R&D Intensities, International Profit Shifting, and Investment Decisions [1]

Michael Overesch [2]

(ZEW)

Ulrich Schreiber [3]

(Mannheim University)

This version: February 2009

Abstract: Multinationals have the opportunity to shift taxable profits to low tax countries by means of intragroup transactions. Although transfer prices must conform to the arm's length standard, market prices are not available if transferred assets or performed services are firm-specific. In these cases, companies have considerable leeway in assessing transfer prices. We use the research and development (R&D) intensity as a proxy for firm-specific assets and services that are associated with enhanced opportunities to shift profits. This paper investigates (i) whether R&D-intensive multinational companies have enhanced opportunities to shift profits and (ii) whether these companies are less responsive to local taxes when they make decisions about real investments. An empirical analysis based on firm-level data on German outbound FDI during the period 1996 until 2005 reveals that the tax response of intragroup transactions depends on the R&D intensity of multinational companies. Furthermore, the impact of taxes on investments decreases with an increasing R&D intensity, leading to the result that the local tax rate becomes less important for investment decisions of R&D intensive multinational companies.

Keywords: Corporate Taxation, Profit Shifting, Investment Decision, R&D Intensity, Firm-Level Data.

JEL Classification: H25, H26, H32

---

[1] We would like to thank the participants of the joint workshop of the Oxford University Centre for Business Taxation and the Centre for International Taxation at the Vienna University of Economics for their helpful comments and the Deutsche Bundesbank for granting access to the MiDi database. Financial support by the German Research Foundation (DFG) is gratefully acknowledged.

[2] Centre for European Economic Research (ZEW), L 7,1, D-68161 Mannheim, +49 621 1235 394, overesch@zew.de.

[3] Mannheim University, Chair of Business Administration and Taxation, Schloss, D-68161 Mannheim, Germany, +49 621 181 1718, Ulrich.Schreiber@bwl.uni-mannheim.de, and Centre for European Economic Research (ZEW), L 7,1, D-68161 Mannheim.

1. Introduction

Empirical literature provides striking evidence that local taxes impact on the investment decisions of multinational companies. De Mooij and Ederveen (2006) find in a meta-analysis, based on 31 empirical studies, that investments negatively respond to host country tax rates. As to profit shifting, multinationals may use debt financing or transfer pricing for inter-company transactions to shift taxable profit from high tax countries to low tax countries. In the presence of profit shifting the negative impact of local taxes on investments should be mitigated. However, empirical evidence on investment effects that are associated with profit shifting activities is still scarce.

Newberry and Dhaliwal (2001), Altshuler and Grubert (2003) as well as Desai, Foley, and Hines (2004) show that debt financing is used by US multinationals to shift profits. This result is confirmed for European and German firms by Huizinga, Laeven, and Nicodème (2008), Mintz and Weichenrieder (2005) as well as Buettner and Wamser (2007). Only a few studies have directly focussed on profit shifting by means of intragroup transactions. Swenson (2001) finds a small tax response of transfer prices. Similarly, Clausing (2003), and Bernard, Jensen, and Schott (2006) find that prices of intragroup trade respond to tax levels. By using aggregated firm data, Clausing (2001, 2006) confirms an impact of taxes on intragroup trade flows between US firms and their affiliates. Grubert (2003) shows, based on a cross-section analysis of US Treasury data, that the ratio of intragroup transactions to total sales of US controlled foreign companies is influenced by taxes.

As to investment effects, Hines and Rice (1994), Grubert and Slemrod (1998) as well as Desai, Foley, and Hines (2006) provide evidence that US investments at typical tax havens are associated with profit shifting. Only a very few empirical studies deal with investment effects in high-tax countries that are associated with profit shifting activities. Grubert (2003) finds that US multinationals whose profit shifting opportunities are higher-than-average choose locations with either extremely low or extremely high tax levels. Using data on German outbound FDI, Overesch and Wamser (2009a) find that the location choices of more internationalized companies are less responsive to host country taxation. Overesch (2009) provides evidence that the investment levels of foreign-controlled subsidiaries in the high-tax country Germany are positively affected by lower

tax rates of their parent companies. Investment effects associated with profit shifting are indirectly supported by Buettner et al. (2008), who find that negative investment effects arise if profit shifting is restricted by thin-capitalization rules.

There is some empirical evidence that profit shifting opportunities are closely related to the use of intangibles within the multinational firm. An early investigation of Harris (1993) finds that multinational companies with "flexible expenses" (among them R&D and advertising) shift more profits than do companies with less flexible expenses. Grubert (2003) finds that the profit shifting activities of U.S. multinationals are driven by the use of intangibles within the group. Overesch and Wamser (2009a) show that, besides financial service entities, R&D activities are very tax-sensitive. Dischinger and Riedel (2008) find that the smaller the statutory tax rate of a subsidiary relative to all other affiliates in the multinational group, the larger is its probability of holding intangible assets and the larger is the amount of intangible assets held.

Our paper adds to this strand of literature by analyzing how intragroup transactions and investment decisions are influenced by the research and development (R&D) intensity of multinational companies. We argue that R&D expenditures serve as a proxy for the availability of intangible assets and the specificity of a firm's assets. There is a wide range of transactions that could be affected by R&D activities. Intangible assets related to R&D activities might be transferred to or used by other companies. Tangible assets traded within the group might also originate from R&D activities. In both cases there is a need to assess transfer prices for firm-specific assets which are not traded in markets. In the absence of market prices, we expect multinational companies to manipulate the transfer price of intragroup transactions concerning R&D-related assets and services. Given the opportunity to shift profits away from investment locations, the local tax rate should be less decisive for multinationals' investments.

The empirical analysis employs a comprehensive firm-level data set of German controlled FDI. In addition, we employ survey data on the R&D intensities of different industries. We find that the tax sensitivity of intragroup transactions increases with an increasing R&D intensity of the firm. We rule out the possibility that these asymmetric profit shifting opportunities are compensated by less or more debt financing as an alternative profit shifting channel. Consequently, the asymmetric profit shifting opportunities should have

an asymmetric impact on investment decisions. We find that the tax sensitivity of investments significantly decreases with a rising R&D intensity of a firm. This supports the view that the host country tax rate becomes less important if there are enhanced opportunities to shift profits.

The remainder of the paper is organised as follows. In Section 2 we discuss the profit shifting opportunities that arise from intragroup transactions of R&D-intensive assets as well as the reverse consequences for the tax sensitivity of investment decisions. Section 3 describes the data used for the empirical analysis. In Section 4 we empirically analyze the income shifting opportunities due to the intragroup transactions of R&D-intensive assets. Section 5 provides empirical evidence on the reverse effects of profit shifting on the tax sensitivity of investment decisions of German multinationals. Section 6 concludes.

2. Profit Shifting and Investment Decisions of Multinational Companies in the Presence of R&D

Multinationals have an incentive to manipulate the transfer prices at which assets are traded and services supplied within the international group in order to shift profits to low taxed companies. In the tax arena, transfer prices have to conform to the internationally accepted arm's length principle. Transfer prices are adjusted for tax purposes if they do not conform to the market price of the transferred asset or performed service. Transfer pricing issues are relatively easy to settle in case of intragroup debt financing, since market prices of capital are generally observable. However, in case of firm-specific assets or services market prices do not exist. It is very likely that intragroup transfers of R&D-intensive companies are to a greater extent characterized by asset specificity. Asset specificity might be relevant for tangible assets (e.g. technical components) as well as for intangible assets (e.g. brands and licenses) or services (e.g. technical assistance).

Two of the three standard methods (OECD, 1995) to assess transfer prices - the comparable uncontrolled price method (CUPM) and the resale price method (RPM) - can not be used under such circumstances, since these methods are based on observable market prices. Thus, only the third standard method - the cost plus method (CPM) - may be employed. As an alternative, the transactional profit split method (TPSM) or the transactional net margin method (TNMM) might be feasible. CPM, TNMM and TPSM all rely

on firm-specific information. Transfer prices are assessed on the basis of the production costs (cost approach) or on the basis of the assets' profits (profit approach). The cost approach is feasible in the case of R&D-related tangible assets as well as in case of contract research where the principal (a group company) commissions R&D and has the ultimate claim to the results achieved by the agent (another group company). In cases where a group company grants another group company the right to produce and sell firm-specific products that stem from the group's R&D activities, or the right to use intangibles that were created in the course of the group's R&D investments, the arm's length price is usually determined according to the profit approaches.[4]

Neither CPM nor TNMM or TPSM can be regarded to be precise methods to determine the arm's length price. As to CPM, the direct production costs might be ascertained with some accuracy. However, the allocation of indirect costs as well as the determination of the appropriate profit margin is far from being precise. Moreover, in case of an intangible, the production costs are mostly an inadequate measure of the asset's value. TNMM is based on a company's transaction-related ratio (e.g. the profit ratio or the profit-turnover ratio) which is compared to the respective ratio of a comparable company. TPSM splits the profit of a transaction according to functions performed and risks taken. As one possibility, the residual profit that is assigned to a transaction may be determined by subtracting the normal return (basic arm's length return) from the total return of the capital invested. Whatever method is employed, the determination of transfer prices for the production, use or transfer of R&D-related assets should give considerable leeway to the companies which they can use to manipulate the transfer prices and to reduce their tax burden. Although anti-abuse rules might prevent in some special cases the use of a low taxed foreign company,[5] it should be difficult for the tax authorities to administer the arm's length principle and to keep their share of the tax revenue.

Profits can also be shifted by means of financial decisions. The tax deductibility of interest expenses generates an incentive to use debt as a source of finance. Desai, Foley, and Hines (2004) emphasize the availability of internal capital markets in the context of mul-

[4] A recent report, for example, shows that profit-based methods are the dominant method used to determine transfer prices in advance pricing agreements concluded by the US Internal Revenue Service (Internal Revenue Service, 2008, Table 19).

[5] Under German CFC-rules, royalty income from intangible assets that were transferred to a low taxed foreign corporation is categorised as 'passive' income and does not escape the German income tax (Sec. 8 Para. 1 No. 6(a) AStG).

tinational companies. Multinational companies that are active in many countries may use internal borrowing to shift profits and to benefit from cross-country profit tax rate differentials. Tax planning strategies, however, are not confined to intercompany loans. Multinationals have an incentive to shift tax deductible external debt (e.g. bank loans) to companies located in high tax countries. A recent study by Huizinga, Laeven, and Nicodème (2008) demonstrates that total borrowing is allocated among affiliates according to countries' tax conditions.

From a conceptual point of view, the two profit shifting instruments – intercompany loans and non-financial intercompany transactions – are not equivalent. Debt financing can be used to shift profits reflecting the nominal interest rate, whereas transfer pricing can be employed to shift economic rents. External debt financing is feasible in high tax countries in order to generate the highest benefit from the interest tax shield. Inter-company loans are used to transfer the normal equity capital return to companies residing in low tax countries. The economic rent might be transferred by exploiting the leeway in assessing transfer prices. To what extent a multinational is able to shift economic rents to a low tax country depends on the assets that are traded or the services that are performed within the multinational group. The more firm-specific a transferred asset or a performed service the greater the opportunity to shift profits.

Even if there is considerable leeway in the assessment of transfer prices, it is very likely that the tax authorities of the host country will manage to reap a share of the multinationals' overall profit. Given that taxable profit consists of the normal return to capital plus an economic rent, multinationals have an incentive to use intercompany debt financing in order to transfer the normal return of equity financed investments to a low tax country. Under these circumstances, the two predominant channels to shift profits, cross-border debt financing and cross-border transfer pricing, should be independent. Especially, R&D intensive companies should not make less use of tax deductible debt although they have greater opportunities to shift profits away by manipulating transfer prices.

Profit shifting reduces the tax burden of multinationals, but may also have an impact on investment decisions. The cost of capital of marginal investments typically increases with a rising local tax rate which negatively impacts on the investment level. High statutory tax rates mitigate positive effects of the tax base (e.g. tax depreciation), reduce the net

present value of profitable investments and deter foreign direct investment. However, if profits can be shifted away, a reverse impact on the tax effect must be taken into account. The local profit tax rate is a less decisive factor for investment decisions if a part of the investment's profit is taxed elsewhere. Marginal investment is less exposed to the profit shifting effect than profitable investment, since the tax burden of marginal investment is significantly determined by the tax base. Profitable investment, by contrast, responds more strongly to the statutory tax rate and, thus, is more exposed to the profit shifting effect.

Given that R&D intensive multinationals are able to shift a considerable part of their taxable profits to low tax countries by means of intercompany transactions, a high host country tax rate should not deter investments. If the opportunity to shift taxable profits depends on the company's R&D intensity, the tax responsiveness of investment decisions should not be uniform. Given that the R&D intensity is predominantly determined by the firm's type of business activity, profit shifting opportunities should vary among industries. As a result, investment decisions of multinationals should be asymmetrically affected by the host country tax rate due to the differences in shifting opportunities. The more R&D-intensive a multinational, the more the company should be able to exploit profit shifting opportunities, and the more investment decisions should be unaffected by the host tax rates.

3. Data and Descriptive Statistics

We basically employ German outbound FDI data for the empirical analysis. This data are firm-level data which are taken from the MiDi (Micro Database Direct Investment) database which is provided by the German Central Bank (*Deutsche Bundesbank*). This is a comprehensive annual micro database of German inbound and outbound FDI positions. For the purpose of this study, we use the data of German outbound FDI. Basically, the dataset provides information about the investment object's balance sheet, including further information on the type of investment and on the investor. The collection of the data is enforced by German law, which requires reporting obligations for certain international

transactions and positions.[6] This aspect of MiDi is worth emphasizing, since we are able to observe virtually all German outbound investments.

Table 1: Host Countries of German outbound FDI in 2005

Host Country	Number of Observations	Percent	Host Country	Number of Observations	Percent
Austria	473	6.90	Luxembourg	30	0.44
Australia	135	1.97	Mexico	107	1.56
Belgium	262	3.82	Netherlands	335	4.89
Bulgaria	25	0.36	New Zealand	22	0.32
Canada	137	2.00	Norway	51	0.74
Croatia	31	0.45	Poland	487	7.10
Czech Republic	405	5.89	Portugal	91	1.33
Denmark	128	1.87	Slovakia	103	1.50
Estonia	10	0.15	Slovenia	27	0.39
Finland	55	0.80	South Korea	76	1.11
France	683	9.96	Spain	391	5.70
Greece	56	0.82	Sweden	168	2.45
Hungary	269	3.92	Switzerland	411	5.99
Irleand	61	0.89	Turkey	90	1.31
Italy	400	5.84	United Kingdom	527	7.69
Japan	137	2.00	USA	637	9.29
Latvia	10	0.15	Other Countries	11	0.16
Lithuania	16	0.23			

German-controlled FDI in 2005. Only directly and wholly-owned subsidiaries are considered. Holding companies and firms from the financial service sector are excluded. The data are taken from the MiDi database provided by the Deutsche Bundesbank (cf. Lipponer, 2007, for a detailed description). 'Other Countries' are Cyprus and Malta.

The database comprises direct and indirect FDI positions above certain threshold levels.[7] A favorable characteristic of the data is the possibility of tracing individual affiliates over time. Therefore, we are able to control for unobservable time-invariant heterogeneity between the subsidiaries. We consider all incorporated affiliates, which are directly held and wholly-owned by a German parent company. Subsidiaries from the financial sector as well as holding companies are not considered. Observations which may have unclear or special tax conditions are excluded.[8] The data cover the period from 1996 until 2005 on an annual basis. We consider subsidiaries in 36 countries, 29 of which are European countries. We include in particular all EU and OECD member states where a complete set

[6] Sec. 26 of Foreign Trade and Payments Act (*Aussenwirtschaftsgesetz*) in connection with Foreign Trade and Payment Regulations (*Aussenwirtschaftsverordnung*).

[7] Since 2002, FDI has to be reported if the participation amounts to 10% or more and the balance-sheet total of the foreign investment in Germany is above 3 million Euros. For details see Lipponer (2007). Though previous years showed lower threshold levels, we apply this threshold uniformly for all years in the sample.

[8] We exclude observations from mining, agriculture, non-profit organizations, and membership organizations because special tax regimes may apply. Furthermore, we exclude observations of subsidiaries whose German parent is not an incorporated and legally independent entity, as well as subsidiaries which are not legally independent enterprises.

of control variables is available.[9] Table 1 provides some descriptive statistics on the geographic distribution of the foreign affiliates in the sample in 2005.

The dependent variables for the following analysis contain firm-level information taken from the MiDi database. For the analysis of intra-group transactions, we employ the two different balance-sheet items *Current Assets of which Claims on Affiliated Enterprises* and *Current Assets of which Claims on Non-German Affiliated Enterprises* as dependent variables. Furthermore, we consider the *Total Debt to Capital Ratio* and the *Internal Debt to Capital Ratio* as the dependent variables for the analysis of a potential interaction between intragroup transfers of R&D intensive products or services and debt financing. Finally, we use the stock of *Fixed Assets* as our dependent variable for the analysis of reverse tax effects on investment decisions due to profit shifting.

Explanatory firm-level variables include a dummy variable that indicates subsidiaries with a *Loss Carryforward*. Furthermore, *Sales* are used as an indicator for the size of the subsidiary and the cash-generating potential when analyzing the tax impact on debt financing. *Tangibility*, defined as the ratio of fixed assets to total assets, is considered as a further determinant of the financial structure. As country characteristics we employ the host country *GDP* which reflects the local market size. Moreover, we use *GDP per Capita* as an indicator for labour costs. Finally, a local *Lending Rate* for credits to the private sector is considered. Table 3 provides some descriptive statistics of the data.

The MiDi data contain information on the industry classification of the German parent company. This allows us to match the firm data with data on industry-specific R&D intensities of German companies. These data are based on a survey among German firms in 2003 and is provided by the *Stifterverband für die Deutsche Wissenschaft* (2006). The reported R&D intensities are measured by the ratio of the R&D expenditures to a firm's sales. The R&D intensities range from 0.1 percent to 40.3 percent. Particularly high R&D intensities are reported for the manufacture of pharmaceutical products, the manufacture of transport equipment, the manufacture of radio, television and communication equipment, the manufacture of aircraft and spacecraft. The R&D intensity is particularly

[9] Although Romania is a EU member state, it is not included because lending rates are not available. Iceland is excluded since no affiliates are reported in the dataset. Finally, Germany is not included as the parent companies' country.

high in case of specific R&D companies.[10] Table 2 depicts the data on industry-specific R&D intensities.

Table 2: R&D Intensities

Industry	R&D Intensity (%)
Manufacture of food products and tobacco products	0.6
Manufacture of textiles	1.5
Manufacture of leather and leather products	1.2
Manufacture of wood and wood products	0.5
Manufacture of paper, publishing, and printing	3.1
Manufacture of coke, refined petroleum and nuclear fuels	0.1
Manufacture of chemicals and chemical products	7.4
Manufacture of pharmaceutical products	14.1
Manufacture of rubber and plastic products	1.6
Manufacture of other non-metallic mineral products	2.1
Manufacture of basic metals	0.8
Manufacture of metal products	2.3
Manufacture of machinery and equipment	3.9
Manufacture of office machinery and computers	3.5
Manufacture of electrical machinery and apparatus	4.5
Manufacture of radio, television and communication equipment	10.0
Manufacture of medical, precision and optical instruments	8.4
Manufacture of motor vehicles, trailers and semi-trailers	6.5
Manufacture of other transport equipment	11.1
Manufacture of aircraft and spacecraft	16.2
Manufacture of furniture	2.6
Electricity, gas, steam and hot water supply	0.2
Construction sector	0.2
Transport and telecommunication	1.0
R&D	40.3
Business services	8.4
Service activities for private persons or public sector	0.3
Other (e.g. wholesale and retail sale, financial services)	0.3

Data are taken from Stifterverband für die Deutsche Wissenschaft (2006), p. 14 of the Annex. R&D intensity is measured by the ratio of the R&D expenditures to a firm's sales.

In accordance with previous literature (Harris, 1993; Harris et al., 1993; Grubert, 2003), we focus on R&D expenses. Companies with high R&D expenses are supposed to own relatively more firm-specific assets. Industry-specific R&D intensity serves as a proxy for the specificity of a group's assets. Thus, asset specificity of transferred assets and services is likely to be higher if the R&D intensity of the group's industry is high.

[10] Although only very few R&D companies are included in our samples, we have checked all our results without these observations. These additional results reveal that our estimations are rather unaffected by including the companies with very high R&D intensities.

Table 3: Descriptive Statistics

Variable	Description	Mean	Std.Dev.
	Firm level variables:		
Current Assets of which Claims on Affiliated Enterprises	In € thousand	4,287	59,586
Current Assets of which Claims on Non-German Affiliated Enterprises [a)]	In € thousand	3,999	63,649
Total Debt to Capital Ratio	Fraction of total debt capital	0.602	0.261
Internal Debt to Capital Ratio	Fraction of internal debt capital	0.260	0.259
Loss Carryforward	Dummy variable	0.305	0.460
Fixed Assets	In € thousand	10,275	101,092
Sales	In € thousand	48,300	332,398
Tangibility	Fraction of fixed assets in total assets	0.258	0.246
	Tax variables:		
STR	Statutory profit tax rate	0.334	0.069
PV of Depr. Allow.	Present value of depreciation allowances	0.802	0.047
HIGH	Dummy variable	0.716	0.451
	Further characteristics:		
R&D Intensity	R&D expenditures as fraction of sales	0.056	0.034
GDP	In billion US dollars	1,714	2,977
GDP per Capita	In US dollars	24,192	11,232
Lending Rate	Local lending rate	0.069	0.055

56,890 observations ([a)] 44,328 observations). Firm-level variables are taken from the MiDi database provided by the Deutsche Bundesbank (cf. Lipponer, 2007, for a detailed description). The tax variables are based on databases provided by the International Bureau of Fiscal Documentation (IBFD), and tax surveys provided by Ernst&Young, PwC and KPMG. *STR* is the statutory corporate tax rate adjusted for surcharges and local profit taxes. *PV of Depr. Allow.* denotes the present value of depreciation allowances calculated for an investment in machinery, assuming a discount rate of 7.1 percent. The *R&D Intensity* is taken from the Stifterverband für die Deutsche Wissenschaft (2006). General country characteristics are taken from various sources: *GDP* in billion US dollars, nominal, and *GDP per Capita* from World Bank's World Development Indicators (2007); the *Lending Rate* refers to private sector debt, which is taken from the IMF International Financial Statistics Yearbook (2007) and augmented with corresponding OECD figures.

As to the tax measures, we employ the statutory tax rate of the corporate income tax adjusted for surcharges and local income taxes. This measure, however, neglects all rules that determine the tax base, and most importantly, the depreciation of fixed assets. Therefore, we additionally consider country-specific depreciation rules by measuring the present value of tax depreciation allowances for machinery. Furthermore, we construct a dummy variable denoted as *HIGH* to capture the opportunity to shift taxable profits to a low taxed company. The dummy variable indicates if the subsidiary is located in a high tax country from the multinational's perspective. The dummy variable equals one for a subsidiary if there is a tax rate below the host country tax rate available at another location of the multinational firm. Otherwise, the dummy becomes zero.

4 R&D Intensities and Profit Shifting

4.1 The Impact of R&D Intensities on Intragroup Transactions

In a first step we test whether intragroup transactions respond to the local tax level. In particular, we analyze whether the tax sensitivity of intragroup transactions increases with increasing R&D intensities. Since the MiDi database does not explicitly provide data on intragroup transactions, our analysis is based on the balance-sheet items *Current Assets of which Claims on Affiliated Enterprises* and the sub item *Current Assets of which Claims on Non-German Affiliated Enterprises.* These variables, most notably, reflect unpaid inter-company bills at the balance-sheet date.[11] This means that the indicators refer to outgoing deliveries, but not to received assets and services. We use each of these two variables as dependent variables. Our estimation equation can be written as:

$$\begin{aligned}(\ln)\text{Transaction Item}_{i,t} = {} & \alpha_0 + \alpha_1 \text{STR}_{i,t} + \alpha_2 (\text{STR}_{i,t} \text{x R \& D Intensity}_{i,t}) \\ & + \alpha_3 \text{R \& D Intensity}_{i,t} + \alpha_4 X_{i,t} + \eta_i + \gamma_t + \varepsilon_{i,t}.\end{aligned} \tag{1}$$

Where *Transaction Item* denotes the amount of intragroup transactions and either refers to *Current Assets of which Claims on Affiliated Enterprises* or to the *Current Assets of which Claims on Non-German Affiliated Enterprises.* In order to avoid that zero-observations are excluded, we add a little constant of €1 to our dependent variable. The subsidiary is denoted by *i* and the respective year by *t*. The heterogeneity between subsidiaries is controlled for by a subsidiary-specific effect η_i. Common time-specific shocks are controlled by a year-specific effect γ_t. *X* is a vector of control variables. Finally, ε is an error term. The variable *STR* is the statutory tax rate. The coefficient α_1 is likely to depict the basic tax sensitivity of intragroup transactions. An increasing statutory tax rate should reduce the amount of these transactions and, thus we expect a negative sign of α_1. We employ the *R&D Intensity* of the parent company as a proxy for the asset specificity of intragroup transaction. The interaction term *STR x R&D Intensity* is likely to test the proposition that the tax elasticity of intragroup transactions increases with a rising R&D intensity of the respective company. This would reflect the enhanced shifting

[11] The financial accounting literature may refer to these positions as *accounts receivable from affiliated parties.* Note that financial transactions are presumably of secondary relevance for this balance-sheet position because financial assets in affiliated companies such as inter-company loans are reported separately.

opportunities associated with the transfer of assets or services that are likely to be firm-specific. Hence, we expect a negative sign for α_2.

Table 4 depicts the empirical results. A first set of results shown by columns (1) - (4) uses the dependent variable *Current Assets of which Claims on Affiliated Enterprises*. Taking into account the panel structure of the data set, we use a fixed effects estimator.[12] Since the tax data vary only at the country level, robust standard errors are clustered within country-year cells in order to avoid overstated significance levels (Bertrand, Duflo, and Mullainathan, 2004; Moulton, 1990). First of all, the empirical results in the columns (1) and (2) indicate a negative but insignificant effect of the STR variable on the amount of intragroup transactions. A loss carry-forward and a higher local lending rate are associated with less intragroup transactions. The latter effect may be explained by the fact that higher local re-financing costs constitute an incentive to pay internal bills faster. Therefore, the unpaid accounts receivable at the balance sheet date are smaller if the lending rate is high. Operating inefficiency of companies that suffer from losses might explain why a loss carry-forward is associated with lower intragroup transactions.

The interaction term between the tax rate and the R&D intensity introduced in column (3) is likely to identify a potential impact of the R&D intensity on the tax sensitivity of internal transactions. The effect of this interaction term is significantly negative. This result suggests that the tax rate sensitivity increases with a rising R&D activity of a company. Since the impact of the pure STR variable is insignificant, our results support the view that profit shifting via intragroup transactions is predominantly driven by the specificity of the transferred assets and services. A firm's opportunity to respond to taxes with intragroup transactions significantly depends on the extent of specificity of the transferred assets and services. This result confirms previous results. Harris (1993), for example, finds that US multinationals shift profits in response to tax incentives only if they have high expenses in terms of R&D, advertising, interest and rents.

With respect to the magnitude of the tax effect, let us consider the point estimator of about -26.2 in column (3). The sample mean of the R&D intensity, defined as the ratio of R&D expenditures to the firm's sales, amounts to 0.05622. Evaluated at this mean value,

[12] The subsidiary-fixed effect is removed by a within transformation, i.e. taking the difference between Equation (1) and the mean of Equation (1) for the respective subsidiary *i* over time (see, e.g., Wooldridge, 2002, p. 265 et sqq.).

Table 4: Taxation and Intragroup Transactions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
STR	-1.04	- 1.04	.397	.336	-.631	-.661	1.24	1.17
	(.896)	(.896)	(.979)	(.987)	(.906)	(.914)	(1.13)	(1.16)
STR x R&D Intensity			-26.2***	-26.2***			-33.9***	-33.8***
			(8.60)	(8.61)			(11.6)	(11.6)
STR x Loss Carryforward				.168				.204
				(.497)				(.526)
R&D Intensity		-1.03	7.77**	7.76**		4.79***	16.2***	16.2***
		(.823)	(2.95)	(2.95)		(1.03)	(4.06)	(4.07)
(ln) Lending Rate	-.221***	-.222***	-.220***	-.220**	-.331***	-.329***	-.325***	-.325***
	(.079)	(.079)	(.078)	(.079)	(.072)	(.072)	(.072)	(.072)
Loss Carryforward	-.175***	-.172***	-.171***	-.228	-.178***	-.179***	-.178***	-.248
	(.036)	(.036)	(.036)	(.176)	(.042)	(.042)	(.042)	(.183)
Adj. R^2	0.659	.659	.659	.659	.635	.636	.636	.635
Observations	56,890	56,890	56,890	56,890	44,328	44,328	44,328	44,328

In columns (1) – (4) the dependent variable is the log of *Current Assets of which Claims on Affiliated Enterprises*. In columns (5) – (8) the dependent variable is the log of *Current Assets of which Claims on Non-German Affiliated Enterprises*. Robust standard errors are in parentheses, which are clustered within country-year cells and robust against random firm-specific and country effects using the Huber-White sandwich formula. (*), (**), (***) denote significance at the (10%), (5%), and (1%) level. All estimates include a full set of firm and time dummies.

a tax rate that is one percentage point higher is associated with a 1.47 percent[13] smaller amount of intragroup transactions. The magnitude of our estimated tax response differs only marginally from the results of previous studies based on US data. For example, Clausing (2006) reports a 1.3 percent smaller intra-group trade balance if the tax rate rises by one percentage point.

Our specification suggests the existence of asymmetric tax effects depending on the level of R&D intensity. The tax elasticity increases in absolute values with a rising R&D intensity of the firm's business. If we consider a firm from the pharmaceutical industry with a mean R&D intensity of about 0.141, the semi-elasticity amounts to -3.69. Hence, a local tax rate that is one percentage point higher leads to a reduction of intragroup transactions by 3.69 percent. By contrast, a firm with a very low R&D intensity does not even respond to taxes with respect to the amount of intragroup transactions. These findings confirm our theoretical expectations on profit shifting opportunities. Since an increasing R&D intensity is associated with higher amounts of firm-specific assets and services, a company has additional opportunities to manipulate the quantities and prices of intragroup transactions.

The specification depicted in column (4) is used to test for the impact of a loss carryforward as a further possible source of asymmetric tax effects on the amount of intragroup transactions. Profits have not to be shifted away in order to avoid tax payments if a company has a loss carryforward. In this case, we would expect a positive sign for the interaction effect between STR and a loss carryforward and thus, a reduced impact of the local tax rate on transactions if a subsidiary has a loss carryforward. The interaction term between the tax rate variable STR and the loss carryforward, however, proves insignificant. Thus, we can not conclude that a loss carryforward leads to a reduced tax response of intragroup transactions or even attracts profits for pure tax reasons.

In the specifications shown by columns (5) - (8) of Table 4, the dependent variable is a sub item of the measure of intragroup transactions used in the previous set of estimations. In this case, we consider only the intragroup transactions carried out with the non-German affiliated companies. A possible home bias of profit allocation due to non-tax reasons can be neglected for this subsample. The results are qualitatively in line with the previous results. The tax response of intragroup transactions is associated with the level

[13] $0.0147 = 0.01 \cdot 26.2 \cdot 0.05622$.

of R&D intensity. When taking into account, for example, the mean value of the R&D intensity of about 0.05838 in the sample used by specification (7), the point estimator of about -33.9 provided by column (7) suggests that a tax rate that is one percentage point higher is associated with a 1.98 percent reduction in intragroup transactions with non-German affiliated companies.[14]

4.2 The Relationship Between Profit Shifting Channels

Previous literature has found striking evidence on a substitutive relationship between the tax elasticity of debt financing and non-debt tax shields.[15] MacKie-Mason (1990), for example, finds empirical evidence that an existing loss carryforward or an investment tax credit reduces the preference for debt. Graham and Tucker (2006) compare the use of debt financing by firms which are engaged in aggressive tax planning and by firms which do not use these structures. They find evidence that non-debt tax shields caused by the tax shelters act as a substitute for debt. In their sample which consists of 76 firms, the 38 firms using tax shelters have debt ratios that are more than 5 percent lower than those of other firms which are not engaged in that type of tax planning.

For our sample, we test whether enhanced opportunities to shift profits by means of intragroup transactions associated with high R&D intensities have an impact on debt financing as the other important profit shifting channel of a multinational company. The results of this analysis are of special relevance for the impact of profit shifting on investment decisions. If, on the one hand, multinational companies substitute reduced opportunities to shift profits via intragroup transactions by extensive debt financing, one does not expect substantial asymmetric tax effects on investment decisions. In that case, the different opportunities arising from different R&D intensities are equalized by using more or less debt financing. On the other hand, if debt financing is unaffected by profit shifting opportunities via intragroup transactions, the asymmetric tax sensitivity of intragroup transactions caused by different shifting opportunities should lead to an asymmetric tax elasticity of investment decisions as well.

[14] However, more formal *t*-tests, which are not reported, reveal that the differences in the tax effects between columns (5)–(8) and columns (1)-(4) are not statistically significant at conventional significance levels.

[15] The idea of 'non-debt tax shields' as substitutes for debt financing has been introduced by De Angelo and Masulis (1980).

We use the following type of equation to estimate the effect of the R&D intensity on the tax sensitivity of debt financing:

$$\begin{aligned}\text{Debt Ratio}_{i,t} = {} & \beta_0 + \beta_1 \text{STR}_{i,t} + \beta_2 (\text{STR}_{i,t} \text{ x R\&D Intensity}_{i,t}) + \beta_3 \text{R\&D Intensity}_{i,t} \\ & + \beta_4 X_{i,t} + \eta_i + \gamma_t + \varepsilon_{i,t}.\end{aligned} \tag{2}$$

Where *Debt Ratio* either refers to *Total Debt to Capital* or *Internal Debt to Capital*. Like in the previous estimations, the subsidiary is denoted by *i* and the respective year by *t*. The heterogeneity between subsidiaries is controlled by a subsidiary-specific effect η_i. Common time-specific shocks are controlled by γ_t. X is a vector of control variables, and ε is an error term. The dependent variable is a measure of the subsidiary's debt-to-assets ratio. The coefficient β_1 reflects the basic tax effect on the debt ratio. This coefficient can be expected to be positive and significant because a higher tax rate should be associated with an increasing use of debt. The coefficient β_2 indicates the relationship between R&D intensity and the tax elasticity of debt financing. If debt financing is a substitute of profit shifting via intragroup transactions, the coefficient should be negative. A higher R&D intensity reflecting increasing profit-shifting opportunities by means of intragroup transactions would be associated with a less pronounced tax sensitivity of debt-financing.

The regression results based on the described investigation approach are shown by Table 5. We use again a fixed effects estimator. Robust standard errors are clustered within country-year cells in order to avoid overstated significance levels. In columns (1) – (4) a first set of results employs the ratio of total debt to capital as the dependent variable. The results suggest a positive and significant effect of the local tax rate on the debt ratio. The magnitude of the effect is in line with previous results. According to specification (4), a statutory tax rate that is one percentage point higher implies a 0.392 percent higher debt ratio.[16] Desai, Foley, and Hines (2004), for example, find a slightly higher semi-elasticity of 0.510 percent for US multinationals; the analysis of Huizinga, Laeven, and Nicodeme (2008) based on European firm data suggests a semi-elasticity of 0.418. In a second set of estimations, which is shown in columns (5) – (8), we only employ the ratio of intercompany debt to capital as the dependent variable since intercompany debt may be used particularly to shift profits within multinational companies. However, the tax effects do not

[16] The semi-elasticity can be calculated by taking into account the coefficient of Column (4) in Table 5 of about 0.236 and the mean value of the debt ratio of about 0.6015: $(0.01 \cdot 0.236) / 0.6015 = 0.00392$.

Table 5: Debt Financing and R&D Intensity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
STR	.214***	.213***	.203***	.236**	.239***	.239***	.264**	.293**
	(.077)	(.077)	(.095)	(.101)	(.083)	(.083)	(.104)	(.105)
STR x R&D Intensity			.213	.215			-.495	-.493
			(.685)	(.692)			(.742)	(.731)
STR x Loss Carryforward				-.103***				-.092*
				(.039)				(.047)
R&D Intensity		.023	-.049	-.049		.058	.108	.108
		(.051)	(.249)	(.251)		(.057)	(.256)	(.256)
Loss Carryforward	.033***	.033***	.033***	.068***	.038***	.038***	.038***	.069***
	(.002)	(.002)	(.002)	(.013)	(.003)	(.003)	(.003)	(.016)
Tangibility	.012	.013	.013	.012	-.028**	-.028**	-.028**	-.028**
	(.012)	(.012)	(.012)	(.012)	(.012)	(.012)	(.012)	(.012)
(ln) Sales	.028***	.028***	.028***	.028***	.002	.002	.002	.002
	(.002)	(.002)	(.002)	(.002)	(.002)	(.002)	(.002)	(.002)
(ln) Lending Rate	.023***	.023***	.023***	.023***	.020***	.020***	.020***	.020***
	(.007)	(.007)	(.007)	(.007)	(.007)	(.007)	(.007)	(.007)
Adj. R^2	0.777	0.777	0.777	0.777	.680	.680	.680	.680
Observations	56,890	56,890	56,890	56,890	56,890	56,890	56,890	56,890

In columns (1) – (4) the dependent variable is the ratio of total debt to assets. In columns (5) – (8) the dependent variable is the ratio of intercompany-debt to assets. Robust standard errors are in parentheses, which are clustered within country-year cells and robust against random firm-specific and country effects using the Huber-White sandwich formula. (*), (**), (***) denote significance at the (10%), (5%), and (1%) level. All estimates include a full set of firm and time dummies

differ much in comparison to the first set of results shown in columns (1) – (4).

With respect to the control variables, a loss carryforward, higher sales and a higher lending rate are associated with additional total debt. Since a loss making affiliate cannot retain profits, the effect on debt is likely to be positive. The positive sign of the sales is in accordance with the view that a larger size of the cash flow improves the access to external capital. Accordingly, the effect of sales on internal debt is insignificant. The positive effect of a higher local lending rate on internal debt can be explained by the fact that the alternative source of debt, namely bank loans, becomes more expensive with a rising lending rate. Higher asset tangibility may imply an easier access to external debt because firms can easily borrow against fixed assets. Agency costs of debt are then reduced by the value of collateral. Therefore, the effect of tangibility on internal debt as a substitute of external debt is likely to be negative.

The results suggest that debt financing is not influenced by different opportunities to shift profits via intragroup transactions. The specifications including an interaction term between the tax rate and the R&D intensity are shown by columns (3) and (7). These specifications do not provide any significant evidence that the tax sensitivity of debt financing is affected by the level of R&D intensity. Therefore, our results do in fact support the view that profit shifting via intragroup transactions with R&D related assets or services and debt financing do not function as substitutes. Asymmetric opportunities to shift profit via intragroup transactions caused by different R&D intensities are not compensated by more or less debt financing.[17]

Finally, in columns (4) and (8) we also account for a potential reverse effect on the tax sensitivity of debt financing if a subsidiary has a loss carryforward. Then, the tax incentive to use debt should be reduced since additional interest expenditures do not immediately save taxes due to the fact that current profits can be compensated by losses carried forward. This hypothesis is confirmed by our regression results. The negative sign for the interaction effect between the statutory tax rate and the loss carryforward dummy suggests that the tax sensitivity of debt financing is significantly reduced if a subsidiary has a

[17] Note that we cannot test for the reverse effect of financial tax planning on the tax response of intragroup transactions. However, this is not necessary for the purpose of this analysis. Our analysis focuses on the effects of the R&D intensity on income shifting and investment decisions. A complete analysis of the interdependencies between different income shifting channels is beyond the scope of this study.

loss carryforward. Regarding column (4), the result suggests that the tax response of total debt is reduced to approximately half its size if the subsidiary has a loss carryforward.

5. R&D Intensities, Profit Shifting, and Investment Decisions

In a final step, we analyze whether the profit shifting opportunities found in the previous Section lead to reverse effects on the tax sensitivity of investments. Given the fact that neither the enhanced profit shifting opportunities via intragroup transactions nor the asymmetric distribution of the shifting opportunities are equalized by debt financing, one would expect asymmetric tax sensitivities of investments as well. For the analysis of the investment decisions we focus on the distribution of real capital, rather than FDI. Real capital is measured, for example, by the stock of property, plant and equipment (e.g., Grubert and Mutti, 1991; Altshuler, Grubert, and Newlon, 2001). Our analysis uses the comparable balance-sheet item *Fixed Assets* as a measure for real economic activity. Additionally, we take the persistence in the amount of fixed assets into account by including lags of this variable, thereby capturing adjustment costs of investment levels (e.g., Chirinko, 1993). We estimate equations of the following type:

$$\begin{aligned}(\ln)\text{FixedAssets}_{i,t} = {} & \delta_0 + \delta_1 (\ln)\text{FixedAssets}_{i,t-1} + \delta_2 \text{STR}_{i,t} + \delta_3 (\text{STR}_{i,t} \text{ x R\&D Intensity}_{i,t}) \\ & + \delta_4 \text{R\&D Intensity}_{i,t} + \delta_5 X_{i,t} + \eta_i + \gamma_t + \varepsilon_{i,t}\end{aligned} \tag{3}$$

The subsidiary is denoted by the subscript *i* and the respective year by *t*. First, we have to control for subsidiary-specific heterogeneity η_i. If we neglected unobserved affiliate characteristics, we would obtain biased coefficients. Our estimation approach removes unobserved affiliate-specific effects. In particular, we estimate equation (3) in first differences.[18] Secondly, we include a time-lag of the dependent variable to capture dynamic effects. Thus, we also take into account the heterogeneity in adjustment dynamics between firms. Since our time-series information is not sufficient to avoid what is called the Nickell bias (Nickell, 1981), we apply a generalized method of moment (GMM) estimator (Arellano and Bond, 1991).[19] We report two-step difference GMM estimations which are generally more efficient than one-step estimates, and standard errors that are corrected

[18] The firm-specific effect is removed by taking the difference of consecutive observations of a subsidiary (see, *e.g.*, Wooldridge, 2002, 279-291).
[19] See Baltagi (2005: 135-164) for a discussion of various estimators for dynamic linear panel data models.

for finite sample bias (Windmeijer, 2005). Lagged levels are used to instrument the lagged dependent variable. A large set of instruments can overfit endogenous variables, and it tends to weaken the usual tests for overidentifying restrictions (see Roodman, 2007). To avoid such problems, our strategy is to use only one lagged value (e.g., *Fixed Assets*$_{t-2}$) of any endogenous explanatory variable within the GMM procedure. Furthermore, we consider a vector of control variables *X* and a time-specific effect γ_t. Note that the first-differencing entirely controls for time-invariant host-country effects.

The coefficient δ_2 captures the pure tax rate effect on the investment level. This effect is expected to be negative, thus indicating the negative effect of a rising tax rate on the investment level. In order to analyse whether a higher R&D intensity as a proxy for higher profit shifting opportunities leads to a reduced tax sensitivity of investments, we insert an interaction term between the tax rate and R&D intensity. The coefficient δ_3 is expected to be positive when taking into account that the basic tax effect δ_2 should be negative and given that the R&D intensity is positive. Hence, we would expect a reduced tax response of the investment level to the local tax rate with a rising R&D intensity of the firm.

Table 6 shows the regression results. The specifications in columns (1) and (2) of Table 6 indicate that the statutory tax rate negatively affects investment. The results are remarkable when taking into account our dynamic specification. The point estimator of column (2) suggests that a tax rate that is one percentage point higher is associated with 0.622 percent less investment in fixed assets. However, this is only a short-run effect. Provided that we employ a dynamic estimation approach, the long run effect is higher and amounts to -1.65.[20] Note that we are unable to identify a significant effect of the tax base reflected by the present value of depreciation allowances. One may speculate whether this result indicates that multinationals do not take into account the timing effects of taxes because these effects are superseded by the tax rate effect on the net present value of investments. The ineffectiveness of tax depreciation rules might also be explained by the fact that the variation of depreciation rules within a country is very small in our sample, and further-

[20] By assuming that (ln) *Fixed Assets*$_{i,t}$ = (ln) *Fixed Assets*$_{i,t-1}$ in the long-run equilibrum and by rearrangig equation (3), the long-run effect can be calculated as $\delta_2 /(1-\delta_1)$. Using the point estimators of column (2) in Table 6, the long run effect is -0.622 / (1-0.622) = -1.65.

more by the fact that we entirely control for heterogeneity between countries by means of first-differencing the Equation (3).

Apart from coefficient estimates and standard errors, we report the Arellano and Bond (1991) test on auto-correlation of residuals. The validity of the GMM-estimator relies on the absence of second-order auto-correlation. The numbers shown in Table 6 are *p*-values, suggesting that no significant second-order auto-correlation exists. Finally, the Hansen J-test (Hansen, 1982) of over-identifying restrictions indicates that the validity of $Fixed\ Assets_{i,t-2}$ as an additional instrument cannot be rejected at any reasonable level of significance.

The effects of the other control variables match theoretical expectations. The size of the host country's local market indicated by the GDP is associated with a larger investment level. Especially vertically-motivated FDI should be negatively affected by rising GDP per capita (Markusen, 2002), since GDP per capita can be interpreted as a proxy of labour costs. This is confirmed by the negative effect of GDP per capita on investment levels. The positive effect of the local lending rate on investment seems to come as a surprise. However, provided that multinationals can use internal capital markets, a higher local price for debt capital may constitute a competitive advantage in comparison to purely domestic companies. Finally, column (2) demonstrates that the results are rather unaffected by inserting the R&D intensity as an additional explanatory variable.

Considering specifications of columns (1) and (2), the tax effects captured by the variable STR entirely include reverse tax effects arising from profit shifting opportunities. The asymmetries due to differences in profit shifting opportunities are not identified. However, when taking into account our previous results (see Table 4 and Table 5), one can expect the profit shifting opportunities to differ due to intragroup transactions. As in the previous analysis we employ the R&D intensity of an industry as a proxy for the level of profit shifting opportunities. Then, in contrast to column (2), the specification in column (3) is likely to separately account for both the non-tax and the tax effect of R&D intensities on fixed assets. The non-tax effect is captured by the plain R&D intensity variable in column (3). The R&D intensity variable has a significantly negative effect on the level of fixed assets. One may speculate whether this effect can be explained by the fact that in-

Table 6: Taxation and Investment Level

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(ln) Fixed Assets $_{t-1}$	.621***	.622***	.620***	.619***	.588***	.633***	.633***
	(.053)	(.053)	(.053)	(.053)	(.052)	(.065)	(.065)
STR	-.621***	-.622***	-1.07***	-1.12***	-1.50**	-.996***	-.996***
	(.178)	(.178)	(.242)	(.242)	(.723)	(.280)	(.280)
STR x R&D Intensity			8.07***	8.09***	7.83***		2.14
			(3.01)	(3.01)	(2.98)		(5.04)
STR x R&D Intensity x (1- HIGH)						2.14	
						(5.04)	
STR x R&D Intensity x HIGH						6.41*	4.27*
						(3.53)	(2.60)
STR x Loss Carryforward				0.150	.271		
				(.209)	(.210)		
STR x Debt Ratio					.541		
					(1.08)		
R&D Intensity		-.243	-2.91***	-2.92***	-2.80***	-1.74	-1.74
		(.293)	(1.05)	(1.05)	(1.04)	(1.31)	(1.31)
Debt Ratio					.292		
					(.431)		
Loss Carryforward	-.019	-.019	-.019	-.069	-.117	-.025	-.025
	(.014)	(.013)	(.014)	(.072)	(.073)	(.015)	(.015)
PV of Depr. Allow.	.052	.051	.062	.064	-.014	.200	.200
	(.174)	(.174)	(.174)	(.174)	(.172)	(.209)	(.209)
(ln) GDP	1.62**	1.62**	1.58**	1.58**	1.40**	1.13***	1.13***
	(.681)	(.681)	(.681)	(.680)	(.685)	(.557)	(.557)
(ln) GDP per Capita	-1.14*	-1.14*	-1.09*	-1.10*	-.839	-.653	-.653
	(.669)	(.668)	(.668)	(.667)	(674)	(.554)	(.554)
(ln) Lending Rate	.145***	.145***	.144***	.145***	.132***	.173***	.173***
	(.024)	(.024)	(.024)	(.024)	(.023)	(.027)	(.027)
Hansen J-test	.571	.569	.565	.561	.239	.827	.827
Test of 2nd order auto-cov.	.684	.680	.676	.670	.733	.418	.418
Observations	34,364	34,364	34,364	34,364	34,364	26,264	26,264

The natural log of the fixed assets is the dependent variable. Time-specific fixed effects are included. Estimation in first differences follows Arellano and Bond (1991). Robust standard errors in parentheses, using the Windmeijer (2005) correction. (*), (**), (***) denote significance at the (10%), (5%), and (1%) level. Numbers reported for the Hansen J-test of overidentification restrictions and for the test of 2nd order auto-covariance are *p*-values. In Column (5), the variables 'Debt Ratio' and 'STR x Debt Ratio' are treated as endogenous variables, and henceforth instrumented by lagged levels of these variables within the GMM procedure.

tangible assets resulting from R&D activities are mostly not reported as assets in the companies' balance sheets according to accounting standards.

The interaction term between R&D intensity and the statutory tax rate STR controls for the tax-related effects of R&D intensity. Correspondingly, unlike the previous specifications in columns (1) and (2), the interpretation of the STR variable has been changed. Now, the coefficient of the plain STR variable only reflects the tax effect, and neglects any R&D activities. Taking into account our results in Section 4, the effect of the STR variable does not reflect the reverse effects on the tax sensitivity of investment decisions which result from profit shifting via intragroup transactions. Not surprisingly, in the specification shown in column (3) the negative effect of the local tax rate of about -1.07 is considerably more pronounced. The significantly positive effect of the interaction between STR and R&D intensity suggests that an increasing R&D intensity is associated with a reduced tax sensitivity of the investment level.

The total tax effect must be calculated by taking into account the negative effect of the statutory tax rate and the reverse effect of the interaction term between R&D intensity and the statutory tax rate. If we consider, *e.g.*, the mean value of the R&D intensity of about 0.05748 for the sample used by specification (3), a one percentage point higher tax rate is associated with a short-term total investment effect of -0.606 percent. This total effect consists of the negative effect of the plain tax rate of about -1.07 and a reverse effect due to R&D-related profit shifting opportunities of about 0.464 (= 8.07 · 0.05748). In the long-run this total tax effect amounts to -1.60.[21] Comparing this result evaluated at sample means to the previous tax effect depicted in column (2), it can be seen that the average tax effect is, of course, quite similar.

However, the results suggest that the tax effects with respect to investments are asymmetrically distributed depending on the respective level of R&D intensities that reflect the different profit shifting opportunities. Let us therefore consider different levels of R&D intensities. On the one hand, let us assume a firm with the minimum R&D intensity observed for our sample, which is of about 0.1 percent. In this case, the negative effect of a higher local tax rate is significantly more pronounced. The point estimators of column (3) suggest that a one percentage point higher tax rate is associated with 1.062 percent

[21] -1.60 = 0.606 · (1-0.620).

smaller investments in the short run, and 2.79 percent less investments in the long run. On the other hand, the negative effect of an increasing local tax rate decreases with a rising R&D intensity. Our point estimators suggest that the effect of local taxes on investments completely vanishes if a company's R&D intensity amounts to 13.3 percent. Taking into account the typical level of R&D intensities shown by Table 2, it can easily be seen that this is by no means an exceptional case. Thus, our results provide evidence for significant asymmetries in tax effects on investments due to different profit shifting opportunities.

The specifications depicted in columns (4) and (5) consider further potential asymmetric tax effects on investment decisions. In column (4) we test whether a loss carryforward leads to a smaller tax sensitivity of investments. Moreover, in column (5) a potentially reverse effect of a higher debt ratio on the tax sensitivity of investments is considered. Since the current debt ratio might be influenced by the current investment level in fixed assets, we treat both the debt ratio and the interaction term of STR and the debt ratio as endogenous variables. Consequently, we also use lagged levels of these variables for the GMM procedure following Arellano and Bond (1991). Although the sign of the additional tax effect is positive, the effect is far from being statistically significant. Thus, we cannot confirm that firms are less responsive to local taxes if they carry forward losses or if they are in debt and deduct interest payments from their taxable profits.[22]

To make it short, the tax sensitivity of investments is particulary small if the R&D intensity of the multinational group is high. Given that the reduced impact of the host country tax rate is caused by profit shifting towards other locations, it is a challenging task to identify the impact of the tax level at other locations of the multinational group. If a part of the local profit is shifted away, this part is effectively taxed by the tax rate imposed at another location of the multinational company. Thus, the respective tax level should affect the net present value of investment in the host country. Since we cannot observe each and every intragroup transaction, it is impossible to observe the relevant other tax rate if the company structure is complex.

[22] Note that we find the expected reverse tax effect of higher debt ratios on investment decisions at conventional significance levels if we do not take account for the potential simultaneity of investment and financing decisions. However, we argue that the identification of investment effects, which may arise as a consequence of debt financing, requires more refined approaches. Buettner et al. (2008), e.g., find negative investment effects if debt financing is restricted by a thin-capitalization rule.

Previous literature has made different assumptions regarding the corresponding tax rate of intragroup profit shifting. Overesch and Wamser (2009b) and Overesch (2009) find that the tax rate of the direct owner of German *inbound* FDI has an impact on the amount of both the intragroup debt and investments in Germany. However, profit shifting between the subsidiary and the direct owner might not be a dominant strategy in our case because profit shifting towards the German parent company does not seem to be very attractive given the fact that the German tax level was comparatively high during the last decade. When analyzing the tax effect on debt financing of multinationals, Buettner and Wamser (2007) employ the minimum tax rate available within the multinational group, whereas Huizinga, Laeven, and Nicodème (2008) use a weighted average of the tax rates available within the multinational firm. Finally, Grubert (2003) assumes a tax rate of 25 percent in order to identify cases where profits are most likely to be shifted away. In sum, it proves to be very difficult to find out the relevant corresponding tax rate if single transactions are unobservable.

Therefore, we use a rather simple approach to identify group companies that most probably gain from profit shifting. As an additional check, we test whether the reverse tax effect on investments is only found if subsidiaries can effectively save taxes by shifting profits to other affiliated firms. We identify subsidiaries that have at least one different location within the multinational company whose tax rate is below the tax rate of the subsidiary's country. Consequently, only those observations of companies remain which are located in a country with a tax rate above the German tax rate or which are affiliated with a company located in a country with a lower local tax rate than the own tax rate. Under these circumstances, the affiliate has the opportunity to reduce tax payments by means of shifting profits away to this lower taxing location. We construct a dummy variable denoted as *HIGH* indicating if a subsidiary is located in a high tax country from the multinational's point of view. The dummy variable is one if the respective subsidiary has an affiliated company located in a country with a comparatively lower tax rate. Otherwise, the dummy becomes zero.

Columns (6) and (7) of Table 7 display these additional regression results using the dummy variable *HIGH*.[23] Column (6) shows that a significant reverse tax effect is only

[23] In order to handle possible technical problems arising from self-selection into one of the subgroups, *e.g.*, if a multinational sets up a new affiliate in a low tax country, we eliminate all observations of companies which have switched between the respective subgroups in different years. In this manner, estimating in

found if the dummy variable *HIGH* is one. Furthermore, the specification in column (7) confirms that the reverse tax effects significantly differ between both subgroups. A reverse effect on the tax sensitivity of investments is only found if a subsidiary has at least one other affiliated company with a lower tax rate. The results support the expectation that increasing profit shifting opportunities due to higher R&D intensities of a company lead to a reverse effect on the tax sensitivity of investments. This reverse effect, however, can only be observed if the subsidiary has the opportunity to save taxes by means of shifting profits because a lower tax rate is available within the multinational group.

6. Summary and Conclusions

Multinationals are able to engage in international profit shifting by means of debt financing as well as non-financial intragroup transactions. Both profit shifting channels are not equivalent. Debt financing may be used to shift the normal return to equity capital, whereas economic rents can be transferred by non-financial intragroup transactions. Transfer prices of intragroup transactions have to conform to the arm's length principle which is based on market transactions that are comparable to the multinationals' transactions. Profit shifting by means of non-financial intragroup transactions is facilitated if market prices of traded assets and supplied services can not be easily observed. The multinationals' leeway with respect to the assessment of transfer prices is especially distinct when R&D-related assets are transferred or R&D-related services are performed. In these cases, market prices do not exist. Thus, profit shifting opportunities based on non-financial intragroup transactions should be asymmetrically distributed among companies due to different business activities.

A country's high statutory corporate income tax rate is likely to increase the tax burden of investments and to deter foreign investment. Reverse effects of the tax base decrease the tax burden. Given asymmetric profit shifting opportunities, investment decisions should not uniformly depend on the local statutory tax rate. Instead, varying profit shifting opportunities should impact on investments. Investments are less driven by the local tax rate if R&D-intensive multinationals have considerable leeway in assessing transfer prices.

---

first-differences leads to consistent results, since the removal of the company-specific effect also controls for the selection into one of the subsamples (see Verbeek and Nijman, 1992; Vella, 1998).

Our main empirical findings are: (i) A higher R&D intensity of a company's business activity is associated with a higher tax sensitivity of intragroup transactions. (ii) A higher profit shifting capacity due to a company's R&D intensity does not impact on debt financing as an alternative profit shifting channel. (iii) Higher profit shifting opportunities due to a higher R&D intensity have reverse tax effects on investments: If the R&D intensity is very high, the negative effect of an increasing local statutory tax rate on investments is completely eliminated.

The recent German tax reform of the year 2008 has amended the transfer pricing rules and introduced a new regulation restricting profit shifting activities (Sec. 1 Para. 3 AStG). Our results suggest that these new provisions could have a negative impact on investments in Germany, since the host country tax rate becomes the more important for investment decisions the less a company is able to shift profits away. However, the tax reform has reduced the German statutory corporate profit tax rate by approximately 9 percentage points which may compensate the negative investment effects to some extent.

Under applicable law, transfer prices are essential for the allocation of multinationals' tax bases. Amendments of transfer pricing regulations might impose additional restrictions on profit shifting opportunities, but they will most likely not totally abolish them. By contrast, the European Commission has recently proposed to replace the prevailing international tax base allocation with formula apportionment of the tax base. Under formula apportionment, the total taxable profit of a European multinational group would be allocated to member states by means of multipliers. Transfer pricing would become irrelevant for European tax purposes. Our results suggest that the mean tax elasticity of multinationals' real investments would significantly increase because transaction based profit shifting does not save taxes within European groups. Multinationals might, of course, exploit profit shifting opportunities with respect to non-European countries where formula apportionment does not apply, or multinationals may engage in profit shifting by measures that impact on the formula itself. Nevertheless, formula apportionment has the potential to reduce profit shifting opportunities. As a consequence, a high tax country might have to reduce its corporate profit tax rate if it is not willing to accept negative real investment effects. Such a country would lose tax revenues due to a tax rate cut instead of losing tax revenues via transfer price manipulations.

In sum, our results suggest that a country's tax policy should be aware of the trade-off between higher tax revenues and lower investments if transfer pricing opportunities are restricted. On the other hand, the restrictions on transfer pricing may reduce the tax asymmetries between companies that have different profit shifting opportunities and, thus, may contribute to reduce competitive disadvantages of companies that are not able to engage in international tax rate arbitrage.

References

Altshuler, R., H. Grubert, and T.S. Newlon (2001), Has U.S. investment abroad become more sensitive to tax rates? in: J.R. Hines (ed.), *International Taxation and Multinational Activity*, Chicago, 8-32.

Altshuler, R. and H. Grubert (2003), Repatriation taxes, repatriation strategies and multinational financial policy, *Journal of Public Economics* 87, 73-107.

Arellano, M. and S.R. Bond (1991), Some tests of specification for panel data: evidence and an application to employment equations, *Review of Economic Studies* 58, 277-297.

Baltagi, B. H. (2005), *The econometric analysis of panel data*, 3. edition., Chichester.

Bernard, A.B., J.B. Jensen, and P.K. Schott (2006), *Transfer pricing by U.S.-based multinational firms*, NBER Working Paper 12493, Cambridge MA.

Bertrand, M., E. Duflo, and S. Mullainathan (2004), How much should we trust differences-in-differences estimates? *Quarterly Journal of Economics* 119, 249-275.

Buettner, T. and G. Wamser (2007), *Intercompany loans and profit shifting – Evidence from company level data*, CESifo Working Paper 1959, Munich.

Buettner, T., M. Overesch, U. Schreiber, and G. Wamser (2008), *The impact of thin-capitalization rules on multinationals' financing and investment decisions*, Bundesbank Discussion Paper 03/2008, Frankfurt.

Chirinko, R.S. (1993), Business fixed investment spending: modelling strategies, empirical results, and policy implications, *Journal of Economic Literature* 31, 1875-1911.

Clausing, K.A. (2001), The impact of transfer pricing on intrafirm trade, in: *International taxation and multinational activity*, edited by J.R. Hines, Chicago, 173-194.

Clausing, K.A. (2003), Tax-motivated transfer pricing and US intrafirm trade prices, *Journal of Public Economics* 87, 2207-2223.

Clausing, K.A. (2006), International tax avoidance and U.S. international trade, *National Tax Journal* 59, 269-287.

DeAngelo, H. and R.W. Masulis (1980), Optimal capital structure under corporate and personal taxation, *Journal of Financial Economics* 8, 3-29.

De Mooij, R.A. and S. Ederveen (2006), *What a difference does it make? Understanding the empirical literature on taxation and international capital flows*, European Commission Economic Papers 261.

Desai, M.A., C.F. Foley, and J.R. Hines (2004), A multinational perspective on capital structure choice and internal capital markets, *Journal of Finance* 59, 2451-2487.

Desai, M.A., C.F. Foley, and J.R. Hines (2006), The demand for tax haven operations, *Journal of Public Economics* 90, 513 -531.

Dischinger, M. and N. Riedel (2008), *Corporate taxes, profit shifting and the location of intangibles within multinational firms*, Working Paper, Munich.

Graham, J.R. and A. Tucker (2006), Tax shelters and corporate debt policy, *Journal of Financial Economics* 81, 563-594.

Grubert, H. und J. Mutti (1991), Taxes, tariffs and transfer pricing in multinational corporate decision making, *Review of Economics and Statistics* 73, 285-293.

Grubert, H. and J. Slemrod (1998), The effects of taxes on investing and income shifting to Puerto Rico, *Review of Economics and Statistics* 80, 365-373.

Grubert, H. (2003), Intangible income, intercompany transactions, income shifting, and the choice of location, *National Tax Journal* 56, 221-242.

Hansen, L.P. (1982), Large sample properties of generalized method of moment estimators, *Econometrica* 50, 1029-1054.

Harris, D.G. (1993), The impact of U.S. tax law revision on multinational corporations' capital location and income shifting decisions, *Journal of Accounting Research* 31 (Supplement), 111-140.

Harris, D.G., R. Morck, J. Slemrod, and B. Yeung (1993), Income shifting in U.S. multinational corporations, in: Giovannini, A., R.G. Hubbard and J. Slemrod (eds.), *Studies in International Taxation*, Chicago, 277-302.

Hines, J.R. and E.M. Rice (1994), Fiscal paradise: Foreign tax havens and American business, *Quarterly Journal of Economics* 109, 149-182.

Huizinga, H., L. Laeven, and G. Nicodème (2008), Capital structure and international debt shifting in Europe, *Journal of Financial Economics 88, 80-118*.

Internal Revenue Service (2008), *Announcement and report concerning advance pricing agreements*, Internal Revenue Bulletin 2008-15, April 14, Washington D.C.

Lipponer, A. (2007), *Microdatabase direct investment - MiDi. A brief guid*e, Bundesbank Working Paper, Frankfurt.

Markusen, J.R. (2002), *Multinational firms and the theory of international trade*, Cambridge, Massachusetts, The MIT Press.

MacKie-Mason, J.K. (1990), Do taxes affect corporate financing decisions? *Journal of Finance* 45, 1471-1493.

Mintz, J. and A.J. Weichenrieder (2005), *Taxation and the financial structure of German outbound FDI*, CESifo Working Paper 1612, Munich.

Moulton, B.R. (1990), An illustration of a pitfall in estimating the effects of aggregate variables on micro units, *Review of Economics and Statistics* 72, 334-338.

Nickell, S.J. (1981), Biases in dynamic models with fixed effects, *Econometrica* 49, 1417-1426.

Newberry, K. and D.S. Dhaliwal (2001), Cross-jurisdictional income shifting by U.S. multinationals: evidence from international bond offerings, *Journal of Accounting Research* 39, 643-662.

OECD (1995), Transfer pricing guidelines for multinational enterprises and tax administrations, Paris.

Overesch, M. (2009), The effects of multinationals' profit shifting activities on real investments, forthcoming in *National Tax Journal*.

Overesch, M. and G. Wamser (2009a), *Who cares about corporate taxation? Asymmetric tax effects on outbound FDI*, forthcoming in *World Economy*.

Overesch, M. and G. Wamser (2009b), Corporate tax planning and thin-capitalization rules: evidence from a quasi experiment, forthcoming in *Applied Economics*.

Roodman, D. (2007), *A short note on the theme of too many instruments*, Working Paper 125, Centre for Global Development, Washington D.C.

Stifterverband für die Deutsche Wissenschaft (2006), *Forschung und Entwicklung in der Wirtschaft – Bericht über die FuE-Erhebungen 2003 und 2004*, Essen.

Swenson, D.L. (2001), Tax reforms and evidence of transfer pricing, *National Tax Journal* 54, 7-25.

Vella, F. (1998), Estimating models with sample selection bias: a survey, *Journal of Human Resources* 33, 681-703.

Verbeek, M. and T. Nijman (1992), Testing for selectivity bias in panel data models, *International Economic Review* 33, 681-703.

Windmeijer, F. (2005), A finite sample correction for the variance of linear efficient two-step GMM estimators, *Journal of Econometrics* 126, 25-51.

Wooldridge, J.M. (2002), *Econometric analysis of cross section and panel data*, Cambridge, Massachusetts, The MIT Press.