Heterogeneity in Tax-Motivated Debt Shifting and its Effects on Corporate Investment*

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Abstract

The purpose of this study is to provide evidence on the causal impact of debt shifting activities of multinational companies on capital accumulation. The identification strategy exploits the corporate tax reform 2008 in Germany as a quasi-natural experiment. This reform reduced the corporate income tax rate by 10 percentage points. Depending on the location of the parent company, the reform abandoned the tax incentive to shift profits to the headquarter via debt financing for some subsidiaries in Germany. Comparing them to purely domestic firms shows that these firms react less to the reduction in the German corporate income tax, although their debt ratio declined stronger. Further, I present evidence that the tax rate of the parent company matters for the subsidiaries' investment spending only if firms use debt shifting to reduce their tax payments. Moreover, the results are in particular strong for firms with a low ratio of profits before interest to their capital stock and firms with low depreciation allowances.

Keywords: Debt shifting, capital accumulation, corporate income taxation.

JEL Classification: H25, F23, G31, G32.

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*I thank Steve Bond, Mike Devereux, Ron Davies, Niels Johannesen, Li Liu, Axel Moehlmann, Tim Schmidt-Eisenlohr and Nadine Riedel as well as participants at the IIPF Conference 2013 in Taomina and the EEA/ESEM Conference 2013 in Goteburg for helpful and valuable comments. The usual disclaimer applies.

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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] 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 be beneficial due to fostering capital accumulation. To study the relationship between debt shifting as a particular form of profit shifting and capital accumulation is the aim of this paper.

In the theoretical literature, it seems almost common wisdom that debt /profit shifting activities foster capital accumulation by reducing the tax burden (Desai et al 2006, Schindler and Schjelderup 2012). In a theoretical world, tax planning activities of multinational firms might thus even be beneficial for residents of a high tax country (Hong and Smart 2010). However, from an empirical perspective things are less clear.

Mintz and Smart (2004), who where one of the first accounting for the relationship between income shifting and capital accumulation in a national context, fail to provide evidence that investment is less influenced by taxes and thus higher for income shifting firms. Based on German inbound data and panel data estimations, Overesch (2009) reports that the tax rate of the parent company affects subsidiaries' investment spending. He explains this finding by profit shifting activities. This is in line with the result by Egger et al (2012), who show that the tax rate of the subsidiary has no explanatory power for capital accumulation if profits are shifted. However, in both papers, profit shifting activities are not studied. This explanation is further challenged by Becker and Riedel (2012). They argue and provide evidence that the impact of the parent tax rate on subsidiaries' investment spending might be due to a common factor, located at the parent company. A paper, which relied on the presence of tax havens instead of tax rates, to investigate the relationship between capital accumulation and profit shifting is by Desai et al (2006a, 2006b). They present evidence that multinational firms with high growth rates in non-tax havens are more likely to have tax havens, leaving the

[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).

[2] See the seminal work of Zodrow and Mieskowski (1986) and empirical evidence by Devereux et al (2008)

[3] E.g. Buettner et al (2012) or Buslei and Simmler (2012).

[4] E.g. Chirinko et al (1999), Bond and Xing (2011), Dwenger (2013).

empirical question open how tax avoidance affects capital accumulation in high tax countries. Buslei and Simmler (2012) study the impact of thin capitalization rule on capital accumulation and provide evidence that restricting the deductibility of interest expenses decreases investment for profit shifting firms.[5] Unfortunately, the regulation affects only few companies and thus generalizability of the results may be limited.

To overcome critique that the results are driven by complementarity between production functions, co-founding factors or small samples, I will based on theoretical prediction compare the financing and investment behavior of multinational subsidiaries and domestic firms in a high tax country in response to a huge reduction in the corporate tax rate. The use of the high tax country is important as it implies that for almost every multinational firms, tax payments could easily be reduced by internal debt financing. The huge reduction in the tax rate, which was announced one year before, ensures identification as adjustment costs could otherwise dampen the results. To account for the potential difference between multinational and domestic firms a propensity score matching approach is applied. To provide further evidence and test my model prediction in more detail I implement a second identification strategy relying on the tax rate differential between the subsidiary and the headquarter for the identification.

Both applied methods provide consistent results. Internal debt financing fosters investment. My results show that multinational firms for which the incentive to shift profits via debt financing to the headquarter was abandoned decreased their capital stock compared to domestic firms. This highlights that debt shifting introduces a tax-advantage for multinational firms and confirms results of prior literature (Desai et al 2006b, Overesch 2009, Egger et al 2012, Simmler and Buslei 2012). My analysis highlights further in line with the prediction of the theoretical model that debt shifting activities are in particular used by capital intensive firms. Their estimated tax rate sensitivity is around 1. An increase in the tax rate differential by 10%-points leads to an increase in the internal debt ratio by 10%-points. Moreover, evidence is provided on the role of depreciation allowances shedding light on on the impact of recent reforms in Europe, which followed the principle "tax base cum base broadening". In line with the theoretical prediction, I show that restricting depreciation allowances increases the tax advantage of multinational firms compared to domestic firms. Thus, recent tax reforms might have decreased the number of firms shifting profits but increased at the same time the tax advantage for firms, which still face an incentive to shift.

The remainder of this paper is as follow. Section two describes the features of the

[5]In the same vein are the results by Buettner et al (2008).

corporate tax reform in the high tax country used in my analysis, which is Germany in 2008. The theoretical model, which incorporates the main elements of the tax reform, is described in section three. After introducing the data and the methodology in section four, section five presents and discusses the results. Finally, section six concludes.

2 Institutional Setting

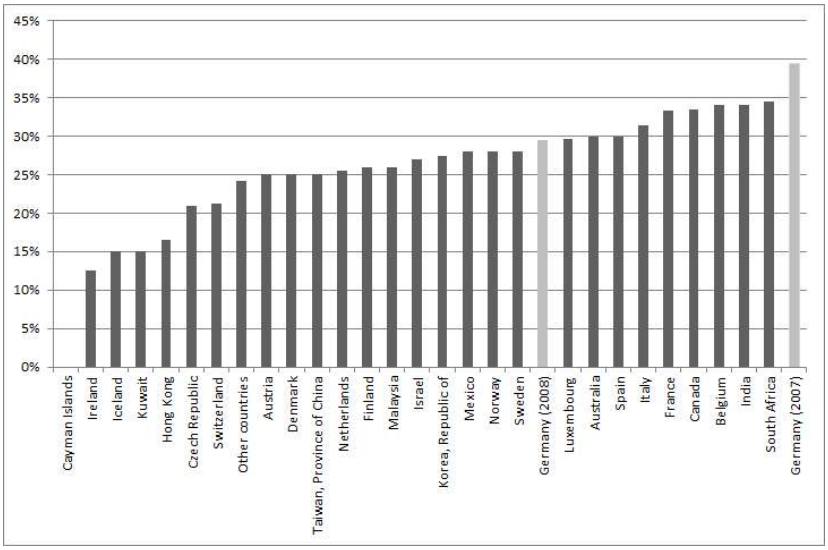
According to the official justification by the government, main aim of the German corporate tax reform 2008 is to increase the location attractiveness and to protect the tax substrate. Up to 2008, Germany had one of the highest corporate income tax rates in Europe. Thus, almost every foreign owned subsidiary in Germany had an incentive to shift part of its profits 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 suggest that profit shifting activities came to a large extend on the cost of Germany (Huizinga and Laeven 2008). Thus, Germany had to react. The answer, implemented by the corporate tax reform 2008, consists mainly of two measures. Firstly, a strong reduction of the tax rate on profits from 40 to 30%. Secondly, the introduction of anti-abuse regulations as the new interest barrier. Interesting in the argumentation of the government is that they seemed to be convinced that profit shifting activities and multinational investments are not linked to each other. Thus, the tax rate reduction is designed to attract more multinational firms whereas the tightened thin capitalization rule should restrict solely debt shifting activities. Since the tightened thin capitalization rule affects only a few corporations due to an included exemption threshold (see Buslei and Simmler 2012), I do not account for it in the main specification but address the impact of the regulation in a sensitivity check.[6]

Further changes due to the 2008 reform addressed the adding back regulations of the local business tax. Due to these adding back regulations, 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.[7] Up to 2008, interest expenses on long term debt (maturity exceeding one year) had to be added back to 50%. To raise

[6]The new thin capitalization rule restricts the deductibility of interest expenses up to 30% of the tax adjusted EBITDA. The regulation, however, includes several escape clauses. The most important one is the exemption limit of 1 million euro, which was retroactively raised to 3 million euro.

[7]The origin of these regulations go back to the 1990s, a time in which the local business tax, set and collected by German municipalities, was designed as a tax on infrastructure usage.

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



Source: DAFNE firm data base, 2008. Corporate income tax rate 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.

additional revenue, this applies beginning in 2008 to all interest payments but only to 25%. The overall share of the local business tax of the overall tax rate is around 50%.[8]

3 Theoretical Background

To understand the impact of debt shifting activities on real investment in more detail and in particular for the corporate tax reform 2008, the cost of capital approach dating back to Jorgenson (1963) and Hall and Jorgenson (1967) is extended. I start summarizing the impact of taxation on the cost of capital for a non-debt shifting firm and afterwards account for debt shifting activities of multinational firms.[9]

[8]Until 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 thus before the reform to roughly 18% for the average multiplier of 400. Since local business tax payments reduce the tax base of the corporate tax rate (including solidarity surcharge), the 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 self-deductibility abandoned. The overall tax rate on profits amounts thus after 2007 to 29% (14% local business tax and 15.8%) The difference between the tax rate on profits and to which interest payments are deductible decreased. It amounted before the reform to 6% and after to 3.5%.

[9]For a more detailed overview of the approach see Devereux (2004).

Starting point of the approach is the problem of the representative firm to maximize the present value V_t of its future cash flows (equation (1)). The cash flow in period s is calculated as after-tax sales (price p_s multiplied with output $F(K_{s-1}, N_{s-1})$) minus wages (with N_{s-1} as the number of employees and w_{s-1} as the wage rate) and depreciation allowances of investment I in period s and the periods before, given by the last term. The value function is subject to a capital accumulation constraint (equation (2)) and the valuation of the capital stock for tax purposes (equation (3)).

$$\begin{aligned} V_t &= E_t \sum_{s=t} (1+r)^{-s} [(1-u_s)[p_s F(K_{s-1}, N_{s-1}) - w_s N_{s-1}] \\ &\quad -q_s I_s + u_s \phi (q_s I_s + K^T_{s-1})] \qquad (1) \\ K_t &= I_t + (1-\delta) K_{t-1} \qquad (2) \\ K^T_t &= (1-\phi) K^T_{t-1} + (1-\phi) q_{t-1} I_t \qquad (3) \end{aligned}$$

The representative firm maximizes the present value of all future cash flows by choosing the state variables, which is firms' capital stock and labor input in period $t+1$ (K_{t+1} and N_{t+1}), subject to equation (2) and (3). After re-arranging the first order condition for the optimal capital stock and denoting the real per cent change in the price of capital as q and the inflation by π, equation (4) follows. Under the reasonable and common assumption in the literature that the expected real change in the capital goods (q) is equal to zero and neglecting inflation, equation (4) can be rewritten as the usual expression of the user costs of capital (equation (6)). The user costs of capital depend on the present value of the depreciation allowances $(1-A)$[10], the finance costs r, the economic depreciation rate δ, and the business tax rate u_t.

$$\begin{aligned} E_t(p_{t+1}) F_K &= \frac{1-A}{1-u_{t+1}} [r + \delta q_{t+1} - (q_{t+1} - 1)] \qquad (4) \\ A &= \frac{u_t \phi (1+r)}{\phi + r} \qquad (5) \\ F_K &= \frac{(1-A)}{(1-u_t)} (r + \delta) \qquad (6) \end{aligned}$$

So far, it is assumed that all investment is financed with retained earnings.[11] To account for internal debt financing, it is necessary that the shareholder of the firm

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

[11] See Devereux (2004), Bond and Xing (2011), Buettner and Hoenig (2011) for the user costs of capital with debt or new equity financing. I ignore these options here as recent research concludes that the user costs of capital assuming retained earnings financing is most informative with respect to investment (Bond and Xing, 2011).

outlined above owns a representative firm in another county. The two countries are G and A (see equation (7)). To account for debt shifting activities, a second source of finance is introduced: internal debt financing. This means that the shareholder decides now over three state variables in each country: investment, labor and the location of equity. If equity in one firm is not sufficient to finance the capital stock, the remaining part is financed with internal debt. The value function for the representative firm in country G and A is thus extended by three terms.[12] The first new term in equation (8) reflects the case that part of the capital stock in country G ($\beta_{G,t-1} * K_{G,t-1}$) is financed with internal debt. In this case, interest payments are deducted from the tax base in country G. 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.[13] Further, debt shifting comes at some costs c, which has the usual properties ($C_\beta > 0, C_{\beta\beta} > 0$) [14] and depend as common in the literature on the fraction of internal debt financing ($\beta_{i=G,A}$). The third new term in the value function considers the impact of internal debt financing of the capital stock in A on profits in G, thus the opposite case. In this case, the tax base in country G is broadened due to the received interest income. The three new terms of the value function of the firm in country A are the same as for the one in country G.

$$V_t = V_{G,t} + V_{A,t} \tag{7}$$

$$\begin{aligned} V_{t,G} = {} & E_t \sum_{s=t} (1+r)^{-s} [(1-u_{G,s})[p_{G,s} F(K_{G,s-1}, N_{G,s-1}) - w_{G,s} N_{G,s-1}] - q_s I_{G,s} \\ & + u_s \phi (q_s I_{G,s} + K^T_{G,s-1}) - (1-u_{G,mod,s}) r \beta_{G,s-1} K_{G,s-1} - c(\beta_{G,s-1}) \\ & + (1-u_{G,s}) r \beta_{A,s-1} K_{A,s-1}] \end{aligned} \tag{8}$$

$$\begin{aligned} V_{t,A} = {} & E_t \sum_{s=t} (1+r)^{-s} [(1-u_{A,s})[p^I_{A,s} F(K_{A,s-1}, N_{A,s-1}) - w_{A,s} N_{A,s-1}] - q_s I_{A,s} \\ & + u_{A,s} \phi (q_s I_{A,s} + K^T_{A,s-1}) - (1-u_{A,mod,s}) r \beta_{A,s-1} K_{A,s-1} - c(\beta_{A,s-1}) \\ & + (1-u_{A,s}) r \beta_{G,s-1} K_{G,s-1}] \end{aligned} \tag{9}$$

The shareholder maximizes the sum of the present value of the future cash flows for

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

[13] 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.

[14] It is assumed that the costs of debt shifting are non deductible. The assumption is not crucial for the results. If the costs would be deductible the firm had, however, an incentive to deduct them in the high tax country.

both representative firms simultaneously. Compared to the domestic firms with only retained earning financing, the shareholder maximizes the value function subject to three state variables in each country, firms' capital stock, labor input and the share of internal debt financing.

Optimal Internal Debt Financing

The first order conditions for the optimal fraction of internal debt financing in country G is given by equation (10) and for country A by equation (11).

$$K_{G,t} r(u_{G,mod,t+1} - u_{A,t+1}) = c_{\beta_{G,t}}(\beta_{G,t}) \tag{10}$$

$$K_{A,t} r(u_{A,mod,t+1} - u_{G,t+1}) = c_{\beta_{A,t}}(\beta_{A,t}) \tag{11}$$

The equations state 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. Due to possible differences in the tax rates four cases of internal debt financing can be distinguished (see Table 1). If the tax rate according to which interest payments are deductible in country G (A) is larger than the tax rate on profits in country A (G) (case 1 (4)), the shareholders will use internal debt to finance the capital stock in country G. In all other cases, the firm will not use internal debt financing.

Table 1: Three cases of debt shifting

	β_G	β_A
$u_A < u_{G,mod}$	> 0	0
$u_{G,mod} < u_A < u_G$	0	0
$u_{A,mod} < u_G < u_A$	0	0
$u_G < u_{A,mod}$	0	> 0

Besides the marginal decision for the optimal β, it is also possible to determine the maximum amount, which is shifted abroad either from G to A or vice versa. This share might be below 1 and may provide an upper bound for shifting profits abroad. It is given by equation (12) as for $\beta_{i,t}^{max}$ with $i = G, A$ taxable profits in country i are zero in period t.[15] The first term in the brackets indicates that a higher ratio of profits before interest payments to the capital stock increases the maximum that can be shifted abroad. Given that β cannot exceed one, this means that firms with a low ratio

[15]One has to derive an expression for firms tax payments in period t+1, set it to zero and solve it for β.

of profits before interest to their capital stock are more likely to react to tax incentives as the optimal share of internal debt financing β is less likely to be constrained due to the fact that it cannot exceed 1. Further and this relates to the second term within the brackets, it is obvious that larger deprecation allowances reduces the fraction, which is shifted abroad. The intuition is straightforward: depreciation allowances reduces the taxable income, thus less income has to be shifted abroad. This means that firms with high depreciation allowance are likely to be less sensitive to tax rate changes as they probably can shift as much as they want and are not constrained by their marginal costs of shifting. Moreover, the first term indicates that the larger the difference between the tax rate on profits and the tax rate to which interest payments are deductible, the larger β^{max}. This means that more firms are constrained because β cannot exceed one.

$$\beta_{i,t-1}^{max} = \frac{u_{i,t}}{u_{mod,i,t}}[\frac{p_{i,t}F(.) - w_{i,t}N_{i,t-1})}{rK_{i,t-1}} - \frac{\phi(q_sI_s + K_{s-1}^T)}{rK_{i,t-1}}] \tag{12}$$

Optimal capital stock with debt shifting

I now turn to the first order conditions for the optimal capital stock of the representative firms in county G with consideration of internal debt financing (equation (13)). It is obvious that if the capital stock of the representative firm in country G is financed with internal debt (positive tax rate differential), the user costs of capital are lower than without shifting. Further, since only $\beta_{G,t}$ affects the return of the capital stock in country G, there will be no difference in the user costs of capital in country G, if profits are shifted from country A to G.

$$F_{K_{G,t}} = \frac{(1 - A_{G,t+1})(r + \delta)) - r\beta_{G,t}(u_{G,mod,t+1} - u_{A,t+1})}{(1 - u_{G,t+1})} \tag{13}$$

$$= UCC_{G,t}^{RE} - \frac{r\beta_{G,t}(u_{G,mod,t+1} - u_{A,t+1})}{p_{G,t+1}(1 - u_{G,t+1})} \tag{14}$$

$$= UCC_{G,t}^{RE} - \gamma\frac{u_{i,t}}{u_{mod,i,t}}[\frac{p_{i,t+1}F(.) - w_{i,t+1}N_{i,t})}{K_{i,t-1}} - \frac{\phi(q_sI_s + K_{s-1}^T)}{rK_{i,t-1}}]\frac{(u_{G,mod,t+1} - u_{A,t+1})}{p_{G,t+1}(1 - u_{G,t+1})} \tag{15}$$

Replacing β with $\gamma\beta^{max}$, equation (15) follows. Thus, we see that the lower the profitability before interest payments to the capital stock and the higher the depreciation allowances the lower the tax advantage of the multinational firm. Further, the share of

the tax rate differential that is used by the foreign owned firm is given by γ. Altogether, the following hypothesis are derived from the neoclassical investment model.

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

Firms with a low ratio of profits before interest to their capital stock and firms with low depreciation allowances react stronger with their internal debt financing to tax rate changes as the fraction of internal debt financing is less likely to be bounded by one or the maximum amount that has to be shifted abroad.

Hypothesis 2: If profits are shifted from country G to A, the capital stock in G is larger than without profit shifting. The relative advantage of the profit shifting firm is decreasing in the ratio of profits before interest payments to the capital stock and decreasing in the depreciation allowances in country G.

More than two countries

So far, it is assumed that the shareholder owns only two firms, he may however own more than two. To understand the incentive in a more general setting, I discuss shortly the incentives with three firms. Besides the firm in G, A, the shareholder owns a firms in T, for example a tax haven, as well. In this case, profits from G can be shifted not only to one but to two other countries. Regarding the costs of shifting, there seems to be no reasons why these might depend on the location to which profits are shifted. The cost function of internal debt financing depends thus on $\beta_{G,t}$, which is the sum of $\beta_{G,A,t}$ the fraction of internal debt financing to country A, and $\beta_{G,T,t}$ the fraction of internal debt financing to country T. Further, it is reasonable to assume that the shareholder prefers profits to be located at the parent company (ω), as in this case for example profits can be distributed [16] and the benefit is decreasing in the fraction that is shifted to the parent. The first order condition for the optimal fraction of internal debt financing are given in equation (16) and (17):

$$r(u_{G,mod,t+1} - u_{A,t+1}) + \omega_{\beta_{G,A,t}}(\beta_{G,A,t}) = c_{\beta_{G,A,t}} \tag{16}$$

$$r(u_{G,mod,t+1} - u_{T,t+1}) = c_{\beta_{G,T,t}} \tag{17}$$

[16] See e.g. Dischinger et al (2013)

It is obvious that now two different cases may arise. 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 (18).

$$F_{K_{G,t}} = UCC^{RE}_{G,t} - \frac{r\beta_{G,A,t}(u_{G,mod,t+1} - u_{A,t+1})}{p_{G,t+1}(1-u_{G,t+1})} - \frac{r\beta_{G,T,t}(u_{G,mod,t+1} - u_{T,t+1})}{p_{G,t+1}(1-u_{G,t+1})} \quad (18)$$

Incentive to shift profits and invest before and after the tax reform 2008
The changed incentives for debt shifting activities of multinational firms due to the corporate tax reform can easily be understood by comparing three subgroups of multinational firms. The groups are formed according to their incentive to shift profits via internal debt financing to the headquarter before and after the corporate tax reform. The first group of multinationals has for example a tax rate on profits in the country of the parent country of 40%. This means, that neither before nor after the reform there is a positive tax rate differential. Thus, the reform did not change the incentive to use debt shifting for these firms. These companies should thus behave as a domestic firm as they are *NonShifter-NonShifter* (Table 2), which means that they should increase their capital stock in response to the tax rate reduction. The second group of subsidiaries (*Shifter:NonShifter*, Table 2) is owned by a parent company that for instance faces a tax rate on profits of 30%. Before the reform, there was a positive tax rate differential and, therefore, an incentive to shift profits; after the reform, however, there is no incentive to shift profits out of Germany. Thus, these firms stopped profit shifting. Their investment spending is therefore less affected by the reduction in the tax rate on profits as the investment spending was already higher before the reform, compared to a firm which does not shift profits before. Finally, the last group of subsidiaries had always an incentive to shift profits as the tax rate on profits in the country of the parent company country is for example only 20%. Although the incentive to use debt financing is reduced, capital accumulation is still higher due to the debt shifting activities.

Table 2: Exemplary Tax Rate Differential

		2007	2008	2009	2010
Tax rate on profits in Germany in %		38.64	38.64	29.89	29.89
Tax rate to which interest expenses are deductible %		32.51	32.51	26.33	26.33
NonShifter:NonShifter	Tax rate differential	-1.36	-1.36	-10.1	-10.1
Tax rate on profits: 40%	No tax-incentive to shift	1	1	1	1
Shifter:NonShifter	Tax rate differential	2.51	2.51	-3.68	-3.68
Tax rate on profits: 30%	No tax-incentive to shift	0	0	1	1
Shifter:Shifter	Tax rate differential	12.51	12.51	6.33	6.33
Tax rate on profits: 20%	No tax-incentive to shift	0	0	0	0

4 Methodoloy & Data

The falsification of the hypothesis outlined in Section 3 will be based on unconsolidated financial statements, ownership and subsidiary data for German incorporated firms between 2004 and 2010 from the database DAFNE. I require that the firms in my sample are owned by another corporation and exclude firms that are owned by parent companies located in countries, which apply the worldwide principle in corporate taxation. Main reasons it that for these subsidiaries the impact of the parent tax rate is already given by the tax system. In my period these are the US, UK and Japan. The share of foreign owned companies is about 20% in my sample. An overview of the location of the parent company is given in Table A.1 in the Appendix. Countries with the largest share of parent companies are France, Switzerland and Netherlands. The data is complemented by a collection of foreign tax rates.[17] Further, to exploit variation in the local business tax rate in Germany, which varies over the 10.000 municipalities, I merged the local business tax rates to the data using firms' postal code.[18]

The identification of the effects of interest are based on the strong reduction of 10%-points in the corporate income tax rate in 2008. This reduction changed the tax-incentive to use internal debt financing and thus provides exogenous variation. To ensure that all firms in my sample are observed before and after the reform, I only

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

[18]The local business tax rates are provided by the Federal Statistical Office (2004-2010). 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 face different local business tax rates.

include firms with at least 4 observations. Due to data limitation but also due to the fact that the place to which profit are shifted is not observed, I assume in the following that shifting takes place to the headquarter of the company. Although this might not be the case for all foreign owned firms, it provides a good approximation and can be justified by several reasons. Firstly, not all multinational firms have tax havens (Gumpert et al 2011, Buettner et al 2013)). Secondly, there seems to be a home bias in multinational firms' profit shifting activities (Dischinger et al 2013).

Thirdly, my estimation strategy is less likely to suffer from a potential omitted variable bias, which would be present if profits are shifted to another place. The main reasons is that a switch from shifting to not shifting is used for the identification. The omitted variable bias depends on the correlation between the variable of interest and the omitted variable. In my case, this is the correlation between the tax rate difference to the head quarter (TRD) and the place where profits are shifted. Since the TRD is negative for some firms after the corporate tax reform, I interact it with a dummy, which is one if the firm has no incentive to shift. The omitted variable bias is reduced as the dummy is not correlated with the tax rate difference to the place to which profits are shifted.

Fourthly, I test the hypothesis outlined above on the one hand in a robust setting for a broad sample of firms, and on the other hand in more detail using only firms, for which liabilities against the parent company are observed. In the first approach a difference-in-differences propensity score matching approach is applied, in the second the tax rate differential is used to identify the effects of interest.

First Approach: Propensity Score Estimation

The first approach compares the behavior of purely domestic owned firms with no link abroad to firms, which had an incentive to shift profits via debt financing to the headquarter before the reform that was abandoned due to the refore, before and after the reform. I start with a descriptive analysis based on the raw sample and afterwards use a propensity score matching approach. The approach stems from the evaluation literature (Heckman et al 1997) and can be used to make treatment and control group more comparable.[19] The approach has *inter alia* been used by Egger et al (2010) to make multinational and domestic firms more comparable. The idea of the matching method is to compare treated and control companies that are sufficiently similar to derive the causal effect. One matches treatment and control group observations on a set

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

of all relevant variables X such that the conditional mean independence assumption is fulfilled, which states that both group would behave similar in the absence of treatment.

The variables on which I match the two groups are: industry classification, debt ratio, firm size (measured as natural logarithm of total assets), and (natural logarithm of the) capital stock in 2006 as well as the change in the capital stock and the debt ratio between 2005 and 2006.[20] I use the 2006 characteristics as the reform was announced in 2007. Since I match on multiple variable, proximity between observations is based on the estimated one-dimensional propensity score. The propensity score is the probability of receiving treatment, i.e. the probability of being a firm for which the incentive to shift profits was abandoned, conditional on the matching variables X. Rosenbaum and Rubin (1985) show that conditioning on X is equivalent to conditioning on the propensity score. The propensity score is estimated by running a logistic regression of the treatment indicator on X. As distance measure I use the linear propensity score, which improves the balance between the treatment and control groups (Rosenbaum and Rubin 1985). I matched the observation using on the one hand 5-to-1 nearest neighbor matching and on the other as as sensitivity check kernel matching, both with replacement. To evaluate the matching quality I report standardized bias before and after matching. 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.

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

Table 3: Descriptive statistics for treatment and control group up to 2007

	Mean		p-value
	Control Group	Treatment Group	t-test (two-sided)
log(Capital Stock in thd. EURO)	6.14	5.54	0.00
Debt ratio	0.45	0.50	0.00
Firm size (log(total assets))	8.29	8.87	0.00
d.log(Capital stock)	0.05	0.02	0.21
d.Debt ratio	-0.01	-0.01	0.57
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	0.42	0.33	0.00
real estate activities	0.05	0.00	0.00
professional, technical activities	0.09	0.01	0.00
support service activities	0.11	0.03	0.00

Source: DAFNE firm data base 2004 - 2010.

Using the estimated weights for the control group, I implement a difference-in-differences specification of the form given in equation (19). My two outcome variables are firms' debt ratio (defined as total liabilities to total assets) and the natural logarithm of firms' fixed assets. The control groups in my setting consists of 6,083 not foreign owned firms with no foreign subsidiaries[21], thus purely domestic firms, observed between 2005 and 2009. The treatment groups in contrast consist of 1,081 foreign owned firms that had before the reform an incentive to shift part of their profits to the headquarter, which was abandoned due to the reform. Also these firms are observed from 2005 to 2009.[22] The impact of the reform on the treated firms is measured by β_1.

$$Y_{i,t} = \alpha_i + \beta_0 \text{ Treatment}_i + \beta_1 \text{Treatment}_i * \text{Reform} + e_{i,t} \tag{19}$$

[21] I account as well for foreign subsidiaries of the parent company.

[22] The use of the strongly balanced panel is necessary as otherwise the matching method would suffer from sample attrition when the difference-in-differences specification is estimated using several years.

An overview of the location of the parent company for the subsidiaries included in the treatment group is given in Table A.1 in the Appendix. Countries with the largest number of parent companies are France, Sweden and Netherlands. Descriptive statistics show that the treatment group is larger, have a higher debt ratio and a lower capital stock (see Table 3). Further there are significant difference with regard to the industries multinational and purely domestic firms are active in. These differences can be addressed using the propensity matching score approach, outlined above.

Second Approach: Structural Approach

The second approach applied in the following is a more structural approach and builds upon the first order conditions derived from the theoretical model. Since the identification will be based on the variation in the tax incentive to use internal debt financing which includes more variation, measurement error is more likely as well. Therefore, I restrict the sample such that the assumption of debt shifting between parent and subsidiary is more plausible. In contrast to the first approach, firms are only included in the analysis, if liabilities against the parent company are observed. To test my hypothesis, I estimate a debt shifting and an investment equation.

The first hypotheses derived from the model refers to the amount of internal debt financing. It is tested using a standard debt shifting equation with the share of liabilities against the shareholder, thus the parent company, to total asset ($\frac{LS_{i,t}}{TA_{i,t}}$) as dependent variable. 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 (20)). Since the TRD is after the corporate tax reform 2008 negative for some firms and should thus not affect the internal debt ratio, I interact the TRD variable with a dummy, which is one if a company has no incentive to shift profits (D(NITS)). I expect that the coefficient α_1 of the TRD is positive since a positive TRD incentives firms to use internal debt financing (Hypothesis 1). 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 these two main variables, I account further in the regression for the business tax rate in Germany, which is identified due to the variation in the local business tax. Moreover, I include firm size (measured as the natural logarithm of total assets) as common in the literature and time dummies to control for the business cycle. The control variables are captured in the matrix $X_{i,t}$. Since the fraction of internal borrowing may depend on a firm specific ($\eta_{1,i}$) effect, estimation is done in first differences.

$$\frac{LS_{i,t}}{TA_{i,t}} = \eta_{1,i} + \alpha_1 TRD + \alpha_2 D(NITS) * TRD + \theta_1 X_{i,t} + \epsilon i, t \quad (20)$$

The impact of internal debt financing on capital accumulation, i.e. the second hypothesis, is tested using a neoclassical investment function. By taking the natural logarithm of equation (14) and assuming a simple Cobb-Douglas Production Function (equation (21)) equation (22) follows. It states that the natural logarithm of the optimal capital stock depends on the user costs of capital with retained earning financing less the tax advantage of the multinational due to debt shifting. From a theoretical point the coefficient of the user costs of capital b_1 should be one in absolute term. Since the main parameter of interest is γ, I re-arrange equation (22) to identify γ, given by $\frac{b_2}{b_1}$. 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 (23)). I expect that the sum of the coefficient b_2 and b_3 should be zero, since multinational firms should behave as domestic firms if no profits are shifted. If, however, the firm has an tax incentive to shift, the firm should invest more. Estimation is done in first difference to account for firm-specific effects ($\eta_{2,i}$).[23] For both equations, reported standard errors are robust to heteroscedasticity and are clustered for the location of the parent.

To explore the heterogeneity with regard to the incentive to shift profits and its impact on investment, I split the sample according to firms' ratio of profits before interest payments to the capital stock . Since profits are not observed for each company in my dataset, I use two-digit industry averages based on the whole population. The mean ratio of profits before interest to the capital stock is around 31%. To uncover the impact of depreciation allowances on internal debt financing and the related impact on the capital stock, I interact the ratio of depreciation allowances to the capital stock with the tax rate differential. As for profits, I use two-digit industry averages, the mean is around 5.4%.

[23] In principle, there are several reasons why the user costs of capital should be instrumented. Due to the short length of my panel, however, IV estimation is not possible.

$$
\begin{aligned}
Sales_{i,t} &= K_{i,t}^{\sigma} N_{i,t}^{1-\sigma} && (21)\\
log(K_{i,t}) &= \eta_{2,i} - b_1 * log[UCC_{G,t} - \gamma\beta^{max}\frac{(u_{G,mod,t} - u_{A,t})}{(1-u_{G,t})}] + \theta_2 log[S_{i,t}] + w_{i,t} && (22)\\
log(K_{i,t}) &= \eta_{2,i} - b_1 * logUCC_{G,t} + b_2\frac{(u_{G,mod,t} - u_{A,t})}{(1-u_{G,t})UCC_{G,t}} && (23)\\
&\quad -b_3\frac{(u_{G,mod,t} - u_{A,t})}{(1-u_{G,t})UCC_{G,t}} D(NITS) + \theta_2 log[S_{i,t}] + w_{i,t}
\end{aligned}
$$

A key variable in the investment equation (22) 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 $UCC_{i,a,j,t}$:

$$
UCC_{i,j,t} = \sum_a \kappa_{i,t}^a UCC_{i,a,j,t} = \sum_a \kappa_{i,t}^a \frac{p_t^I}{p_t^S}\frac{((1-u_{i,t}z_{a,t})(r_t + \delta_{a,j,t})}{1-u_{i,t}} \quad (24)
$$

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.

[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".

Table 4: Descriptive statistics for the second sample

	Obs.	Mean	P50	SD
All firms				
Capital Stock in thd. EURO	21,041	41,887	4,459	911,932
Turnover in thd. EURO	21,041	83,302	17,108	465,926
LS/TA	21,041	0.19	0.09	0.23
Business tax rate	21,041	0.35	0.37	0.05
UCC	21,041	0.13	0.12	0.05
d.log(Capital stock)	15,142	0.03	-0.01	0.68
d.log(Turnover)	15,142	-0.00	0.03	1.13
d.LS/TA	15,142	-0.00	-0.00	0.11
D.Business tax rate	15,142	-0.02	0.00	0.03
d.log(UCC)	15,142	-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.

An overview of the location of the parent for the subsidiaries included in my analysis are reported in Table A.1 in the Appendix. The country with the largest number of parent companies are France, followed by Switzerland, Sweden and Netherlands. The share of foreign owned firms amounts to roughly 20%. Descriptive statistics for the second sample are shown in Table 4. The average firm in my sample has a fraction of internal debt against against its shareholders of 19%, the median is 9%. Mean and median of the capital stock and sales suggest a skewed distribution with respect to the two variables. The mean of the UCC in the whole sample is 13%. The tax rate differential 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. Finally, 31% of the foreign owned firms in my sample have no incentive to shift profits. For around 9% of the foreign owned firms the incentive to shift was abandoned due to the reform. The tax advantage of the multinational, given by TRD/(1-Business tax rate), equals 2% or roughly 15% of the UCC.

5 Results

I start with presenting the results for the first approach, firstly the graphical analysis and then the regression results based on the propensity score estimation. Afterwards, results for the debt shifting and neoclassical investment equation are reported based on the less broad sample of firms for which liabilities against the parent company are observed.

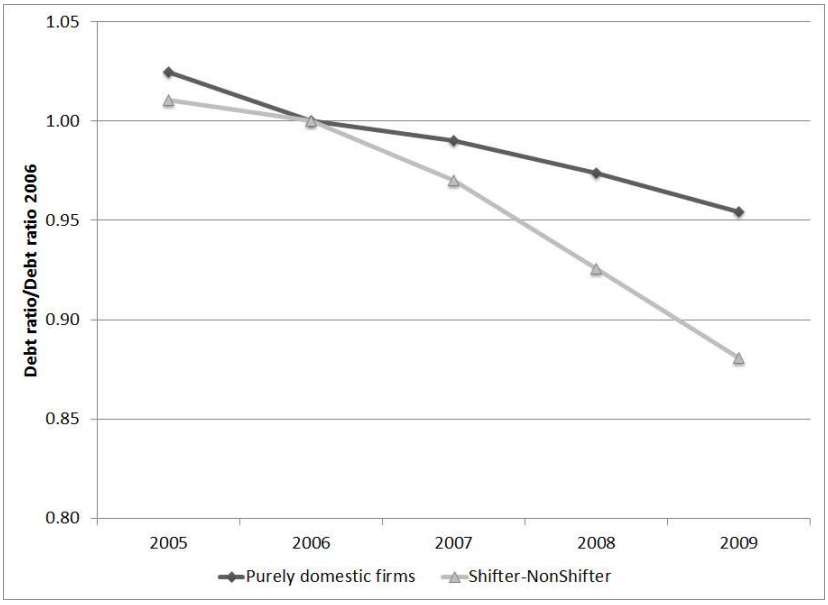
5.1 First Approach: Propensity Score Matching

The evolution of the debt ratio for purely domestic firms and multinational firms, which had before the reform an incentive to shift that was abandoned due to the reform, are presented in Figure 2. The debt ratio is normalized by groups' mean debt ratio in 2006. The figure shows that both type of firms decreased their debt ratio. This is as expected as the reform reduced the tax advantage of debt by lowering the tax rate on profits (e.g. Modigliani and Miller, 1963 and Feld et al 2013). Interestingly, the reduction of the debt ratio started already in 2007. This can be explained by anticipation as the tax rate reduction was known in 2007. In line with the hypothesis, the debt ratio of the treatment group. i.e. firms for which the incentive to shift profits was abandoned, decreases stronger. However, this evidence should be interpreted with caution, as the common trend assumption for both groups does not seem to be fulfilled. Further, given the difference with regard to observable characteristics as shown above (see Table 4), co-founding factors due to the corporate tax reform 2008 are likely.

The evolution of the capital stock for both type of firms are shown in Figure 3. The natural logarithm of the capital stock is normalized by the groups' mean in 2006. The graphs show that 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 shift was abandoned, did not increase their capital stock. However, also with regard to the capital stock, the common trend assumption is questionable.

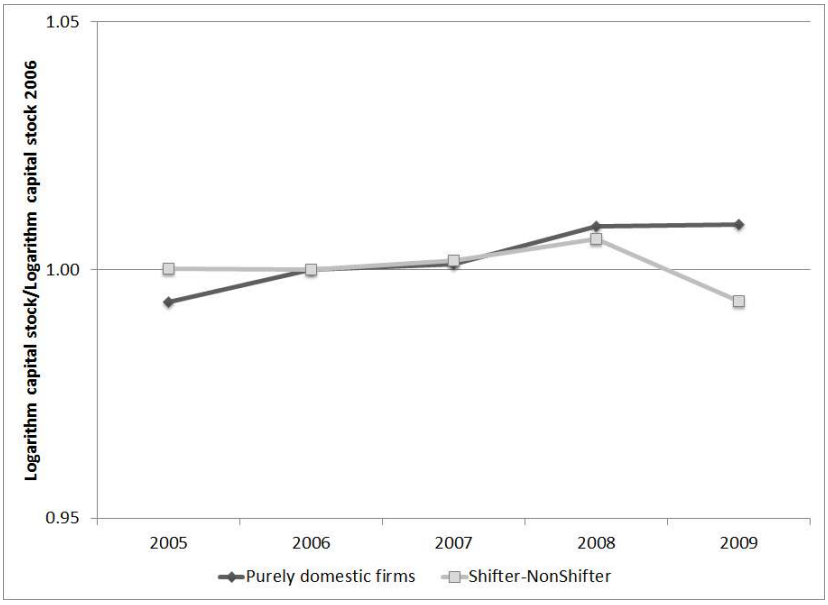
To make the common trend assumption more plausible as well as to exclude co-funding factors between treatment and control group, I use in the following a propensity score matching approach (Heckman et al 1997). This approach can be used to account for selection on observables as it is the case in my study (see Table 4). Before I report the results for the matched sample, I provide information on the propensity score estimation. The results from the logistic regression used to estimate the propensity

Figure 2: Evolution Debt Ratio for Domestic Firms and Shifter-NoShifter



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.

Figure 3: Evoluation Capital Stock for Domestic Firms and Shifter-NoShifter



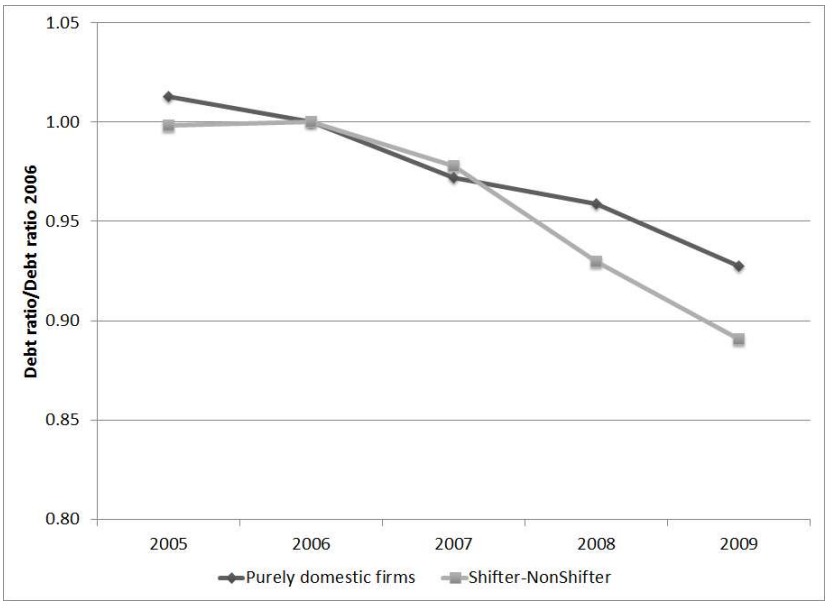
Notes: Groups and sample as described in the text.
Source: DAFNE firm data base, 2005 - 2009.

score are shown in Table A.2 in the Appendix and reflect the differences between foreign owned firms and domestic owned firms. After having estimated the propensity score, I apply 5-to-1 nearest neighbor matching to identify suitable control observations for every firm in the treatment group. To evaluate the matching quality I refer to the standardized bias for each variable in X. These are shown in Table A.3 in the Appendix. They suggest that in particular strong differences exist with regard to total assets, debt ratio and the capital stock, for which the bias exceed 15%. After matching, for all variable the bias is below 5%.

The evolution of debt ratio and capital stock for the matched sample are shown in Figure 4 and 5, respectively. The common trend assumption seems now fulfilled as between 2005 and 2006 both groups exhibit a similar trend. Further, the results are much clearer compared to the non-matched sample. Both groups reduced their debt ratio after 2007, the reduction is however stronger for firms for which the tax incentive to shift profits was abandoned. This is in line with hypothesis 1. With respect to the capital stock, the graphical analysis is again very clear. Purely domestic firms increased their capital stock remarkably, whereas the capital stock of *Shifter-NonShifter* stayed almost constant over the time horizon. This is in line with hypothesis 2. These firms were already less affected by the high tax rate in Germany such that the reduction does not foster their capital accumulation.

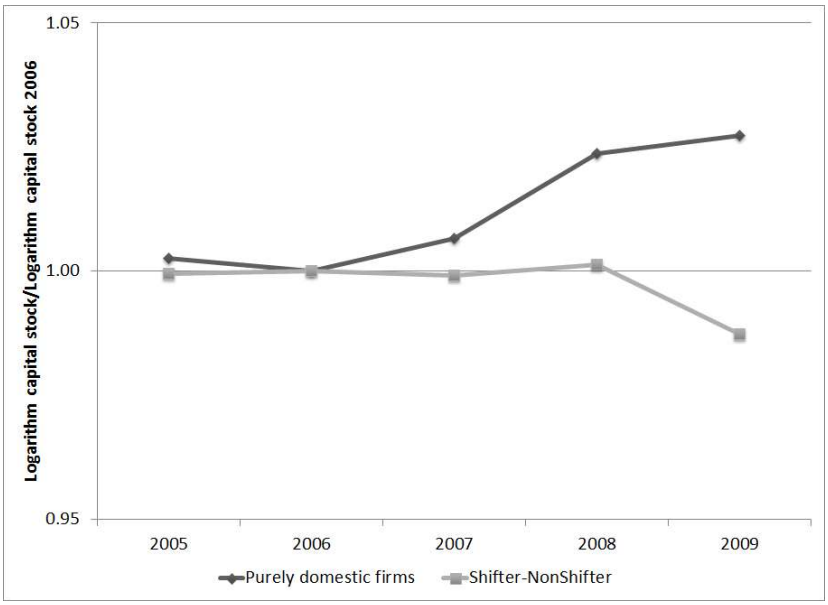
The clear picture of the graphical analysis is confirmed in the difference-in-differences regression analysis accounting for firm specific effects (see Table 5). Column (1) and (2) show the results for the debt ratio and the natural logarithm of the capital stock as dependent variable based on the original sample, (3) and (4) for the matched sample using 5-to-1 nearest neighbor and (5) and (6) for kernel matching. In all specification, there is a statistically significant, negative impact for the treatment group due to the corporate income tax reduction in 2008. The results based on the matched samples suggest that on average the treatment group reduced their debt ratio between 2.0% (5-to-1 nearest neighbor) and 2.2% (kernel matching) compared to domestic firms. This is in line with the hypothesis that these firms stopped using internal debt financing to reduce their taxable income. Further, the findings present evidence that the corporate tax reform decreased on average firms debt ratio by about 1.9 to 1.8%, which matches quite well with the result of the meta-stuy by Feld et al (2013). Due to the reduced tax advantage of debt, firms use more equity financing. With regard to the capital stock, the results suggest that firms which stopped shifting profits abroad decreased their capital stock by around 10 to 11% compared to domestic firms. Overall, the basic hypothesis of the model cannot be rejected. Debt shifting activities and capital accumulation are

Figure 4: Evolution Debt Ratio for Domestic Firms and Shifter-NoShifter: Matched Sample



Notes: The debt ratio is defined as total liabilities to total assets. Only companies with at least four observations between 2004 and 2010 are included. Groups are formed as described in the text.
Source: DAFNE firm data base, 2004 - 2010.

Figure 5: Evoluation capital stock for domestic firms and Shifter-NoShifter based on matched sample



Notes: Sampe and Groups as described in the text.
Source: DAFNE firm data base, 2004 - 2010.

linked to each other. Firms which are able to reduce their tax burden by shifting part of their profits to low tax jurisdictions via debt financing have on average a higher capital stock than domestic firms. If the tax incentive to shift profits is abandoned by a reduction in the subsidiaries' tax rate, these firms decrease their debt ratio and do not increase their capital stock compared to domestic firms.

Table 5: Results of difference-in-differences specification

Sample	All firms		Nearest Neighbor		Kernel Matching	
Dep. Var	Debt Ratio	Capital Stock	Debt Ratio	Capital Stock	Debt Ratio	Capital Stock
Specification	(1)	(2)	(3)	(4)	(5)	(6)
D(year > 2007)	-0.022***	0.054***	-0.019***	0.124***	-0.018***	0.018***
	(0.002)	(0.014)	(0.002)	(0.008)	(0.003)	(0.021)
D(Shifter-NonShifter)	-0.027***	-0.070*	-0.020***	-0.099***	-0.022***	-0.110**
* D(year > 2007)	(0.005)	(0.038)	(0.005)	(0.043)	(0.005)	(0.043)
Observations	36,520	36,520	16,975	16,975	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.

5.2 Second Approach: "More Structural"

I now turn to the results for the more structural approach. Compared to the first approach, it has the advantage that the estimated coefficient are related to the potential tax savings of shifting profits abroad. Further, due to the sample selection, the assumption that part of the profits is shifted to the headquarter is a more realistic one, as liabilities against the headquarter are observed for each firm.

Table 6: Results: Debt shifting equation

Dependent variable: Change in liabilities against shareholders			
Specification	(1)	(2)	(3)
d.Business tax rate [= ($u_{G,t}$]	-0.328	-0.044	-0.330
	(0.231)	(0.255)	(0.232)
d.TRD [= $u_{G,mod,t} - u_{A,t}$] (1)	0.288***		
	(0.092)		
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 TRD > 0, 0 else)			0.285***
			(0.088)
d.Firmsize	0.035***	0.035***	0.035***
	(0.007)	(0.007)	(0.007)
Observations	15,142	15,142	15,142
Coeff (1) + (2)	0.023	-0.031	
	(0.079)	(0.150)	

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.

I start with presenting the results for the debt shifting equation (Table 6). The dependent variable is the change in the ratio of liabilities against shareholders to total assets. Column (1) present the baseline specification with the tax rate differential, i.e. the difference between the tax rate to which interest expenses are deductible in Germany and the tax rate in the country of the parent company, and the interaction term. The results show that the TRD has a significant impact on the ratio of liabilities against shareholder to total assets, if it is positive. In case firms do not have an incentive to shift profits, the impact of the tax rate differential is zero (bottom line of the table, standard errors are calculated using the delta method). This confirms again the first hypothesis derived from the model. Further, it adds 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 in the equation (column 2) or if the TRD is defined as zero if it would be negative (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. This is also slighter smaller, statistically not different from the impact estimated in the first approach (*Shifter-NonShifter* had before the reform an average TRD of 4.3%). It is however slightly larger compared to prior estimates (e.g. Buettner and Wamser 2012). One explanation could be that I focus solely on liabilities against the parent companies instead of overall internal debt and use a very homogeneous set of firms.

Table 7: Result: Investment equation

Dependent variable: Growth rate of the capital stock			
Specification	(1)	(2)	(3)
d.log(UCC)	-1.258***	-1.138***	-1.258***
	(0.138)	(0.074)	(0.138)
d.$\frac{TRD}{(1-BTR)*b_1UCC}$ (1)	0.136**		
	(0.052)		
d.$\frac{TRD}{(1-BTR)*b_1UCC)} * D(NITS)$ (2)	-0.152*		
	(0.085)		
d.$\frac{u_{G,t}}{(1-BTR)*b_1UCC}$		0.163**	
		(0.075)	
d.$\frac{u_{G,mod,t}}{((1-BTR)*b_1UCC)} * D(NITS)$		-0.157	
		(0.136)	
d.$\frac{u_{A,t}}{(1-BTR)*b_1UCC)}$ (1)		-0.135**	
		(0.065)	
d.$\frac{u_{A,t}}{(1-BTR)*b_1UCC)} * D(NITS)$ (2)		0.155	
		(0.114)	
d.($\frac{TRD}{(1-BTR)*b_1UCC)}$ if TRD>0,0 else)			0.134**
			(0.051)
d.log(Sales)	0.044***	0.043***	0.044***
	(0.013)	(0.013)	(0.013)
Observations	15,142	15,142	15,142
Coeff (1)+(2)	-0.016	0.020	
	(0.052)	(0.134)	

Notes: 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, own calculations.

I turn to the results of the capital stock equation. Since I showed that firms only shift profits via internal debt financing if the tax rate differential is positive, I am now in the position to analyze the impact of debt shifting activities on capital accumulation. The results are presented in Table 7. The dependent variable is the growth rate of the capital stock (change in the natural logarithm of fixed assets). The results show that

the elasticity of the capital stock with respect to its user costs is around -1, which is line with my expectation and the prior literature (e.g. Dwenger 2013). The coefficient for sales is however quite small, which suggest 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, there is not impact of the TRD (bottom line of the table, coefficient is statistically not different from zero). This holds again for including the two tax rate separately as well as including a modified TRD which is zero if there is a negative TRD. Overall the findings are in line with my expectations and similar to the results of the first approach. *Shifter-NonShifter* had in 2007 a TRD of 4.3% which translate to a 7.6% higher capital stock.[28]

Heterogeneity in tax-motivated profit shifting

I come now to the heterogeneity of tax motivated debt shifting. Based on the model outlined above, I have two hypothesis, which affect debt shifting and thus capital accumulation. The first relates to the fact that debt shifting is mainly done due to quantities not by changing the interest rate. Therefore, the ratio of profits before interest to the capital stock affects how much profits a firm is able to shift abroad. If the ratio of profits to the capital stock is large, the firm is likely to be constrained as the fraction of internal debt to the capital stock cannot exceed one. Thus, I expect a much higher tax rate sensitivity of the internal debt ratio for firms with a low ratio of profits to the capital stock. Moreover, if more profits can be shifted away, the firms should face a lower tax burden and thus have a higher capital stock. The second heterogeneity relates to depreciation allowances. Since depreciation allowances reduce firms taxable profits, profit shifting firms have to shift less if depreciation allowances increase. Thus, if a firm has high depreciation allowances, it is also likely that the firm can shift as much as it wants. This suggest a lower tax rate sensitivity as a change in the tax savings is less likely to affect the amount which is shifted. The amount shifted abroad is not determined by marginal costs but by the maximum amount, which has to be shifted abroad. With respect to the capital stock, this suggest that less profits have to be shifted and thus that the tax advantage of the multinational is decreasing in the ratio of depreciation allowances to the capital stock.

The results for the two hypothesis for the change in liabilities against the parent company as dependent variable are presented in Table 8 and for the growth rate of

[28]The TRD divided by (1-business tax rate) gives 7.1%, multiplying this number with the estimated coefficient of 0.15 gives 1.1% or 7.6% of the UCC. The estimated elasticity of the capital stock to its user costs is -1.

the capital stock in Table 9. To keep the interaction terms manageable, I split the sampling at the median of the average 2-digit industry ratio of profits before interest to the capital stock and interact the TRD with the average 2-digit industry ratio of depreciation allowances to the capital stock. The results 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 which are likely to be constrained as the fraction of internal debt cannot exceed one seem not to react. Column (2) and (4) shed light on the role of depreciation allowances. It is shown that higher depreciation allowances reduce the tax sensitivity remarkable or if there would be no depreciation allowances, the rate sensitivity would be 2, which is almost 10 times higher than the one found in the baseline regression.

This heterogeneity shows up as well in the investment behavior of these firms (Table 9). Firms with a low ratio of profits before interest to their capital stock face a much larger tax advantage compared to domestic firms. The reasons is that these firms as shown above are able to use debt financing to re-allocate a large share of their profits, which fosters their capital accumulation.

Table 8: Heterogeneity: Debt shifting equation

Dependent variable: Change in liabilities against shareholders				
Specification	(1)	(2)	(3)	(4)
Sample	$\frac{pF(.)-wL}{K}$ < Mean		$\frac{pF(.)-wL}{K}$ > Mean	
d.Business tax rate [= ($u_{G,t}$]	0.203	0.198	-0.622*	-0.624*
	(0.130)	(0.130)	(0.352)	(0.350)
d.(TRD if TRD > 0, 0 else)	1.207***	2.038***	0.102	-0.148
	(0.422)	(0.275)	(0.102)	(0.282)
d.(TRD if TRD > 0, 0 else) * $\frac{Depr.A}{K}$		-21.382*		5.441
		(12.146)		(4.753)
d.Firmsize	0.023***	0.023***	0.048***	0.048***
	(0.005)	(0.005)	(0.010)	(0.010)
Observations	7,467	7,467	7,675	7,675

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 9: Heterogeneity: Investment equation

Dependent variable: Growth rate of the capital stock				
Specification	(1)	(2)	(3)	(4)
Sample	$\frac{pF(.)-wL}{K}$ < Mean		$\frac{pF(.)-wL}{K}$ > Mean	
d.log(UCC)	-1.152***	-1.148***	-1.497***	-1.497***
	(0.107)	(0.103)	(0.178)	(0.178)
d.($\frac{TRD}{(1-BTR)*b_1UCC)}$ if TRD>0,0 else)	0.436**	0.863***	0.098**	0.089
	(0.178)	(0.291)	(0.047)	(0.100)
d.($\frac{TRD}{(1-BTR)*b_1UCC)}$ if TRD>0,0 else) * $\frac{Depr.A}{K}$		-11.006*		0.186
		(5.087)		(1.883)
d.log(Sales)	0.046***	0.046***	0.042***	0.042***
	(0.014)	(0.014)	(0.014)	(0.014)
Observations	7,467	7,467	7,675	7,675

Notes: 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, own calculations.

Sensitivity Analysis

To check the sensitivity of the results, I conduct two robustness tests. The first relates to the fact that part of the German owned firms might be active in profit shifting activities as well. Thus, I used only foreign owned firms to estimate the equation of the heterogeneity analysis. The results for the debt ratio are shown in Table A.4, column (1) and (3), and for the capital stock in Table A.5, column (1) and (3), and are not statistically different from the results for the sample with German firms.

The second sensitivity check accounts for the the redesigned thin capitalization rule in Germany (see Buslei and Simmler 2012). 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 along 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 of the results with respect to this regulation, I re-estimate the last specification using only firms with net interest expenses below 1 million euro. The results for the debt shifting equation are reported in column (2) and (4) of Table A.4 and for the investment equation in column (2) and (4) of Table A.5. Again the results are not statistically

different from the ones using the whole sample, which is due to the fact that only a few firms are affected by the regulation.

6 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 of central importance as governments try to increase the location attractiveness by reducing the tax rate on profits and introducing or tightening thin capitalization rules to prevent profit shifting activities at the same time. If firms' finance and investment decisions are independent, both measures would work. If however, debt shifting activities foster investment spending by reducing the tax burden, both measures work in different directions.

To uncover the relationship between debt shifting and capital accumulation, I extend the neoclassical investment model to account for internal debt financing. The hypothesis derived from the model are tested using a sample of domestic and multinational firms between 2004 and 2010 in Germany. The identification of the causal impact is based on the corporate tax reform 2008. This reform reduced substantially the tax rate on profits in Germany, from 40 to 30%. Due to the strong reduction, the incentive to shift profits to the headquarter was abandoned for some companies. I exploit the reduction to provide empirical evidence on the causal impact of debt shifting on real investment using two different approaches. One the hand a difference-in-difference propensity score estimation is used to compare foreign owned firms, for which the incentive to shift profits was abandoned and purely domestic firms. Secondly, I estimate a more structural model focusing on the tax incentive to shift profits between the headquarter and the subsidiary in Germany. Both method provide consistent reulsts. They show in line with the theoretical predictions that profit shifting activities lead to higher capital accumulation as the tax burden is reduced. Thus, a tax decrease in the subsidiaries' tax rate does not foster capital accumulation if part of the subsidiaries' profits have been shifted abroad before the reduction. Moreover, my results highlight that there is substantial heterogeneity in the tax incentive to use internal debt financing. Firstly, only firms with a low ratio of profits before interest to the capital stock are able to use debt shifting to re-allocate a large share of their profits. Secondly, depreciation allowances affect the incentive to re-allocate profits as well as they reduce the taxable income. This heterogeneity in debt financing shows up in the investment equation as well. Thus, the tax advantage of the multinational differs strongly between firms.

In a broader sense, my results highlight that tax policy may affect investment behavior differently, depending on firms profit shifting activities. Thus, a reduction in tax rates may also be justified by re-installing competition between (purely) domestic and multinational firms. In this paper, I showed that multinational firms, which shift profits, have a tax advantage compared to domestic firms, what I have to leave open for future research is whether this tax advantage affects market structures as well.

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8 Appendix

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	4919	2260	1175
Germany	79461	30415	16322
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	104098	35620	21041

Notes: Sample 1 includes German owned firms that do not have foreign subsidiaries as well as 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. 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

Log(Total Assets 2006)	0.261***
	(0.019)
Debt Ratio 2006	0.278**
	(0.127)
Log(Capital Stock 2006)	-0.130***
	(0.013)
d.log(capital stock 2006)	-0.019
	(0.047)
d.Debt Ratio 2006	0.557*
	(0.309)
Industry dummies	
agriculture, forestry and fishing	-3.622***
	(1.012)
electricity and gas supply	-2.687***
	(0.196)
water supply	-0.899***
	(0.219)
construction	0.120
	(0.126)
wholesale and retail trade	-3.703***
	(1.012)
transportation and storage	-1.444***
	(0.156)
information and communication	-1.566***
	(0.289)
accommodation	-1.938***
	(0.106)
real estate activities	-5.311***
	(1.005)
professional, technical activities	-4.137***
	(0.420)
support service activities	-2.645***
	(0.201)
Observations	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 one for purely domestic firms. Stars *,**,*** indicate significance at the 1/5/10% level.
Source: Dafne firm database, 2004 to 2010, own calculations.

Table A.3. Standardized Bias before and after nearest neighbor matching

	Treatment Group	Control Group			
	Mean	Mean		Standardized Bias in %	
Variables		Before	After	Before	After
Variables		Matching	Matching	Matching	Matching
Log(Capital Stock) 2006	5.53	6.12	5.27	-16.56	7.37
Debt Ratio 2006	0.5	0.45	0.49	14.43	1.62
Firmsize (log(total assets) 2006	8.81	8.26	8.81	23.02	-0.2
Growth rate capital stock 2006	0.00	0.04	-0.02	-5.21	2.79
Growth rate debt ratio 2006	0.00	-0.01	0.00	5.51	1.93
Industry dummies					
agriculture, forestry and fishing	0.00	0.01	0.00	-12.93	2.22
manufacturing	0.25	0.05	0.24	57.51	2.17
electricity and gas supply	0.03	0.1	0.02	-29	2.76
water supply	0.03	0.01	0.03	7.6	-0.77
construction	0.22	0.04	0.21	55.16	3.01
wholesale and retail trade	0.00	0.01	0.00	-13.3	4.38
transportation and storage	0.06	0.06	0.07	-0.58	-2.91
information and communication	0.01	0.01	0.01	2.2	-2.04
accommodation	0.33	0.41	0.35	-18.07	-4.17
real estate activities	0.00	0.05	0.00	-31.89	2.22
professional, technical activities	0.00	0.08	0.00	-40.12	-0.49
support service activities	0.03	0.10	0.02	-31.36	1.7

Source: Dafne firm database, own calculations.

Table A4. Standardized Bias before and after kernel matching

	Treatment	Control			
	Treatment Group	Control Group			
	Mean	Mean		Standardized Bias in %	
Variables		Before	After	Before	After
Variables		Matching	Matching	Matching	Matching
Log(Capital Stock) 2006	5.53	6.12	5.41	-16.56	3.41
Debt Ratio 2006	0.5	0.45	0.49	14.43	0.85
Firmsize (log(total assets) 2006	8.81	8.26	8.81	23.02	-0.17
Growth rate capital stock 2006	0.00	0.04	0.00	-5.21	0.94
Growth rate debt ratio 2006	0.00	-0.01	0.00	5.51	0.29
Industry dummies					
agriculture, forestry and fishing	0.00	0.01	0.00	-12.93	-1.27
manufacturing	0.25	0.05	0.24	57.51	2.6
electricity and gas supply	0.03	0.1	0.03	-29	-0.88
water supply	0.03	0.01	0.02	7.6	2.26
construction	0.22	0.04	0.21	55.16	2.72
wholesale and retail trade	0.00	0.01	0.00	-13.3	-1.37
transportation and storage	0.06	0.06	0.06	-0.58	-0.17
information and communication	0.01	0.01	0.01	2.2	-0.74
accommodation	0.33	0.41	0.34	-18.07	-2.73
real estate activities	0.00	0.05	0.00	-31.89	-6.3
professional, technical activities	0.00	0.08	0.00	-40.12	-4.74
support service activities	0.03	0.10	0.03	-31.36	-1.17

Source: Dafne firm database, own calculations.

Table A.5: Sensitivity Analysis: Debt shifting equation

Dependent variable: Change in liabilities against shareholders				
Specification	(1)	(2)	(3)	(4)
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
d.Business tax rate [= ($u_{G,t}$]	0.789	0.178	-0.433	-0.640*
	(1.123)	(0.141)	(0.906)	(0.363)
d.(TRD if TRD > 0, 0 else)	1.958***	2.044***	-0.132	-0.122
	(0.337)	(0.281)	(0.318)	(0.290)
d.(TRD if TRD > 0, 0 else) * $\frac{Depr.A}{K}$	-21.371*	-21.866*	5.493	4.803
	(12.393)	(12.618)	(4.680)	(4.895)
d.Firmsize	0.027	0.023***	0.034*	0.048***
	(0.017)	(0.005)	(0.017)	(0.010)
Observations	544	7,336	2,778	7,508

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				
Specification	(1)	(2)	(3)	(4)
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
d.log(UCC)	-2.149**	-1.178***	-1.758***	-1.511***
	(0.776)	(0.103)	(0.491)	(0.178)
d.($\frac{TRD}{(1-BTR)*b_1UCC)}$ if TRD>0,0 else)	0.794**	0.841**	0.142	0.064
	(0.281)	(0.291)	(0.110)	(0.109)
d.($\frac{TRD}{(1-BTR)*b_1UCC)}$ if TRD>0,0 else) * $\frac{Depr.A}{K}$	-9.958**	-10.583**	0.509	0.739
	(4.289)	(5.019)	(1.988)	(2.095)
d.log(Sales)	0.159***	0.046***	0.077***	0.041***
	(0.054)	(0.015)	(0.021)	(0.014)
Observations	544	7,336	2,778	7,508

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.