 33 1/3 years. The yearly rate for the declining balance method is 0.2 for fixed assets. Because of missing information about the relevant lifetime for different fixed assets, I assumed a relevant lifetime of 16.9 years based on the investigation of depreciation allowances in Germany from Oestreicher and Spengel (2002).

[27]I used the overall yield on corporate bonds r_t provided by the German Central Bank in its series "Yields on debt securities outstanding issued by residents/corporate bonds/monthly average."

assets structure for the weighting.[28] Heterogeneity with respect to the use of internal debt financing is as for the first approach, studied by firstly spitting the sample according to the firm's incentive to engage in debt financing and, secondly, interacting the TRD with the amount of depreciation allowances to total assets.

Table 6: Descriptive statistics for the second sample

	Obs.	Mean	P50	SD
All firms				
Capital Stock in thd. EURO	20,993	41,963	4,468	912,975
Turnover in thd. EURO	20,993	83,418	17,130	466,342
LS/TA	20,993	0.19	0.09	0.23
Business tax rate	20,993	0.35	0.37	0.05
UCC	20,993	0.13	0.12	0.05
d.log(Capital stock)	15,113	0.03	-0.01	0.68
d.log(Turnover)	15,113	-0.00	0.03	1.13
d.LS/TA	15,113	-0.00	-0.00	0.11
D.Business tax rate	15,113	-0.02	0.00	0.03
d.log(UCC)	15,113	-0.02	0.01	0.15
Only foreign owned firms				
Dummy(No incentive to shift, NITS)	4,719	0.31	0.00	0.46
TRD	4,719	0.03	0.03	0.07
TRD/(1-Business tax rate, BTR)	4,719	0.05	0.04	0.11
d.Dummy(NITS)	3,322	0.09	0.00	0.35
d.TRD	3,322	-0.01	0.00	0.04
d.(TRD/(1-BTR))	3,322	-0.02	0.00	0.06

Source: DAFNE firm data base 2004 - 2010.

In the final sample for the second approach 20,993 firms are included. Around 20% are foreign owned. Countries with the largest number of parent companies are France, followed by Switzerland, Sweden and the Netherlands (see Table A.1 in the Appendix). The average firm in the sample has a fraction of internal debt to its shareholders of 19%, the median is 9% (see Table 6). The mean of the *UCC* is 13%. The tax rate differential, which is the difference between the tax rate to which interest expenses are deductible (incorporating the adding back regulation of the local business tax) and the tax rate of the parent company, for all foreign owned firms as described above has a mean of 3% and decreases over time due to the corporate tax reform. Further, there is substantial variation in the tax rate differential. There are no incentives to shift profits abroad for 31% of the foreign owned firms. For

[28] In case the twice lagged asset structure is not observed, lagged and then the current asset structure are used.

around 9% of the foreign owned firms, the incentive to shift vanished with the reform. The tax advantage of the multinational, given by TRD/(1-Business tax rate), equals 2% or roughly 15% of the *UCC*.

6.2 Results

The results for the debt shifting equation, with the change in the ratio of liabilities against shareholders to total assets as dependent variable, are reported in Table 7. Column (1) presents the baseline specification with the tax rate differential (TRD) and the interaction term. The results show that the TRD has a significant positive impact on the ratio of liabilities to shareholders to total assets, if it is positive, otherwise no impact is found (bottom line of the table, standard errors are calculated using the delta method). This is in line with the first hypothesis derived from the model and adds further evidence to the prior literature on debt shifting as a switch in the two regimes (from shifting to non-shifting) is used for the identification. The baseline results also holds if the two tax rates enter separately (column (2)) or, if the TRD is defined as zero, it would be negative (column (3)). The size of the coefficients, which are statistically not different between the specifications, suggests that an increase in the TRD by 10%-points increases the share of liabilities against shareholders by 2.9%-points. Compared to the prior literature that found an increase of around 1%-points (e.g. Huizinga et al., 2008; Buettner and Wamser, 2013), the result seems quite large. However, at least three reasons may explain the difference. The first relates to the dependent variable and the used tax differential. In most of the papers on debt shifting, the dependent variable is the overall internal debt ratio, which include all liabilities to other group members, except the parent company (e.g. Buettner and Wamser, 2013), or even the overall debt ratio (e.g. Huizinga et al., 2008). The used tax differential is thus a (asset-) weighted tax differential. In case the weighting is not appropriate, a measurement error occurs which bias the estimated coefficient to zero. In contrast, this study focuses solely on liabilities to the parent company and thus no weighting is necessary to derive the correct tax rate differential. Secondly, I explicitly account for the

direction of shifting by including the interaction term with the tax rate differential and the dummy that is one if the firm has no incentive to shift profits abroad. Other papers focus solely on liabilities of companies without accounting whether firms shift in or outwards. To assess whether this explains part of the difference, I estimate a specification without controlling for the interaction with the No-Incentive-to-Shift dummy. The result is shown in column (4). The estimated coefficient for the tax rate differential decreases by 0.1 and is now much closer to prior studies. Finally, adjustment costs may play role as well. Since I focus on a particular strong reduction, these are likely to be of minor importance.

Table 7: Results: Debt shifting equation

Dependent variable: Change in liabilities against shareholders				
	(1)	(2)	(3)	(4)
d.Business tax rate [= ($u_{G,t}$]	-0.331	-0.047	-0.333	-0.350
	(0.231)	(0.254)	(0.232)	(0.227)
d.TRD [= $u_{G,mod,t} - u_{A,t}$] (1)	0.288***			0.185**
	(0.092)			(0.072)
d.TRD*D(NITS) (2)	-0.311**			
	(0.148)			
d.($u_{G,mod,t}$*D(NITS))		-0.275		
		(0.172)		
d.$u_{A,t}$ (1)		-0.316***		
		(0.112)		
d.($u_{A,t}$*D(NITS)) (2)		0.286*		
		(0.155)		
d.(TRD if > 0, 0 else)			0.285***	
			(0.088)	
d.Firmsize	0.035***	0.035***	0.035***	0.035***
	(0.007)	(0.007)	(0.007)	(0.007)
Observations	15,113	15,113	15,113	15,113
Coeff (1) + (2)	-0.023	-0.031		
	(0.079)	(0.140)		

Notes: Robust standard errors, clustered for the location of the parent, in parenthesis. Each regression includes a full set of time dummies (not reported). Stars *, **, *** indicate significant at the 10/5/1% level.
Source: DAFNE firm database, 2004 to 2010, own calculations.

The results for the heterogeneity analysis show that firms within an industry with a low ratio of profits before interest to the capital stock react four times as strong than in the baseline estimation to tax incentives with their internal debt financing (Table 8, column (1)). In contrast firms that are not likely to engage in internal debt financing due to fixed costs, seem not to react. Further, the results suggest - in line with the hypothesis - that more generous depreciation allowances reduce the tax sensitivity remarkable.

Table 8: Results: Heterogeneity debt shifting equation

Dependent variable: Change in liabilities against shareholders				
Sample	$\frac{pF(.)}{K}$ < Mean		$\frac{pF(.)}{K}$ > Mean	
	(1)	(2)	(3)	(4)
d.Business tax rate [= ($u_{G,t}$]	0.231*	0.224**	-0.600*	-0.601*
	(0.112)	(0.100)	(0.356)	(0.355)
d.(TRD if > 0, 0 else)	1.467***	2.287**	0.112	0.118
	(0.506)	(0.830)	(0.093)	(0.110)
d.(TRD if > 0, 0 else) * $\frac{Depr.A}{K}$		-14.710*		-0.115
		(8.218)		(0.707)
d.Firmsize	0.026***	0.027***	0.045***	0.045***
	(0.005)	(0.006)	(0.011)	(0.011)
Observations	6,915	6,915	8,198	8,198

Notes: Robust standard errors, clustered for the location of the parent, in parenthesis. Each regression includes a full set of time dummies (not reported). Stars *, **, *** indicate significant at the 10/5/1% level.
Source: DAFNE firm database, 2004 to 2010, own calculations.

The estimated sensitivity of internal debt for firms without depreciation allowances amounts to 2.3 and is thus almost 7 times higher than the one found in the baseline regression. To check whether the change in the internal liabilities shows up in interest payments as well, I use (net) interest result to total assets for a subsample of firms for which the variable is available, as dependent variable (Table A.4 in the Appendix, column (1) and (3)). The results suggest that an increase of 10%-points in the tax rate differential, decrease the net interest results to total assets by around 0.008 for firms that are likely to engage in debt financing. In case firms react only with their liabilities to shareholders to the changed tax incentive this suggest an interest rate of 6%-points on liabilities to the parent company which seems quite plausible.[29] For the other firms the sign is even positive suggesting that firms likely to engage in transfer pricing use less debt financing.

To assess further whether firms unlikely to engage in debt financing use transfer pricing to reduce their tax payments, I estimate the same specification using before interest profits to total assets as the dependent variable (Table A.4 in the Appendix, column (2) and (5)). Only the TRD for the group of firms that are unlikely to engage in debt financing is significant.

[29]In case of a 1%-points change in the TRD, the share of internal liabilities increases by 1.5%-points (Table 7, column (5)), which gives with a interest rate of 6% a change in the interest results to total assets of 0.0009. The change in the interest results based on the estimated coefficient in Table A.4, column (1) amounts for an increase in the TRR of 1%-points to 0.00084 (0.084 * 0.01).

Since the used TRD accounts, in particular, for the incentive to use debt financing but differs from the incentive to use transfer pricing due to the adding back regulation of the local business tax, I re-run the regression using the TRD for transfer pricing (column (3) and (6)). The precision of the estimates increases (decreases) for firms unlikely (likely) to engage in debt financing. This suggest that firms not likely to engage in debt financing use transfer pricing.

The results of the capital stock equation (Table 9) show that the elasticity of the capital stock with respect to its user costs is not statistically different from -1, which is line with my model and the prior literature (e.g. Dwenger, 2014). The coefficient for sales is, however, as in other studies quite small and suggests decreasing returns to scale. An impact of the tax advantage of the multinational on investment spending is only found for debt shifting firms. If firms do not shift profits, the TRD does not affect investment (bottom line of the table, coefficient is statistically not different from zero). This holds when including the two tax rate separately as well as a modified TRD, which is zero if the TRD is negative.

Regarding firm heterogeneity, the results suggest that capital accumulation of firms with a low ratio of profits before interest to their capital stock depends much more strongly on the TRD (Table 10, column (1) and (3)). The reason is that only these firms are able to use debt financing to reallocate a large share of their profits, which reduces the tax burden on capital and thus fosters investment. The advantage is, however, decreasing in the generosity of the depreciation allowances as they reduce the tax burden on capital as well (column (2) and (4)). In contrast is the impact on investment of firms engaging in transfer pricing. For these firms profit shifting does only to a small extent affect investment. This suggests in line with the results of the first approach that transfer pricing and debt financing affect capital accumulation in different ways.

Sensitivity Analysis

To check the sensitivity of the results, four robustness checks are made. The first relates to the fact that German owned firms might be differently

Table 9: Result: Investment equation

Dependent variable: Growth rate of the capital stock B = $(1 - BTR) * UCC$			
	(1)	(2)	(3)
d.log(UCC)	-1.259***	-1.139***	-1.260***
	(0.138)	(0.074)	(0.138)
d.$\frac{TRD}{B}$ (1)	0.136**		
	(0.052)		
d.$\frac{TRD}{B} * D(NITS)$ (2)	-0.151*		
	(0.085)		
d.$\frac{u_{G,mod,t}}{B} * D(NITS)$		0.163**	
		(0.075)	
d.$\frac{u_{G,mod,t}}{B} * D(NITS)$		-0.156	
		(0.136)	
d.$\frac{u_{A,t}}{B}$ (1)		-0.135**	
		(0.065)	
d.$\frac{u_{A,t}}{B} * D(NITS)$ (2)		0.154	
		(0.114)	
d.($\frac{TRD}{B}$ if >0,0 else)			0.134**
			(0.051)
d.log(Sales)	0.044***	0.043***	0.044***
	(0.013)	(0.013)	(0.013)
Observations	15,113	15,113	15,113
Coeff (1) + (2)	-0.016	0.020	
	(0.052)	(0.134)	

Notes: Robust standard errors, clustered for the location of the parent, in parenthesis. Each regression includes a full set of time dummies (not reported). Stars *, **, *** indicate significant at the 10/5/1% level.
Source: DAFNE firm database, 2004 to 2010, own calculations.

Table 10: Result: Heterogeneity investment equation

Dependent variable: Growth rate of the capital stock and B = $(1 - BTR) * UCC$				
Sample	$\frac{pF(.)}{K}$ < Mean		$\frac{pF(.)}{K}$ > Mean	
	(1)	(2)	(3)	(4)
d.log(UCC)	-1.071***	-1.059***	-1.571***	-1.578***
	(0.123)	(0.110)	(0.147)	(0.148)
d.($\frac{TRD}{B}$ if >0,0 else)	0.459**	0.923***	0.098**	-0.064
	(0.267)	(0.044)	(0.118)	
d.($\frac{TRD}{B}$ if >0,0 else) * $\frac{Depr.A}{K}$		-9.119***		3.294
		(2.449)		(2.327)
d.log(Sales)	0.055***	0.055***	0.036**	0.035**
	(0.014)	(0.014)	(0.015)	(0.014)
Observations	6,915	6,915	8,198	8,198

Notes: Robust standard errors, clustered for the location of the parent, in parenthesis. Each regression includes a full set of time dummies (not reported). Stars *, **, *** indicate significant at the 10/5/1% level.
Source: DAFNE firm database, 2004 to 2010, own calculations.

affected by the business cycle. Thus, I exclude all domestic owned firms from the sample and re-estimate the equation of the heterogeneity analysis. The results for the debt ratio are shown in Table A.5, column (1) and (4), and for the capital stock in Table A.6, column (1) and (3). They are statistically not different from the results for the sample shown above.

The second sensitivity check accounts for the redesigned thin capitalization rule in Germany (see Buslei and Simmler, 2013). The regulation, which was introduced in 2008, restricts the amount of deductible interest expenses to 30% of the tax adjusted EBITDA (earnings before interest, taxes, depreciation and amortization). Since the German government, however, was not interested in harming its own economy, the regulation came with several escapes clauses. The most important one is the exemption limit of 1 million euro. If firms exhibit net interest expenses below the threshold, the regulation is not applied. This exemption limit was raised retroactively in 2009 to 3 million euro due to the impact of the financial crisis. To check the sensitivity, I re-estimate the last specifications using only firms with net interest expenses below 1 million euro. The results for the debt shifting equation are reported in column (2) and (5) of Table A.5 and for the investment equation in column (2) and (4) of Table A.6. Again the results are not statistically different from the ones using the whole sample, which is due to the fact that only few firms are affected by the regulation.

In the third sensitivity check debt shifting equation is estimated using the overall internal debt ratio, which is the sum of liabilities to the parent company and to all other group members. The main idea is to assess whether the changed incentive to engage in debt financing to the headquarter causes an increase in liabilities to other subsidiaries. If this is the case, the estimated coefficient for the TRD should shrink sharply. The results suggest, however, that no substitution took place (Table A.5, column (3) and (6)).

Finally, the fourth sensitivity test relates to the potential endogeneity of the *UCC*. To address whether this biases the estimates for the tax advantage of the multinational firm in the capital stock equation, I use the twice-lagged assets structure for weighting the asset-specific *UCC*. The results are shown in Table A.7 in the Appendix. Although the estimated coefficient decreases

for the *UCC*, the ones for the tax advantage as well as for the impact of the depreciation allowance remain basically unchanged.

7 Comparing the two Methods

Although the two methods rely on different samples, the results of the two approaches can be compared for the first sample using the structural parameters estimated from the second approach. The comparison of the two approaches is informative about the estimated relationship of debt financing and capital accumulation using the two different approaches as well as differences between the two methods. Table 11 summarizes the estimated coefficients for the two methods. For a comparison, the change in the debt ratio and the capital stock based on the structural approach is calculated using the change in the TRD and TRD/(1-BTR)*UCC* for *Shifter-NonShifter* for the first sample from 2007 to 2008. The comparison show that the ratio between the change in the (internal) debt ratio and in the capital stock are almost identical for the two methods (around 21%). The absolute impact differs however. The impact found in the structural approach is only half the size of the DiD impact. Two reasons can explain the difference and both are related to the used tax rate differential, which is the Achilles' heel of the second approach. The first explanation questions whether the adding back regulation for the local business tax before the reform were binding. According to the regulation, 50% of the interest payments on long term debt had to be added back. Since multinational firms could try to avoid the regulation by using only short term loans, the used tax rate differential would not been the correct one. To compare whether this changes the picture, the impact is calculated using the estimated coefficients of the structural approach again and the modified TRD. The results of the two approaches are now very, very similar. However, another plausible explanation for the difference could be that part of the subsidiaries does not shift profits to the headquarters but to other subsidiaries in low tax countries. If one assumes that only 30% of all multinational firms shift to the headquarters, whereas the rest shift to tax havens, and uses a weighted average of the TRD (similar to equation 16),

the results are again very similar. Most likely both explanation are able to explain part of the difference.

Comparing the estimated impact for firms likely to engage in debt shifting with no depreciation allowances leads to similar conclusions. Firstly, the ratio of the change in debt financing to the change in capital stock is in the structural approach again around 21%. The ratio for the DiD approach is lower but the coefficient for the debt ratio has not been estimated very precisely. Secondly, the absolute impact found in the structural approach is again much lower. However, as before, both explanations, that the adding back regulation were not binding and that some firms shift to other subsidiaries, lead to a very similar impact for the change in the capital stock for the structural and the DiD approach.

Table 11: Comparison of the results DiD and structural approach

	DiD	Structural Approach		
	Estimated Coefficient	Estimated Coefficient	TRD resp. $\frac{TRD}{(1-BTR)UCC}$	Estimated Impact
Baseline estimation results				
Change in the debt ratio	-0.022***	0.285***	-0.043	-0.012***
	(0.005)	(0.088)		(0.004)
Change log(capital stock)	-0.107**	0.134**	-0.443	-0.059**
	(0.040)	(0.051)		(0.022)
$\frac{d.Debt}{d.log(capitalstock}$ in %	21			21
A1: TRD if adding back regulation local business tax before the reform was not binding				
[A2: 30% shift to the headquarter and 70% to other subsidiaries]				
Change in the debt ratio	0.022***	0.285***	-0.073 [-0.075]	-0.021*** [-0.022***]
	(0.005)	(0.088)		(0.006) [(0.007)]
Change log(capital stock)	-0.107**	0.134**	-0.744 [-0.0769]	-0.099** [-0.103**]
	(0.040)	(0.051)		(0.038) [(0.039)]
Firm likely to engage in debt shifting with no depreciation allowances				
Change in the debt ratio	-0.068	2.287***	-0.043	-0.095***
	(0.063)	(0.830)		(0.035)
Change log(capital stock)	-0.776**	0.923***	-0.443	-0.435***
	(0.235)	(0.267)		(0.118)
$\frac{d.Debt}{d.log(capitalstock}$ in %	9			22
A1: TRD if adding back regulation local business tax before the reform was not binding				
[A2: 30% shift to the headquarter and 70% to other subsidiaries]				
Change in the debt ratio	-0.068	2.287***	-0.073 [-0.075]	-0.161*** [-0.168***]
	(0.063)	(0.830)		(0.061) [(0.062)]
Change log(capital stock)	-0.776**	0.923***	-0.744 [-0.769]	-0.733*** [-0.782***]
	(0.235)	(0.267)		(0.199) [(0.205)]

Notes: The TRD in alternative 1 is calculated as a weighted average. The TRD amounts for the case of shifting to other subsidiaries to 9%. The TRD for alternative 2 is before (after) the reform calculated as the difference between the tax rate on profits (tax rate to which interest expenses are deductible) in Germany and the tax rate on profits abroad before. The TRD/(1-BTR)UCC are adjusted to the changed TRD.

8 Conclusion

The aim of this paper is to provide evidence on the causal relationship of debt shifting activities of multinational firms on capital accumulation. This is important as profit shifting activities have, so far, been seen as welfare decreasing for countries. If these activities, however, foster capital accumulation, they might to some extend be beneficial as recently pointed out in the theoretical literature as they reduce the negative impact of taxation on capital accumulation (e.g. Hong and Smart, 2010).

To uncover the relationship between debt shifting as a particular form of profit shifting and capital accumulation, I exploit the 2008 German corporate income tax reform, which reduced the tax rate on profits by 10%-points, using two different methods. The first compares the financing and investment behavior of purely domestic and multinational firms before and after the reform using a difference-in-differences approach. To account for differences between the two groups, a propensity score matching approach is used. The second approach exploits the change in the tax incentive to engage in debt shifting to the parent company for the identification. Both methods provide consistent results and are in line with the hypothesis of the neoclassical investment model, which is extended to account for internal debt financing.

The findings suggest firstly that internal debt financing fosters capital accumulation by decreasing the tax burden on capital. Thus, the tax rate reduction in Germany had only a modest impact on investment spending of German subsidiaries, if their profits were shifted abroad via debt financing before the reform. In particular, these are firms with a low ratio of profits to the capital stock. Firms that are less likely to engage in debt financing and that seem to engage in transfer pricing exhibit a much smaller decline in investment compared to domestic firms. This suggest in line with the theoretical results by Schindler and Schjelderup (2013) that only internal debt financing fosters capital accumulation but not transfer pricing. Secondly, the results show that depreciation allowances reduce the tax sensitivity of internal borrowing as they reduce taxable income. Since depreciation allowances decrease the tax burden on capital as well, they lower the tax advantage of

firms engaging in debt shifting with respect to the capital stock.

Altogether the results suggest that debt shifting activities are to some extend welfare increasing. The results, however, also speak for tax cuts to increase the competitiveness of firms not engaged in debt shifting. Domestic firms have a competitive disadvantage as they are not able to engage in internal debt financing, at least as long as they remain solely domestic. Further, my findings highlight the role of recent EU tax reforms following the principle *tax rate cut cum base broadening*. The reduction in the tax rate might have decreased the number of firms shifting profits, but the reduction in the generosity of depreciation allowances increased the tax advantage of firms still shifting profits, thus it is likely that more firms will become multinational given these benefits (Bucovetsky and Haufler, 2008). This paper shows that being a multinational firm allows to invest more, what has to be left open for future research is whether the tax advantage affects the competition structure in markets as well.

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Appendix - Additional Descriptive Statistics and Regression Results

Table A.1: Descriptive statistics on the location of the (ultimate) parent company

	All firms	Sample 1	Sample 2
Australia	340	120	53
Austria	1464	140	224
Belgium	878	440	127
Canada	376	75	47
Cayman Islands	125	0	19
Czech Republic	29	0	11
Denmark	1951	190	242
Finland	596	105	138
France	4,919	2,260	1,175
Germany	78,918	30,415	16,274
Hong Kong	67	0	14
Iceland	27	0	10
India	256	110	27
Ireland	374	0	56
Israel	160	30	12
Italy	1816	0	314
Korea, Republic of	256	85	114
Kuwait	83	0	24
Luxembourg	644	150	82
Malaysia	29	5	24
Mexico	85	35	14
Netherlands	2315	210	413
Norway	423	175	87
Other countries	705	40	80
South Africa	95	0	14
Spain	642	250	140
Sweden	2040	760	416
Switzerland	3753	0	800
Taiwan	189	25	42
Total	103,555	35,620	20,993

Notes: Sample 1 includes German owned firms that do not own foreign subsidiaries and foreign owned firms that had before the reform an incentive to shift profits via internal debt financing to the headquarter, which was abolished due to the reform. All firms in sample 1 are required to be observed in every year between 2005 and 2009. Sample 2 includes all firms for which liabilities against the parent company are observed.
Source: DAFNE firm database, own calculations.

Table A.2: Logistic regression of the propensity score

Matching variables	all	without (1), (2), (3)
Log(Total Assets 2006)	0.246***	0.240***
	(0.019)	(0.019)
Debt Ratio 2006 (1)	0.289**	
	(0.127)	
Log(Capital Stock 2006)	-0.125***	-0.116***
	(0.013)	(0.013)
d.Debt Ratio 2006 (2)	1.052***	
	(0.313)	
d.log(capital stock 2006) (3)	-0.125***	
	(0.047)	
Industry dummies		
agriculture	-3.636***	-3.774***
	(1.012)	(1.011)
electricity and gas supply	-2.690***	-2.898***
	(0.196)	(0.194)
water supply	-0.918***	-0.966***
	(0.219)	(0.218)
construction	0.117	0.225*
	(0.125)	(0.124)
wholesale and retail trade	-3.740***	-3.741***
	(1.012)	(1.011)
transportation and storage	-1.446***	-1.568***
	(0.155)	(0.154)
information and communication	-1.555***	-1.259***
	(0.288)	(0.281)
accommodation	-1.934***	-1.759***
	(0.105)	(0.101)
real estate activities	-5.332***	-5.371***
	(1.005)	(1.005)
professional, technical activities	-4.142***	-4.334***
	(0.420)	(0.419)
support service activities	-2.663***	-2.719***
	(0.200)	(0.200)
Observations	7,124	7,124

Notes: The dependent variable is the treatment indicator. It equals one for firms that had before the corporate tax reform an incentive to shift profits via internal debt financing to the headquarter, but not after the reform. It is zero for purely domestic firms. Stars *,**,*** indicate significance at the 1/5/10% level.
Source: DAFNE firm database, 2005, 2006, own calculations.

Table A.3: Standardized bias before and after matching

	Mean		Standardized Bias in %			
	Treatment	Control	Before	After matching		
Matching method				Kernel	NN	Kernel
Matching variables				all		without (1), (2), (3)
firm size (log(total assets) 2005	8.81	8.26	22.89	2.24	0.25	1.39
debt ratio 2005 (1)	0.5	0.45	14.28	-0.08	0.29	6.64
log(capital stock) 2005	5.54	6.12	-16.41	3.10	5.70	2.94
d.debt ratio 2006 (2)	0.00	-0.01	5.5	-0.26	-0.54	10.81
d.log(capital stock) (3) 2006	0.00	0.04	-5.21	1.07	-0.26	-8.38
Industry dummies						
agriculture, forestry and fishing	0.00	0.01	-12.93	-1.31	0.65	-0.92
manufacturing	0.25	0.05	57.57	2.99	0.25	2.63
electricity and gas supply	0.03	0.10	-28.99	-1.04	0.03	-1.05
water supply	0.03	0.01	7.62	2.5	0.03	3.41
construction	0.22	0.04	54.98	1.76	0.22	2.21
wholesale and retail trade	0.00	0.01	-13.3	-1.41	0.00	-1.01
transportation and storage	0.06	0.06	-0.56	0.16	0.06	0.61
information and communication	0.01	0.01	2.22	-0.25	0.01	-0.20
accommodation	0.33	0.41	-18.00	-2.13	0.33	-3.27
real estate activities	0.00	0.05	-31.89	-6.45	0.00	-5.8
professional, technical activities	0.00	0.08	-40.12	-4.88	0.00	-3.76
support service activities	0.03	0.10	-31.34	-1.34	0.03	-1.14

Notes: Control group consists of purely domestic firms, that are observed between 2005 and 2009. Treatment group includes firms that had before the reform an incentive to engage in debt financing, which was abolished due to the reform.
Source: DAFNE firm database, 2005,2006, own calculations.

Table A.4: Results interest results and profits

	(1)	(2)	(3)	(4)	(5)	(6)
		$\frac{pF(.)}{K}$ < Mean			$\frac{pF(.)}{K}$ > Mean	
Dep. Variable	Interest	Profits before		Interest	Profits before	
(scaled by total assets)	Results	Interest		Results	Interest	
d.Business tax rate	-0.076***	-0.598**	-0.600**	-0.076	0.307	0.353
	(0.009)	(0.235)	(0.235)	(0.050)	(0.269)	(0.287)
d.TRD (1)	-0.087**	-0.281		0.012**	-0.179**	
	(0.033)	(0.164)		(0.005)	(0.082)	
d.TRD*D(NITS) (2)	0.106**	0.363*		-0.015	-0.095	
	(0.044)	(0.203)		(0.009)	(0.157)	
d.TRD (modified) (1)			-0.224			-0.187**
			(0.206)			(0.081)
d.TRD (modified)*D(NITS)			0.333			-0.196
			(0.443)			(0.262)
Observations	5,680	5,680	5,680	6,707	6,707	6,707
Coeff (1) + (2)	0.020	0.082	0.109	-0.003	-0.274*	-0.384
	(0.015)	(0.087)	(0.259)	(0.008)	(0.144)	(0.246)

Notes: Robust standard errors in parenthesis. Each regression includes a full set of firm and time dummies (not reported). Stars *, **, *** indicate significant at the 10/5/1% level.
Source: DAFNE firm database, 2004 to 2010, own calculations.

Table A.5: Sensitivity analysis: Debt shifting equation

Dependent variable: Change in liabilities against shareholders (LS) resp. against group members (LGM)						
Sample	$\frac{pF(.)-wL}{K}$ < Mean			$\frac{pF(.)-wL}{K}$ > Mean		
Dependent variable	LS		LGM	LS		LGM
German owned firms excluded	x			x		
Firms with interest results > 1 million EURO excluded		x			x	
	(1)	(2)	(3)	(4)	(5)	(6)
d.Business tax rate [= ($u_{G,t}$]	0.282	0.194*	0.247**	-0.365	-0.617*	-0.346
	(2.360)	(0.106)	(0.117)	(0.866)	(0.366)	(0.456)
d.(TRD if > 0, 0 else)	2.544***	2.299**	2.126***	0.099	0.119	0.120***
	(0.896)	(0.824)	(0.666)	(0.162)	(0.111)	(0.042)
d.(TRD if > 0, 0 else) * $\frac{Depr.A}{K}$	-14.849*	-14.797*	-16.836**	-0.013	-0.205	-0.720**
	(8.487)	(8.161)	(7.773)	(0.731)	(0.671)	(0.325)
d.Firmsize	0.041**	0.026***	0.034***	0.028	0.045***	0.070***
	(0.017)	(0.005)	(0.005)	(0.018)	(0.011)	(0.010)
Observations	429	6,802	6,913	2,893	8,013	8,194

Notes: Robust standard errors, clustered for the location of the parent, in parenthesis. Each regression includes a full set of time dummies (not reported). Stars *, **, *** indicate significant at the 10/5/1% level.
Source: DAFNE firm database, 2004 to 2010, own calculations.

Table A.6: Sensitivity analysis: Investment equation

Dependent variable: Growth rate of the capital stock with $B = (1 - BTR) * UCC$)				
Sample	$\frac{pF(.)-wL}{K}$ < Mean		$\frac{pF(.)-wL}{K}$ > Mean	
German owned firms excluded	x		x	
Firms with interest results > 1 million EURO excluded		x		x
Specification	(1)	(2)	(3)	(4)
d.log(UCC)	-2.196**	-1.088***	-1.730***	-1.592***
	(0.818)	(0.110)	(0.478)	(0.148)
d.($\frac{TRD}{B}$ if >0,0 else)	0.806***	0.920***	-0.007	-0.069
	(0.285)	(0.264)	(0.147)	(0.119)
d.($\frac{TRD}{B}$ if >0,0 else) * $\frac{Depr.A}{K}$	-6.494***	-9.029***	3.183	3.386
	(1.418)	(2.392)	(2.261)	(2.358)
d.log(Sales)	0.167**	0.055***	0.074***	0.035**
	(0.069)	(0.015)	(0.018)	(0.014)
Observations	429	6,802	2,893	8,013

Notes: Robust standard errors, clustered for the location of the parent, in parenthesis. Each regression includes a full set of time dummies (not reported). Stars *, **, *** indicate significant at the 10/5/1% level.
Source: DAFNE firm database, 2004 to 2010, own calculations.

Table A.7: Sensitivity analysis w.r.t UCC: Investment equation

Dependent variable: Growth rate of the capital stock		
$\frac{pF(.)-wL}{K}$ < Mean	x	
$\frac{pF(.)-wL}{K}$ > Mean		x
	(1)	(2)
d.log(UCC-mod)	-0.252***	-0.317***
	(0.044)	(0.080)
d.($\frac{TRD}{(1-BTR)*b_1UCC)}$ if TRD>0,0 else)	0.860**	-0.054
	(0.335)	(0.104)
d.($\frac{TRD}{(1-BTR)*b_1UCC)}$ if TRD>0,0 else) * $\frac{Depr.A}{K}$	-8.923**	2.649
	(3.390)	(2.035)
d.log(Sales)	0.061***	0.041***
	(0.016)	(0.013)
Observations	6,915	8,198

*Notes:*Robust standard errors, clustered for the location of the parent, in parenthesis. Each regression includes a full set of time dummies (not reported). Stars *, **, *** indicate significant at the 10/5/1% level.
Source: DAFNE firm database, 2004 to 2010, own calculations.

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