The Effects of Corporate Taxes on Business Behavior

Microsimulation and Meta-Analyses

Zur Erlangung des akademischen Grades eines
Doktors der Wirtschaftswissenschaften

(Dr. rer. pol.)

an der Fakultät für Wirtschafts- und Sozialwissenschaften
der Ruprecht-Karls-Universität Heidelberg

vorgelegte

DISSERTATION

von

Jost Henrich Heckemeyer

Juli 2012

Erstgutachter:	Prof. Dr. Lars P. Feld
Zweitgutachter:	Prof. Dr. Christoph Spengel
Tag der Disputation:	18. Juli 2012

Acknowledgments

First of all, I would like to thank my thesis supervisor Lars P. Feld. His earnest interest in my research topics, his support and the ideas he provided were highly encouraging and contributed significantly towards my dissertation. I am also very much indebted to Christoph Spengel who was the second supervisor on my committee. None of this would have been possible without his great enthusiasm and his deep confidence in my abilities. Furthermore, I thank Stefanie Walter, who completed my thesis committee, for her much appreciated efforts.

The work described in this doctoral thesis was carried out at the Centre for European Economic Research (ZEW). It received financial support from the Fritz Thyssen Foundation. All this support is gratefully acknowledged.

Special thanks go to my colleagues, past and present, at the ZEW Mannheim, the Walter Eucken Institute in Freiburg and the Chair of Business Administration and Taxation II at the University of Mannheim. You were all great colleagues and working with you has always been a pleasure. Christof Ernst and Benedikt Zinn, being your office mate was much fun, thank you! In particular, I would like to express my gratitude to Katharina Finke and Michael Overesch who are co-authors on some of the research projects included in this dissertation. I will not forget our pleasant and fruitful collaboration.

I would like to include a word of thanks to all members of the "Meta-Analysis of Economics Research" network. Our workshops were highly inspiring and enjoyable. Special thanks go to Tom Stanley who has supported me in many ways.

In addition, I would like to thank all staff members of the Tax Policy Division at the International Monetary Fund (IMF) for the warm welcome I received during my research visit in 2011. I had a great and productive time in Washington D.C.. Many thanks to Ruud de Mooij for making this possible.

I am extremely grateful to my parents, my sister Karolin, and my brother Arnd Christian for their unconditional support throughout all my life.

Susanne, thank you for always being at my side. Thank you from the heart.

Heidelberg, July 2012 *Jost Henrich Heckemeyer*

Overview

Table of Contents

Tables

Figures

Abbreviations

BizTax	corporate tax microsimulation model put forward by Bach et al. (2007, 2008)
CCCTB	common consolidated corporate tax base
CCTB	common corporate tax base
CGE	computable general equilibrium
Ch.	chapter
CIT	corporate income tax
CorpSim	corporate tax microsimulation model put forward by Creedy and Gemmell (2009, 2010)
CORTAX	CGE model put forward by Bettendorf and van der Horst (2006)
DCGE	dynamic calculable general equilibrium
DIECOFIS	Development of a System of Indicators on Competitiveness and Fiscal Impact on Enterprise Performance
DIW	Deutsches Institut für Wirtschaftsforschung, Berlin
e.g.	exempli gratia
EATR	effective average tax rate
EBIT	earnings before interest and taxes
EBITDA	earnings before interest, taxes, depreciation and amortization
EBT	earnings before taxes
EMTR	effective marginal tax rate
et al.	et alii
FDI	foreign direct investment
i.e.	id est
IfoMOD	CGE model put forward by Keuschnigg et al. (2005)
iid	independent and identically distributed
ISTAT	Italian Statistical Office
ln	natural logarithm
MNE	multinational enterprise
MRA	meta-regression analysis
MTR	marginal tax rate
OLS	ordinary least squares
ROA	return on assets

ROE	return on equity
WACC	weighted average cost of capital
WLS	weighted least squares
ZEW	Zentrum für Europäische Wirtschaftsforschung, Mannheim
ZEW TaxCoMM	ZEW Corporate Tax Microsimulation Model

Symbols

Chapter 3

Section 3.1: Decomposing the Aggregate Tax Base Elasticity

e	aggregate semi-elasticity of taxable corporate income
e^D	marginal tax effect on the corporate debt ratio
e^{INV}	semi-elasticity of marginal investment
e^{PS}	semi-elasticity of multinational profit shifting activity, i.e. reported EBIT
e^{LOC}	semi-elasticity of infra-marginal investment
e^{OF}	semi-elasticity of the corporate share of business
w^N	share of normal return in the total corporate tax base
w^M	share of profits from multinational activity
w^F	share of assets owned by foreigners

Section 3.2.4: Some Basic Microeconomic Principles of Firm Behavior

Y	production (gross domestic product)
L	labor input
K	capital input
α_L , α_K	share parameters for respectively labor and capital in the production function
σ	elasticity of substitution between labor and capital
w	real wage rate
d	debt ratio of firms
z	unit cost of financial distress
r	real world rate of return on capital
$\hat{r}$	nominal world rate of return on capital
Π	corporate income tax base
I	investment
τ	statutory tax rate on corporate income
D	fiscal book value of physical capital
δ_τ	depreciation rate of capital for tax purposes

δ_{κ}	real economic depreciation rate of capital
R	discount factor of the investor
λ, μ	Lagrangian multipliers, shadow values of fiscal depreciation allowances and physical capital
β	deductible fraction of corporate interest payment
Div	dividends of firms (distributed profit)
c	cost of capital
A	present value of the tax savings from depreciation allowances for one unit of capital
$\tilde{r}$	marginal cost of finance
t	time index

Section 3.3: Modeling Behavior in the ZEW TaxCoMM Framework

Exogenous variables and parameters

τ^{STR}	combined statutory tax rate on corporate income (corporate income tax incl. solidarity surcharge and local trade tax)
τ^{DIFF}	Difference between the overall corporate tax burden (at company and top-rate shareholder level) and the overall tax rate of a pass-through entity
τ^{SC}	solidarity surcharge
τ^{TT}	local trade tax rate
τ^{SH}	tax rate on dividends at the shareholder level
τ^{PIT}	personal income tax rate (top bracket)
e^{D}	marginal tax effect on the debt ratio (long-term)
e^{INV}	semi-elasticity of capital stock with respect to the EMTR (long-term)
$\varepsilon_{INV,UCC}$	elasticity of capital with respect to the user cost
e^{PS}	semi-elasticity of EBIT
e^{LOC}	semi-elasticity of location choice
e^{OF}	semi-elasticity of the corporate share of business
λ	speed of adjustment of the debt ratio
σ	speed of adjustment of the capital stock
r	real capital market interest rate
$\hat{r}$	nominal capital market interest rate

Firm-specific simulated tax rates and cost of finance

τ^{D}	proxy for the marginal tax rate on corporate income; marginal tax incentive to finance with debt
β	deductible fraction of corporate interest payment
τ^{EMTR}	effective marginal tax rate (EMTR)
c	cost of capital
$\tilde{r}$	real marginal cost of finance
$\hat{\tilde{r}}_{h,t}^{B}$	nominal marginal cost of finance

Tax responsive firm variables

d	debt-to-assets ratio
d^{*}	long-term target debt-to-assets ratio
K	capital stock (tangible fixed assets)
K^{*}	long term target capital stock
I	investment of firms
D	corporate debt
IE	interest expense
P	gross taxable profit (before loss-offset)
CTR	corporate income tax due
TTR	trade tax due

h	firm index
t	time index
B	benchmark
1R	first round
2R	second round

Chapter 4: The Econometric Framework for Classical Meta-Analysis and Meta-Regression

γ_0	true empirical effect
$\hat{\gamma}$	primary estimate of the empirical effect
$\bar{\gamma}$	meta-estimate of the true empirical effect
ε	random error term, reflecting primary sampling error
μ	random error term, reflecting heterogeneity beyond sampling error
v	nested random error term

w	analytic weights for weighted least squares estimation
$\mathbf{x}$	vector of study-specific variables/characteristics
$\mathbf{z}$	vector of model-specific variables/characteristics
$\boldsymbol{\beta}$	vector of meta-coefficients for study-specific variables/characteristics
$\boldsymbol{\delta}$	vector of meta-coefficients for model-specific variables/characteristics
λ	inverse Mills ratio
ρ	coefficient of correlation
α	coefficient for publication bias, function of ρ and λ
σ_x	standard deviation of random variable x
$\hat{\sigma}_x$	estimate of the standard deviation (standard error) of random variable x
i	study index
s	estimate index
Q	Q-test statistic
BP	Breusch Pagan-test statistic

Part I

Introduction

Chapter 1

Introduction

The majority of instruments employed to evaluate business tax policies leave open the issue of micro-level heterogeneity. At the same time, heterogeneous effects of tax policies on individual firms and their aggregate revenue implications turn out to be important. The viability of reform proposals is highly dependent on expected revenue consequences because governments face budget constraints. Revenue effects must also be considered if different reform proposals are to be compared. Moreover, the predicted effects on certain types of firms and industries also play a role.

It thus makes much sense to extend the range of analytical instruments available for corporate tax policy analysis with a simulation model designed to account for the full distribution of firms and the associated micro-level heterogeneity. Based on such broad assessment, tax policy effects for aggregate tax revenue and firm-specific tax burdens can be derived.

This concept is generally referred to as microsimulation. It has already been tried numerous times and is well-proven for tax-benefit analyses relating to the household sector. However, it is rather new to corporate tax policy analysis. One of the first corporate tax microsimulation models publicly documented and made available for applied tax policy analysis was developed by Reister (2009) and Reister et al. (2008) at the Centre for European Economic Research (ZEW Mannheim).

In this dissertation, the microsimulation model developed at ZEW Mannheim, the ZEW TaxCoMM, will be enhanced by incorporating the behavioral responses of firms to corporate taxes. A wealth of theory and empirical evidence shows that taxable corporate income is elastic with respect to tax rates. Any appraisal of tax reform effects ignoring the implications of firm behavior is therefore incomplete. Only with behavioral responses included will the model be able to evaluate tax reform effects beyond mere first round implications. The contribution of this dissertation is thus to significantly extend the scope of analysis of the microsimulation. It adds to create a simulation approach which can provide valuable insight and a better understanding of the consequences of business tax reforms.

In this dissertation, the behavioral algorithms of ZEW TaxCoMM are developed and finally applied. Model parameterization is thus a key issue. A broad literature investigates the effects of taxes on business behavior. As a consequence, empirical evidence on the size of the tax distortions abounds. There is often more than one plausible elasticity estimate in the large number of disparate studies, depending on countries, time, and methodological approach. The selective use of model parameters can thus be a weakness of empirical models (Steiner, 2008). For this reason, comprehensive meta-analyses are conducted for the purpose of model parameterization.

The meta-analyses presented in this dissertation synthesize the evidence obtained from 2,167 primary estimates of the various tax effects on business behavior. They, respectively, refer to the tax impact on foreign direct investment, capital structure choice, and profit shifting behavior. Conceptually, meta-analysis is a form of quantitative literature survey. It relies on econometric methods to systematically identify the quantitative impact of explicit or implicit choices of study design on the obtained empirical evidence. Consequently, each meta-study presented in this dissertation stands on its own and contributes to the surveyed strand of literature. It offers "specific reasons, based on the studies themselves, why the evidence on a certain question may appear contradictory or overly varied" (Stanley, 2001: 132). With the insights gained from the meta-analyses, the plausible response intensities for the modeled behavioral margins are predicted and employed to parameterize the behavioral algorithms of the microsimulation model.

Finally, the functioning of the enhanced model is tested and illustrated by applying it to one of the most prevalent topics in corporate tax policy analysis: tax harmonization in the European Union. In March 2011, the European Commission renewed its ambitions to harmonize company taxation within the European Union by publishing a draft Council Directive for a Common Consolidated Corporate Tax Base (CCCTB). Among other things, this draft directive governs a harmonized definition of the corporate income tax base. We will evaluate the impact of the European Commission's proposal on German firms and aggregate German tax revenue. The role of behavioral adjustments to this hypothetical reform will be particularly highlighted.

The dissertation is structured according to the key issues raised above. **Part II** of the dissertation is focused on the incorporation of firm behavior into the model. Chapter 2 will briefly explain the overall concept of ZEW TaxCoMM. The model compares a benchmark scenario with one or more counter-factual reform scenarios. Scenarios are defined with respect to the tax law in effect. Under the benchmark scenario, the simulation computes firm-specific tax burdens according to the tax law of a pre-defined status quo. The reform scenario considers a modified tax law. Modifications might refer to statutory tax rates or the tax base definition of the major taxes levied on corporations in Germany: the corporate income tax including solidarity surcharge, and the local trade tax.

Chapter 3 develops the behavioral algorithms for ZEW TaxCoMM. We take into account behavioral responses to tax reform at five margins of decision which are known to be the central components of the aggregate tax base elasticity. The model simulates behavioral responses of corporate debt policy, marginal investment decisions, and profit shifting activity. The long-term effects of the tax impact on the discrete choices of location and legal form are implemented at the aggregate level. The behavioral algorithms are designed in a way that corresponds to standard microeconomic conceptions of optimal firm behavior.

In **Part III** of this dissertation, the focus will be on the quantitative meta-analyis of primary empirical evicence on the size of the essential tax distortions.

Chapter 4 explains the econometric framework of classical meta-analysis and meta-regression. Classical meta-analysis computes precision-weighted means of the reported tax effects, uniformly scaled according to a common effect size index, and tests for the significance of the genuine effect. In a meta-regression analysis, the reported effect size index, often a regression parameter, is regressed on a set of (mostly) dummy variable predictors which represent differences in method, design and data used by the primary estimation.

Chapter 5 presents a meta-analysis on the relationship between foreign direct investment and company taxation. The scientific interest in international tax competition has considerably increased since harmonization efforts in Europe have intensified, but also due to rising capital mobility in the last thirty years. The empirical literature has consequently grown heavily in recent years leading to an abundance of empirical studies that consider the impact of taxation on patterns of capital mobility. We update and methodologically extend former meta-analyses on FDI and taxation. The precision weighted average tax semi-elasticity of FDI based on 704 primary estimates is 2.55 in absolute terms.

Chapter 6 puts forward a meta-study investigating the tax effect on corporate capital structure. The study fills a gap in the literature because it quantitatively examines the factors which determine the high variation and disagreements in the empirical evidence on this issue. For this purpose, we extract 1,143 point estimates of the marginal tax effect on the debt ratio out of 46 studies. Synthesizing the evidence by means of meta-regression analyses, we conclude that the tax impact on debt is indeed substantial. Our results suggest that, in particular, the tax rate proxy used for identification determines the outcome of primary analyses. Accounting for all potential misspecification biases, we predict a positive marginal tax effect on the debt ratio of 0.3.

Chapter 7 quantitatively reviews the distinct strands of empirical research dealing with different strategies of multinationals to shift affiliate profits to low-tax jurisdictions. Surprisingly, no attempt has yet been made to systematically compare the distinct shifting channels with regard to their economic significance. The meta-analysis covers 40 studies on corporate profit shifting behavior. Based on the meta-regressions, the semi-elasticity of profit with regard to shifting incentives amounts to -1.71. The predicted semi-elasticity of EBIT is -1.28. Furthermore, we find some tentative evidence that the volume of shifted tax bases is, to a large extent, i.e. approx. 80%, driven by firms' inter-company transactions.

Part IV of this dissertation brings together the behavioral algorithms developed in Part I and the information on the values of the behavioral response intensities obtained from the meta-analyses in Part II of the dissertation. The functioning of the model is tested and illustrated by applying it to one of the most prevalent topics in corporate tax policy analysis: tax harmonization in the European Union.

Chapter 8 explains how the behavioral algorithms of ZEW TaxCoMM are parameterized. While household microsimulation models exploit sample data for the purpose of model parameterization, the parameterization of ZEW TaxCoMM will be based on prior information on the response elasticities. The simulation sample covers three years and is a purely national dataset. The variation in tax rates would thus be insufficient to produce reliable estimates of the behavioral response elasticities. In view of the abundant empirical literature and the sophisticated meta-analyses in Part II, we conclude that the possible advantage of exploiting direct sample information is outweighed by the high quality of prior knowledge.

Finally, Chapter 9 provides evidence on the impact of the harmonized corporate tax base definition, as proposed by the European Commission (2011), on German firms and aggregate German tax revenue. Our simulation shows that, in the economic environment of the period from 2005 to 2007, a switch from current German tax law to the proposed harmonized tax base definition, in the short term and without considering the behavioral response of firms, would reduce aggregate tax revenue of the corporate income tax incl. solidarity surcharge, and the trade tax by 8.6%. This effect is mainly due to a massive frontload of tax depreciation allowances. Plausibly assuming that the German government follows a balanced budget rule and adjusts the corporate income tax rate, we investigate the behavioral responses of firms to this supposedly revenue-neutral reform. The simulation results show that the behavioral responses of firms would prevent the reform from being effectively revenue-neutral. By contrast, considering the short term responses of corporate debt policies, marginal investment and profit shifting activity, aggregate tax revenue is simulated to decline by 1.2% relative to the benchmark levels under the current German tax regime. Taking a deeper look into the future, the tax revenue would decrease by 1.9%. If we, in addition, simulate the responses in the location decisions of multinational firms and also account for the reform's impact on the decision to incorporate, the behavior induced loss of tax revenue collected from the corporate share of business could rise to -7%. The simulated behavioral adjustments of firms imply a behavioral tax base elasticity of -0.1 in the very short term and, depending on the considered response margins, of -0.2 to -0.6 in the long-term. This is fully in line with the existing empirical evidence on the aggregate tax base elasticity.

Chapter 10 in **Part V** presents a summary and a brief outlook on possible future research directions.

Note that Chapter 5 draws upon Feld and Heckemeyer (2011). Chapter 6 is based on Feld, Heckemeyer and Overesch (2011). The enhancement of the microsimulation model and, in particular, the simulation analysis in Chapter 9 is based on joint efforts with Katharina Finke.

Part II

A New Corporate Tax

Microsimulation Approach

Chapter 2

The ZEW TaxCoMM

2.1 Introduction

Economists have long since analyzed the distortions which taxation creates in business decisions. Empirical analyses, inter alia, rely on the neoclassical investment theory (Jorgenson, 1963; Hall and Jorgenson, 1967; Devereux and Griffith, 1999, 2003), use sophisticated model firm approaches (Spengel, 1995) or they disclose the tax influence on cost-benefit trade-offs underlying corporate financing choices (Modigliani and Miller, 1963; Graham, 1996a, 1999). Experience from recent business tax reforms, however, shows that ex-ante reform appraisals based on such approaches were, in a sense, incomplete. In particular, they lacked a well-founded assessment of the consequences for aggregate tax revenue and, at the micro-level, the characteristics of reform winners and losers.[1]

For this reason, we develop a new approach and employ micro-level accounting data in order to calculate firm-specific taxes due under different tax policy scenarios. Using a micro-based simulation approach, we are able to quantify tax reform consequences for a business population of firms which, according to their economic, financial and tax status, may be affected by tax policy in very different ways. The geographical focus of the microsimulation model, which we call ZEW TaxCoMM, is currently restricted to Germany. In principle, however, the approach could be generalized to cover a variety of countries. In this chapter, we will introduce the overall concept of the microsimulation model (Section 2.2), the main logic of its tax assessment algorithms (Section 2.3) and put it into perspective with related approaches (Section 2.4).

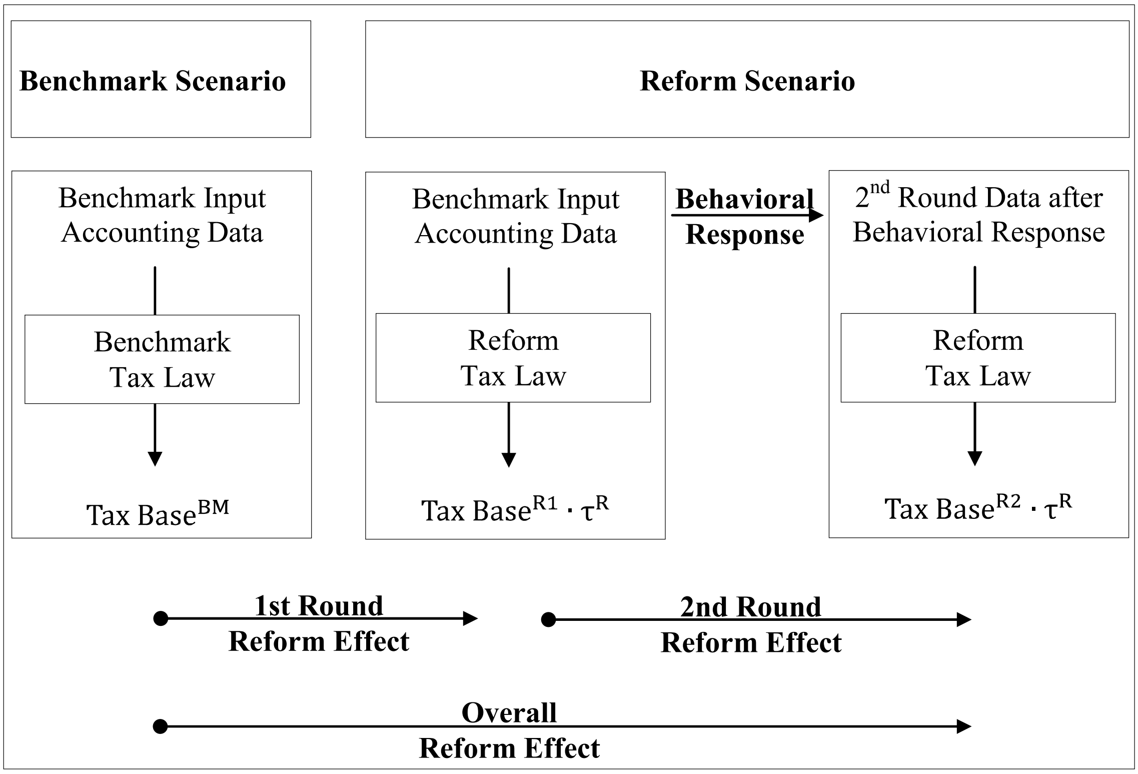
---

1 For example, in the run-up to the 2008 business tax reform in Germany, revenue effects were only roughly evaluated but prominently discussed. See, for example, Bundestag Printed Paper 16/4841.

2.2 The Overall Concept of the Model

Figure 2.1 illustrates the overall concept of ZEW TaxCoMM. The model compares a benchmark scenario with one or more counter-factual reform scenarios. Scenarios are defined with respect to the tax law in effect. Under the benchmark scenario, the simulation computes firm-specific tax burdens according to the tax law of a pre-defined status quo. The reform scenario considers a modified tax law. Modifications might refer to statutory tax rates or the tax base definition of the major taxes levied on corporations in Germany: the corporate income tax including solidarity surcharge, and the local trade tax. The comparative analysis between the benchmark and the tax reform scenario proceeds in two steps.

Figure 2.1: Overall Concept of the ZEW TaxCoMM Micro-Simulation Model



In the first step, ZEW TaxCoMM accounts for the effects arising immediately from the modification of the tax legislation, holding the accounting input data and, thus, the reflected economic activity of firms constant. We denote these effects as “first round” effects. In a second step, the economic activity of firms is simulated to respond to the reform, and the input data is accordingly adjusted. The simulated effects on the tax base and revenue are now denoted by the term “second round” effects. According to this understanding, first and second round effects do not necessarily differ with respect to the time dimension considered, but with respect to whether firm behavior is taken into account.

In both steps of the analysis, the tax due is assessed for each firm. The firm-specific simulation results can be aggregated up to an industry or the overall national level.

2.3 The Simulation of the First Round Effects of Tax Reforms

The author of this dissertation has contributed to the conception and programming of the tax assessment procedures required for the first round analysis (Reister, 2009; Reister et al, 2008; Finke et al., 2010). However, the conceptual work on this first stage of analysis is not an integral part of this dissertation. For clarity, the intuition of the simulation will be briefly explained.

ZEW TaxCoMM uses firm-specific financial accounting data taken from the DAFNE database, which is provided by Bureau van Dijk. DAFNE contains detailed financial information on 900.000 German corporations for the years from 1999 to 2010. The model requires a balanced firm data panel over three years. The financial data is complemented by data from additional sources provided by the Federal Statistical Office on municipal business tax rates and survey data on German tax accounting practice (Reister, 2009). The survey was conducted among executive certified tax consultants and certified public accountants, and investigated the tax accounting practice in the fields of applied depreciation methods, loss-offsetting patterns and the valuation of goodwill, accrued/deferred items or provisions. Insights gained from this survey have, in addition to a careful consideration of all relevant tax and commercial law provisions, contributed to approximate and finally overcome the gap between financial and tax accounting.

ZEW TaxCoMM starts, for each firm in each simulation year, from the reported profit on ordinary activities. Adjustments of ordinary profit take into account differences between financial and tax accounting schemes. For that purpose, the model refers directly to profit and loss accounts or simulates required information on the basis of balance sheet data. Generally, the simulation procedure follows a modular structure. Each module is attributed to one distinct item which needs to be modified for tax purposes. This structure easily adapts to different tax policy scenarios. A general description of the tax assessment algorithms is provided in a separate technical documentation (Reister, 2009; Reister et al., 2008).

The model's tax assessment procedures bring in line reported balance sheet data with periodical flows. These flows enter the firm's profit and loss account and are assessed for tax purposes. The assessment exploits and never contradicts all available information from financial statements. It consistently traces firm-level developments over the simulation period of three assessment years. The main idea is to think of balance sheet carrying amounts as displaying a certain generational structure, in terms of layers which have been acquired at different points in time. The tax base consequence of, for example, a change in depreciation rates on periodical depreciation amounts, can only be assessed assuming a certain generational structure of the depreciated assets. The true generations of assets are, however, unobserved. It therefore seems plausible that, e.g., fixed movable assets are assumed to have been acquired continuously. The inferred generational structure of assets allows adjusting the depreciation of newly acquired assets in each of the three simulation periods to any type of tax law scenario. The same idea applies to the inference of current appropriations to provisions. These can also be brought in line with observed provision carrying amounts in the balance sheet. Again, appropriations are generally assumed to occur continuously. If there are differences in recognition[2] or measurement[3] between financial and tax accounting, the inferred flows are adjusted for the assessment of the tax base.

After it all, we simulate taxable profit for each firm in each of the three assessment years. We thereby account for all relevant tax regulations governing, for example, the treatment of interest expenses (add-backs for trade tax purposes, deduction limits under the German earnings stripping rule), integrated fiscal units, and tax exempt income (foreign permanent establishments, dividend income). The tax base is obtained by deducting available tax-loss carry-forwards according to the loss-offset regulation of the analyzed tax policy scenario. By applying the prevailing tax rates, the final tax due can be computed for each individual firm.

ZEW TaxCoMM's capacity to approximate the true tax base of firms was thoroughly validated based on accounting data, tax statistics, and tax law as of 2004. The validation was based on a two-step comparison of the model's tax assessment results with information from official German tax statistics.[4] First, firms were classified according to

2 Provisions for maintenance deferred by more than three months are only recognized for financial but not for tax accounting purposes.

3 For example, specific provisions for warranty obligations are discounting at a rate of 5.5% according to German tax law. They remain undiscounted for financial accounting purposes.

4 See Reister et al., 2008.

type of industry and turnover size. The simulation sample was extrapolated by multiplying each firm within the distinct industry-turnover classes with a factor obtained from comparing, for each class, the number of firms in the sample with the turnover statistics for corporate firms (Statistisches Bundesamt, 2006). While the simulation sample is statistically not representative, this method can smooth out structural biases of our sample, in particular any potential overrepresentation of large firms.[5]

Subsequently, we counted the number of firms in clusters defined by industry and gross taxable corporate income in the extrapolated sample. If the tax assessment algorithms work without any severe bias, the number of firms must, respectively for each cluster defined by industry and taxable income, match with the number of firms displayed in the corporate income tax statistics. This was indeed the case.[6] We conclude that the tax assessment generally works without systematic error. This should also hold true for future applications of the model because its conception and functioning remain unaffected by changes in tax law parameters.

2.4 The ZEW TaxCoMM in Perspective

The appeal of microsimulation modeling is already acknowledged by Orcutt et al. (1976). As microsimulation models process data on a vast number of economic units, they can provide a broad basis for the ex-ante assessment of the effects from policy reforms. While numerous microsimulation models focus on private households (for surveys with a focus on Germany, see Wagenhals, 2004 or Peichl, 2005), the number of models referring to firm data is still limited. Besides the ZEW TaxCoMM approach, two sophisticated micro-simulation models concerned with the evaluation of corporate tax policy are publicly documented.

The Italian DIECOFIS project developed a corporate micro-simulation model under the aegis of the Italian statistical office ISTAT (Castellucci et al., 2003; Oropallo and Parisi, 2005). The DIECOFIS model represents a one-periodic approach based on cross-sectional financial accounting data. The statistically representative dataset (29,196 corporations, reporting year 2000) underlying the DIECOFIS model has been assembled from numerous sources comprising published financial statements and survey data on Italian firms. In order to simulate the corporate tax burden of companies, the given fi-

5 Note that the same extrapolation procedure is applied to corporate balance sheet statistics by the German Central Bank (Deutsche Bundesbank, 1998).

6 For details, please refer again to Reister et al., 2008.

nancial accounting data are first transformed into tax data. Subsequently, the firm-specific corporate income is computed in detail and multiplied by the statutory corporate income tax rate.

Similar to the DIECOFIS model, the ZEW TaxCoMM uses financial accounting data as a primary input because access to highly detailed firm-level tax accounts is restricted for confidentiality reasons. An additional obstacle to the use of primary tax data is that the official disaggregate statistics are only published in three-year intervals. We therefore take advantage of the fact that tax accounts are linked to much more accessible financial statements through the so-called German authoritative principle.[7] More precisely, we use the operating profit as a nexus between the financial and the tax accounting sphere and adjust it, when necessary, for tax purposes.

Another sophisticated corporate tax microsimulation model besides DIECOFIS and ZEW TaxCoMM is put forward by the German Institute for Economic Research (DIW). The model is called BizTax. It differs from the ZEW TaxCoMM mainly in regard to the employed data. Meanwhile, a common feature is its exclusive focus on Germany: BizTax has been primarily designed to evaluate selected aspects of the German corporate tax reform of 2008 (Bach et al., 2007, 2008). It is based on a statistically representative firm-level dataset sampled from official individual local trade tax and income tax files for the year 2001. The input data is updated to the year 2008 (or further, if required) by means of yearly turnover tax statistics. Despite the far-reaching data update, BizTax is a one-periodic simulation model based on cross-sectional data. The available tax data restricts the simulation of reform-induced changes in the tax base to lump-sum adjustments of benchmark profits.

Notwithstanding some consistencies, ZEW TaxCoMM presents features which distinguish it from DIECOFIS and BizTax. ZEW TaxCoMM simulates a multi-periodic tax assessment, covering three consecutive years under each analyzed policy scenario. The multi-periodic framework enables the model to capture the effects from dynamic features of the tax code, such as depreciation patterns or loss-offset regulation. Furthermore, with the enhancements introduced in this dissertation, the model considers behavioral responses of firms to changes in tax legislation. The integration of behavioral responses extends the scope of analysis beyond mere first round reform effects. To the best of our knowledge, there exists only one behavioral corporate tax microsimulation

7 See Schoen (2005) for an introduction and a discussion of the linkage between the computation of corporate taxable income and the profit an loss statement in the financial accounts under German law.

model. The model, CorpSim, is put forward by Creedy and Gemmell (2009, 2010). The model is, however, of limited use for the detailed evaluation of tax policy reforms broadly altering the tax base definition (see Section 3.2.2). After all, we consider ZEW TaxCoMM the first sophisticated corporate tax micro-simulation model designed for second round tax policy evaluation.

Chapter 3

Extension of ZEW TaxCoMM: Behavioral Responses to Tax Reform

3.1 Decomposing the Aggregate Tax Base Elasticity

Theory and empirical evidence suggest that taxable corporate income is elastic with respect to tax rates, yet, a careful look at the literature reveals that there still is no clear consensus about the size of the aggregate tax elasticity of taxable corporate income. Clausing (2007), Brill and Hassett (2007) and Devereux (2007a) put forward empirical analyses based on aggregate OECD data. According to this literature, the top of the corporate income tax Laffer curve is reached if the corporate income tax rate ranges around 30%. At this point, the aggregate tax base elasticity takes on a value of -1. Hence, aggregate revenue from corporate income taxation would be irresponsive to a change in tax rates because any such change induces an inversely proportional change of the corporate income tax base. According to this evidence, high taxing countries like the United States or Germany should find themselves on top or on the decreasing segment of the Laffer curve, with elasticity values equal to or less than -1. This conclusion is, however, not corroborated by recent studies based on more disaggregate industry-level data. For the United States, Gruber and Rauh (2007) report an elasticity of taxable corporate income with respect to the effective marginal tax rate of -0.2. For Germany, Dwenger and Steiner (2008) document an elasticity of about -0.5. According to these results, both countries are clearly on the rising segment of the Laffer curve.

Despite the heterogeneous empirical evidence on the size of the aggregate tax base response, any appraisal of tax reform consequences ignoring the implications of firm behavior would be incomplete. By definition, a micro-based modeling approach should thus try to account for the tax base effects which run via the behavioral responses at various corporate tax margins. We will therefore decompose the aggregate tax base response into partial elasticities associated with the distinct behavioral tax margins of the firm. Then, we will simulate the responses "bottom-up" from the micro-level.

Formally, the aggregate semi-elasticity of taxable corporate income, e, is known to decompose into five parts (De Mooij and Ederveen, 2008):

$$e = w^N e^D + w^N e^{INV} + w^M e^{PS} + w^F e^{LOC} + e^{OF} \tag{3.1}$$

where e^D represents the marginal tax effect on the debt ratio of the firm while the other response intensities, measured as semi-elasticities, refer to, respectively, the response in the marginal investment distortion (e^{INV}), multinational profit shifting (e^{PS}), the infra-marginal effect on location choices (e^{LOC}) and the choice of organizational form (e^{OF}). The variables w^N , w^M and w^F represent, respectively, the share of normal return on equity in the total corporate tax base, the share of profits made by multinationals, and the share of assets owned by multinationals. As the ZEW TaxCoMM is based on a sample of firm-level data, these shares will be implicit in the simulation and do not have to be set exogenously.

3.2 Behavioral Responses to Tax Reform: Related Modeling Approaches

Given that we are breaking new ground in the implementation of behavioral responses into a corporate tax microsimulation model, we will seek inspiration in related modeling approaches. In different contexts and fields of research, economic agents' behavioral response to tax is captured in behavioral household microsimulation models (see Section 3.2.1), in a behavioral corporate microsimulation framework put forward by Creedy and Gemmell (2009, 2010) (see Section 3.2.2), and in computable general equilibrium frameworks with a focus on tax policy analysis (see Section 3.2.3). Some microeconomic principles of firm behavior which can, to some extent, guide the incorporation of behavioral responses in ZEW TaxCoMM will also be discussed (see Section 3.2.4). The considerations in this Section 3.2 will guide the basic modeling choices made in Section 3.3.

3.2.1 Behavioral Household Microsimulation Models

The aim of household tax-benefit microsimulation modeling is very similar to what motivates corporate tax microsimulation, i.e. the ex-ante evaluation of relevant policy reform proposals (Harding, 1996; Gupta and Kapur, 2000). These models use a detailed representation of a tax system and they are also based on micro data. The main difference is, evidently, that household microsimulation models are concerned with household and/or individuals instead of firms.

There are various realizations of tax-benefit household microsimulation models which are used for empirical analysis of the impacts of taxes, social security contributions, and transfers on the income and labor supply of private households.[8] Household microsimulation models may differ with respect to whether analyses are performed upon a population of agents at a given point in time (static models) or whether agents are subject to dynamic aging. Furthermore, independent of their static or dynamic nature, household microsimulation models vary in the way they integrate agents' behavioral responses to policy reforms. Microeconomic theory suggests that changes in tax-benefit regimes affect factor supply, factor demand, and the demand for goods. By far the most commonly modeled response margin in household microsimulation is the labor supply response (for a discussion, see Peichl, 2005). Microeconomic labor supply functions are estimated directly on the basis of the simulation data sample. In some cases, the regression equations are of reduced form; more structural models (e.g. the STSM model put forward by ZEW (Jacobebbinghaus and Steiner, 2003; Clauss and Schubert, 2009) or the FiFoSiM put forward by Fuest, Peichl and Schaefer (2005) refer to an explicitly modeled household utility function.[9]

The reform-induced responses of factor demand are much less frequently considered in household microsimulation models. According to Peichl (2005), the reason for the common neglect of the factor demand response is that information requirements are high and, at the same time, difficult to meet because access to relevant firm data is limited. Furthermore, simulated changes in labor demand depend heavily on the assumed structure and competitiveness of the labor market. Similarly, the response of the demand for goods is difficult to model because price elasticities are difficult to identify on the basis of the available micro data (Peichl, 2005).

Even in the rich field of household microsimulation, the representation of behavioral responses thus remains a challenge if the ambition is to model adjustments beyond the

8 See Wagenhals (2004) for an overview of models applied to the German economy.

9 A common assumption in structural models is that preferences are represented by a translog utility function as proposed by Van Soest (1995).

standard labor supply reaction. In particular, the simulation of the factor demand response originating from adjustments in firm behavior is still open for research.

3.2.2 The Microsimulation Model by Creedy and Gemmell (2009, 2010)

Creedy and Gemmell (2009, 2010) develop a simple corporate tax microsimulation model, CorpSim. In Creedy and Gemmell (2009) the model is employed to explain the high volatility of corporate tax revenue in the UK relative to the growth of profits. In Creedy and Gemmell (2010) the CorpSim framework is used to illustrate variations of the tax base elasticity over the business cycle.

The general approach of the CorpSim model presented by Creedy and Gemmell (2009, 2010) is to obtain an initial simulated distribution of gross taxable profits. For this purpose, a mixture of lognormal distributions is fitted to UK company profit data in 2003-04. After the initial period, firm profit develops according to systematic and stochastic elements: In addition to a trend growth rate, cyclical behavior is captured via a sine wave together with a stochastic component which allows for firm heterogeneity.

In contrast to the ZEW TaxcoMM, the model put forward by Creedy and Gemmell is not based on observed individual firm data in the form of firm-specific balance sheets or profit and loss accounts. Firm-level heterogeneity is instead introduced by defining initial taxable profit as a random variable. Furthermore, profit development over time is subject to random shocks.

Similar to the elasticity decomposition shown in equation (3.1), the behavioral response margins modeled in the CorpSim framework relate to the real economic activity of firms and, in addition, to profit shifting. However, the rationale underlying equation (3.1) is to view the tax base as the sum of ordinary returns on equity and economic rents. The amounts of ordinary and excess returns entering the tax base result from the economic decisions of firms. These are affected by tax at different margins. Thus, equation (3.1) establishes a direct link between the behavioral margins affected by tax and the overall tax base response. By contrast, Creedy and Gemmel (2009, 2010) take another view: The partial elasticities in the CorpSim model do not relate to the economic decisions of firms but to the two technical tax base components: gross profit and tax deductions. These variables are simulated to be tax responsive but it is less clear which economic choices are actually supposed to drive the responses. In particular, investment activity is not modeled to be directly tax responsive. By contrast, profits are considered the principal determinants of firms' economic activity. The rationale for investment being determined by profit is that capital markets are imperfect and all firms are creditconstrained. This is a strong assumption.[10]

The behavioral responses incorporated into the ZEW TaxCoMM will not assume imperfect capital markets. Furthermore, in line with the notion underlying equation (3.1), we will explicitly model the response of economic decisions to changes in the tax environment. These responses will have implications for taxable income which have to be simulated explicitly. This contrasts with the approach chosen in CorpSim which directly refers to the "behavioral" response of technical tax base components.

3.2.3 Firm Behavior within CGE Frameworks: CORTAX and IFOmod

Computable general equilibrium (CGE) models analyze the impact of exogenous shocks on the whole economy. As such, these models are not limited to the business sector but include the household sector, the public sector, and a foreign sector in order to capture general equilibrium interactions between these economic sectors which run, primarily, via induced price changes in labor and goods markets. A more recent CGE model with a particular focus on tax policy analysis within the European context is CORTAX, put forward by Bettendorf and van der Horst (2006) and extended in several applications (Bettendorf et al., 2010; De Mooij and Devereux, 2011). Furthermore, Keuschnigg et al. (2005) and Radulescu and Stimmelmayr (2010) present IFOmod, a dynamic calculable general equilibrium growth (DCGE) model, calibrated to the German economy.

A CGE model relies, in general, on a very structural microeconomic framework. Each economic sector is represented by at least one type of representative economic agent. Thus, in the simplest case the business sector is modeled by just one type of representative firm. More refined CGE models with a focus on business taxation, however, tend to distinguish between different but still stylized firm types. The CORTAX model integrates three firm types: a domestic firm, a multinational parent company and a multinational subsidiary (Bettendorf and van der Horst, 2006). IFOmod models a domestic corporate firm and one multinational corporate firm. Furthermore, it also considers a non-incorporated firm (Keuschnigg et al., 2005). Agents' decisions and responses to reform are derived directly from the underlying microeconomic optimization problem. With regard to the corporate sector, the marginal investor is supposed to maximize firm value, i.e. the present value of expected dividends, yet, all CGE approaches have to cope with model complexity which is steeply increasing in the level of modeling detail. Thus, complexity often turns out to be a limiting factor.

[10] See Section 3.3, p. 32, for a discussion.

In particular, the simultaneous modeling of all potentially relevant decision margins of the firm from microeconomic principles is very difficult. For this reason, the CORTAX model, which tries to cover the most relevant corporate behavioral margins presumably responsive to tax, resorts to a simple ad-hoc extension when it comes to the integration of multinational location decisions. The IFOmod is less comprehensive with regard to multinational response margins. In return, it is structurally more complete in other aspects. Notably, the disruption cost function related to capital stock adjustment is explicitly modeled in IFOmod while disruption costs associated with investment are ignored in CORTAX. We thus conclude that these models trade off the number of considered response margins against the refinement and structuredness of their representation in the model.

There are also important similarities between CORTAX and IFOmod. Both models are dynamic in that they refer to intertemporal optimizing behavior. Moreover, the institutional detail of the two CGE models remains rather limited as compared to a sophisticated corporate tax micro-simulation model. The corporate tax base basically comprises the returns on investment and depreciation allowances while other important tax base components are ignored. As a result, neither model provides a basis for the analysis of disaggregate reform impacts nor the evaluation of tax revenue implications from reforms that broadly modify the definition of the tax base.

3.2.4 Some Basic Microeconomic Principles of Firm Behavior

This section highlights some basic principles of value-maximizing firm behavior. In particular, we use a simplified version of the corporate sector model implemented in the general equilibrium model CORTAX and described in Bettendorf and van der Horst (2006) to derive the first order conditions for two essential corporate decision margins affected by tax: capital structure choice and capital demand. While the presented microeconomic framework is simple and, for now, leaves aside any short-term dynamics, it will serve as guidance for the implementation of marginal investment and financing decisions into the ZEW TaxCoMM framework.

The firm model starts with the assumption that the corporate firm produces with a Constant-Elasticity-of-Substitution (CES) production function of employment L and capital K.[11]

$$Y = \left[\alpha_L L^{\rho} + \alpha_K K^{\rho}\right]^{\frac{1}{\rho}} \tag{3.2}$$

where $\rho = \frac{\sigma - 1}{\sigma}$ and σ is the elasticity of substitution between labor and capital. α_L and α_K are share parameters. The value of the representative firm is equal to the discounted stream of future dividends which follow from the cash flow restriction

$$Div_t = Y_t - w_t L_t - \left(d_t r + z_t\right) K_t - \tau \Pi_t - I_t + d_{t+1} K_{t+1} - d_t K_t \tag{3.3}$$

where w denotes the wage rate, d is the debt-to-capital ratio, r is the real market interest rate, z denotes debt-related cost associated, in particular, with financial distress (Kraus and Litzenberger, 1973) or agency conflicts between equity and debt claimants (Jensen and Meckling, 1976; Myers, 1977). Π is the corporate income tax base. t is the subscript index for year. The corporate income tax base Π is defined as

$$\Pi_t = Y_t - w_t L_t - \left(\beta d_t \hat{r} + z_t\right) K_t - \delta_\tau D_t \tag{3.4}$$

where β is the deductible fraction of interest payments, $\hat{r} = (1+r)(1+\pi) - 1$ is the nominal market interest rate with r as the real market interest rate and π as the rate of inflation. δ_τ is the depreciation rate of capital for tax purposes and D represents the fiscal book value of physical capital. The equations of motion for fiscal and physical capital are, respectively,

$$D_{t+1} = I_t + \left(1 - \delta_\tau\right) D_t \tag{3.5}$$

$$K_{t+1} = I_t + \left(1 - \delta_\kappa\right) K_t \tag{3.6}$$

where I stands for gross investment, δ_τ is again the depreciation rate for tax purposes and δ_k denotes the real economic depreciation rate. The Lagrangian function reflecting the representative firm's value maximization problem is thus written as

[11] For the sake of clarity and brevity, we set the share of value added in production to 100% and ignore complicating factors such as location-specific capital and personal taxes. These factors do not affect the fundamental nature of the first order conditions of optimal firm behavior which we aim to investigate.

$$L = \sum_{s=t}^{\infty} \left\{ \mathrm{Div}_s - \lambda_{s+1} \left(D_{s+1} - I_s - (1-\delta_\tau) \mathrm{D}_s \right) - \mu_{s+1} \left(K_{s+1} - I_s - (1-\delta_k) \mathrm{K}_s \right) \right\} R_s \qquad (3.7)$$

, where R_s is the discount factor of the investor defined as $R_s = \frac{1}{(1+r)^{s-t+1}}$. Differentiating (3.7) with respect to the debt-to-capital ratio d yields the first-order condition for debt policy

$$\frac{\partial z}{\partial d} = \frac{\tau\beta\hat{r}}{1-\tau} \qquad (3.8)$$

The optimality condition requires the marginal after-tax cost of an incremental change in the debt ratio to equal the tax saving from an additional unit of debt interest expense.

To derive the first-order condition for capital, equation (3.7) is differentiated with respect to K. Using $R_t = (1-r) R_{t-1}$ and the first order condition of investment $\mu = 1 - A$ with $A = \tau\delta_\tau / (\hat{r} + \delta_\tau)$ as the present value of the stream of depreciation allowances in terms of tax savings for one unit of capital[12], the resulting optimality condition

$$\left[\left(\frac{\partial Y_t}{\partial K_t} - z_t \right)(1-\tau) - d_t\hat{r}(1-\tau\beta) - d_t + \mu_{t+1}(1-\delta_k) \right] R_t + (d_t - \mu_t) R_{t-1} = 0 \qquad (3.9)$$

simplifies to

$$\frac{\partial Y}{\partial K} = c \qquad (3.10)$$

where the user cost of capital c and the marginal cost of finance $\tilde{r}$ are defined as:

$$c = \frac{\tilde{r} + \delta_k - A(r + \delta_k)}{1-\tau} = \frac{1-A}{1-\tau}\left(r + \delta_k + z(1-\tau)\right) - \frac{d\tau\beta\hat{r}}{1-\tau} \qquad (3.11)$$

$$\tilde{r} = d\left(r - \tau\beta\hat{r}\right) + (1-d) r + (1-\tau) z \qquad (3.12)$$

Obviously, in the Bettendorf and van der Horst (2006) framework, the marginal cost of finance $\tilde{r}$ (see equation (3.12)) reflects the overall capital structure of the firm. The marginal debt-equity mix is unobservable, so that the convention is to use average debt shares, i.e. the debt-to-assets ratio d, as a proxy for the debt share in marginal financing.

---

[12] This formula is for declining balance depreciation. More generally, the present value of the stream of depreciation allowances in terms of tax savings for one unit of capital is defined as $A = \tau \sum_{t=1}^{T} \frac{\phi_t}{(1+\hat{r})^t}$ with ϕ_t as the rate of depreciation in percent of the acquisition cost and T as the depreciation period.

Remember that the debt ratio itself is again influenced by tax considerations (see equation (3.8)).

The desired target level of capital input in the long term is easily derived from inserting the derivative of (3.2) with respect to K into the optimality condition (3.10):

$$K = \alpha_K^{\sigma} \cdot Y \cdot c^{-\sigma} \tag{3.13}$$

Taking the logarithm of (3.13) gives the standard static log-linear capital demand function:

$$\ln K = \sigma \ln \alpha_K + \ln Y - \sigma \ln c \tag{3.14}$$

Evidently, the elasticity of substitution σ is also the user cost elasticity of capital demand. Equation (3.14), augmented with short-term dynamics, will be one of the central concepts exploited within the ZEW TaxCoMM's behavioral framework which will be discussed in full detail in the following Section 3.3.

Complicating this framework and introducing a multinational parent with (at least) one foreign subsidiary, one can formally show that profit shifting is another tax margin in the multinational parent's profit maximization problem. Tax aggressive transfer pricing is attractive a long as the organizational cost associated with charging a different price less than the real cost are less than the associated tax benefit. As we do not have the data to simulate transfer price adjustments in detail, we abstain from formally elaborating on this margin. We instead refer the reader to Bettendorf and van der Horst (2006: 13-15) for the details. In Section 3.3, in particular Section 3.3.2.1.3, we describe how the simulation accounts for multinational firms' profit shifting activity.

To the best of our knowledge, due to excessive complexity, no formal microeconomic model of the firm has ever jointly incorporated all five tax margins which are known to drive the tax base elasticity. In particular, discrete response margins are, if at all, introduced in the form of ad-hoc extensions (Bettendorf and van der Horst, 2006; Bettendorf et al., 2010). For similar reasons, we will not simulate the discrete responses of location choice and choice of legal form at the firm level, but account for them at the aggregate level.

3.3 Modeling Behavior in the ZEW TaxCoMM Framework

3.3.1 Basic Modeling Choices

Standard household microsimulation models tend to put a focus on just one behavioral tax margin: individual labor supply. The number of relevant behavioral margins composing the tax base elasticity in a firm model is considerably higher. This is clear from the elasticity decomposition in equation (3.1) and the previous attempts to model corporate behavioral responses to tax reform, as made in Creedy and Gemmell (2009, 2010) or sophisticated CGE approaches like CORTAX or IFOmod. The set of behavioral margins includes both real economic and shifting responses to tax, thus affecting firm decisions on investment, financing, the location of production, the firm's legal form and paper profit shifting (De Mooij and Ederveen, 2008). The economic significance of each of these partial responses has been confirmed by a broad empirical literature. At the same time, these tax margins have never been considered simultaneously in a single model framework without resorting to some plausible, yet ad-hoc elements. Furthermore, the focus of the most stringent approaches presented so far was clearly on the long-run response to tax reform.

With regard to the integration of behavioral responses into the ZEW TaxCoMM framework, the challenge is thus to consistently reflect the complete set of the most important behavioral tax margins. Moreover, given that the ZEW TaxCoMM traces reform consequences – both first round and second round – over three simulation periods after the simulated reform shock, it must also be able to consider the short-term dynamics of the adjustments in firm behavior. Eventually, firm-level heterogeneity present in the simulation sample data must be consistently embedded.

Despite these complexities, the model will be designed in such way that consistency with established microeconomic principles of firm behavior is guaranteed. In particular, the representation of financing and marginal investment decisions will be in line with what we can infer from the standard microeconomic optimization problem of the firm (see the previous Section 3.2.4). This is, to a certain extent, consistent with the approach chosen in standard household microsimulation models, which also take the underlying microeconomic optimization problem as a point of departure. Nevertheless, these household models are able to arrive at an estimable labor supply equation and can thus exploit the simulation sample data for the purpose of model parameterization. By contrast, the parameterization of the behavioral algorithms in the ZEW TaxCoMM framework will be based on prior information on the response elasticities obtained from the empirical literature. Given that the ZEW TaxCoMM simulation sample covers no more than three years and, in addition, is a purely national dataset, the variation in tax rates would clearly be insufficient to produce reliable estimates of the behavioral tax-rate elasticities. In view of an abundant empirical literature on the considered behavioral tax margins, we conclude that the possible advantage of exploiting direct sample information is outweighed by the high quality of prior knowledge. In the course of the parameterization, we can, in addition, set response intensities in a way that reflects empirically found interdependencies between the different margins. This holds in particular for the profit shifting and investment margins modeled at firm-level. The detailed paramterization of the behavioral algorithms explained in this Section 3.3 will be discussed in detail in Chapter 8.

Another difference with both standard cross-sectional household microsimulation models and CGE approaches is that ZEW TaxCoMM does not just take a deep look into the future, but instead has the ambition to trace reform consequences consistently over time within a three-year horizon. In the presence of disruption costs, a mere focus on long-term responses and optimality conditions would miss out on the short-term dynamics of the adjustment process. Still, modeling the adjustment process within a formal framework is hardly feasible. Too little is known, both theoretically and empirically, about the exact shape of the disruption cost functions and resulting patterns of, e.g., capital stock adjustment (see the survey by Bond and van Reenen, 2007). We therefore adopt a simple partial adjustment model of the level of the capital stock which has been quite successful in empirical work (Bond and van Reenen, 2007; Buettner and Wamser, 2009a; Overesch and Wamser, 2009). Capital demand equations which take some form of a simple partial adjustment model are derived both from reduced form approaches and from more structural representations of the investment process (Bond and van Reenen, 2007). The plain partial adjustment model is also the standard model in dynamic empirical investigations of corporate capital structure choices (see, e.g., Flannery and Rangan, 2006; Lemmon et al., 2008; Huang and Ritter, 2009). We will thus use it to simulate the short-term dynamics of corporate debt ratios, too.

3.3.2 Behavioral Algorithms Implemented in ZEW TaxCoMM

In the following, we describe in detail how corporate behavioral responses to tax reform are integrated into the ZEW TaxCoMM model. Continuous responses are modeled directly at the firm-level (see Section 3.3.2.1). Section 3.3.2.1.1 deals with tax reform effects on corporate debt policy. Section 3.3.2.1.2 explains how the model captures the tax effect on firms' marginal investment decisions. Section 3.3.2.1.3 focuses on the profit shifting response of multinational firms. Consequences from behavioral adjustments in discrete choices of location and legal form are captured at the aggregate level (see Section 3.3.2.2). The parameterization of the algorithms will be discussed in Chapter 8.

3.3.2.1 Behavioral Responses Modeled at the Micro Level

3.3.2.1.1 Corporate Debt Policy Response

According to most tax systems, interest expenses are deductible from corporate taxable income while equity payouts are generally not. The resulting corporate tax advantage of debt financing rises with the marginal tax rate (MTR) applicable on the next unit of taxable income.[13] The marginal tax rate, i.e. the tax incentive to finance with debt, must be computed individually for each firm because it depends on the firm's tax status. A very refined method to capture the firm-specific tax advantage of debt is put forward by Graham (1996a, 1999), who employs a sophisticated simulation procedure (see Chapter 6 for details).[14] Still, the so-called dichotomous tax rate is an easily available and efficient proxy for the tax incentive to finance with debt (Graham, 1996b). The dichotomous tax rate for a profitable firm with positive taxable income takes on the value of the statutory tax rate; otherwise it is 0. We use a refined version of the simple dichotomous tax rate which is supposed to capture the tax advantage even more precisely. It takes into account the fact that even for profitable firms, interest expenses might not always be fully deductible so that the tax savings from one additional unit of interest are effectively reduced. For each company h in the simulation sample, we define the tax rate on interest expenses as $\tau^{D}_{h,t} = \beta_{h,t}\tau^{STR}_{h,t}$, where $\tau^{STR}_{h,t}$ is the statutory tax rate and $\beta_{h,t} \in [0,1]$ represents the share of incremental interest expense which is effectively tax deductible. $\beta_{h,t}$ shrinks to 0 if firm h is loss-making[15] or if the deduction of interest is effectively restricted by a binding interest deduction ceiling. By contrast, $\beta_{h,t}$ shows a value of 1 if

[13] In principle, the *net* tax advantage of debt, i.e. after accounting for personal taxes levied on interest income, should determine corporate financial policy. However, the tax position of the (marginal) investor is generally unknown. Empirically, the gross corporate tax advantage turns out to significantly drive the corporate debt ratio (Graham, 1999; see also Chapter 6).

[14] Recently, Blouin et al. (2010) have suggested a non-parametric procedure to estimate marginal tax rates; Graham and Kim (2009) extend the original Graham approach by using an autoregressive process (instead of assuming a simple random walk) to simulate firm-specific time series of EBIT.

[15] In the simulation, we define a firm to be loss-making if it reports losses in at least two of the three simulation periods. In this case, we assume that current losses or existing loss carry-forwards reduce the effective tax rate reduction from using debt to zero.

interest is fully deductible.[16] In Germany, $\beta_{h,t}$ generally has values below 1 due to interest add-backs for trade-tax purposes.

We now consider the adjustment process with which capital structures are simulated to respond to a change in the tax incentive to finance with debt. In line with recent contributions by Flannery and Rangan (2006), Lemmon et al. (2008) and Huang and Ritter (2009), we assume that these financial policy adjustments are costly. As a result, capital structures do not adjust immediately toward new target structures. Again in line with the above literature, we assume that a fraction λ of the gap between the actual debt ratio $d_{h,t-1}$ and target leverage $d^*_{h,t}$ is closed in each period, leading to the following partial adjustment model:

$$\Delta d_{h,t} = \lambda\left(d^*_{h,t} - d_{h,t-1}\right) \tag{3.15}$$

By rearranging, we obtain the difference equation

$$d_{h,t} = \left(1-\lambda\right) d_{h,t-1} + \lambda d^*_{h,t} \tag{3.16}$$

Iterating forward yields the solution of (3.16), i.e. a trajectory that satisfies the equation (3.16) at any point in time.

$$d_{h,t} = \lambda \sum_{i=0}^{t-1} \left(1-\lambda\right)^i d^*_{h,t-i} + \left(1-\lambda\right)^t d_{h,0} \tag{3.17}$$

For each firm *h,* the trajectory in (3.17) describes the actual debt level in terms of the debt ratio $d_{h,t}$ as a function of past and current target leverage $d^*_{h,t-i}$ and an initial value $d_{h,0}$. Note that the debt targets $d^*_{h,t-i}$, which drive the trajectory $\left\{d_{h,t}\right\}$, are themselves unobserved. Immediately observed are only the actual debt ratios $d_{h,t}$ realized under the benchmark tax regime.

However, it is now possible to describe $\left\{d_{h,t}\right\}$ for potential reform scenarios which are supposed to differ from the benchmark scenario underlying the trajectory in (3.17) only with regard to the tax regime. All other non-tax micro and macro determinants of firm's debt targets are held constant. The trajectory $\left\{d^R_{h,t}\right\}$, where the superscript "R" stands

16 $\beta_{t,h}$ might immediately change in the course of a reform either because interest deductibility is generally restricted or, in the German case, regulation on interest add-backs to the German trade tax base are changed. Meanwhile, it can also change due to second round behavioral responses of firms which run into or out of binding deduction limits while adjusting their capital structures. The ZEW TaxCoMM algorithms take into account these complexities in order to correctly reflect effective marginal incentives to finance with debt.

for "reform scenario", results if, starting from the initial period of analysis, a modified tax regime applies while, in every period *t*, all non-tax micro and macro conditions affecting debt targets will be exactly the same as in the benchmark scenario:

$$d_{h,t}^{R} = \lambda \sum_{i=0}^{t-1} (1-\lambda)^{i} (\underbrace{\mathrm{d}d_{h}^{*}}_{=e^{D}\cdot\, \mathrm{d}\tau_{h}^{D}} + d_{h,t-i}^{*}) + (1-\lambda)^{t} d_{h,0} \tag{3.18}$$

, where $\mathrm{d}d_{h}^{*}$ is the decisive shift in long-run debt targets which is exclusively caused by the modified tax environment as compared to the benchmark scenario. Note that equation (3.18) assumes $\mathrm{d}d_{h}^{*} = e^{D} \cdot \mathrm{d}\tau_{h}^{D}$ to be the same in each period t. It is easy to reformulate (3.18) to capture year-specific shocks in the tax incentive.[17]

For clarity, we now mark the first trajectory described in (3.17) with the superscript "B" for "benchmark scenario". Having defined the trajectories in (3.17) and (3.18), we can look at the difference in debt ratios under the two scenarios for each firm in each period *t*. All variables and parameters unaffected by the tax regime change cancel out and are thus fully controlled for in the simulation.

$$d_{h,t}^{R} - d_{h,t}^{B} = \lambda \sum_{i=0}^{t-1} (1-\lambda)^{i} \;\mathrm{d}d_{h}^{*} = \left(1-(1-\lambda)^{t}\right) e^{D} \mathrm{d}\tau_{h}^{D} \tag{3.19}$$

As is clear from equation (3.19), the gap between the two scenarios is increasing over time and converges to the long-run debt response to the tax regime change, with $\lim_{t\to\infty}\left(d_{h,t}^{R} - d_{h,t}^{B}\right) = e^{D}\mathrm{d}\tau_{h}^{D}$.

In principle, we could, for each firm h in each period t, consistently calculate the debt ratio under the tax reform scenario on the basis of observed benchmark capital structure as $d_{h,t}^{R} = \left(d_{h,t}^{R} - d_{h,t}^{B}\right) + d_{h,t}^{B}$. As outlined in Chapter 2, the benchmark input data for the microsimulation covers three periods $t = \{1,2,3\}$. Thus, the analysis of the reform scenario trajectory will be limited to these periods, i.e. $\left\{d_{h,t}^{R}\right\}_{t=1}^{3}$.

Note that both the long-term tax sensitivity of debt targets, as expressed by the size of the marginal tax effect on the debt ratio e_{h}^{D}, and the speed of adjustment (SOA) toward target debt ratios, λ, are empirical issues. These behavioral parameters depend on

---

[17] The formula with year-specific incentive shocks reads quite similarly to (3.18): $d_{h,t}^{R} = \lambda \sum_{i=0}^{t-1} (1-\lambda)^{i} (\mathrm{d}d_{h,t-i}^{*} + d_{h,t-i}^{*}) + (1-\lambda)^{t} d_{h,0}$ and the difference between reform and benchmark scenario is $d_{h,t}^{R} - d_{h,t}^{B} = \lambda \sum_{i=0}^{t-1} (1-\lambda)^{i} \;\mathrm{d}d_{h,t-i}^{*}$.

the magnitude of the tax advantage and the relative importance of debt-related costs which offset this advantage at the margin. These costs may be in particular related to financial distress (Kraus and Litzenberger, 1973) or agency conflicts between equity and debt claimants (Jensen and Meckling, 1976; Myers, 1977). A comprehensive quantitative assessment of the empirical literature on the tax effect on corporate capital structure choices (see Chapter 6) will guarantee a plausible parameterization of the simulated financial policy response to tax reform. The parameterization itself will be discussed in Chapter 8.

3.3.2.1.2 Corporate Marginal Investment Response

According to neo-classical theory, firms accumulate capital as long as decreasing marginal returns to scale cover at least the cost of finance and depreciation. The minimum pre-tax rate of return on investment required by the investor is called the cost of capital (Jorgenson 1963; Hall and Jorgensen 1967). Thus, a firm is supposed to invest up to the point where the marginal investment project earns just the cost of capital (see equation (3.11) in Section 3.2.4). Consequently, the standard approach to investigating the marginal investment disincentive caused by taxes refers to the tax impact on the cost of capital. If saving is perfectly elastic, general equilibrium effects are absent and production is described by a CES function, the user cost elasticity is indeed the sole determinant of the impact on the capital stock for a given change in the cost of capital (Chirinko, 2002). In particular, ZEW TaxCoMM does not model any tax reform effects via potential effects on the liquidity position of firms. While there is voluminous literature on the relationship of investment and financial variables, current profits or cash flow (for a survey, see Hubbard, 1998), there is increasing evidence challenging the standard financial constraint model[18] or even indicating that any identified investment sensitivities to cash flow could indeed be spurious (Bushman et al., 2008).

With regards to the user cost elasticity of capital, there is a broad empirical literature which investigates the relationship between business investment and the cost of capital. However, the tax distortion is often not expressed in terms of the cost of capital, but in terms of the effective marginal tax rate (EMTR). The EMTR is defined as the relative wedge between the cost of capital c and the required post-tax real rate of return on in-

[18] In their survey of the financial constraints literature, Hassett and Newmark (2008) conclude that the general financial constraint model is challenged on three grounds: First, cash flow effects could simply be due to measurement error in standard empirical investigations. Second, existent cash flow effects might actually not be caused by liquidity constraints. Third, even if financial constraints exist, cash flow sensitivity need not necessarily increase in the degree of the constraint.

vestment. Ignoring personal taxes levied on investment income, the required post-tax return equals the real capital market interest rate r and the EMTR (denoted as τ^{EMTR}) is just a monotonous transformation of the cost of capital, $\tau^{EMTR} = (c - r)/c$. However, the EMTR is easier and much more convenient to interpret. In particular, it conveys more information on the tax wedge introduced in the costs of capital and, thus, the degree to which optimality conditions are distorted. The EMTR is also the standard measure of investment disincentives in the major CGE models focusing on corporate taxes.[19]

Recalling the definition of the cost of capital from equation (3.11) in Section 3.2.4,[20] it is clear that, in the presence of taxes, the cost of capital depends on the source of funds used to finance the marginal investment. This raises the question of which type of funds, equity or debt, is actually financing the marginal investment. Due to the tax deductibility of interest, the cost of debt finance is all but unaffected by the corporate income tax.[21] Thus, if debt was indeed the preferred marginal source of funds, taxes would exert very little effect on the marginal investment decision. Still, equity financing is frequently observed in practice. Moreover, as it is the cost of equity which is primarily affected by corporate taxes, one could also argue that induced marginal investment is predominantly financed with equity (De Mooij, 2005). Following a standard convention (see Egger et al., 2009a; De Mooij and Devereux, 2011), we strike the balance between the two views and assume that marginal investment is financed by a mix of funds which is identical to the average financing structure of the firm. The weighted average cost of capital is a standard discount rate used in corporate finance (Brealey et al., 2008). Accordingly, ZEW TaxCoMM computes the firm-specific benchmark cost of capital considering the benchmark tax law and observed benchmark debt ratios, while the cost of capital under the reform scenario take into account the new tax regulation and reform-adjusted capital structures, i.e. financing weights. The reform-induced change in the cost of capital is thus not only determined by the direct influence of the reform changes

[19] See Bettendorf and van der Horst (2006).

[20] The cost of capital as defined in (3.11) and used for the purpose of the mircosimulation captures the impact of depreciation allowances for the considered type of asset and of the applicable statutory tax rates on the required pre-tax rate of return. Differences between equity and debt financing are also reflected.

[21] For a debt financed investment, the net cost of capital amounts to the real market interest rate if depreciation schemes are neutral, i.e. correspond to economic depreciation. Otherwise, taxes have an influence via the present value of the reduction in tax from depreciation allowances. The EMTR then is usually negative.

in depreciation allowances and statutory tax rates, but also driven by any reform triggered adjustments in the capital structure of the firm.[22]

Importantly, we take the capital market interest rate as given. In applications of ZEW TaxCoMM we will set the nominal interest rate according to the average yield on domestic industry bonds outstanding, as published by the German Federal Bank. Inflation rates are obtained from the German Statistical Office.[23] In addition, we perform sensitivity analyses with alternative interest values to check the robustness of results. Furthermore, we compute financing-weighted EMTRs both for immovable fixed assets (buildings) and movable tangible fixed assets (equipment and machinery). Assuming that the marginal investment bundles both asset types according to their average proportions reported in the firm's balance sheet, the scenario-specific EMTR for each firm represents a weighted average of the two asset-specific EMTRs. For companies with tax losses we set the EMTR to zero, assuming that all marginal returns are shielded from taxation due to sufficient current losses or loss carry-forwards.[24]

Knowing the tax distortions for marginal investment as expressed by each firm's EMTR under the benchmark and the reform scenario, we have to deal with the investment response to the reform change in these distortions. Indeed, a considerable amount of research has dealt with the relationship between corporate taxation and domestic business investment (for reviews, see, for example, Hassett and Hubbard, 2002; Bond and van Reenen, 2007). However, much of this research has focused on aggregate data. By contrast, there is only a "dearth of microeconometric studies that focus on estimating the sensitivity of investment to changes in taxes" (Bond and van Reenen, 2007).[25] Still, there is a consensus in both the theoretical and empirical literature that capital cannot adjust without external or internal costs preventing immediate adjustment to target levels. At the same time, however, there is no general consensus on the dynamic time pattern of the capital adjustment.

---

22 For the structural representation of this interrelation derived from the firm's optimization problem, see Section 3.2.4. Note that, in line with the empirical literature, costs of financial distress are ignored in the cost of capital formulation because these are unobservable to us. Thus, we slightly deviate from the expression in (3.11).

23 In the application of the model in Chapter 9 which is based on a simulation sample covering the period from 2005 to 2007, the nominal interest rate determined accordingly is 4.3% (Deutsche Bundesbank, 2011) and the inflation rate is 1.8% (Statistisches Bundesamt, 2011a). Thus, the real interest rate is 2.5%.

24 In the simulation, we define a firm to be loss-making if it shows tax losses in at least two of the three simulation periods.

25 An exemption is the literature on the relationship of foreign direct investment and host country taxation. For a comprehensive quantitative survey, see Chapter 5. Still, adjustment dynamics are ignored in most of this literature.

Chirinko et al. (1999) investigate adjustment patterns over time by means of an ad-hoc distributed lag model; but their results contradict established notions on the long-run user cost elasticity of capital (Cummins et al., 1994; Hasset and Hubbard, 2002; Dwenger , 2010). More structural models explicitly integrate adjustment cost functions to derive the short-term dynamics. For the sake of convenience, however, these functions are often modeled to be convex in investment volumes. This simplifying assumption is, again, not beyond debate (Caballero et al., 1995; Cooper and Haltiwanger, 2006). In their literature survey, Bond and van Reenen (2007) therefore conclude that the actual adjustment process appears very complex and that empirical research has not been very successful in characterizing it. To account for short-term dynamics, we thus adopt a simple but empirically well-proven partial adjustment model of the level of the capital stock (see, for example, Buettner and Wamser, 2009; Overesch and Wamser, 2009). Static capital demand, interpreted as the desired level of capital in the long run, is easily derived within microeconomic frameworks (see equation (3.14) in Section 3.2.4; Bond and van Reenen, 2007; Nickell, 1978). Partial adjustment models account for the fact that these desired capital levels are not reached immediately. Please note that, in this respect, the following computation of the between-scenario differences in capital levels is similar to the simulation of the debt response to tax reform (see Section 3.3.2.1.1), which has also used a partial adjustment framework to model short-term dynamics.

We assume that firm h closes a fraction θ of the gap between the actual capital stock in logarithms, $\ln K_{h,t-1}$, and the desired capital stock in logarithms, $\ln K^*_{h,t}$.[26] Thus, we have

$$\Delta \ln K_{h,t} = \theta\left(\ln K^*_{h,t} - \ln K_{h,t-1}\right) \approx \frac{I_{h,t}}{K_{t-1}} - \delta \qquad (3.20)$$

, where the term on the right-hand side of (3.20) is the net investment rate. $I_{h,t}$ is gross investment and δ is the economic depreciation rate. We rearrange and iterate forward to the solution of the partial adjustment model which describes for each firm h the realized capital stock, $\ln K_{h,t}$, as a function of past and current capital targets, $\ln K^*_{h,t-i}$, and an initial capital stock, $\ln K_{h,0}$:

[26] For the purpose of the simulation, capital is defined as tangible fixed assets which we observe in the firms' balance sheets.

$$\ln K_{h,t} = \theta \sum_{i=0}^{t-1} (1-\theta)^i \ln K_{h,t-i}^* + (1-\theta)^t \ln K_{h,0} \tag{3.21}$$

Note that the capital targets, $\ln K_{h,t-i}^*$, which drive the trajectory $\{\ln K_{h,t}\}$ are themselves unobserved. Only the realized capital levels under the benchmark scenario, $\{\ln K_{h,t}\}$ are observed in the simulation input data. Yet, it is again possible to define the trajectory $\{\ln K_{h,t}\}$ for different scenarios which are supposed to differ from the benchmark scenario underlying the trajectory in (3.21) exclusively with regard to the tax regime. All other non-tax micro and macro determinants of firms' capital targets are held constant. The trajectory $\{\ln K_{h,t}^R\}$, where the superscript "R" stands for "reform scenario", results if, starting from the initial period of analysis, a modified tax regime applies while, in every period t, all non-tax micro and macro conditions affecting capital targets are exactly the same as in the benchmark scenario:

$$\ln K_{h,t}^R = \theta \sum_{i=0}^{t-1} (1-\theta)^i \Big(\underbrace{\mathrm{d} \ln K_h^*}_{= e^{INV} \cdot \, \mathrm{d}\tau_h^{EMTR}} + \ln K_{h,t-i}^* \Big) + (1-\theta)^t \ln K_{h,0} \tag{3.22}$$

, where $\mathrm{d} \ln K_h^*$ is the decisive shift in long-run capital targets which is exclusively caused by the modified tax environment as compared to the benchmark scenario. Recalling equation (3.14) in Section 3.2.4, we know that the long-run capital target, $\ln K_{h,t}^*$, will respond to a reform shock in the cost of capital with intensity $\varepsilon_{INV,\,UCC} = \sigma$. For expository purposes, we transform the user cost elasticity of the capital stock t into the semi-elasticity with respect to effective marginal tax rate e^{INV} which is more common in empirical research.[27] Note that equation (3.22) assumes $\mathrm{d} \ln K_h^* = e^{INV} \cdot \mathrm{d}\tau_h^{EMTR}$ to be the same in each period t. It is again easy to re-formulate (3.22) to capture year-specific shocks in the EMTR.[28]

We again mark the first trajectory described in (3.21) with the superscript "B" for "benchmark scenario". Having defined the trajectories in (3.21) and (3.22), we can now look at the difference in capital levels under the two scenarios in each period t. All vari-

---

[27] Simple algebra shows that we just have to divide by $\left(1-\tau^{EMTR}\right)$, i.e. $e^{INV} = \varepsilon_{INV,UCC} / \left(1-\tau^{EMTR}\right)$.

[28] The formulas have to be adjusted just analogously to what we did in Footnote 17 for the debt response.

ables and parameters unaffected by the tax regime change cancel out and are thus fully controlled for in the simulation.

$$\ln K_{h,t}^{R} - \ln K_{h,t}^{B} = \theta \sum_{i=0}^{t-1} \left(1-\theta\right)^{i} \ \mathrm{d} \ln K_{h}^{*} = \left(1-\left(1-\theta\right)^{\mathrm{t}}\right) e^{INV} \mathrm{d}\, \tau_{h}^{EMTR} \tag{3.23}$$

Analogous to what was shown with regard to the debt response, the gap between the two scenarios is increasing over time and converges to the long-run response to the tax regime change, here with $\lim_{t\to\infty}\left(\ln K_{h,t}^{R} - \ln K_{h,t}^{B}\right) = e^{INV} \mathrm{d}\, \tau_{h}^{EMTR}$.

For each firm h in each period t, we calculate the capital stock under the tax reform scenario on the basis of observed benchmark capital stock as $\ln K_{h,t}^{R} = \left(\ln K_{h,t}^{R} - \ln K_{h,t}^{B}\right) + \ln K_{h,t}^{B}$. Again, due to the restricted time horizon of the benchmark and first round simulations, the analysis of the reform scenario trajectory will be limited to $\left\{\ln K_{h,t}^{R}\right\}_{t=1}^{3}$.

Plausible values for the two main behavioral parameters, e_{h}^{INV} and the adjustment speed of capital θ, will be distilled from the literature. In particular, with regard to the investment response of multinational affiliate companies, Chapter 5 provides a comprehensive quantitative meta-analysis. The detailed parameterization based on this meta-study will be discussed in Chapter 8.

3.3.2.1.3 Corporate Profit Shifting Response

Given separated affiliate accounts, multinational companies have enhanced tax planning opportunities by means of cross-border profit shifting. In particular, transfer pricing of intra-group trade, in addition to the internal reallocation of debt, can serve as a channel to shift profits between jurisdictions. Against this background, transfer pricing audits aim to ensure compliance with the arm’s length principle. In return, multinational firms may tend to internally transfer firm-specific assets and services for profit shifting purposes. Such assets and services provide for higher discretion in setting transfer prices because they are specific to the firm and not traded on an external market. Overesch and Schreiber (2010) show that firms with a strong focus on R&D, a natural proxy for the firm-specificity of assets, indeed exploit additional opportunities to manipulate the quantities and prices of intra-group transactions. Moreover, the location of intangible assets, e.g. patents and licenses, is documented to be driven by tax considerations (Karkinski and Riedel, 2009; Dischinger and Riedel, 2011).

It is generally difficult to minutely trace intra-group transactions in accounting data and, in particular, to disentangle their impact on taxable corporate income. With our simulation input data being restricted to Germany, we cannot observe the allocation of intangible assets within the multinational firm either. Still, we can indirectly model the between-scenario difference in profit shifting activities by drawing on the profit response to tax reform as the ultimate result of a firm's profit shifting efforts. Ideally, we would be interested in the portion of economic profit that is actually reported in the books. Evidently, neither information on unreported profits nor on the proportion of underreporting is directly identifiable. Fortunately, however, a considerable amount of empirical literature has quantified the tax sensitivity of reported profits, holding economic returns constant. Thus, we can model the implications from a tax reform-induced change in the proportions of profit shifting activity.

The tax incentive to shift profits abroad is measured by a plain (combined) statutory tax rate, $\tau_{h,t}^{STR}$.[29] In line with the seminal study on profit shifting activities put forward by Huizinga et al. (2008), we focus on a firm's earnings before interest and tax (EBIT). EBIT is supposed to capture those shifting activities which run via the route of related-party transactions, i.e. transfer prices and/or trade quantities. Those tax planning strategies which are built around the financial structure of a firm are already captured by the debt policy response modeled in Section 3.3.2.1.1.[30]

Equally in line with prior evidence, we assume that profit shifting is based on flexible tax planning strategies and adjusts quickly to a change in international tax incentives. Thus, the shifting response unfolds fully from the first period of simulation onward and in the reform scenario the targeted shift in declared EBIT will be immediately achieved, given that all other determining factors are held constant. Multiplying the semi-elasticity of EBIT with respect to the international tax rate difference, $e_h^{PS} = \frac{\partial \ln EBIT_{h,t}}{\partial(\tau^h - \tau^f)}$, by the reform change in the statutory tax rate, $\mathrm{d}\,\tau_h^{STR}$, gives the reform-induced shift in periodical EBIT in logarithms:

$$\ln EBIT_{h,t}^{R} - \ln EBIT_{h,t}^{B} = e_h^{PS} \cdot \mathrm{d}\,\tau_h^{STR} \tag{3.24}$$

[29] Profit shifting incentives result from exploitable international tax rate differences. Yet, as ZEW TaxCoMM exclusively focuses on the analysis of German tax policy scenarios, foreign tax rates are implicitly held constant. Thus, any changes in the domestic German tax rate will consistently measure the corresponding change in the incentive to shift profits abroad.

[30] The international shifting incentives which, for the case of multinational firms, adds to the purely domestic tax incentive to finance with debt will be taken into account by implementing increased values for the marginal tax effect on the debt ratio (see Chapter 8).

where the superscripts "R" and "B", respectively, mark the reform and benchmark scenario values.

Based on observed benchmark values of EBIT for each firm h in each of the three simulation periods, we can calculate the reform's impact on EBIT via the partial profit shifting response. The parameterization of the profit shifting response will be discussed in Chapter 8. It will be based on the comprehensive meta-study on the tax sensitivity of profit shifting activity put forward in Chapter 7. In particular, we will be able to capture empirically found interdependencies between the capacity to shift profits abroad and the sensitivity of investment decisions to local tax rates (Overesch and Schreiber, 2010).

3.3.2.1.4 Profit Implications from the Responses at the Micro Level

The firms' behavioral responses to reform will have implications for firm profit which will then be subject to tax. These behavior-induced implications for profit add to the respective consequences arising merely from the change in the tax law captured by the first round reform simulations of ZEW TaxCoMM. To distinguish the second round behavioral effects from the purely technical reform consequences due to changes in the tax legislation, we isolate the behavior-induced change in affected profit components and mark them with the superscript "2R".

We first compute the income consequences arising from the simulated adjustments in both capital stock and capital structure in the three simulation periods $t = \{1, 2, 3\}$. Given that the reform-induced upward or downward shift in capital stock in each period t is exclusively induced by a change in the marginal effective tax rate on investment, it seems plausible to assume that the contribution to ordinary income, before deduction of financing expenses, equals the marginal cost of finance in nominal terms. Thus, if the reform scenario generally shows a higher capital stock as compared to the benchmark level, we assume a rate of return equal to $\hat{\tilde{r}}_{h,t}^{R}$, the nominal cost of finance in the reform scenario.[31] If, instead, the reform scenario comes along with an increase in the cost of capital and capital stocks are accordingly reduced as compared to the benchmark, the corresponding profit loss is calculated using the benchmark nominal financing cost, $\hat{\tilde{r}}_{h,t}^{B}$, as the return of marginal benchmark investment which is not produced in the reform

[31] $\hat{\tilde{r}}_{h,t} = d_{h,t}\left(\hat{r} - \tau^{STR}\beta_{h,t}\hat{r}\right) + \left(1 - d_{h,t}\right)\hat{r}$, with $\hat{r}$ as the nominal capital market interest rate. Throughout the model, we ignore the presence of risk and, as a consequence, any differences between rates of return on equity and debt.

scenario. The reform-induced change in each firm's annual EBIT which is caused exclusively by the shift in capital stock, $\Delta^{2R}EBIT_{h,t}^{INV}$, is thus calculated according to equation (3.25).

$$\Delta^{2R}EBIT_{h,t}^{INV} = \begin{cases} \hat{\tilde{r}}_{h,t}^{B}\left(K_{h,t}^{R}-K_{h,t}^{B}\right), & \left(K_{h,t}^{R}-K_{h,t}^{B}\right)<0 \\ \hat{\tilde{r}}_{h,t}^{R}\left(K_{h,t}^{R}-K_{h,t}^{B}\right), & \left(K_{h,t}^{R}-K_{h,t}^{B}\right)\geq 0 \end{cases} \tag{3.25}$$

Please recall that the scenario-specific cost of capital for each firm in each period also reflects the scenario-optimal debt ratio as simulated in Section 3.3.2.1.1. The scenario-adjusted debt ratio in combination with the information on the between-scenario differences in capital stocks (Section 3.3.2.1.2) allows calculating the difference in the debt level $D_{h,t}^{R}-D_{h,t}^{B}$ and corresponding interest expenses as another important part of the tax base implications of switching from the benchmark to the reform scenario. The according shift in the absolute amount of debt is given by $D_{h,t}^{R}-D_{h,t}^{B}=d_{h,t}^{R}K_{h,t}^{R}-d_{h,t}^{B}K_{h,t}^{B}$. Given a nominal interest rate $\hat{r}$ which remains unchanged in both the reform and the benchmark scenario, the tax base implication of this difference in debt levels, i.e. the reform-induced shift in interest expenses, $\Delta^{2R}IE_{h,t}$, is

$$\Delta^{2R}IE_{h,t}=\hat{r}\left(D_{h,t}^{R}-D_{h,t}^{B}\right)=\hat{r}\left(d_{h,t}^{R}K_{h,t}^{R}-d_{h,t}^{B}K_{h,t}^{B}\right) \tag{3.26}$$

Furthermore, we have to take into account the reform-induced EBIT shift caused by adjusted profit shifting efforts of multinational firms, $\Delta^{2R}EBIT_{h,t}^{PS}=\ln EBIT_{h,t}^{R}-\ln EBIT_{h,t}^{B}$, as immediately calculated in equation (3.24) of Section 3.3.2.1.3. In sum, the firm-specific reform impact on profit, $\Delta^{2R}P_{h,t}$, which is due to behavioral responses in investment, financing, and profit shifting behavior in each simulation period t adds up to

$$\Delta^{2R}P_{h,t}^{INV+PS+D}=\Delta^{2R}EBIT_{h,t}^{INV}+\Delta^{2R}EBIT_{h,t}^{PS}-\Delta^{2R}IE_{h,t} \tag{3.27}$$

As illustrated with Figure 2.1 in Chapter 2, these behavior-induced changes in profit components will enter the ZEW TaxCoMM tax assessment algorithms, which will then compute the gross and net taxable income for, respectively, corporate income and trade tax purposes for each firm h in each simulation period t.

3.3.2.2 Behavioral Responses Modeled at the Macro Level

3.3.2.2.1 Corporate Infra-Marginal Investment Response

In the transnational investment decision multinational firms face, the discrete choice of where to locate a profitable and indivisible investment project precedes continuous decisions on the scale of investment and on the allocation of income from capital (Devereux, 2007b). The tax impact on location choice is thus an integral part of the overall tax base response. Still, as it refers to the geographical allocation of an economic rent, location choice is not affected through the effective marginal tax rate, but through the effective average tax rate, reflecting the proportion of the pre-tax economic rent taken by the government (Devereux and Griffith 1999, 2003). A main driver of the effective average tax rate (EATR) on profitable investment is the statutory tax rate. At the company level, the EATR is effectively a linear combination of EMTR and the statutory tax rate. The impact of the statutory tax rate is increasing with the proportion of excess return in total returns on investment. In the following, we will assume that discrete and indivible investment projects subject to the location decision earn considerable rents. As a consequence, we refer to the combined statutory tax rate to capture the effective tax burden on infra-marginal investment.

As the tax burden on infra-marginal investment influences the probability of seeing such profitable investment projects undertaken, tax reforms impacting on the statutory tax rate will eventually have an effect on the number of multinational affiliates located in Germany. However, simulating this effect at the micro level by making the simulation sample dynamic in the sense of allowing for the birth (new location) and death (relocation) of multinational affiliates requires a stochastic mechanism, generating or eliminating firm observations. Under the assumption that probabilities of affiliate birth or death are uniformly distributed and independent of affiliate characteristics, however, a reform-induced relative change in the number of multinational affiliates should entail a proportional shift in aggregate tax revenue from multinational activity. We can therefore implement the behavioral response with respect to location choice at the aggregate level. Correspondingly, the ZEW TaxCoMM model captures the reform shock via the change in the pooled sample median of the firm-specific statutory tax rates, $\mathrm{d}\tau^{STR}_{median}$.[32]

[32] In Germany, variation in the firm-specific combined statutory tax rate, τ^{STR}, comes from variation in local trade tax multipliers between municipalities.

The partial effect which the behavioral response to $\mathrm{d}\,\tau_{median}^{STR}$ exerts on the aggregate corporate tax revenue is given by equation (3.28).

$$CTR_t^{LOC,2R} - CTR_t^{LOC,1R} = e^{LOC}\mathrm{d}\,\tau_{median}^{STR} \sum_{h \in H_M} CTR_{h,t}^{1R} \tag{3.28}$$

$CTR_{h,t}^{1R}$ is the corporate tax due in period t simulated in the first round of the reform scenario for firm h. The sum over all firms within the subsample of multinational affiliates H_M gives the aggregate corporate income tax revenue originating from multinational activity, $CTR_t^{LOC,1R}$.[33] Correspondingly, $CTR_t^{LOC,2R}$ describes aggregate corporate income tax revenue collected from multinationals located in Germany after behavioral responses in location choice are taken into account. The response intensity is measured as the semi-elasticity of the number of foreign locations (nol) with regard to the local statutory tax level, $e^{LOC} = \frac{\partial \ln nol}{\partial \tau^{STR}}$.

The consequences caused by reform effects on location choice for the trade tax revenue are calculated accordingly.

$$TTR_t^{LOC,2R} - TTR_t^{LOC,1R} = e^{LOC}\mathrm{d}\,\tau_{median}^{STR} \sum_{h \in H_M} TTR_{h,t}^{1R} \tag{3.29}$$

$TTR_{h,t}^{1R}$ is the trade tax due in period t simulated in the first round of the reform scenario for firm h. The sum over all multinational firms gives the respective aggregate trade tax revenue from multinational activity, $TTR_t^{LOC,1R}$. Correspondingly, $TTR_t^{LOC,2R}$ represents aggregate trade tax revenue collected from multinationals after behavioral responses in location choice, ignoring all other responses. All other parameters and variables are as defined above.

The response intensity e^{LOC} linked to the reform-induced tax rate variation can be inferred from the literature. To guarantee a plausible parameterization, we again benefit from meta-analytical techniques synthesizing the related empirical evidence (see Chapter 5). The parameterization of the response in location choice following from this quantitative literature survey will be discussed in Chapter 8.

---

[33] To identify multinational firms we resort to ownership information provided in the DAFNE database. A firm is defined to be multinational if it is either directly or indirectly majority-owned by a foreign parent or if it directly or indirectly holds the majority in a foreign subsidiary.

3.3.2.2.2 Response in Choice of Legal Form

Non-tax institutional and economic factors have long been considered to dominate the choice of legal form (MacKie-Mason and Gordon, 1997; Goolsbee, 1998). Entrepreneurs were, in particular, supposed to weigh the benefits linked to the limited liability of incorporation or better access to external financing and the costs related to, for example, legal reporting obligations. In more recent years, however, empirical research has provided evidence that tax-related aspects also play a significant role for the choice between running an incorporated or a non-incorporated firm (Goolsbee, 2004; De Mooij and Nicodème, 2008; Elschner, 2010). Profits generated by partnerships and sole proprietorships are passed through and immediately subject to tax as income from business on the owner's level. Corporations, on the other side, pay a separate corporate income tax while personal taxes apply only to dividend pay-outs or realized capital gains from the disposal of shares.

Similar to the simulation of tax reform impacts on location choice described in Section 3.3.2.2, the response with regard to the choice of organizational form is modeled at the aggregate level. The response in each period t is linked to the reform-induced change in the pooled sample median of the difference between the overall corporate tax burden (at company and shareholder level) and the overall tax rate of a pass-through entity, $\mathrm{d}\tau^{DIFF}_{median}$.[34] Equation (3.30) formally describes the partial reform impact on the aggregate corporate income tax revenue, i.e. ignoring all other tax distortions.

$$CTR_t^{OF,2R} - CTR_t^{OF,1R} = e^{OF}\,\mathrm{d}\tau^{DIFF}_{median} \sum_{h \in H} CTR^{1R}_{h,t} \qquad (3.30)$$

$CTR^{1R}_{h,t}$ is again the corporate tax due simulated for firm h in period t. $CTR_t^{OF,1R}$ and $CTR_t^{OF,2R}$ are again the respective aggregates before and after behavioral adjustment. This time $CTR_t^{OF,2R}$ reflects the partial response to legal form choice, all other firm decisions held constant. e^{OF} is the semi-elasticity of the size of the corporate sector with regard to the tax rate difference between non-pass-through and pass-through entities.

[34] This scenario-specific difference between the overall corporate tax burden and the tax burden of a pass-through entity is calculated assuming a 50% payout ratio for corporations: $\tau^{DIFF} = \left[0.5\tau^{STR} + 0.5(\tau^{STR} + \tau^{SH}(1+\tau^{SC})(1-\tau^{STR}))\right] - \left[(\tau^{PIT} + \tau^{TT} - credit^{TT})(1+\tau^{SC})\right]$, where τ^{STR} is again the combined statutory tax rate at the corporate level, τ^{SH} is the tax rate on dividends at shareholder level, τ^{SC} is the solidarity surcharge at shareholder level, τ^{PIT} is the (top) personal income tax rate on earned income, τ^{TT} is the local trade tax rate and $credit^{TT}$ is the trade tax credited against personal income tax.

The partial impact on trade tax revenue is calculated accordingly in equation (3.31). $TTR_{h,t}^{1R}$ is again the trade tax due simulated for firm h in period t. $TTR_t^{OF,1R}$ and $TTR_t^{OF,2R}$ represent, respectively, aggregate trade tax revenue before and after behavioral adjustment. All other parameters are as defined above.

$$TTR_t^{OF,2R} - TTR_t^{OF,1R} = e^{OF} d\tau_{median}^{DIFF} \sum_{h \in H} TTR_{h,t}^{1R} \tag{3.31}$$

The parameterization of the response in choice of legal form will be discussed in Chapter 8, where we also explain the parameterization of all other modeled response margins.

3.3.3 Some Potential Qualifications – A Discussion

We are convinced that ZEW TaxCoMM's approach to incorporating behavioral responses provides valuable insights on second round tax reform consequences. Some potential qualifications should still not be ignored. First, the simulation does not capture all of the various effects at work when the economy adjusts to policy shocks. Second, the aggregation of micro-level implications ignores spillovers between firms. Third, we discuss whether the simulation is vulnerable to the so-called "Lucas critique".

ZEW TaxCoMM's simulation of firm-level responses focuses on partial responses to tax reform. It thus ignores general equilibrium interactions. As a consequence, the simulation model only captures the immediate investment response to tax reform through the user cost of capital; instead, it will not consider any effects from induced changes in the scale of production.[35] Potential effects running via the capital market interest rate are not considered, either. The interest rate is held constant across all tax policy scenarios. In short, we trade off a general equilibrium perspective against a high level of institutional detail and a broad representation of firm-level heterogeneity. Nonetheless, we consider the information loss associated with the disregard of general equilibrium interactions to be fairly limited. The direct channel via the factor price is indeed shown to be the key determinant of capital formation (Fox and Fullerton, 1991). Furthermore, given high international capital mobility, interest rates should indeed be irresponsive to changes in capital demand in one country.

---

[35] Scale effects on capital accumulation add to the effect via the cost of capital and, for a fall in the cost of capital, result both from higher production due to decreasing operating costs. These might again be compensated through lower production following from countervailing decreases in government expenses required to balance the government's revenue loss from the tax policy (Chirinko, 2002).

ZEW TaxCoMM aggregates micro-level reform consequences up to the macro level. Potential spillover effects on, e.g., productivity, between firms are ignored. According to endogenous growth theory, however, externalities of economic activities could matter when going from the micro-level to aggregate outcomes. The simulation thus does not consider this type of between-firm interactions and considers the aggregate tax reform consequence to be the sum of individual firm implications.

The third qualification goes back to Lucas (1976). In his famous "Lucas critique", Lucas raised the concern that estimated behavioral parameters, which naturally refer to the past, may not be robust to new and unprecedented situations. This concern would be particularly relevant if the empirical approaches are ad-hoc and of reduced form, mixing structural behavioral parameters with the expectation-formation process. In these cases, identified causalities would not be invariant to breaks in the expectation formation of economic agents. Such breaks are likely to occur when there are fundamental changes in tax policy.

Although the Lucas critique has been reported to be of minor relevance in applied research (Stanley, 2000a), it still poses a challenge. However, ZEW TaxCoMM's behavioral simulation algorithms are in line with established microeconomic models of the firm and reflect behavioral patterns which can be derived from such frameworks. Still, due to the multitude of response margins considered and due to the various dimensions of firm-level heterogeneity, the responses are not explicitly derived from one unified structural model of the firm. Furthermore, in light of the critique, it seems appropriate not to be arbitrarily selective but to base the parameterization on a comprehensive synthesis of high-quality empirical evidence. This is what is done here.

After all, these potential qualifications must be kept in mind when interpreting the simulation results. These should be considered with appropriate care. Yet, this does generally hold for all ex-ante evaluations of policy reforms and therefore is no particularity of the ZEW TaxCoMM approach. We are convinced that the microsimulation is a complementary instrument for the appraisal of tax policy reform due to its hitherto unachieved capacities in capturing the existing heterogeneity of reform impacts across firms.

Part III

Quantitative Literature Reviews

Chapter 4

The Econometric Framework for Meta-Analysis

4.1 Introduction

Meta-analysis is a form of quantitative literature survey. It relies on econometric methods to systematically disentangle the quantitative impact of explicit or implicit choices of study design on obtained empirical evidence. Exploiting the virtues of statistical analyses, meta-analysis reasonably complements high-quality narrative surveys (Stanley, 2001). Various applications of meta-analysis are put forward in several fields of economics.[36] In a meta-regression, an effect size index, often a regression parameter, extracted from primary analyses is taken as the dependent variable and modeled as a function of (mostly) dummy variable predictors which represent differences in method, design, and data used by the primary estimation. Meta-regression analysis thus helps to systematically explain the considerable variation found in empirical research. In other words, it helps to "offer specific reasons, based on the studies themselves, why the evidence on a certain question may appear contradictory or overly varied" (Stanley, 2001: 132).

Sophisticated meta-studies suggest a broad range of meta-analytical techniques. Instructive examples are e.g. Stanley (2005, 2008), Brons et al. (2008) and in particular

[36] For a comprehensive introduction and a thorough discussion of the concept of meta-analysis in economics, see Florax et al. (2002). Meta-analysis is applied, for example, in the field of international economics by Havranek and Irsova (2011) and Goerg and Strobl (2001) on productivity spillovers associated with multinational firm activity, by De Mooij and Ederveen (2003) on taxation and foreign direct investment; in the field of labor economics by Card and Krueger (1995) on minimum wage effects, by Stanley and Jarrell (1998) on gender wage discrimination and by Card et al. (2010) on labor market policy evaluations; or in the field of environmental economics by Smith and Huang (1995) on property value models.

Brons (2006) and Bom and Ligthart (2008).[37] We follow these more sophisticated approaches and present the full set of meta-analytical estimators in a formally integrated framework.

4.2 Classical Meta-Analysis

In an initial step, meta-analytical techniques are used to combine single study results to produce an overall estimate which subsequently can be tested for significance. One possible way to directly uncover the overall statistical significance of the empirical relationship of interest would be to perform Fisher's combined test on p-values of the individual estimates. However, this test suffers from several shortcomings. In particular, it does not indicate the sign of the effect that was tested for significance (Jarrell and Stanley, 2004). Therefore we concentrate on the computation of pooled effect estimates via the use of fixed or random effects meta-analysis.

In this section and all other sections of Chapter 4, the effect size index used in the meta-analysis is supposed to be a semi-elasticity. However, the econometric framework applies without change to all other types of uniformly scaled effect size indices estimable in regression analyses, i.e. regression parameters such as elasticities or marginal effects.

Conceptually, all "traditional" meta-analytical estimators are based on weighted least squares (WLS) techniques. These are efficient if estimation models are heteroskedastic and the nature of heteroskedasticity is known. WLS estimation uses inverse (conditional) error term variances as analytic weights in order to give observations with smaller variances a larger weight and therefore greater influence in the estimates (Greene, 2003, Ch. 11.5).

Turning to the most basic meta-analytical model, the fixed effects (FE) meta-analysis assumes exactly one true effect to underlie all primary estimates.[38] Let γ_0 denote this true semi-elasticity. The primary estimates $\hat{\gamma}_i$ sampled from studies $i = 1,...,N$ are supposed to deviate from the true coefficient due to sampling error alone. Put differently, primary estimates $\hat{\gamma}_i$ are solely explained by an intercept γ_0 and a random error term

[37] The very foundations of meta-analysis, also in a technical sense, have meanwhile been laid by inter alia Hedges and Olkin (1985), Hunter and Schmidt (1990), Stanley and Jarrell (1989, 1998), Jarrell and Stanley (1990) and Stanley (1998, 2000a, b).

[38] The term "fixed" (vs. "random") thus refers to the characteristics of the underlying true semi-elasticity. Therefore, the meta-analytical terminology should not be confused with the homonymous panel econometric approaches.

$\varepsilon_i \sim N(0, \sigma^2_{\varepsilon_i})$ representing primary sampling error. To obtain a meta-estimate $\bar{\gamma}$ of the common true semi-elasticity, observed primary estimates $\hat{\gamma}_i$ are only regressed on a constant $x = 1$. Equation (4.1) formally depicts the fixed effects model.

$$\hat{\gamma}_i = \gamma_0 + \varepsilon_i \tag{4.1}$$

This model is easily shown to be heteroskedastic. For each primary semi-elasticity estimate, susceptibility to sampling error is reflected by its variance $V(\hat{\gamma}_i)$. The degree of sampling error depends fundamentally on sample size which differs from study to study. From equation (4.1) it is obvious that $V(\hat{\gamma}_i) = \sigma^2_{\varepsilon_i}$. Thus, ε_i is heteroskedastic. The nature of this heteroskedasticity is well known as estimates of $V(\hat{\gamma}_i)$ can be immediately obtained from primary regression results.[39] Therefore it is easy to account for by using WLS estimation with analytic weights $w_i = 1/\hat{\sigma}^2_{\varepsilon_i} = 1/\hat{V}(\hat{\gamma}_i)$.[40] The conventional (WLS) fixed effects meta-estimator $\bar{\gamma}$ of γ_0 is given by

$$\bar{\gamma} = \frac{\sum_{i=1}^{N} w_i \hat{\gamma}_i}{\sum_{i=1}^{N} w_i}, \tag{4.2}$$

with all variables and parameters as defined above.

In contrast to fixed effects meta-analysis, random effects (RE) meta-analysis explicitly allows for heterogeneity of primary effect size estimates beyond pure sampling error. Let $\hat{\gamma}_i$ be the tax effect estimate sampled from studies $i = 1,...,N$ and ε_i a random disturbance term representing sampling error with moments as defined above, then the true unobserved semi-elasticity is not assumed fixed but supposed to contain a study-specific random component $\mu_i \sim iid(0, \sigma^2_\mu)$ such that

$$\hat{\gamma}_i = \gamma_0 + \mu_i + \varepsilon_i \tag{4.3}$$

---

39 Generally, studies indicate estimated standard errors $\sqrt{\hat{V}(\hat{\gamma}_i)}$ of primary coefficients. Although statistical problems (e.g. error-in-variables bias) might arise from the use of weights which are themselves estimates (Macaskill et al., 2001), precision weighted meta-analyses have proved to be quite reliable in simulation studies (Stanley, 2008).

40 Note that the weights w_i referred to throughout this section are the so-called *analytic weights* used for WLS estimation. If one thinks of WLS estimation as applying OLS to weighted observations, the observation weights correspond to the square root of the analytic weights (e.g. Greene, 2003, Ch. 11.5; Baum, 2006, Ch. 6.21).

The pooled estimator is described by formula (4.2), but the (efficient) weights applied to calculate $\bar{\gamma}$ are different. The nested meta-disturbance varies with $V(\mu_i + \varepsilon_i) = \left(\sigma_\mu^2 + \sigma_{\varepsilon_i}^2\right)$. Obviously, it includes an additive (between) variance component σ_μ^2 which represents that part of the variance $V(\hat{\gamma}_i)$ beyond pure sampling error. While information on $\sigma_{\varepsilon_i}^2$ is obtained from primary study results, σ_μ^2 has to be estimated in a first step of the WLS meta-regression.[41] After all, inverse variance weights are computed as $w_i = 1\big/\left(\hat{\sigma}_\mu^2 + \hat{\sigma}_{\varepsilon_i}^2\right)$.

Since the underlying assumptions of fixed and random effects meta-analysis are mutually exclusive, there is a need to choose the adequate estimator for the data at hand by using statistical tests. A common test for the null hypothesis of between-study homogeneity, i.e. a between-study variance σ_μ^2 of zero, is the Q-test which is based on the χ^2-distributed Q-statistic given by

$$\mathrm{Q} = \sum_{\mathrm{i=1}}^{\mathrm{L}} w_i \hat{\gamma}_i^2 - \frac{\left(\sum_{i=1}^{L} w_i \hat{\gamma}_i\right)^2}{\sum_{i=1}^{L} w_i} \sim \chi^2(\mathrm{L}-1), \tag{4.4}$$

with all variables as defined above and w_i as the fixed effects weights.

As soon as the computed Q-statistic allows the rejection of the null hypothesis of between-study homogeneity, the simple fixed effects meta-analysis is no longer applicable. But even classical random effects meta-analysis remains limited in scope as it does not attempt to systematically explain this excess variability of primary effect size estimates.[42]

4.3 Meta-Regression Analysis

Consequently, most modern meta-studies turn to meta-regression and go beyond classical meta-analysis based on "empty models" by introducing relevant explanatory varia-

41 In regards to the estimation of σ_μ^2, Thompson and Sharp (1999) describe various estimators which are applicable. Precisely, we will rely on residual maximum likelihood (REML) techniques to estimate σ_μ^2.

42 This simple decision between fixed and random effects is further complicated by the presence of publication selection, as we find here. With publication bias, the fixed effects weighted average is less biased than random effect meta-analysis (Stanley, 2008; Stanley and Doucouliagos, 2007). Also, publication bias may, in part, be caused by selection across these random effects. In which case, all random effects meta-analyses are no longer strictly valid.

bles. Since these meta-regression models imply a conceptual extension of classical random effects meta-analyses, the underlying econometric models remain relatively straightforward. The notation chosen hereafter will take account of the fact that many meta-studies follow the suggestions by Bijmolt and Pieters (2001) to use the information from all estimated models in primary studies for meta-regressions (so-called multiple sampling).[43]

Depending on whether all the heterogeneity beyond sampling error can be systematically captured by the moderator variables, meta-regression analysis can be classified into fixed effects versus random (also called mixed) effects meta-regression.

The fixed effects meta-regression model is given by

$$\hat{\gamma}_{is} = \gamma_0 + \mathbf{x_i}\boldsymbol{\beta} + \mathbf{z_{is}}\boldsymbol{\delta} + \varepsilon_{is} \tag{4.5}$$

where $\hat{\gamma}_{is}$ represents the s^{th} effect size estimate sampled from study *i*. γ_0 is the intercept and $\mathbf{x}_i$ and $\mathbf{z}_{is}$ are vectors with respectively study-specific and model-specific variables. ε_{is} is the error term with conditional moments $E\left(\varepsilon_{is} \middle| \mathbf{x_i}, \mathbf{z_{is}}\right) = 0$ and $V\left(\varepsilon_{is} \middle| \mathbf{x_i}, \mathbf{z_{is}}\right) = \sigma^2_{\varepsilon_{is}}$.

Correspondingly, the random (also called mixed) effects meta-regression can be written as

$$\hat{\gamma}_{is} = \gamma_0 + \mathbf{x_i}\boldsymbol{\beta} + \mathbf{z_{is}}\boldsymbol{\delta} + \mu_{is} + \varepsilon_{is} \tag{4.6}$$

where $\mu_{is} \sim iid(0, \sigma^2_\mu)$ is the remaining unexplained heterogeneity.[44] All other variables are as defined in (4.5).

Generally, both fixed effects and random effects meta-regression models are estimated by WLS in order to account for heteroskedasticity. The employed analytical weights w_{is} correspond to the reciprocal conditional (nested) error term variances. In the case of a fixed effects meta-analytic framework, the nature of the heteroskedasticity is known. In analogy to the classical fixed effects analysis, it is easy to see from equation (4.5)

---

[43] The following discussion on clustered error structures could, in principle, also apply to classical meta-analysis if this were already based on multiple sampling. For brevity and clarity reasons we put the focus on meta-regression analysis. It also seems more appropriate in this context as meta-regression explicitly aims at the econometrically most refined breakdown of heterogeneity beyond sampling error.

[44] In principle, these models might be extended to more complex forms known as random coefficient models (see e.g. Goldstein, 1995). Also more than two levels might be considered. Econometrically, this affects the definition of the nested error terms.

that $\sigma^2_{\varepsilon_{is}} = V\left(\hat{\gamma}_{is} \middle| \mathbf{x_i}, \mathbf{z_{is}}\right)$. Remember that we can derive information on $V\left(\hat{\gamma}_{is} \middle| \mathbf{x_i}, \mathbf{z_{is}}\right)$ from documented primary results. Analytical weights employed in WLS estimation are thus $w_{is} = 1 \big/ \hat{\sigma}^2_{\varepsilon_{is}} = 1 \big/ \hat{V}\left(\hat{\gamma}_{is} \middle| \mathbf{x_i}, \mathbf{z_{is}}\right)$.

Furthermore, if WLS is applied to estimate a random effects meta-regression model, efficient variance weights contain an additive component. It holds that $V\left(\mu_{is} + \varepsilon_{is} \middle| \mathbf{x_i}, \mathbf{z_{is}}\right) = \sigma^2_{\mu} + \sigma^2_{\varepsilon_{is}}$. Thus, employed weights are given by $w_{is} = 1 \big/ \left(\hat{\sigma}^2_{\mu} + \hat{\sigma}^2_{\varepsilon_{is}}\right)$. As in classical random effects meta-analysis, σ^2_{μ} must be estimated in a first step. Again, $\hat{\sigma}^2_{\varepsilon_{is}}$ is generally given in the primary literature.

Estimates of model (4.6) should be preferred over those of model (4.5) if the Q-test for heterogeneity still rejects the null of no unobserved heterogeneity after the introduction of the meta-regressors.

None of the estimators outlined so far, however, explicitly account for the cluster-sample characteristics of the meta-dataset and the implied possibility of dependency of observations originating from study-specific unobserved heterogeneity. When model (4.6) is transformed, it shows a hierarchically nested error structure. Efficient estimation then has to be based on cluster-econometric techniques that account for the observation dependency within studies. The meta-analytical literature in this case often refers to hierarchical or multilevel models. As opposed to the fixed and mixed effects meta-regressions, multilevel models account for non-zero off-diagonal elements of the variance-covariance-matrix, e.g. for within-study correlation resulting from the unobserved study-specific effects. Basically, these models correspond to random effects models in cluster-econometric terms and as such can be written as

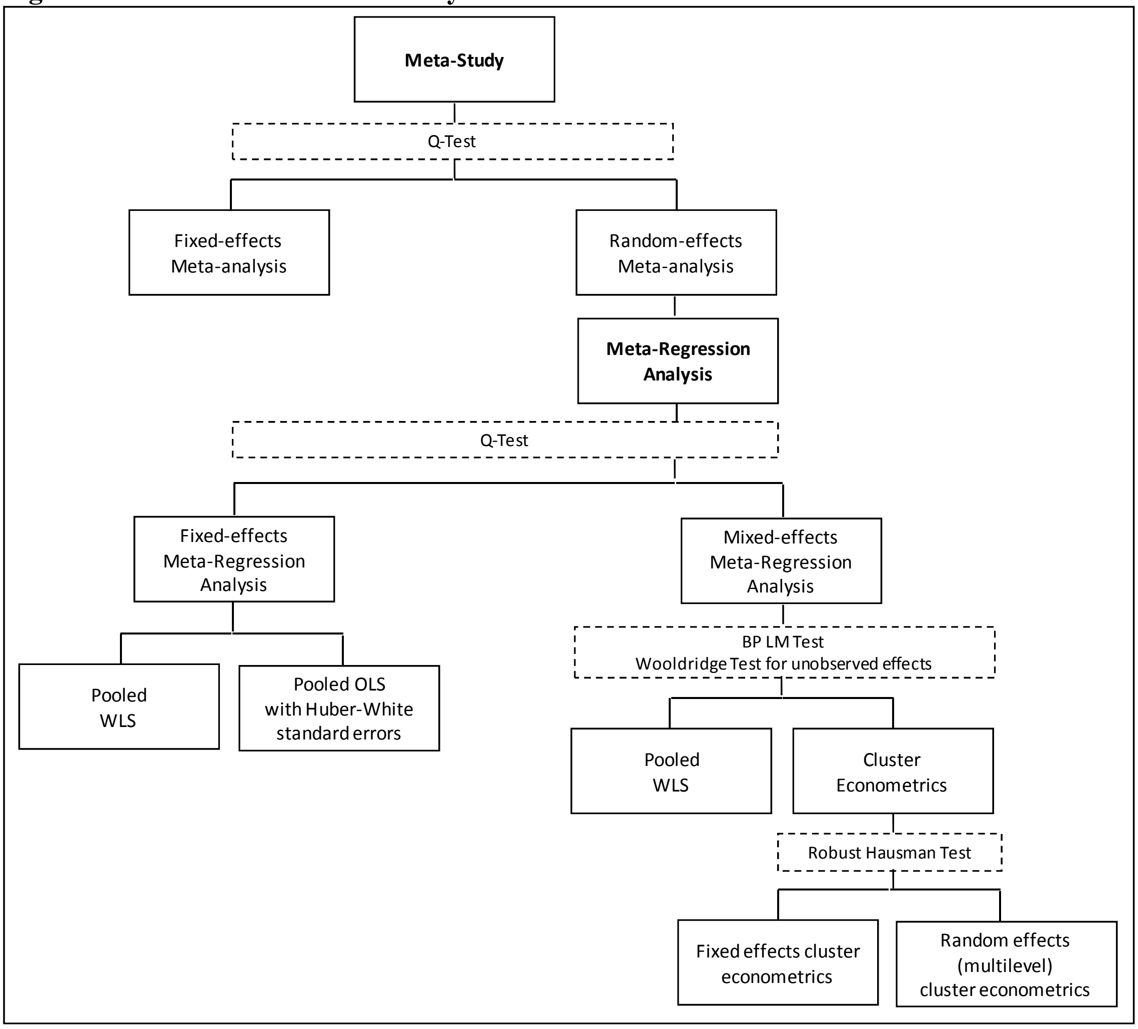
$$\hat{\gamma}_{is} = \gamma_0 + \mathbf{x_i}\boldsymbol{\beta} + \mathbf{z_{is}}\boldsymbol{\delta} + \mu_i + \varepsilon_{is} \tag{4.7}$$

with $\mu_i \sim iid(0, \sigma^2_{\mu})$ being the unobserved heterogeneity at the study-level.

Such multilevel estimation should, however, be considered with caution. If unobserved study-level heterogeneity is present, it might be correlated with the meta-regressors. Then, neither multilevel meta-analysis nor any pooled estimators will be consistent. In this case only a fixed effects cluster-econometric approach is viable. However, fixed effects estimation does not allow to identify the impact of study characteristics on the reported evidence. Following Wooldridge (2002: Ch. 11.5), it might also make sense to stick to pooled OLS but making inference robust to within-study correlation. In practice, both alternatives may be used according to the main parameters of interest (study or model level) and robustness can be checked by applying some of the alternative estimators.

Figure 4.1 shows the schema of meta-analytical estimators and their conceptual relationships. Furthermore, it indicates the tests used to choose the most suitable meta-regression estimator for the structure of the meta-data at hand.

Figure 4.1: A Schema of Meta-Analytical Estimators



4.4 Publication Selection

So far we have focused on the methodological framework integrating all meta-analytical estimators. However, another important issue in meta-analysis is the identification and remedy of publication bias.[45] Either party involved in the scientific publication process, i.e. authors as well as journal editors or reviewers, may prefer empirical results which

[45] For a concise methodological survey see Stanley (2005). Stanley has been pioneering meta-analysis in economics with a focus on publication bias (see also Stanley, 2001, 2008).

meet fundamental expectations concerning the effects and relationships assessed. Consequently, research results which in significance and/or sign do not correspond to the presumed or real standards might be doomed. In the strand of research dealing with FDI and taxation, for example, there might exist an expectation of an adverse tax effect on FDI. Fortunately, meta-analysis can assess whether unexpected results are systematically discarded from the literature and significant adverse effects are thereby over-represented.

The intuition is straightforward. If only or primarily significantly adverse estimates survive the publication process, published semi-elasticities are correlated with their primary standard errors.[46] Put differently, when effect size compensates for estimation uncertainty, results will more likely find approval and be reported. Meta-regression analyses, however, are able to provide a more fundamental backing to this idea (Stanley, 2005; Stanley, 2008; Stanley and Doucouliagos, 2007):

In the absence of publication selection, observed primary semi-elasticities should vary symmetrically around the genuine pooled effect. Any imprecision in the estimates is supposed to be purely random (see Section 4.1). In the presence of publication selection, the distribution of semi-elasticities will be truncated. Systematically dropping estimates with the "wrong" sign or low significance skews the published semi-elasticities in the desired direction. Thus, if publication selection is present, pooling the observed semi-elasticities clearly overstates the adverse tax effect on FDI.

Standard sample selection models (Heckman 1979) refer to the inverse Mills ratio in order to capture distortions in the (conditional) mean of an incidentally truncated dependent variable. However, identifying the inverse Mills ratio for each observation in the selected sample requires information about non-selected observations. By definition, information on unpublished primary results is not available to the meta-analyst. Still, an econometric remedy is available. The degree of sampling error which causes repeated estimates to scatter around the true effect depends fundamentally on sample size, which again differs between studies. Thus, the variation of estimates around the genuine semi-elasticity is clearly heteroskedastic (also see Section 4.2). Intuitively, the bias induced by truncating a random distribution of estimates, ceteris paribus, increases with its dispersion. Consequently, identification of selection bias in meta-analysis is not based on the inverse Mills ratio, but on heteroskedastic standard deviations (Stanley and Doucou-

[46] Remember that we argue based on semi-elasticities which have been pre-multiplied by -1, such that high semi-elasticities represent high adverse tax effects on FDI.

liagos, 2007). In more formal terms, classical meta-analysis is extended as follows to capture the bias in observed semi-elasticities $\hat{\gamma}_i$:

$$\hat{\gamma}_i = \gamma_0 + \rho\sigma_{\varepsilon_i}\lambda + v_i \tag{4.8}$$

γ_0 again represents the fixed true underlying effect. v_i is the disturbance term, which either represents pure sampling error (fixed effects meta-analysis), or additionally nests excess random heterogeneity (random effects meta-analysis). λ is the inverse Mills ratio, and ρ represents the coefficient of correlation between v_i and the disturbance of the underlying selection process (not shown here, for details see Greene, 2003, Ch. 22.4; or Stanley and Doucouliagos, 2007). Standard selection models in a first step identify λ for each observation i and use it for identification of the term $\rho\sigma_{\varepsilon_i}$. Though the meta-analyst has no prior information on λ, he benefits from the fact that the estimate, $\hat{\sigma}_{\varepsilon_i}$, of the primary standard error is known (see Section 4.1). Thus, some function of $\hat{\sigma}_{\varepsilon_i}$ can be employed to identify publication bias. After all the considerations, the classical meta-analysis equation extended to account for publication selection reduces to a very simple MRA:

$$\hat{\gamma}_i = \gamma_0 + \alpha\hat{\sigma}_{\varepsilon_i} + v_i \tag{4.9}$$

Testing whether $\alpha = 0$ provides for a test on the presence of publication bias. The disturbance term v_i differs according to whether meta-analytical models assume fixed or random underlying effects. In order to account for the heteroskedasticity in v_i, equation (4.9) is estimated with WLS as discussed in Section 4.2. The resulting estimate of the intercept γ_0 is regularly considered as the bias-corrected pooled effect (Sutton et al., 2000; Macaskill et al., 2001; Stanley, 2005).

Notably, the inverse Mills ratio is known to be a non-linear function of factors that determine sample selection. In particular, Stanley and Doucouliagos (2007) argue that it is not constant with respect to the primary standard error. Therefore, they propose to base the test for publication bias on squared standard errors included in the meta-analytical models.

This meta-analytic methodology of publication bias correction, of course, is not restricted to the bivariate context. It is highly advisable to integrate the correction into multiple meta-regressions. Otherwise, asymmetries in observed semi-elasticities which are due to underlying heterogeneity systematically produced by different data sets, different time periods, or different countries might misleadingly be attributed to publication selection (Stanley, 2005).

Based on simulation analyses, Stanley (2008) and Stanley and Doucouliagos (2007) show that both the linear and the non-linear model variant effectively account for publication bias in reported primary effects.

Chapter 5

A Meta-Study on FDI and Company Taxation*

5.1 Introduction

The political interest in tax competition, coordination, and harmonization has remained high in Europe for more than 45 years (see the Neumark-Report in 1963). Most recently, the EU considers harmonization of corporate taxation in form of a common consolidated corporate tax base (CCCTB) combined with formula apportionment (Weiner, 2006; Schoen et al., 2008). Not surprisingly, the scientific interest in international tax competition has considerably increased since harmonization efforts in Europe intensified, but also due to rising capital mobility in the last thirty years. Theoretical studies in public economics highlight numerous and heterogeneous conditions for tax competition to be harmful and tax coordination to be useful (see the surveys by Wilson, 1999; Feld, 2000; Wilson and Wildasin, 2004; Fuest, Huber and Mintz, 2005). Without referring to empirical evidence, no unambiguous predictions could however be obtained. The empirical literature on tax competition has consequently grown heavily in recent years leading to an abundance of empirical studies that consider the impact of taxation on patterns of capital mobility, notably foreign direct investment (FDI). These empirical studies also report heterogeneous results leaving us with a similarly diverse picture as the theoretical analyses (see the surveys by Hines, 1997, 1999; Devereux 2007b). Regarding diverse empirical results, economists could adopt meta-analytical methods to gain clearer insights as to the effects of international taxation (Jarrell and Stanley, 1989,

* This chapter draws upon Feld and Heckemeyer (2011).

2005; Stanley, 2001). De Mooij and Ederveen (2003, 2005, 2006, and 2008) pioneer this approach in the economics of international taxation. Empirical analyses on the relationship of FDI and taxation vary widely with respect to central characteristics such as data and estimation approach. Our meta-study uses this variation to explain the heterogeneity in the estimated tax response of FDI.

Precisely, we extend former meta-analyses on FDI and taxation put forward by De Mooij and Ederveen (2003, 2005, 2006, and 2008) in three ways. First, we add 16 more recent publications. Second, we code additional meta-regressor variables to address potentially important issues in research on FDI and taxation. Third, we present a structured statistical strategy to choose the meta-regression model and estimator most suitable for the meta-data at hand. Finally, this meta-study yields additional insights into the primary empirical evidence and its most important driving factors. As compared to prior surveys, this meta-analysis is based on a much broader methodological basis and a considerably richer meta-dataset.

The remainder of the chapter is organized as follows: In Section 5.2, we provide a brief review of the empirical evidence on the effect of host country corporate taxes on FDI. In Section 5.3 we present descriptive statistics of the meta-dataset. Furthermore, in Section 5.4 we set out the study characteristics coded to explain the heterogeneity in the primary evidence. Detailed results of both classical meta-analysis as well as sophisticated meta-regression analysis are discussed in Section 5.5. Finally, Section 5.6 concludes.

5.2 Qualitative Literature Review

Following theoretical analyses on the impact of international tax differentials on FDI (Fuest, Huber and Mintz, 2005), multinationals' options for location choice are the starting point for empirical analyses. In particular, studies in international economics distinguish horizontal expansions from vertical investment decisions and analyze both issues separately. Multinationals that engage in horizontal investments want to establish production abroad in order to serve local markets. In contrast, vertical investments serve to geographically allocate a company's production chain with the aim of exploiting inter-locational differences in relative factor endowments. Based on these insights, Horstmann and Markusen (1992) develop an instructive theory on horizontal FDI. They show that a multinational will locate production in direct proximity to a foreign market if the corresponding reduction of distance-related costs is advantageous as compared to the reduced potential of exploiting economies of scale at the plant-level. The more important economies of scale, the less likely local production will be, at least in small foreign countries. As for vertical FDI, Helpman (1984, 1985) argues that splitting the value chain is driven by the multinational's aim to reduce total production costs. As long as reductions in production costs, due to lower factor prices abroad, exceed corresponding set-up costs, the multinational firm will engage in foreign unskilled-labor intensive production. Coherently, Overesch and Wamser (2009) find that cost-driven vertical FDI is more tax-sensitive than horizontal cross-border investments. Markusen (1997, 2002) presents the so-called knowledge-capital model as a unified approach that explains both, horizontal and vertical, motivations for foreign investment. This model has become standard in theoretical FDI research.

Some recent empirical studies on the effect of corporate taxes on FDI refer to the above-mentioned concepts in order to come up with a theoretically solid estimation strategy (e.g. Devereux and Lockwood, 2006). Other studies opt for a gravity set-up as successfully applied in the empirical trade analyses (e.g. Bellak et al., 2009). The gravity approach explains inter-country FDI patterns through a combination of mass variables (e.g. GDP, population) and distance variables. This basic set-up is regularly augmented by presumably important policy and locational factors. These are – in addition to a measure of corporate tax levels – indicators for e.g. political risk, openness or infrastructure. Thus, they often employ sets of explanatory variables whose importance is also justified by theoretical considerations.[47]

Pioneering empirical studies on the tax sensitivity of FDI, however, relied on a very different foundation. Taking investment models based on "Tobin's q" as a starting point, these early approaches regress time-series of aggregate bilateral FDI inflows into the US on proxies for its marginal rate of return (Hartman, 1984; Boskin and Gale, 1987; Newlon, 1987; Young, 1988; Murthy, 1999).[48] As a major result, these studies report a lower tax sensitivity of FDI financed by transfers of funds as compared to FDI financed by retained earnings. Slemrod (1990) fundamentally reconsiders this prior research. In contrast to the earlier studies, he documents that retained earnings are less tax sensitive than transfers of funds. Moreover, his analysis accounts for the influence of home country taxes and considers differences in home country double taxation relief. Generally, home countries of investing multinationals may tax the parent's worldwide

[47] For a microeconomic foundation of gravity models in FDI research, see e.g. Head and Ries (2008) or Kleinert and Toubal (2010).

[48] For surveys that cover this early strand of the literature in detail see Hines (1997, 1999), De Mooij and Ederveen (2003) or Bloningen (2005).

income and credit the foreign taxes paid against the home country tax liability in order to avoid double taxation of profits (credit system). Otherwise, they only tax domestic corporate income and exempt foreign profits (exemption system). If the home country applies a credit system and taxes profits higher than foreign host countries, host country taxation is not final. Instead, the final tax burden on foreign investment income will always correspond to the home country tax rate. Thus, FDI from (high-tax) home countries applying the credit system might be less sensitive to host country taxes. Slemrod, however, does not report clear-cut results on the influence of double taxation relief. In a later study, Jun (1994) finds that the system of double taxation relief only affects the influence of the home country tax rate on FDI. Instead, Wijeweera et al. (2007) confirm presumptions that investors from exemption countries are more responsive to tax.

In addition to the question of double taxation relief, Slemrod (1990) touches upon another relevant issue in the research conducted on FDI and taxation: From a methodological point of view, it is preferable to use tax measures which reflect the forward-looking nature of investment decisions. Still, the early literature in the lines of Hartman (1984) measures the tax-induced disincentive to investment by a "backward-looking" macroeconomic average tax rate, computed as total taxes paid divided by a measure of profits. As they are based on actual tax payments after corporate tax planning or discretionary tax provisions, these tax rates capture the "true" tax burden on investments. However, by construction, such implicit tax rates are susceptible to endogeneity. If taxes paid are influenced by recent investment activity, e.g. through depreciation allowances, FDI inflows and the host country average tax rate might be simultaneously determined (Devereux, 2007b). Furthermore, simultaneity might be rooted in a high correlation of foreign affiliates' profits and retained earnings used to finance FDI (Slemrod, 1990).[49]

Forward-looking tax rates are based on neoclassical investment theory (Jorgenson, 1963) and reflect tax-induced distortions in the cost of capital. By definition they capture the disincentive to invest at the corporate decision margin. Slemrod (1990) employs forward-looking effective marginal tax rates (EMTR) as do more recent studies that calculate effective marginal tax rates according to the methodology put forward by King and Fullerton (1984) and extended by Devereux and Griffith (1999, 2003). Devereux and Griffith (1999, 2003) develop a consistent neoclassical approach to compute effec-

[49] However, macroeconomic or microeconomic implicit tax rates are still employed in a series of later studies (Grubert and Mutti, 1991, 2000; Hines and Rice, 1994; Mutti and Grubert, 2004).

tive average tax rates (EATR). These reflect national or bilateral tax incentives on the discrete choice of where to locate profitable, i.e. infra-marginal, investment projects.[50] Effective tax rates which capture cross-border tax regulations perform well in recent empirical analyses (Bellak et al., 2009; Egger et al., 2009b).

Moreover, the number of studies focusing on discrete location choices has multiplied during recent years. The reason for this is improved data availability. While US economists have had access to firm-level panel data for many years (e.g. Bartik, 1985; Papke, 1991; Swenson, 2001a), micro data for Europe has become available only recently.[51] As a consequence, a rising number of studies focus on one or both distinct stages of the transnational investment decision: discrete location choice and/or continuous choice of investment levels, underlining that the scope of investment is chosen conditional on the location decision. Studies based on aggregate FDI data can hardly disentangle these two consecutive firm choices (Devereux, 2007b).[52] Micro data studies are also appealing because they can directly refer to (tangible) fixed assets when analyzing continuous investment decisions (Buettner and Wamser, 2009a; Overesch and Wamser, 2010a). This balance-sheet item measures real economic activity more precisely than FDI in its broad definition. Aggregate FDI flows in general do not only reflect changes in the real capital stock of foreign affiliates, but they also comprise purely financial transactions (e.g. M&A) to acquire existing real capital.

An important strand of mainly the US literature, however, aggregates firm-level data on tangible fixed assets, referred to as property, plant and equipment (PPE). They thus capture real economic activity while keeping an aggregate perspective (Grubert and Mutti, 1991, 2000; Hines and Rice, 1994; Hines, 1996; Altshuler et al., 2001; Devereux and Lockwood, 2006; Bobonis and Shatz, 2007). Firm-level analysis of tax influences on discrete location choice is either based on count data approaches (Papke, 1991; Stoewhase, 2005a; Overesch and Wamser, 2009, 2010a) or latent variable models, notably conditional logit estimation (Bartik, 1985; Devereux and Griffith, 1998; Swenson, 2001a). Some authors also apply fixed effect logit estimation to their micro data panels

[50] Equally, Devereux and Griffith (1999) integrate bilateral tax regulation into the computation of effective tax rates on marginal investments.

[51] The very rich Microdatabase Direct Investment (MiDi) publicly provided by the Deutsche Bundesbank since 2003 has lead to a rising number of studies with a focus on German and European cross-border investments. In contrast, studies employing aggregate panel data have focused much earlier on European or OECD FDI patterns (e.g. Devereux and Freeman, 1995; Billington, 1999; Buettner, 2002; Gorter and Parikh, 2003; Bénassy-Quéré et al., 2005; Demekas et al., 2007; or Wolff 2007).

[52] Some studies based on aggregate data, however, employ two-stage selection methods in order to account for the sequential transnational investment decision (Razin et al., 2005; Wolff, 2007).

in order to control for unobserved firm-specific location preferences (Buettner and Ruf, 2007; Buettner and Wamser, 2009a). Unobserved variables which are possibly correlated with taxes might lead to biased estimates of the tax effect on FDI. Aggregate location conditions are supposed to be insufficiently captured by observed variables (Becker et al., 2006). Therefore, authors of both aggregate and micro panel data studies regularly control for unobserved time constant country effects in their empirical analyses. Macroeconomic time fixed effects might affect FDI patterns, as well. Consequently, in many panel data analyses, they are equally accounted for by inclusion of time dummies. Controlling for unobserved fixed effects can indeed alter the size and particularly the significance of tax effect estimates. Apparently, tax incentives can sometimes be hardly distinguishable from unobserved country and time characteristics (Wolff, 2007; Goodspeed et al., 2007).

Related to the issue of – more or less observed – location characteristics is the inclusion of public expenditure variables into regression models assessing the determinants of FDI. The impact of public spending on multinationals' investment decisions has only recently gained attention. Adopting the traditional Tieboutian (1956) perspective on inter-jurisdictional tax differences, the spending side must however not be neglected. This has been recognized by theoretical studies (Keen and Marchand, 1997; Sinn, 2003) and has been much emphasized in a recent empirical analysis by Bénassy-Quéré et al. (2007).[53] Bénassy-Quéré et al. (2007) find that the overall effect of taxation on FDI is moderated by public spending. The immediate adverse tax effect is compensated for if tax receipts finance better public inputs. Baldwin and Krugman (2004) show that agglomeration effects in geographic centers might allow governments to tax business more heavily. Some studies therefore put an additional focus on the agglomeration effects (e.g. Bobonis and Shatz, 2007; Goodspeed et al., 2007).

5.3 The Meta-Dataset

The meta-dataset used for this analysis includes 29 studies taken from the earlier meta-studies on FDI and taxation by De Mooij and Ederveen (2003, 2005, 2006, and 2008) plus 16 additional papers or journal articles. The new studies have been detected by comprehensively searching the EconLit database for empirical literature on the tax sen-

[53] If spending is broadly defined as comprising those factors which generally reflect the quality of public inputs, studies accounting for infrastructure endowment or education levels also belong to this strand ofliterature (e.g. Bellak et al., 2009).

sitivity of FDI. Precisely, we searched the database for the central keywords "FDI and tax" as well as "multinational and tax." Furthermore, we conducted internet searches and scanned appropriate journals as well as working paper series.[54]

We sample all tax effect estimates from individual primary studies. Such multiple sampling allows for more powerful tests and more accurate estimates due to a larger underlying sample as compared to single estimate sampling. Moreover, choosing one estimate from each study must rely on predefined sampling rules, which might be less than fully objective.[55] Eventually, our meta-sample contains 704 observations. This corresponds to an increase of the meta-dataset by 65% as compared to the one employed in De Mooij and Ederveen (2005, 2006, 2008).[56]

The consistent effect size index referred to in this meta-study is the tax-rate elasticity of FDI, also known as semi-elasticity. If original estimates do not conform to this index they are consistently transformed.[57] Semi-elasticities resulting from such transformation are evaluated at the sample mean of the dependent variable. Precisely, the semi-elasticity indicates the percentage change in the response variable (here: some measure of FDI) in reaction to a one percentage point change in the explanatory variable (here: some measure of the host country tax rate). It is thus a coherent and concise measure of the tax influence on FDI. Equation (5.1) illustrates this interpretation more formally:

$$\text{semi-elasticity} = \frac{\partial \ln FDI}{\partial tax\ rate} = \frac{\partial FDI}{FDI} \cdot \frac{1}{\partial tax\ rate} \tag{5.1}$$

54 Please note that we did not evaluate studies on non-EU transition or developing economies.

55 Meta-analyses based on multiple sampling of estimates are e.g. found in Feld et al. (2007), De Mooij and Ederveen (2003, 2005, 2006, 2008) and Abreu et al. (2005). The question whether one estimate or all results should be sampled from primary studies, however, is not fully beyond controversy. For a discussion of pros and cons, see e.g. Stanley (2001).

56 The sample underlying the meta-analyses in De Mooij and Ederveen (2005, 2006, 2008) comprises six more studies than exploited in De Mooij and Ederveen (2003). We evaluate and integrate these studies ourselves as we have access to the meta-sample of 2003 only. Note that one study (Bénassy-Quéré et al., 2001) contained in the 2003 sample is updated by a more recent version (Bénassy-Quéré et al., 2005). Unfortunately, we were not able to derive semi-elasticities from fixed effect logit estimates in Buettner and Ruf (2007) as well as Buettner and Wamser (2009a). Due to missing information on primary standard errors, results from fixed effect logit estimation in Barrios et al. (2009) were not included in the meta-sample, either. Furthermore, after carefully looking at the meta-data, we consider the highest and lowest percentile of tax effect estimates as outliers. Thus, we exclude them from the meta-sample (14 observations). Lastly, two estimates from Billington (1999) are excluded due to surprisingly low standard errors (<0.00015). Because these standard errors are based on only 56 observations, we regard these two estimates as "precision outliers". Both estimates together would take up a weight of more than 95% in the classical fixed effect meta-analysis based on median estimates and would thus dominate the remaining 98 percent of this research literature.

57 Linear models with a log-level specification directly produce point estimates of semi-elasticities. Other specifications yield coefficients which represent e.g. marginal effects or elasticities. Whether such transformation was required is documented in Table A.1 in the Appendix A.

The semi-elasticity of FDI with respect to tax rate changes as defined in (5.1) is expected to be negative. In order to facilitate the interpretation of results, we pre-multiply each semi-elasticity in our meta-dataset by (-1). Consequently, the higher, i.e. the more positive, the semi-elasticities reported hereafter, the more important is the implied adverse tax effect on FDI.

Table 5.1 lists the results of the literature sampling procedure. Among the 45 studies contained in the meta-dataset, 15 analyses are dated 2006 or later. The sample thus covers a considerable number of very recent contributions to the empirical evidence. References are marked with “P” if they have already been published in refereed economic journals or in a book. Referring to the number of studies, the share of published work in the meta-sample amounts to 78% (35 studies). The 592 estimates sampled from these publications make up for 84.1% of all primary estimates contained in the meta-sample. Obviously, studies differ considerably with respect to the quantity of reported semi-elasticities. Precisely, the number of estimates obtained per study varies between 2 and 95. Most importantly, the literature evaluated for the purpose of this meta-study is indeed heterogeneous with respect to reported tax effects on FDI. The mean semi-elasticity per study ranges from -1.26 in Swenson (1994) to a value of 9.80 as documented by Hines (1996). Correspondingly, both studies report extreme median estimates of respectively -2.72 and 9.99. Furthermore, the mean semi-elasticity of the overall meta-sample is 3.35. Remarkably, the median estimate amounts to a lower value of 2.49. The minimum semi-elasticity of -8.80 is sampled from Slemrod (1990). The same study also contributes the maximum estimate contained in the meta-sample (32.62). This considerable span shows that tax effect estimates are not only heterogeneous across, but also within studies. This is clearly illustrated by the study-specific standard deviations of estimates in column 7 of Table 5.1. Nine references display standard deviations exceeding a value of 5. But there are also studies which report far less dispersed semi-elasticities.

Table 5.1: Papers on the Tax Sensitivity of FDI Included in the Meta-Analysis: Reference, Number of Estimates and Descriptive Statistics

	Study	No. of estimates	Semi-elasticities Mean	Median	Min	Max	Std.Dev.
1	Altshuler et al. 2001, P	20	2.74	2.58	1.38	4.02	0.79
2	Bartik 1985, P	3	6.90	6.55	5.69	8.46	1.42
3	Bellak and Leibrecht 2007*, P	11	3.10	4.10	-0.70	6.60	3.17
4	Bellak et al. 2009*, P	11	4.48	4.90	3.60	5.50	0.77
5	Bénassy-Quéré et al. 2005** , P	17	4.79	4.00	0.20	14.29	3.75
6	Bénassy-Quéré et al. 2007*, P	19	4.13	4.38	-0.16	6.21	1.64
7	Bobonis and Shatz 2007*, P	14	1.66	1.30	-8.39	9.86	5.66
8	Boskin and Gale 1987, P	12	5.80	2.68	-0.26	21.19	7.56
9	Broekman and Vliet 2001	3	3.35	3.51	2.51	4.02	0.77
10	Buettner, 2002	23	1.48	1.59	-0.53	2.76	0.69
11	Buettner and Wamser 2009a*, P	28	1.03	1.01	-0.30	1.83	0.53
12	Cassou 1997, P	15	2.89	2.31	-3.10	10.69	3.96
13	Demekas et al. 2007*, P	8	3.31	1.30	-0.60	11.50	4.83
14	Desai et al. 2004a, P	2	0.64	0.64	0.62	0.66	0.03
15	Devereux and Freeman 1995, P	4	1.56	1.55	1.41	1.70	0.12
16	Devereux Griffith 1998, P	10	0.84	0.94	0.05	1.20	0.40
17	Devereux and Lockwood 2006*	7	0.36	0.36	0.15	0.48	0.12
18	Egger et al. 2009b*, P	20	2.62	1.92	0.06	7.78	2.43
19	Egger et al. 2009c*	6	0.46	1.62	-2.18	1.99	2.05
20	Goodspeed et al. 2007*	4	2.20	2.25	1.60	2.70	0.54
21	Gorter and Parikh 2003, P	28	4.20	4.20	-5.07	17.22	4.52
22	Grubert and Mutti 1991, P	6	1.71	1.59	0.62	3.27	1.18
23	Grubert and Mutti 2000, P	15	3.97	4.24	1.69	5.84	1.21
24	Hajkova et al. 2006*	45	2.48	2.10	-1.20	6.10	1.73
25	Hartman 1984, P	6	2.60	3.46	-2.04	4.05	2.30
26	Hines 1996, P	44	9.80	9.99	1.10	31.90	6.47
27	Hines and Rice 1994, P	3	3.72	3.33	1.24	6.59	2.69
28	Jun 1994	10	0.50	1.26	-5.89	5.39	3.17
29	Murthy 1989, P	4	0.62	0.71	-0.54	1.60	1.00
30	Mutti and Grubert 2004*, P	11	2.39	2.15	0.37	4.84	1.27
31	Newlon 1987, P	2	0.42	0.42	-3.45	4.28	5.47
32	Overesch and Wamser 2009*, P	51	2.12	2.14	-1.40	6.59	1.53
33	Overesch and Wamser 2010a*, P	12	0.97	0.93	0.55	1.33	0.25
34	Pain and Young 1996	6	1.51	1.38	0.39	2.77	1.22
35	Papke 1991, P	2	4.85	4.85	0.90	8.80	5.59
36	Razin et al. 2005*	3	2.59	3.46	0.68	3.64	1.66
37	Slemrod 1990, P	53	3.70	3.51	-8.80	32.62	7.07
38	Stoewhase 2005a**, P	14	4.74	4.41	-5.45	20.31	7.09

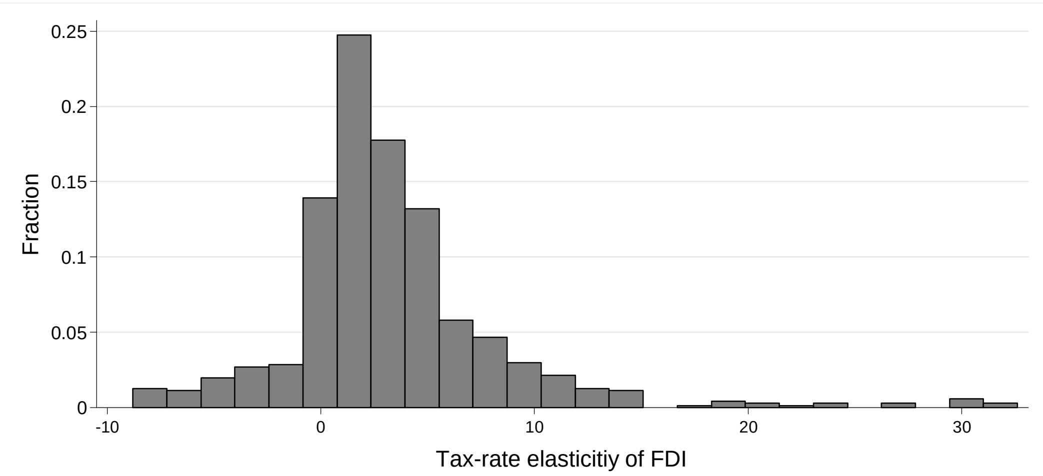
Table 5.1 (Continued)

Study		No. of estimates	Semi-elasticities Mean	Median	Min	Max	Std.Dev.
39	Stoewhase 2005b, P	14	5.26	4.30	2.08	10.78	2.71
40	Swenson 1994, P	10	-1.26	-2.72	-5.08	8.07	4.25
41	Swenson 2001a, P	95	3.95	3.19	-8.00	29.92	8.39
42	Wei 1997	5	5.20	5.00	4.67	6.19	0.64
43	Wijeweera et al. 2007*, P	8	4.90	5.57	-4.01	10.58	5.30
44	Wolff 2007*, P	8	1.35	1.55	-0.79	2.73	1.24
45	Young 1988, P	12	1.05	2.07	-5.29	9.23	4.17
	Overall	704	3.35	2.49	-8.80	32.62	5.16

Notes:
* Study is new to the meta-sample and was not subject to meta-analysis before.
** An updated study version was included as compared to De Mooij and Ederveen (2006, 2006, 2008).
P marks studies which are published in refereed economic journals or books.

The detailed sample distribution of primary tax effect estimates is depicted in Figure 5.1. Clearly, the distribution is positively skewed. The right tail of the histogram documents infrequent but fairly high tax effect estimates.

Figure 5.1: Histogram of Estimated Tax Semi-Elasticities of FDI as a Fraction of the Meta-Sample (N = 704)



As the median tells, 50% of reported semi-elasticities take on values below 2.49. Moreover, the 1st quartile of the sample distribution is as small as 0.89. Still, only 94 estimates, i.e. a sample fraction of 13.4%, are zero or negative, reflecting an attracting tax effect on FDI. Another 25% of primary estimates ranges between the median and a semi-elasticity of 4.88, representing the 3rd quartile of the sample distribution.

5.4 The Meta-Regressor Variables

Not only did we add 16 new studies to the meta-sample, we also coded additional study characteristics at the overall paper or single estimate level. Based on the insights gained from the literature review in Section 5.2, we believe these characteristics to be crucial in explaining the heterogeneity in tax effect estimates.

In particular, we try to capture model specifications in more detail; more specifically, we code for whether primary studies control for unobserved country and/or time fixed effects. As discussed in the literature review (Section 5.2) unobserved location and time characteristics might play an important role in empirical analyses on the tax sensitivity of FDI. We therefore divide primary estimations into five categories, each coded as a binary dummy variable. It takes on a value of one if the primary estimates fall under the stated category and a value of zero otherwise. We differentiate time series analyses (binary dummy: TS), (pooled) cross-section studies with control for neither country nor time fixed effects (NO_FIX), studies with control for country fixed effects only (C_FIX), studies with control for time fixed effects (T_FIX), and studies with control for both country and time fixed effects (CT_FIX).

Regarding tax burden measures employed in primary work, we classify employed effective tax rates in detail by evaluating whether the effective tax rate reflects only host country provisions or also encloses cross-border tax regulations (e.g. withholding taxes). Therefore, we code two new binary dummy variables: one for estimates based on the bilateral effective marginal tax rate (BEMTR) and one for estimates on the basis of bilateral effective average tax rates (BEATR). Instead, the two dummies EMTR and EATR respectively stand for pure host country effective marginal or average tax rates. If implicit tax rates are used, we differentiate whether these have been calculated at the macroeconomic (binary dummy MAC_ITR) or at the microeconomic level (MIC_ITR).[58] Primary regressions referring to statutory tax rates instead of implicit or effective tax burdens are captured by the binary dummy STR.

The literature review in Section 5.2 shows considerable differences in dependent variables across studies. Therefore, we precisely categorize whether a study analyzes the determinants of aggregate FDI stocks (binary dummy: FDI_STOCK), aggregate FDI flows (FDI_FLOW), foreign affiliates' fixed assets at the firm-level (FIRM_FA), for-

[58] Note that even microeconomic implicit tax rates are generally not firm-specific. Primary regressions regularly refer to the median microeconomic implicit tax rate for each host country.

eign affiliates' fixed assets at the aggregate country level (AGG_FA), counts of affiliates in foreign locations (COUNT), or discrete response variables. In line with De Mooij and Ederveen (2003), we differentiate whether studies refer to discrete investment choice in general (DISCRETE), M&A investment (DISCRETE M&A) or explicitly the creation/extension of new plants (DISCRETE PLANTS). In particular, we presume that tax semi-elasticities of FDI positions and incremental FDI are not identical. By definition, stocks should be more sluggish in reaction than flows. We also presume that results from firm-level analysis differ from those based on aggregate data. Furthermore, the classification allows analyzing if location choice is empirically more or less tax sensitive than continuous investment.

As a lot of new evidence on the tax-responsiveness of FDI patterns in Europe has emerged in recent years, we code a binary dummy for studies focused exclusively on European countries as investment targets (INVEST_EU).

Moreover, we introduce a binary dummy variable (PUB_SPEND) taking a value of one if the primary estimation controls for public spending on productivity enhancing inputs.[59] Meta-analysis offers the opportunity to put the results reported by Bénassy-Quéré et al. (2007) or Goodspeed et al. (2007) into a broader context. In econometric terms, we assess if the omission of public spending variables biases the estimated tax effects. Intuitively, we regard results from primary regressions which do not explicitly account for the expenditure side as estimates of an overall tax effect on FDI. In a specification without control for public spending, tax-financed public inputs can implicitly moderate the estimated tax impact on foreign activity. Instead, if public spending is controlled for, the expenditure side is held constant. Thus, the tax coefficient reflects the pure ceteris paribus disincentive to invest caused by the tax system. In this logic, the coefficient for the meta-regressor PUB_SPEND compares the effect taxes exert ceteris paribus on foreign investments with their overall impact after accounting for tax-financed public investments.

Other explanatory characteristics at study or estimate level are adopted from the prior meta-analyses by De Mooij and Ederveen. They can also be inferred from the literature review in Section 5.2 and are plausibly the source of the heterogeneous empirical evidence on the tax sensitivity of FDI. In detail, the list of meta-regressors contains binary dummies for the double taxation relief system employed in investors' home countries.

[59] Productivity-enhancing inputs are captured by variables reflecting e.g. infrastructure endowment, education expenses, or public investment levels in general.

The dummy CREDIT takes on a value of one if the parent country applies the credit system and zero otherwise. The dummy EXEMPT marks estimates based on firm data where parent countries exempt foreign income. Whether foreign direct investments are financed by retained earnings or transfers of funds is captured by the binary dummies FIN_RE and FIN_TR. Furthermore, the binary meta-regressors MAN and NONMAN respectively mark estimates based on investment data taken from the manufacturing industry or from non-manufacturing industries, in particular the financial and services industry. The dummies HORIZON_FDI and VERT_FDI mark estimates which exclusively refer to horizontal or vertical investment. Moreover, the PUB_SPEND variable introduced above does not remain the only dummy variable referring to controls used in primary regressions. Binary dummies also capture whether population size (POP), Gross Domestic Product (GDP), openness of the economy (OPEN), wage levels (WAGE) or agglomeration effects (AGGLO) have been controlled for in the estimation of tax effects on FDI. In particular, the latter meta-regressor AGGLO is closely related to the issues discussed in the realm of controls for public spending. As noted in the literature review, agglomeration effects might enhance private productivity and moderate the tax sensitivity of investors. Whether home country tax levels have been integrated into the primary specification is coded by the binary dummy HOME. The dummy POINT marks point estimates of the semi-elasticities where no prior transformation was required. Finally, the mean sample year and the standard error are also employed as meta-regressors.

Table 5.2 gives the integrated list of meta-regressor variables available for analysis. Furthermore, it indicates the overall number of semi-elasticities as well as the number of significant estimates showing these respective characteristics. According to the table, each characteristic seems to be sufficiently represented in the sample as to allow for its consideration in empirical meta-analysis. Moreover, the meta-sample counts 387 significant semi-elasticities which make up 55% of all 704 estimates. Generally, this pattern is also observed for the individual study characteristics. Only in a few categories, there is considerable over- or underrepresentation of significant results. Semi-elasticities based on bilateral effective average tax rates are significant in almost 100% of the observed cases.

Table 5.2: Coded Study Characteristics: Observations and Significance

	Semi-elasticities			Semi-elasticities	
	Overall	Significant		Overall	Significant
Total sample	**704**	**387**	**Total sample**	**704**	**387**
Dependent variable			**Double taxation relief**		
FDI			Credit system (CREDIT)	177	105
Stock (FDI_STOCK)	111	73	Exemption system (EXEMPT)	275	122
Flow (FDI_FLOW)	227	120	Mixed	252	160
Fixed asset positions			**Motivation for FDI**		
Aggregate (AGG_FA)	125	73	Horizontal (HORIZON_FDI)	9	5
Firm-level (FIRM_FA)	36	33	Vertical (VERT_FDI)	9	6
Counts of affiliates (COUNT)	86	36	Mixed	686	376
Discrete response			**Type of industry**		
Unspecified invest. (DISCRETE)	47	26	Manufacturing (MAN)	265	139
M&A (DISCRETE M&A)	24	7	Non-manufacturing (NON-MAN)	37	16
New plants (DISCRETE PLANTS)	48	19	Mixed	402	232
Data type/unobservables			**Target region**		
Country & time fixed effects (CT_FIX)	208	122	Only Europe (INVEST_EU)	212	129
Country fixed effects (C_FIX)	217	106	Not exclusively Europe	492	258
Time fixed effects (T_FIX)	106	65	**Type of primary tax effect**		
No fixed effects (NO_FIX)	74	53	Semi-elasticity (POINT)	262	170
Time series (TS)	99	41	Transformation required	442	217
Type of tax data			**Controls**		
Statutory tax rate (STR)	259	112	Public spending (PUB_SPEND)	159	109
Effective marginal tax rate			No control	545	278
National (EMTR)	126	60	GDP (GDP)	460	272
Bilateral (BEMTR)	51	39	No control	244	115
Effective average tax rate			Population (POP)	167	116
National (EATR)	51	32	No control	537	271
Bilateral (BEATR)	43	41	Openness (OPEN)	110	73
Implicit tax rate			No control	594	314
Microeconomic (MIC_ITR)	115	77	Agglomeration effects (AGGLO)	174	89
Macroeconomic (MAC_ITR)	59	26	No control	530	298
Source of finance			Wage level (WAGE)	158	102
Retained earnings (FIN_RE)	45	21	No control	546	285
Transfers of funds (FIN_TR)	70	30	Home country taxes (HOME)	149	81
Mixed	589	336	No control	555	306

5.5 Results

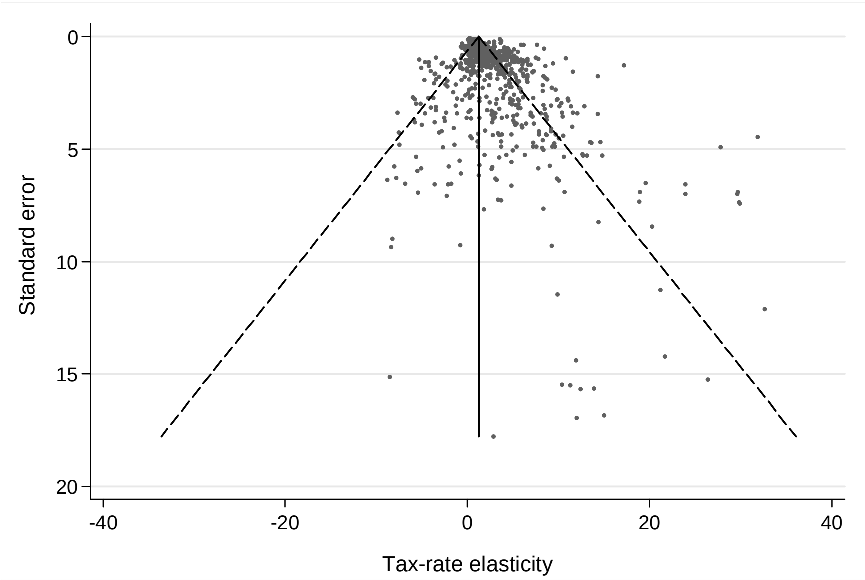
5.5.1 Classical Meta-Analysis

Before plunging into econometric analyses, we seek to get a feeling as to whether publication selection is of concern in the empirical literature on FDI and taxation. For this purpose, we resort to an illustrative graphical representation, generally referred to as the funnel plot (Egger et al., 1997). The funnel plot basically picks up the fundamental idea of publication selection outlined in Chapter 4. More precisely, it graphically plots primary effect estimates against their respective standard errors. With rising sampling error, estimated tax semi-elasticities of FDI are expected to scatter more widely. However, estimates are supposed to symmetrically disperse around the genuine empirical effect. If, instead, semi-elasticities are scattered asymmetrically, there is a first indication for publication selection.[60]

Figure 5.2 shows the funnel plot for our meta-sample of 704 estimated semi-elasticities. Interestingly, the evidence gained from the graphical representation is not clear-cut. For rather low standard errors the estimates scatter in a quite – though not perfectly – symmetrical pattern around the pooled semi-elasticity. With increasing imprecision, however, there is a tendency towards high semi-elasticities. Strikingly, almost no unexpected (i.e., attracting), tax effects on FDI are reported by studies coping with large sampling errors. One might speculate here that publication selection is more pronounced if authors or reviewers are faced with high imprecision of their estimates, making them even more eager to meet fundamental expectations.

To conclude, in all subsequent econometric analyses, we will account for publication selection using the approaches discussed in Chapter 4. However, since first indications for publication selection are not overly strong, we will also provide meta-analytical estimations without publication bias correction in order to check robustness.

Figure 5.2: Funnel Plot of 704 Estimated Tax Semi-Elasticities; Including the Pooled Fixed Effects Estimate (Solid Line) with a Pseudo 95% Confidence Interval (dashed lines)



The results of the classical meta-analysis are given in Table 5.3. The first sample contains the studies' median estimates, and the second sample is the overall meta-

60 In its logic, the funnel plot is closely related to the fixed effects model, see Stanley and Doucouliagos (2010) for details.

dataset, including all estimates extracted from the 45 studies covered. Furthermore, on each sample we estimate three models which differ in the way they account for potential publication bias (see Section 4.2 for the details). The first model we estimate does not correct for publication bias. The second copes with publication bias by including primary standard errors in the first power. The third model employs primary standard errors in squares to correct for publication selection.

Table 5.3: Results of Classical Meta-Analysis: Random and Fixed Effects, Publication Bias

Estimates sampled and meta-estimator	No publication bias correction		Publication bias correction based on					
			standard errors			squared standard errors		
	Pooled effect	CI 95%	Pooled effect	CI 95%	PB	Pooled effect	CI 95%	PB
Median Estimates								
Random Effects	**2.14**	**1.71**	**1.16**	**0.56**	**1.15**	**1.90**	**1.45**	**0.18**
	(0.00)	**-2.58**	**(0.00)**	**-1.75**	**(0.00)**	**(0.00)**	**-2.36**	**(0.02)**
Fixed Effects	1.07	0.87	0.57	0.35	1.84	1.00	0.80	0.45
	(0.00)	-1.28	(0.00)	-0.79	(0.00)	(0.00)	-1.20	(0.00)
All estimates								
Random Effects	**2.55**	**2.31**	**1.57**	**1.25**	**0.79**	**2.28**	**2.04**	**0.09**
	(0.00)	**-2.79**	**(0.00)**	**-1.91**	**(0.00)**	**(0.00)**	**-2.53**	**(0.00)**
Fixed Effects	1.24	1.13	0.77	0.64	1.52	1.19	1.08	0.18
	(0.00)	-1.35	(0.00)	-0.90	(0.00)	(0.00)	-1.30	(0.00)

Notes:
Pooled effects are from fixed and random effects meta-analysis (WLS). CI 95% represents 95% confidence interval limits. PB (Publication bias) shows coefficients $\hat{\alpha}$ for standard error or squared standard error respectively. P-values are given in parenthesis.
Preferred estimates are from random effects meta-analysis. Results from Q-test for each considered combination of sample and specification are available upon request.

In each case, we run both a pooled fixed effects as well as a pooled random effects classical meta-analysis, giving the estimated pooled semi-elasticities, $\bar{\gamma}$.[61] In addition, we report corresponding p-values and the 95% confidence limits for the pooled semi-elasticity. The coefficients, $\hat{\alpha}$, on the standard errors indicate the presence of publication selection. In all cases, the Q-test easily rejects the null hypothesis of no heterogeneity beyond sampling error at all common significance levels. Thus, the Q-test provides evidence for using the random effects meta-analysis. Results based on random effects meta-analysis are therefore highlighted in Table 5.3. Moreover, we will primarily refer to these random effects estimates when discussing the results of the classical meta-analysis.

Turning to the detailed results, Table 5.3 documents that the pooled tax semi-elasticity of FDI is indeed statistically significant ($p < 0.01$) no matter how it is calcu-

[61] Based on the "all estimates" sample, we also ran regressions taking into account fixed cluster, i.e. study, effects.The results, which are available upon request from the authors, are very close to the pooled random effects estimates shown in Table 5.2.

lated. This result is highly robust to varying samples as well as different forms of publication bias correction. We find that the pooled semi-elasticity estimated on the full meta-sample ($\bar{\gamma}$ = 2.55) is close to the one obtained from the sample of median results ($\bar{\gamma}$ = 2.14), as long as publication selection is not accounted for. If publication selection is (linearly) controlled for, bias-corrected pooled semi-elasticities shrink considerably as compared to the uncorrected results. The sample of median estimates in this case yields a pooled semi-elasticity of 1.16, while the pooled effect obtained from the full meta-sample amounts to only 1.57.[62]

However, Stanley and Doucouliagos (2007) note that pooled effect estimates may be biased downwards in the case of linear publication bias correction, i.e. when standard errors enter the meta-analytical model rather than their squares. Furthermore, they show that this bias is largely remedied when the included standard errors are squared. Looking at the results from the model including squared standard errors, publication bias corrected pooled effects are indeed less slashed than in the case of linear correction. Although publication selection still turns out to be statistically significant, pooled effects are rather close to those from the uncorrected model.

In sum, the pooled tax semi-elasticity of FDI is highly significant. High host country tax rates indeed cause a disincentive to invest in that country. Furthermore, there seems to be statistically significant publication selection in the literature on FDI and taxation. The induced bias in reported tax effects on FDI is, however, "economically small".

5.5.2 Meta-Regression Analysis

The meta-analytic schema as set out in detail in Section 4.3 suggests a coherent strategy to find the most suitable meta-regression estimator (see Figure 4.1). The list of relevant characteristics at the study and estimate level was given in Section 5.4 (see Table 5.2). All meta-regressions use the full meta-sample of 704 primary semi-elasticities.

First, we will explicitly test for presence of unobserved cluster effects. More specifically, we do not solely argue based on the results of a standard Breusch-Pagan LM test. Instead, we additionally employ a test proposed by Wooldridge (2002, Ch. 10.4.4) which is in particular robust to heteroskedasticity of the regression error terms.

---

[62] If the two precision-outlying estimates drawn from Billington (1999), see remarks in footnote 56, are included, pooled semi-elasticities based on medians go down to 0.13 (no publication bias control), 0.08 (linear publication bias control) and 0.13 (non-linear publication bias control). Almost the same reduction is observed for the "all estimates" sample. In contrast, random effects estimates turn out to be robust to these 'precision outliers.'

Under the null hypothesis of no within-cluster correlation, this statistic is distributed asymptotically as standard normal. Not rejecting the null clearly advocates the use of pooled estimators. The test statistic's null distribution, however, is only asymptotically valid. With $N = 45$ studies we are clearly at the lower bound of the sample size needed for reliable asymptotic inference. Still, we are confident that the test yields important insights.

If there is evidence for unobserved study-specific heterogeneity, we check whether the nested error is uncorrelated with the meta-regressors. The standard tool in this regard, i.e. the Hausman test, is not robust to heteroskedasticity in the disturbances. Therefore, we alternatively propose the robust artificial regression approach described in Wooldridge (2002, CH. 10.7.3) to test the null hypothesis of no correlation between individual error component and the independent variables.

Table 5.4: Tests to Identify the Preferred Meta-Regression Estimator

	Unobserved heterogeneity at the study level?		**Excess heterogeneity at the primary estimate level?**
Test:	**(1)** **Breusch Pagan LM Test**	**(2)** **Wooldridge Test**	**(3)** **Q-Test**
H0 Hypothesis:	*No unobserved effects*	*No unobserved effects*	*No excess heterogeneity*
Specification 1 No control publication bias	BP = 0.30 p-value: 0.585	WO = -0.451 p-value: 0.652	Q = 2565.83 p-value: 0.000
Specification 2 Control for publication bias (linear)	BP = 0.64 p-value: 0.424	WO = -0.739 p-value: 0.460	Q = 2398.53 p-value: 0.000
Specification 3 Control for publication bias (squared)	BP = 1.26 p-value: 0.262	WO = -1.001 p-value: 0.317	Q = 2480.35 p-value: 0.000

Notes:
BP, WO and Q denote test statistics of the BP LM test, the Wooldridge-type test and the Q-test respectively. P-values are given below the test statistics.
1. Study-specific unobserved effects: The Breusch Pagan LM test and the Wooldridge-type test assume a *null* of no unobserved study-specific effects. Under the null the Breusch Pagan LM test is χ^2-distributed, while the Wooldridge-type test is asymptotically distributed as standard normal under the null. Both tests do not reject the null at standard significance levels.
2. Excess heterogeneity at primary estimate level: The Q-test is based on a test statistic which is χ^2-distributed under the null of no excess heterogeneity. Here, the null of no *heterogeneity* is rejected at very high significance levels.

Table 5.5 (at the end of this section) shows the results of the meta-regression analysis. Reported coefficients represent ceteris paribus changes in the expected tax semi-elasticity on FDI, if the respective binary meta-regressor variable switches from zero to one. Put differently, coefficients depict the expected effect on estimated semi-elasticities triggered by a deviation from a pre-defined benchmark model. For each family of characteristics at the study and estimate level, the respective benchmark characteristics is indicated in parenthesis. Only a few meta-regressor variables are continuous (standard error, squared standard error, and the mean sample year). Accordingly, their coefficients represent standard marginal effects.

Table 5.5 reports results for three different specifications which again are estimated by three different estimators. Similar to the classical meta-analysis, the first model does not account for publication selection. Both other specifications, however, include a term which captures possible bias from publication selection. Again, one of these models includes primary standard errors in the first power, while the second model includes them in squares. We apply three pooled estimators to these specifications. Both the standard Breusch Pagan LM test for unobserved effects as well as the Wooldridge test for unobserved effects provide no indication for unobserved study-specific heterogeneity. Both tests do not reject the null hypothesis of no cluster effects at any common significance level for any specification. Test results are given in Table 5.4.

We conclude that the comprehensive list of meta-regressor variables sufficiently explains study-level heterogeneity. Therefore, our estimation techniques do not have to account for any cluster effects. As the results of a Q-test tell, there is, however, unobserved heterogeneity at the estimate level (Table 5.4, column 3). Clearly, the meta-data show properties of a mixed effects meta-regression model. Thus, our preferred estimator is mixed effects pooled WLS, accounting for the excess heterogeneity in its weighting scheme. Still, we are interested in the robustness of results to the application of less efficient estimators. Therefore, we additionally resort to fixed effects meta-regression (pooled WLS) as well as simple pooled OLS. In contrast to the WLS estimators, pooled OLS does not remedy the inherent heteroskedasticity of the meta-regression disturbances. Therefore, we base statistical inference on robust Huber-White standard errors.[63] Pooled OLS has been used to estimate prior meta-analyses of the empirical evidence on the relationship of FDI and taxation (De Mooij and Ederveen, 2003, 2005, 2006, 2008).

---

[63] We also ran a standard RESET test on all three specifications employed. The results forced us to reject the null of correct specification. We truncated our meta-sample at its high end and successively reran the test until the null is no longer rejected. Considering the results from meta-regressions on this truncated sample, no qualitative differences occur with respect to the insights obtained on the basis of the full meta-sample.

Thus, OLS results reported in Table 5.5 are directly comparable and should isolate the mere effect of considerably updating the meta-database.

Table 5.5 reveals that most coefficients are indeed robustly estimated across all specifications and estimators.[64] Notably, we find robust evidence for publication selection in the research strand focusing on the tax semi-elasticity of foreign investment. Independent of the power of the standard error, respective coefficients are significantly different from zero according to all estimates run. In addition, meta-regression analysis permits detailed conclusions on underlying sources of heterogeneity beyond publication bias. Although out-of-sample predictions must be interpreted with care, researchers might want to get a feeling for the existing evidence. The detailed results are organized in the following broad topics:

Results for Type of Data Employed and Treatment of Unobservables

FDI stocks are more sluggish than incremental FDI flows. What is intuitively clear, gets confirmed by our meta-regression results. Moreover, the types of investment subject to primary analyses might vary in tax-responsiveness. Fixed assets reflect investment in real productive capital, while FDI in its broad definition also contains financial transactions. The pooled OLS results without publication bias correction (Table 5.5, column 1) indeed suggest aggregate fixed asset positions to be more tax responsive than mixed capital data such as broadly defined FDI. This has been documented before by De Mooij and Ederveen (2008). The result is, however, not robust to control for publication selection and weighting for the precision of the estimates. Both fixed and mixed effects meta-regressions suggest that tax effects on aggregate financial assets are not different from those on aggregate FDI in its more general definition. Instead, meta-regression results underscore that studies using firm-level information on fixed assets produce particularly small semi-elasticities. We conclude that the level of aggregation seems to play a more important role for estimated tax effect sizes than the composition of examined capital data.

Table 5.5 also documents that discrete response models generally produce small semi-elasticities. However, this result is not confirmed for studies exploiting counts of foreign affiliates (Table 5.5, columns 7-9). We thus hesitate to attribute the negative coefficients for the discrete choice dummy to a particularly low tax-responsiveness of

---

64 As the evidence is fairly robust across estimators, there is no need to restrict the focus on only one of them. If for some issues the insights gained from the meta-regressions are ambiguous, we will primarily refer to our preferred estimator, i.e. mixed effects WLS.

location choices in general. Instead, the level of aggregation might again make the difference. Count data models most often refer to aggregate counts, while discrete choices are, by definition, examined at the micro level.

Last but not least, discrete choice analyses identify a pronounced difference in tax-responsiveness between M&A transactions and real capital investments in plants. While conforming to earlier findings of De Mooij and Ederveen (2003, 2005, 2008), this result is somewhat contrary to the reported equivalence of the tax sensitivity of aggregate FDI in its broad definition and aggregate fixed assets. We conclude that any heterogeneous tax effects on discrete real and financial capital investments apparently disappear in comprehensive FDI statistics. These do not only mix real productive investments with financial transactions, but arise from both discrete and continuous investment decisions.

Data Structure and Control for Unobserved Effects

The regression results confirm that the treatment of unobservables in primary studies significantly influences outcomes. The benchmark study set in the meta-regressions relies on panel data with full control for country and time fixed effects. The tax-responsiveness of FDI reported on the basis of this econometrically prudent model indeed drops behind what is documented in econometrically less conservative estimates. Either of the binary dummies for time series analysis or pooled estimations is robustly significant and positive. Both set-ups do not econometrically capture any potential unobserved error components. Obviously, these play a role. Which effects are at work here might become clearer when considering the coefficients for the two remaining binary dummies in this category of study characteristics. Studies exclusively controlling for time fixed effects do not produce results different from those obtained from the benchmark specification. Instead, semi-elasticities gained from specifications which exclusively control for country fixed effects are systematically larger than the benchmark estimates with full control for country and time fixed effects. We conclude that unobserved aggregate location factors are less of a concern than general macroeconomic time trends. If these are econometrically captured by time dummies, the partial effect of taxation on FDI patterns becomes significantly less discernible.

The Type of Tax Data

The meta-regression coefficients shown in Table 5.5 reveal that the bilateral effective average tax rate (BEATR) very effectively captures the disincentive on FDI caused by the tax system. Interestingly, the pure host country effective average tax rate (EATR) does not lead to significantly different semi-elasticities as compared to the benchmark study which is set to use statutory tax rates. While it contrasts with earlier findings of De Mooij and Ederveen (2003, 2006), this result is plausible. Both the statutory tax rate and the EATR are indeed highly correlated. Excess returns are effectively taxed at statutory rates. Thus, on highly profitable investments the statutory tax rate determines large parts of the effective tax burden. We conclude that the inclusion of bilateral tax regulations into the effective tax rate makes the difference. Reflecting the findings of Egger et al. (2009b), bilateral effective tax rates are successfully tailored to capture tax incentives on cross-border investments.

The results with respect to effective marginal tax rates are less clear-cut. The coefficient for application of the national EMTR in primary studies shows a negative sign in all meta-regressions. It is, however, not statistically different from zero in some of the specifications. The mixed effects meta-regression estimates which control for publication selection (Table 5.5, Columns 8-9) do not show a significant difference in semi-elasticities as compared to studies employing statutory tax rates. While equally not robust across all meta-regression estimates, the coefficients for the use of bilateral effective marginal tax rates are instead positive according to pooled OLS and mixed effects results. Integration of bilateral tax regulation seems to foster the identified intensity of adverse tax effects on cross-border investments. Importantly, results suggest that the tax sensitivity of FDI is less pronounced for both bilateral and national effective marginal tax rates as compared to the effective average tax rates. In accordance with De Mooij and Ederveen (2008) we carefully interpret these results as indication for continuous investments being at least slightly less responsive to taxes than discrete location decisions. However, tax incentives on marginal investments might in general be more difficult to capture than tax effects on the location of discrete infra-marginal investment projects.

As for the impact of using macroeconomic or microeconomic implicit tax rates in primary analyses, fixed effects meta-regressions report significant and positive coefficients for microeconomic ITR; pooled OLS results suggest significant and negative coefficients for macroeconomic ITR. These results are, however, not confirmed by the mixed effects meta-regressions. Although arguably prone to endogeneity problems, backward-looking measures of the average tax burden on investments thus do not seem to systematically distort empirical outcomes.

Public Spending

Strikingly, we do not identify a significant omitted variable bias if the expenditure side is not controlled for. In other words, public spending implicitly adjusting to tax changes does not moderate tax effects as compared to specifications which explicitly control for the provision of public inputs. This result contradicts theoretical presumptions. It might, in part, be explained by hitherto insufficiently precise proxies for relevant public inputs. Possibly, these do not effectively capture effects arising from the provision of public infrastructures. On the other hand, the link between corporate taxes and public infrastructure endowments might be too weak to translate into empirical effects.

Europe as FDI Target Region

We also test whether tax effects significantly differ if studies focus exclusively on European countries. The benchmark model is defined by those studies which examine a mix of regions, typically a broad set of OECD countries, or put a focus on the US. According to results from mixed effects meta-regression, however, estimated adverse tax effects on FDI do not significantly differ depending on the target region.

Further Characteristics of Exploited Data and Employed Specifications

The meta-regression specifications documented in Table 5.4 include a number of meta-regressor variables reflecting further study characteristics which in particular refer to the underlying data or controls (see Section 5.4). Generally, most of our results are in line with earlier findings by De Mooij and Ederveen. The results from recent studies added to the meta-sample thus do not stand in contrast with the earlier evidence.

Notably, we find that semi-elasticities increase with average sample years underlying the primary estimates. However, the qualifications put forward by De Mooij and Ederveen (2008) apply. Increasing tax semi-elasticities over time might plausibly be attributed to ever increasing capital mobility. However, improvements in econometric techniques can also lead to more pronounced empirical tax effects on FDI.

Furthermore, the type of industry assessed in primary analyses is at the source of heterogeneity in reported empirical evidence. Investment responses to tax changes are more pronounced for analyses with a focus on manufacturing industries as compared to studies exploiting mixed data. Surprisingly, the same result holds for studies which examine non-manufacturing industries. Probably, many analyses focusing on non-manufacturing firms actually use datasets which do not cover the exact complement to manufacturing industries. Thus, it should be highly mobile financial and service companies which drive the results for "non-manufacturing" data samples.

If primary studies focus on a specific business motivation for engaging in foreign activity, results are not systematically different from studies not specifying any motivations. Reported coefficients in Table 5.5 are smaller for horizontal FDI as compared to vertical FDI. For pooled OLS meta-regressions (Table 5.5, columns 1-3), the coefficient on horizontal FDI is negative, though insignificant. These differences in coefficient magnitude reflect the results by Overesch and Wamser (2009), who report vertical FDI to be more sensitive to tax.

There is no empirical consensus about the impact of home country tax relief on the tax sensitivity of investment choices. According to the mixed effects meta-regressions, neither a focus on investors from credit countries nor a focus on multinationals exclusively headquartered in exemption countries leads to systematically different semi-elasticities as compared to mixed data.

Insights on the tax-responsiveness of differently financed investments are corroborated as well. Meta-regression results in Table 5.5 document that investments financed by transfers of funds turn out to be less affected by host country taxes. No robust insights are obtained for the impact of most variables in our list of controls (GDP, population, agglomeration effects) which might be correlated with tax. However, we find that identified tax effects on FDI are significantly reduced as soon as the openness of the host economy is controlled for. This is indeed plausible. Winner (2005) shows that economic openness is negatively related to the tax burden on capital. In the case of no control for openness, the FDI enhancing effect of economic openness might be mistakenly attributed to low taxes.

The meta-dummy reflecting control for home country taxes in primary regressions displays a negative coefficient, as well. However, the effect is not significant in the case of mixed effects meta-regression. Finally, point estimates of semi-elasticities drawn from primary studies do not robustly differ from those semi-elasticities which were obtained by transformation.

Table 5.5: Results of Meta-Regression Analysis

Standard errors (in the case of WLS estimation) or robust Huber-White standard errors (POLS estimation) are given in parentheses. ***/**/* denotes significance at the 1%/5% /10% level. Primary semi-elasticities haven been pre-multiplied by (-1). All study/model characteristics except "standard error" and "sample mean" are coded as dummy variables. Dummy variable names as described in Section 3.2 are given in block capitals. A benchmark model represents the characteristics redundant to the variables explicitly included. The benchmark characteristics are indicated in parenthesis for each study dimension, written in bold letters. Estimated coefficients of the dummies indicate the effect on primary semi-elasticities of choosing a characteristic in lieu of the benchmark specification. Preferred estimates are from random effects meta-regressions (WLS).

Dependent variable: Semi-elasticities	**Pooled OLS**			**Fixed effects meta-regression (Pooled WLS)**			**Mixed effects meta-regression (Pooled WLS)**		
	No correction for publication bias	Publication bias correction based on standard errors	Publication bias correction based on squared standard errors	No correction for publication bias	Publication bias correction based on standard errors	Publication bias correction based on squared standard errors	No correction for publication bias	Publication bias correction based on standard errors	Publication bias correction based on squared standard errors
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Dependent variable (FDI stocks)									
FDI flows, FDI_FLOW	2.850***	2.276***	2.550***	1.305***	1.085***	1.199***	1.706***	1.386***	1.530***
	(0.716)	(0.696)	(0.690)	(0.376)	(0.365)	(0.371)	(0.530)	(0.513)	(0.515)
Firm Assets, FIRM_FA	-1.978**	-0.998	-1.734*	-1.632***	-1.470***	-1.680***	-1.838***	-1.383**	-1.743**
	(0.987)	(0.906)	(0.899)	(0.440)	(0.427)	(0.433)	(0.709)	(0.684)	(0.686)
Aggregate Assets, AGG_FA	2.462***	0.705	1.073	-0.442	-0.434	-0.514	0.203	-0.160	-0.162
	(0.871)	(0.849)	(0.859)	(0.408)	(0.395)	(0.402)	(0.620)	(0.600)	(0.605)
Counts of foreign affiliates, COUNT	1.097	0.253	0.725	-0.727*	-1.091***	-0.874**	0.063	-0.350	-0.176
	(1.071)	(1.011)	(1.025)	(0.409)	(0.400)	(0.404)	(0.598)	(0.579)	(0.581)
Discrete choice, DISCRETE	-1.591	-2.287**	-2.220**	-2.368***	-1.947***	-2.341***	-2.213***	-2.173***	-2.370***
	(1.128)	(1.039)	(1.051)	(0.501)	(0.489)	(0.493)	(0.738)	(0.711)	(0.717)
DISCRETE M&A	-7.190***	-8.462***	-7.837***	-7.407***	-8.462***	-7.988***	-8.005***	-8.848***	-8.551***
	(1.883)	(1.741)	(1.783)	(1.146)	(1.119)	(1.134)	(1.084)	(1.062)	(1.063)
DISCRETE PLANTS	3.589**	2.213	2.908*	3.252***	1.858*	2.469**	2.656***	1.612*	1.989**
	(1.598)	(1.472)	(1.506)	(0.983)	(0.973)	(0.981)	(0.959)	(0.946)	(0.943)

Table 5.5(continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Data structure/ Unobservables (Panel with country and time fixed effects)									
Time series, TS	2.562**	0.908	1.528	2.423***	2.259***	2.364***	2.425***	1.975***	2.137***
	(1.163)	(1.178)	(1.147)	(0.484)	(0.469)	(0.476)	(0.743)	(0.719)	(0.722)
No fixed effects, NO_FIX	2.445***	2.790***	2.577***	1.215***	1.131***	1.239***	1.854***	1.905***	1.936***
	(0.546)	(0.541)	(0.535)	(0.240)	(0.233)	(0.237)	(0.417)	(0.402)	(0.405)
Time fixed effects, T_FIX	-1.132**	-0.566	-0.701	0.220	0.0118	0.202	-0.259	-0.202	-0.123
	(0.499)	(0.501)	(0.494)	(0.166)	(0.163)	(0.163)	(0.343)	(0.329)	(0.332)
Country fixed effects, C_FIX	1.954***	2.025***	1.949***	0.611**	0.581**	0.607***	1.556***	1.460***	1.561***
	(0.555)	(0.540)	(0.536)	(0.237)	(0.229)	(0.233)	(0.386)	(0.372)	(0.374)
Type of tax data (Statutory tax rate)									
EMTR	-1.233**	-0.594	-0.874	-0.445*	-0.466**	-0.401*	-0.666*	-0.483	-0.508
	(0.546)	(0.551)	(0.548)	(0.230)	(0.222)	(0.226)	(0.375)	(0.362)	(0.365)
Bilateral EMTR, BEMTR	0.836**	1.206***	0.860**	-0.165	-0.026	-0.111	0.602	0.808**	0.674*
	(0.388)	(0.384)	(0.373)	(0.244)	(0.237)	(0.240)	(0.402)	(0.387)	(0.389)
EATR	0.138	0.709	0.373	0.132	0.064	0.140	-0.013	0.137	0.114
	(0.465)	(0.444)	(0.449)	(0.187)	(0.181)	(0.184)	(0.392)	(0.377)	(0.380)
Bilateral EATR, BEATR	3.355***	3.484***	3.307***	1.517***	1.454***	1.531***	2.572***	2.507***	2.583***
	(0.520)	(0.521)	(0.511)	(0.287)	(0.278)	(0.282)	(0.445)	(0.428)	(0.431)
Microeconomic ITR, MIC_ITR	-1.310**	-0.688	-0.890	0.496*	0.544**	0.525**	-0.368	-0.212	-0.218
	(0.630)	(0.623)	(0.630)	(0.261)	(0.253)	(0.257)	(0.389)	(0.376)	(0.379)
Macroeconomic ITR, MAC_ITR	-2.152*	-1.640	-1.911*	-0.594	-0.126	-0.420	-0.844	-0.422	-0.645
	(1.189)	(1.078)	(1.112)	(0.462)	(0.452)	(0.456)	(0.602)	(0.584)	(0.585)
Double taxation relief (Mixed)									
Credit System, CREDIT	-0.191	-0.623	-0.335	0.175	0.377	0.189	0.371	0.337	0.312
	(0.546)	(0.565)	(0.544)	(0.289)	(0.281)	(0.285)	(0.381)	(0.368)	(0.370)
Exemption system, EXEMPT	2.011***	0.458	1.143**	-0.475**	-0.519**	-0.558**	0.196	-0.350	-0.194
	(0.618)	(0.571)	(0.560)	(0.234)	(0.227)	(0.231)	(0.357)	(0.355)	(0.353)

Table 5.5 (continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Type of industry (Not specified)									
Manufacturing, MAN	1.635***	1.941***	1.794***	0.475	0.607**	0.537*	1.338***	1.358***	1.390***
	(0.544)	(0.493)	(0.507)	(0.315)	(0.305)	(0.310)	(0.386)	(0.373)	(0.375)
Non-manufacturing, NONMAN	1.148	1.166	1.160	2.178***	2.349***	2.240***	1.885***	1.948***	1.919***
	(0.859)	(0.862)	(0.843)	(0.371)	(0.360)	(0.365)	(0.497)	(0.479)	(0.482)
Motivation for FDI (Mixed)									
Vertical FDI, VERT_FDI	0.227	0.402	0.293	0.854	0.649	0.850	0.661	0.680	0.722
	(0.446)	(0.494)	(0.464)	(0.812)	(0.787)	(0.799)	(0.831)	(0.802)	(0.807)
Horizontal FDI, HORIZON_FDI	-0.442	-0.0738	-0.352	0.203	0.253	0.262	0.016	0.230	0.124
	(0.449)	(0.511)	(0.467)	(0.641)	(0.620)	(0.631)	(0.776)	(0.747)	(0.752)
Type of Finance (Mixed)									
Retained earnings, FIN_RE	2.422	2.477*	2.130	-0.385	-0.0729	-0.276	0.433	-0.0545	-0.233
	(1.537)	(1.440)	(1.401)	(0.379)	(0.370)	(0.374)	(0.615)	(0.596)	(0.598)
Transfers of Funds, FIN_TR	-1.041	-0.647	-0.912	-0.714**	-0.419	-0.610*	-1.103**	-0.881*	-0.948**
	(0.720)	(0.776)	(0.743)	(0.322)	(0.314)	(0.317)	(0.484)	(0.467)	(0.470)
FDI Target Regions (Not exclusively Europe)									
Europe, INVEST_EU	-0.816	0.012	-0.406	-0.862***	-0.643***	-0.794***	-0.545	-0.259	-0.391
	(0.528)	(0.505)	(0.506)	(0.247)	(0.241)	(0.243)	(0.355)	(0.344)	(0.345)
Control Variables (Not included)									
Publics spending, PUB_SPEND	-0.002	0.330	0.174	0.155	0.175	0.162	-0.042	-0.000	-0.00837
	(0.407)	(0.410)	(0.401)	(0.218)	(0.211)	(0.214)	(0.302)	(0.291)	(0.293)
GDP	-1.189*	-0.560	-0.880	-0.0155	0.166	0.022	-0.427	-0.251	-0.291
	(0.640)	(0.631)	(0.621)	(0.273)	(0.265)	(0.269)	(0.379)	(0.366)	(0.368)
Population size, POP	1.385**	1.175**	1.363**	0.387	0.185	0.328	0.921**	0.732*	0.850**
	(0.595)	(0.570)	(0.565)	(0.261)	(0.254)	(0.257)	(0.427)	(0.411)	(0.414)
Openness, OPEN	-2.061***	-1.761***	-1.860***	-1.381***	-1.383***	-1.379***	-1.795***	-1.716***	-1.764***
	(0.447)	(0.461)	(0.443)	(0.270)	(0.262)	(0.266)	(0.392)	(0.377)	(0.379)

Table 5.5 (continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Agglomeration effects, AGGLO	-1.632***	-0.812	-0.972	0.545*	0.616**	0.594*	-0.426	-0.221	-0.243
	(0.610)	(0.650)	(0.641)	(0.307)	(0.298)	(0.303)	(0.407)	(0.394)	(0.396)
Wage level, WAGE	1.136**	0.474	0.895*	-0.111	0.006	-0.0825	0.727**	0.565	0.607*
	(0.525)	(0.521)	(0.505)	(0.231)	(0.224)	(0.227)	(0.363)	(0.351)	(0.353)
Control for home taxes, HOME	-0.597	-1.304*	-1.027	-0.614*	-0.636*	-0.649*	-0.446	-0.641	-0.603
	(0.825)	(0.787)	(0.775)	(0.337)	(0.326)	(0.331)	(0.429)	(0.415)	(0.417)
Mean sample year	0.127**	0.089*	0.093*	0.163***	0.161***	0.165***	0.114***	0.116***	0.115***
	(0.0502)	(0.048)	(0.0485)	(0.019)	(0.019)	(0.0190)	(0.032)	(0.0308)	(0.031)
Publication bias									
Standard error		0.646***			0.873***			0.685***	
		(0.161)			(0.128)			(0.115)	
Squared standard error			0.036***			0.110***			0.081***
			(0.012)			(0.0229)			(0.015)
Primary tax effect (transformation required)									
Semi-elasticity (POINT)	-0.826	-0.451	-0.696	-0.924***	-0.518**	-0.814***	-0.699*	-0.427	-0.592
	(0.595)	(0.577)	(0.580)	(0.255)	(0.254)	(0.252)	(0.372)	(0.361)	(0.361)
Constant	-250.3**	-176.4*	-183.3*	-323.0***	-319.4***	-327.1***	-225.7***	-230.1***	-226.5***
	(99.57)	(95.86)	(96.24)	(38.25)	(37.01)	(37.64)	(63.54)	(61.06)	(61.53)
N	704	704	704	704	704	704	704	704	704
R^2	0.278	0.337	0.321	0.587	0.614	0.601	0.336	0.372	0.366
F-test (H0: all coefficients = 0)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

5.6 Conclusions

Tax competition and harmonization are among the central themes in public economics. Proof of this contention is the ever increasing amount of theoretical and empirical studies. Although meta-analyses of these empirical studies exist, we provide new insights on the implications of publication selection, data type and aggregation, treatment of unobserved effects, the type of tax data employed as well as the moderating influence of control variables, in particular public spending, on the estimated tax rate effects on FDI.

The median tax semi-elasticity of FDI based on 704 primary estimates is 2.49 in absolute terms. The precision weighted average of the full sample of semi-elasticities is 2.55, again in absolute terms. Remarkably, our meta-analysis finds robust evidence for publication selection in the primary literature. Accommodating this publication selection reduces this semi-elasticity to 2.28 or even down to 1.19 when the fixed-effects MRA is used.

Elaborate meta-regressions show that studies based on aggregate data report significantly larger semi-elasticities than firm-level analyses. Precisely, semi-elasticities estimated on the basis of micro data fall below results from aggregate studies by approximately 1.8. Furthermore, the econometric treatment of unobserved variables in primary specifications significantly impacts estimated tax effects on FDI. Notably, tax effects might be difficult to discern from macroeconomic time trends. Integrating bilateral tax regulations into effective tax rates indeed leads to more effective measurement of adverse tax incentives on foreign investment. Regarding the control variables, it is most interesting that primary estimates are not significantly affected by the inclusion of public spending. According to most estimates in the literature, the spending side does not moderate the tax rate effects. The results reported by Bénassy-Quéré et al. (2007) thus do not find general support. This might be due to the fact that only crude measures of public inputs are used in many studies. Certainly, more research is needed to find out whether the provision of public goods is empirically related to tax rate effects or whether this is really a pure tax competition game.

Chapter 6

A Meta-Study on Capital Structure Choice and Company Taxation*

6.1 Introduction

Theoretical arguments for the tax sensitivity of capital structures are convincing. Empirical findings, on the other hand, have for years been rather weak. Only 12 years ago, Parrino and Weisbach (1999: 39) concluded:

> "Despite over 40 years of research, we still know surprisingly little about the determinants of capital structure. There is general agreement that debt has a tax advantage over equity, but disagreement over the magnitude of this tax advantage and the relative importance of the costs of debt that offset this tax advantage at the margin."

Even today, despite a surge of studies providing point estimates for the tax effect on corporate capital structure, the empirical evidence remains ambiguous. Surprisingly, however, no study has ever quantitatively examined the factors which determine the variation in empirical evidence. The contribution of this study is to fill in this gap. We do not put forward another direct estimate of the tax effect on corporate capital structure. We present instead a meta-analysis of the empirical literature, using econometric methods to synthesize the previously obtained evidence. By taking recourse to meta-regression analyses, we can systematically relate variation in sign and size of reported tax effects on capital structure to underlying primary study and data characteristics (Stanley, 2001). Our study thus complements excellent qualitative surveys of the tax response of capital structure choices (e.g., Graham, 2003).

* This chapter is based on Feld, Heckemeyer and Overesch (2011).

The fundamental argument for a tax effect on corporate financial policy relies on an important benefit associated with debt financing, which is the interest tax shield. According to most tax systems, interest expenses are deductible from corporate taxable income while equity payouts are not. The value of the implied tax shield from interest deductions clearly grows with the marginal tax rate (Modigliani and Miller, 1963). Several theoretical models explain capital structure choices of firms as result of a trade-off between the benefit and the cost of debt financing. While cost is, for example, related to financial distress (Kraus and Litzenberger, 1973) or agency conflicts between equity and debt claimants (Jensen and Meckling, 1976; Myers, 1977), the tax shield significantly contributes to the benefit of debt.[65] The general tax advantage of debt is also acknowledged if capital structure choices follow other concepts (Gordon, 2010), like pecking order (Myers and Majluf, 1984) or market timing theory (Baker and Wurgler, 2002).

This study provides a comprehensive quantitative assessment of the existing empirical evidence on the marginal debt response to tax. We thus aim to shed light on the underlying causes of the disagreements highlighted by Parrino and Weisbach (1999). For this purpose, we extract 1,143 point estimates of the marginal tax effect on the debt ratio out of 46 studies. While a lot of primary studies indeed report positive tax effects on debt financing, surprisingly, a number of studies also find robust evidence suggesting a negative effect of taxes on leverage (e.g., Booth et al., 2001; Huang and Ritter, 2009). Synthesizing the evidence by means of meta-regression analyses, we conclude that the tax impact on debt is indeed substantial. Our results suggest that, in particular, the tax rate proxy used for identification determines the outcome of primary analyses. More refined measures like the simulated marginal tax rate suggested by Graham (1996a, 1999) avoid a significant downward bias in estimates for the debt response to tax. Moreover, we find that debt characteristics, the econometric specification, the set of control-variables, and publication selection in primary studies exert significant influence on estimated tax effects. Accounting for all potential misspecification biases, we predict a positive marginal tax effect on the debt ratio of 0.3.

Some recent studies focus on capital structures and related tax planning activities of multinational firms. We extensively deal with this literature as well. Generally, our re-

[65] Non-tax explanations for a benefit of debt are discussed in the literature, as well. Jensen (1986) and Stulz (1990), e.g., argue that debt can help to reduce agency problems between managers and stockholders.

sults suggest that the tax effects on debt are higher in the case of multinational firms. We conclude that tax incentives associated with multinational activity should be modeled very carefully, with an emphasis on the additional incentives arising from cross-border profit shifting opportunities. Furthermore, evaluating all relevant studies in the literature, we can securely conclude that intra-company debt is the most flexible device to respond to tax incentives.

The remainder of the chapter is organized as follows. In Section 6.2, we survey the empirical evidence on the impact of taxes on capital structure choices. Thereafter, in Section 6.3, our meta-sample is presented and the meta-variables are described in Section 6.4. The results of the meta-regressions are presented in 6.5. Finally, Section 6.6 concludes.

6.2 Qualitative Literature Review

Theoretical arguments for the tax sensitivity of companies' capital structures are strong. By contrast, empirical support has for long been rather weak. Faced with the discrepancy between theory and observed evidence (Myers, 1984; Parrino and Weisbach, 1999), empirical researchers accepted the challenge. During the last two decades, numerous studies have indeed documented a significant tax effect on the debt policy of firms. A first strand of literature avoids the use of direct marginal tax rate (MTR) proxies altogether (see MacKie-Mason, 1990; Dhaliwal et al., 1992; Trezevant, 1992; Downs, 1993; Barklay and Smith, 1995; Graham and Tucker, 2006). Instead, these studies exploit the DeAngelo and Masulis (1980) finding of a significant correlation between non-debt tax shields and the unobserved true MTR. While these studies indirectly confirm a significant tax impact on debt financing by reporting strong effects of non-debt tax shields, another strand of literature has directly estimated quantitative effects of taxes. Since the aim of our study is a quantitative assessment of the existing empirical evidence, we review those studies which provide point estimates for the marginal tax effect on capital structure choices.[66]

The identification of the quantitative tax effect on corporate debt levels hinges upon an adequate approximation of the unobserved marginal tax incentive to finance with

[66] Some studies do not examine tax effects on debt, but focus on related variables such as leasing or interest expenses (see e.g. Sharpe and Nguyen, 1995; Ayers et al., 2001). As we are interested in the direct quantitative impact of a change in the MTR on capital structure choices, we exclude these papers from the following survey. For the same reason, we do not consider studies that refer to incremental debt (see e.g. Graham, 1996a; Alworth and Arachi, 2001; Amromin and Liang, 2003) or bond offerings (see e.g. Newberry and Dhaliwal, 2001). For a thorough survey see Graham (2003).

debt. Importantly, the tax benefit of debt is a function of not only statutory tax rates but various dynamic features of the tax code. It results from firm-specific characteristics which interact with various details of the tax code like non-linear tax scales, investment tax credits, or loss carry-back and carry-forward rules. Still, empirical researchers have been quite innovative in capturing the marginal tax advantage of debt. A milestone in this respect was set by Shevlin (1990) and Graham (1996a, 1999). They simulate firm-specific marginal tax rates over a forecasted stream of taxable income, integrating the most important dynamic features of the tax code.[67]

Graham et al. (1998) and Graham (1999) regress debt-to-firm-value of U.S. companies on these simulated tax rates. In addition, Graham (1999) extensively examines the role of personal taxes. Under most tax regimes, personal taxes inflict a tax penalty on interest income relative to returns on equity. Graham shows that the net tax benefit of debt significantly influences corporate debt financing. The same holds true for the gross tax advantage at the corporate level, and in addition, for the personal tax penalty itself. In an application to debt-to-value ratios of a cross-section of large listed U.S. firms, Graham et al. (2004) extend the simulation of MTRs and include employee stock option deductions.

Graham (1996b) and Graham and Mills (2008) document that the simulated marginal tax rate indeed is the best available proxy for the unobserved true marginal tax rate. Still, due to the complex nature of the simulation procedure, empirical analyses are often based on proxies which are easier to calculate. Many studies consider information on firm-level tax payments and compute an average tax rate as taxes paid divided by the pre-tax income of the firm. Booth et al. (2001) resort to average tax rates when analyzing the determinants of capital structures in various developing countries. Like several papers that consider average tax rates, however, they report only insignificant or even negative tax effects on the use of debt financing.

A straightforward but much simpler approximation of the tax benefit of debt is the statutory corporate income tax rate. The studies by Gordon and Lee (2001, 2007) take advantage of the progressive corporate income tax scale in the U.S. and exploit variation in relative statutory tax rates.

---

67 Recently, Graham and Kim (2009) and Blouin et al. (2010) suggest new procedures to simulate marginal tax rate measures. Yet, we know of no study that uses these new tax measures in a capital structure regression. Therefore, these measures cannot be considered by our meta-study.

In particular, average or statutory tax rates suggest themselves as proxies for the tax incentive in studies which focus on international accounting and tax data. In these cases, the identifying variation emerges from international differences in tax legislation. Rajan and Zingales (1995) were the first to look at systematic determinants of capital structure choices across countries. Based on consolidated financial statements, their analysis remains rather descriptive. Inspired by this first approach, numerous studies use cross-country data to disentangle the determinants of corporate financial policies. Some of these papers exploit cross-country samples but keep a focus on domestic firms (Overesch and Voeller, 2010). However, new important research questions arise if multinational firms are considered. As these have subsidiaries in more than just one country, additional tax incentives affect corporate debt policy. Precisely, subsidiaries of multinational firms do not exclusively rely on debt from external sources. They can also borrow internally from their parent company or from other affiliated companies. This opens up possibilities to reallocate debt within the multinational and to exploit international tax rate differentials in a way that the overall company tax burden is reduced. Papers dealing with tax incentives at work within the multinational group necessarily deviate from Rajan and Zingales (1995) in that they use non-consolidated financial statements of subsidiaries. Only on the basis of this unconsolidated data, host-country taxes can be attributed to internal leverage.

Altshuler and Grubert (2003) and Desai et al. (2004b) were the first to examine balance sheet data of foreign subsidiaries of multinational corporations. More recently, improved data availability favored the assessment of tax effects on capital structures of European multinationals (Huizinga et al., 2008; Buettner et al., 2009; Mintz and Weichenrieder, 2010). Altshuler and Grubert (2003) and Mintz and Weichenrieder (2010) find significant tax effects only on internal debt ratios. By contrast, Desai et al. (2004b) and Buettner et al. (2009) report significant effects for both external and intra-company debt. While the marginal tax effect on companies' debt ratio is higher for third-party debt, the tax elasticity, however, turns out to be more pronounced for intra-company debt financing.

By means of an internal reallocation of debt, multinationals can shift profits from high-tax jurisdictions to low-tax jurisdictions.[68] Huizinga et al. (2008) empirically split

[68] Since debt financing is a potential channel through which profits are shifted from high- to low-tax countries, there are attempts to restrict the use of inter-company loans by introducing what is called thin-

the total tax effect on the debt policy of multinational firms into a purely domestic effect and an international profit shifting incentive. The latter is identified by the tax rate differential between the host-country tax rate and a weighted average of the statutory tax rates available within the multinational firm. Their results document that ignoring the shifting motive significantly underestimates the overall tax response. Moreover, some empirical studies focus on the tax asymmetries between subsidiary and parent company. Mills and Newberry (2004) find a negative impact of the tax level of parent companies on debt financing of foreign controlled subsidiaries in the U.S.

This brief survey shows that numerous studies provide point estimates for the marginal tax effect on capital structure choices; however, the reported evidence and the empirical approaches vary significantly. Studies particularly differ in the employed proxy for the marginal tax rate, their focus on tax incentives (e.g., corporate taxes, personal taxes, and international taxation), the type of firms (e.g., domestic firms, multinational firms) and in the data sources. In the following sections, we analyze whether and to what extent these different study characteristics systematically explain the heterogeneous estimates for the tax effect on the corporate debt ratio.

6.3 The Meta-Dataset

For the purpose of this meta-study we thoroughly surveyed 46 primary studies in total. These were identified by comprehensively searching the EconLit database for empirical literature on the tax sensitivity of corporate capital structure choices. Precisely, we searched the database for the central keywords "Capital Structure" and "Tax". Furthermore, we conducted additional internet searches and scanned relevant journals as well as working paper series.[69]

In this meta-study, we refer to the marginal tax effect on the corporate debt ratio estimated in primary studies as our effect size index. The marginal effect on the corporate debt ratio represents the percentage point change of the debt ratio in response to a one percentage point change in the tax rate. It indicates the debt change in percent of total assets, triggered by a one percentage point change in the tax rate. Generally, the literature provides point estimates of this marginal tax effect.

---

capitalization or earning stripping rules. The effects of thin-capitalization rules are considered by some recent studies like Buettner et al. (2008) and Overesch and Wamser (2010b).

[69] We particularly searched through the Journal of Finance, Journal of Financial Economics, Review of Financial Studies, Journal of Public Economics, Journal of Financial and Quantitative Analysis, Journal of Corporate Finance, Financial Management, European Financial Management, National Tax Journal, International Tax and Public Finance, and the SSRN working paper database.

Equation (6.1) illustrates the marginal tax effect on the corporate debt ratio (e^D) more formally, where *d* represents the debt ratio as defined by debt *D* and total assets *A* and τ is the tax rate:

$$e^D = \frac{\partial \, d}{\partial \, \tau} = \frac{\partial \left(\frac{D}{A} \right)}{\partial \, \tau} \quad (6.1)$$

We sample all tax effect estimates found in each relevant primary study. Such multiple sampling allows for more accurate estimates and inference due to a larger underlying sample as compared to single estimate sampling. Otherwise, selecting one single estimate from each study would require predefined and - most importantly - objective sampling rules, which can hardly be justified. Moreover, the additional heterogeneity obtained from considering all robustness checks reported in a study is welcome in statistical meta-analyses.

Our basic sample (Sample A) of primary study results contains all marginal tax effects on the debt ratio which mainly result from variation in the domestic tax rate. In some cases these effects might jointly reflect both domestic tax incentives and the international profit shifting incentive. In addition, in our Sample B we even more rigorously exclude all tax effects estimated on the bases of multinational company data. In return, we define a Sample C of tax effect estimates drawn from studies which focus exclusively on multinational subsidiaries. Here, we also add effect estimates which exclusively reflect profit shifting incentives. After all, the three subsamples join to a full meta-dataset of 1,143 observations obtained from the 46 studies, each representing one estimated marginal tax effect on the corporate debt ratio. Table 6.1 provides descriptive statistics for every single primary study. At the bottom of the table, descriptive statistics at sample level are shown. Most studies contribute either to the non-international sample (Sample B) or the international sample (Sample C); some studies contribute to both. In total, our basic sample includes primary estimates from 43 studies, while Sample B and Sample C respectively regroup evidence from 29 and 19 studies.

Table 6.1: Papers on Capital Structure Choice Included in the Meta-Analysis

	Study	Sample	No. of effects	Marginal tax effects on debt				
				Mean	Median	Min	Max	Std.
1	Aggarwal & Kyaw, 2008	C	12	0.24	0.23	0.03	0.44	0.12
2	Altshuler & Grubert, 2003	A, C	6	0.17	0.13	-0.02	0.39	0.16
3	Antoniou et al., 2008	A, C	23	0.00	0.00	-0.05	0.04	0.02
4	Barion et al., 2010	A, B	4	0.39	0.37	0.29	0.52	0.10
5	Bartholdy & Mateus, 2008	A, B	81	0.05	0.00	-2.30	2.59	0.44
6	Bauer, 2004	A, C	8	0.07	0.05	-0.05	0.24	0.12
7	Booth et al., 2001	A, B	78	-0.03	-0.03	-0.47	0.3	0.13
8	Buettner et al., 2008	A, C	9	0.10	0.16	-0.10	0.20	0.12
9	Buettner et al., 2009	A, C	6	0.18	0.18	0.14	0.24	0.04
10	Buettner & Wamser, 2009b	A	73	0.05	0.03	-0.07	0.14	0.06
		C	115	0.06	0.08	-0.07	0.14	0.05
11	Byoun, 2008	A, B	8	-0.05	-0.05	-0.11	0.00	0.04
12	Charalambakis et al., 2008	A, B	10	0.04	0.05	0.01	0.06	0.02
13	Chen & Strange, 2005	A, B	4	0.00	0.00	-0.02	0.03	0.02
14	Cheng & Green, 2008	A, B	6	0.01	0.01	0.00	0.01	0.01
15	De Jong et al., 2008	A	42	-0.06	0.00	-1.10	0.10	0.19
16	Desai, Foley & Hines, 2004b	A, C	32	0.18	0.17	0.05	0.40	0.09
17	Dischinger et al., 2010	A	50	0.31	0.30	0.09	0.67	0.14
		C	72	0.23	0.24	0.02	0.67	0.16
18	Dwenger & Steiner, 2009	A, B	13	1.88	2.14	-0.84	3.82	1.45
19	Faulkender & Petersen, 2006	A, B	1	-0.14	-0.14	-0.14	-0.14	.
20	Gordon & Lee, 2001	A, B	9	-0.02	0.05	-0.42	0.30	0.23
21	Gordon & Lee, 2007	A, B	29	0.10	0.11	-0.07	0.30	0.08
22	Graham, 1999	A, B	97	0.11	0.12	-0.04	0.25	0.06
23	Graham et al., 1998	A, B	2	-0.03	-0.03	-0.13	0.07	0.15
24	Graham et al., 2004	A, B	15	0.17	0.18	0.06	0.31	0.06
25	Green & Murinde, 2008	A, B	8	-0.01	0.01	-0.22	0.05	0.09
26	Hebous & Weichenrieder, 2010	A, C	28	0.11	0.09	-0.95	2.05	0.61
27	Homaifar et al., 1994	A, B	14	0.36	-0.05	-2.13	3.32	1.93
28	Huang & Ritter, 2009	A, B	24	-0.24	-0.29	-0.95	0.69	0.34
29	Huizinga et al., 2008	A	58	0.23	0.21	0.11	0.34	0.05
		B	54	0.22	0.21	0.11	0.32	0.05
		C	6	0.21	0.22	0.09	0.34	0.10
30	Jog & Tang, 2001	A	13	0.42	0.41	-0.08	0.89	0.28
		B	3	0.49	0.52	0.41	0.53	0.07
		C	12	0.38	0.38	-0.08	0.89	0.30

Table VI
(Continued)

	Study	Sample	No. of effects	Marginal tax effects on debt				
				Mean	Median	Min	Max	Std.
31	Kesternich & Schnitzer, 2010	A, C	7	0.20	0.20	0.18	0.22	0.01
32	Klapper & Tzioumis, 2008	A, B	10	0.06	0.05	0.03	0.19	0.05
33	Lasfer, 1995	A, B	6	0.00	0.00	-0.01	0.01	0.00
34	Liu & Tian, 2009	A, B	12	0.02	0.01	-0.02	0.08	0.03
35	López-Gracia & Sorgorb-Mira,	A, B	6	0.00	0.00	0.00	0.00	0.00
36	Michaelas et al., 1999	A	3	-0.04	-0.03	-0.05	-0.03	0.02
37	Moore & Ruane, 2005	A, C	43	0.32	0.34	-0.02	0.83	0.13
38	Mills & Newberry, 2004	C	2	0.31	0.31	0.12	0.49	0.26
39	Mintz & Weichenrieder, 2010	A, C	42	0.10	0.08	-0.13	0.44	0.12
40	Oeztekin, 2009	A, B	76	0.00	0.00	-0.19	0.34	0.06
41	Overesch & Voeller, 2010	A, B	22	0.14	0.12	-0.29	0.44	0.19
42	Overesch & Wamser, 2010b	C	15	0.34	0.21	0.19	0.78	0.23
43	Pfaffermayr et al., 2008	A, B	20	0.61	0.71	0.19	1.02	0.24
44	Ruf, 2010	A, C	3	0.45	0.45	0.45	0.47	0.01
45	Ramb & Weichenrieder, 2005	A	8	0.03	0.03	-0.02	0.14	0.05
		C	12	0.02	0.02	-0.04	0.14	0.05
46	Shivdasani et al., 2010	A, B	3	0.04	0.05	0.01	0.06	0.03
	Basic Sample		**1012**	**0.13**	**0.07**	**-2.30**	**3.82**	**0.42**
	Excluding Pure Multinational Studies (B)		**660**	**0.11**	**0.03**	**-2.30**	**3.82**	**0.48**
	Exclusively Multinational Studies (C)		**453**	**0.16**	**0.11**	**-0.95**	**1.05**	**0.22**
	Overall Meta-Dataset		**1143**	**0.13**	**0.08**	**-2.30**	**3.82**	**0.39**

Notes: Sample A denotes the basic sample containing all marginal tax effects on the debt ratio which mainly result from variation in the domestic tax rate. In some cases these effects might jointly reflect both domestic tax incentives and the international profit shifting incentive. Sample B excludes estimates based on pure multinational firm data. By contrast, Sample C contains only tax effect estimates drawn from studies which focus exclusively on multinational subsidiaries.

Table 6.1 shows that with a value of 0.16 the mean marginal tax effect is most pronounced in Sample C, which includes those studies with an exclusive focus on multinational firms. Instead, the mean marginal tax effect in Sample B, which in return excludes these studies, amounts to 0.11. Consistently, the Basic Sample A as well as the overall meta-dataset display means of 0.13. Median marginal effects are below the means in all meta-samples, hinting at sample distributions which are positively skewed. Notably, in Sample B, 50% of all primary estimates report marginal tax effects less than 0.03. Still, the range of values is considerable. In particular, the relative dispersion of estimates turns out to be high. The relative standard deviation, calculated as the ratio of the absolute standard deviation to the mean, is above 3 and 4, respectively, in Samples A and B, and still exceeds a value of 1 in Sample C. The descriptive statistics at study-level corroborate this finding of high variation in marginal tax effects. Within a considerable number of studies, relative standard deviations are again above 1. Obviously, the variation in our meta-samples has its origin not only in varied evidence between studies but also within studies. We aim to systematically explain both between and within-study variance of reported marginal tax effects by meta-regressions.

6.4 The Meta-Regressor Variables

A central challenge in conducting a quantitative meta-study is to find an agreement over which study characteristics, i.e. meta-regression moderator variables, are the important ones to include in the analysis (Stanley, 2001). Regarding the literature on the tax sensitivity of capital structure, however, we are convinced that the essential study characteristics can be inferred from the narrative review of the empirical evidence in Section 6.2. Furthermore, the primary studies themselves often raise and discuss pivotal issues in empirical research on corporate capital structure. Finally, we clearly benefit from insightful work put forward by, for example, Graham (2003), Frank and Goyal (2007) or Lemmon et al. (2008).

After all, we presume six main groups of study characteristics to substantially drive the varied empirical results on the tax sensitivity of capital structures. We will therefore consider them as explanatory variables in our meta-regressions.

Proxies for the Marginal Tax Incentive

A central focus is, of course, on the tax measure employed for analysis. The literature survey in Section 6.2 highlighted that researchers have used different tax measures to capture the marginal tax advantage of debt. Therefore, we carefully classify proxies for the marginal tax incentive according to their degree of refinement and computational complexity.

An easily available proxy for the marginal tax incentive is the statutory corporate income tax rate. It might, however, only be a rough approximation. Unless the corporate tax scale is progressive, this measure does not capture any firm-specific information on the corporate tax status. If a firm finds itself near tax exhaustion due to low profitability, accrued non-debt tax shields or tax-loss carry-forwards, its marginal tax incentive to finance with debt is going to fall short of what the statutory tax rate suggests. Identified effects of the statutory tax rate on debt might therefore underestimate the true relationship between the marginal tax rate and capital structure choices. Consequently, some empirical researchers refrain from using statutory tax rates in their capital structure regressions. Instead, they use more refined approaches to take into account information on the actual tax status of the firm.

The previous empirical literature employs mainly two methods to approximate the tax incentive of debt financing more carefully. The first group opts for an average tax rate computed as paid taxes divided by pre-tax income. The tax payments which figure in the numerator of the average tax rate implicitly capture the degree of tax exhaustion and its implications for the incentive to finance with debt.

Still, some caveats remain which keep the average tax rate from being a precise proxy for the effectively decisive economic marginal tax rate.[70] First, in the terminology of Graham (2003), the average tax rate is still to be qualified as a rather static proxy. It clearly misses the fact that a firm's economic tax status considerably depends on its future profitability. Second, the average tax rate by definition reflects the tax burden on an average dollar of income. Additional interest deductions will, however, shield *marginal* income from taxation. Thus, the exact tax benefit of debt at the corporate decision margin is systematically missed.

As highlighted in the literature survey of Section 6.2, Shevlin (1990) and Graham (1996a, 1999) therefore propose a different method and put forward a sophisticated stochastic simulation technique to compute firm-specific effective marginal tax rates. The simulation procedure according to Graham accounts for the most important dynamic features of the US tax code, i.e. net operating loss carry-forwards and carry-backs, investment tax credits, and the alternative minimum tax.[71]

Another pivotal issue in the conception of a proxy for the marginal tax rate is that the corporate tax status is endogenous to debt levels (Graham, 2003). If a company issues debt, it reduces its taxable income through interest deductions. The amount of taxable income has again direct influence on the statutory tax rate in progressive tax systems, on average tax rates or on simulated tax rates. If no precautions are taken in the computa-

[70] The economic marginal tax rate according to Scholes and Wolfson (1992) is defined as the present value of current and future taxes owed on an extra dollar of income earned today.

[71] Simulated marginal tax rates are calculated for each firm and year separately by assuming that taxable income follows a random walk with drift over 18 years into the future. Then, the present value of the tax bill is calculated. Afterwards, it is recalculated after adding one dollar to taxable income in the current period. Results from 50 simulations (based on 50 separate forecasts of taxable income) are averaged to finally represent the firm-specific marginal tax rate.

tion of the tax variable, the reported tax effects on debt policy might be negatively biased. This has been thoroughly examined by Graham et al. (1998) for the case of simulated tax rates. Their study shows that simulated proxies based on taxable income before financing expenses are immune to these endogeneity concerns. In regard to average tax rates, however, only a few studies tend to neutralize the impact of financial decisions by referring to before-financing profits (e.g. Lasfer, 1995; Charalambakis et al., 2008) or by considering the host country median of average tax rates (e.g. Desai et al., 2004b).

To contrast studies employing the statutory tax rate with more sophisticated approaches, we code two binary dummy variables *ATR* and *SMTR*, which mark tax effect estimates respectively gained from average tax rates and the Graham simulated marginal tax rate.

Debt Characteristics

Generally, primary studies focus on different measurements and types of debt. Since we only consider studies in our meta-sample which have estimated the impact of a change in the MTR on capital structure choices, the dependent variable of the primary studies is always a share of debt in total funds; yet, the measurement of the debt share varies. The considered primary studies use debt measured at book values or at market values. In order to test if the definition of the dependent variable affects the tax effect, we consider a dummy variable *Debt Measured at Book Value* in our meta-regressions which is one if debt is measured at book values and zero if measured at market values.

Moreover, primary estimations often distinguish between debt items of different maturity. It is an empirical question whether debt maturity exerts a significant impact on the tax sensitivity. On the one hand, a smaller tax response of long-term debt can be expected because it is difficult to adjust to yearly fluctuations in the marginal tax incentive. On the other hand, long-term debt is associated with higher amounts of interest deductions, as compared to short-term debt items containing, for example, trade payables that do not carry any interest deductions. As tax-deductible interest causes the tax advantage of debt over equity financing, long-term debt could be more tax responsive. In order to analyze whether reported tax effects systematically depend on debt maturity, we code a dummy variable *Long-Term Debt*, which has the value one if a tax effect refers exclusively to long-term debt and the value zero otherwise.[72]

Econometric Specification of Primary Studies

The empirical literature dealing with capital structure choices has traditionally tried to explain changes in the capital structure of a firm with contemporaneous changes of capital structure determinants; but an immediate adjustment of the capital structure is not in line with the existence of adjustment costs. Therefore, some recent studies have modeled dynamic aspects of capital structure adjustment.[73] By considering the lagged value of the debt share, a partial adjustment process is identified. Notably, a dynamic specification carries an important implication for the coefficient estimated for the tax rate. The coefficient only reflects the short-term adjustment toward a target debt ratio, while the long-term effect is calculated by taking into account the adjustment speed. In our meta-regression analysis, we therefore consider a dummy variable Dynamic Specification, which marks tax coefficients from dynamic specifications.

Lemmon et al. (2008) show that corporate capital structures are to an important extent determined by unobserved time-invariant firm-specific factors. Some empirical analyses of the tax effect on corporate capital structure control for such unobserved firm-specific heterogeneity, which indeed might be correlated with tax levels. This, however, comes at the cost that the variation of tax rates between firms is absorbed by the firm-fixed effects. Gordon and Lee (2001) point out that in numerous studies, e.g. Graham et al. (1998) and Graham (1999), the identification of tax effects is indeed predominantly based on cross-sectional variation of tax rate proxies between firms. On the one hand, controlling for unobserved firm-fixed effects might therefore reduce reported tax effects on corporate capital structure. On the other hand, it might correct for unknown omitted variable bias. To find out, we explicitly define a binary dummy variable Firm Fixed Effects Included which marks estimates resulting from analyses where unobserved firm-fixed effects are modeled.

A firm's individual corporate tax status varies over time and so does the marginal tax incentive to finance with debt. Nevertheless, there can also be unobserved time trends

[72] We abstain from separately analyzing the tax response of short-term debt because in our meta-sample the number of primary estimates that refer to short-term debt is very low (1.5%). By contrast, 16.3% of our primary estimates refer to long-term debt,

[73] Studies which estimate a dynamic model of the capital structure choice comprise Fama and French (2002), Flannery and Rangan (2006), Antoniou et al. (2008), Lemmon et al. (2008) and Huang and Ritter (2009).

affecting all firms equally. Reasons why the general attractiveness of debt financing might change over time are, for example, general business cycle effects, financial crises or changes in the institutional environment. Leaving such time trends unmodeled in panel data analyses could affect the identification of tax effects on debt policy. We therefore code a binary dummy variable Time Fixed Effects Included marking primary estimates free of any potential biases resulting from unmodeled time trends.

Control Variables in Primary Studies

The isolation of the tax effect in capital structure regressions requires control for other non-tax factors which determine corporate debt ratios and are possibly correlated with tax. Indeed, their omission could considerably affect reported results.

Frank and Goyal (2007) thoroughly identify a core set of six observable capital structure determinants. Their list of the most relevant explanatory variables includes controls for firm size, tangibility, profit, inflation, firm-specific growth options and industry median leverage. Whether the disregard of these core determinants indeed influences reported partial tax effects on the debt ratio is an empirical question. In order to answer it, we code six binary dummy variables, one for each of these determinants. If estimates are obtained from regressions including such a control variable, the respective dummy is one. Otherwise it has the value zero.[74]

Data Sample Characteristics

The 46 primary studies in our meta-sample are based on 20 different databases, which differ in terms of geographic coverage and types of firm represented. Some databases, e.g. Compustat, exclusively cover national firm data from only one country. Others, e.g. Compustat Global Vantage, cover cross-country firm data. In regard to the types of firms represented in the data, some databases only contain information on publicly listed firms; others also include unlisted small and medium sized firms. Furthermore, some of the international databases focus exclusively on subsidiaries of multinational firms, e.g. Bureau of Economic Analysis data. Finally, the data coverage varies due to very different reporting obligations and data collection procedures across countries. In

[74] To mark estimates that rely on a specification taking into account a certain control variable, we group the control variables used in primary studies according to the classification chosen by Frank and Goyal (2007). For example, studies controlling for firm assets or firm sales are regrouped as controlling for firm size. Moreover, we consider industry fixed effects as a control for the typical leverage in that respective industry.

order to capture the heterogeneity of data used in primary studies, we will control for database fixed effects in our meta-regressions.

Furthermore, the data used in primary empirical studies is disclosed at very different dates. While, for example, Gordon and Lee (2001) have estimated tax coefficients based on data for a period from 1954 to 1995, other studies, e.g. Graham et al. (2004), provide evidence based on year 2000 data. The response to taxes might, however, vary over time because tax advisors are always searching for new tax planning strategies. Still, it is an empirical question whether the refinement in tax-optimal structures is not offset by the introduction of specific anti-avoidance rules. We therefore take into account a variable *Average Sample Year* which is the average disclosure year of the data used in the underlying estimation.

Publication Selection

It is an established conjecture that academic journals might have a tendency to publish papers with statistically significant results (De Long and Lang, 1992). Furthermore, the parties involved in the scientific publication process, i.e. both authors and journal reviewers, may prefer empirical results which comply with standard predictions concerning the direction of the assessed relationships. Consequently, research results which do not correspond to conventional economic theory in significance or sign might be doomed (“file-drawer problem”). If publication bias is indeed present, it can be statistically tested: If (and only if) there is publication selection in the literature, coefficient estimates and their associated standard errors will be correlated. The sign of the correlation will indicate the direction of the bias (Card and Krueger, 1995; Egger et al., 1997; Stanley, 2008).

6.5 Meta-Regression Analysis

6.5.1 Main Results

Our main results are displayed in Table 6.2. The regressions are based on Sample A as described in Section 6.3. That is, we consider 1012 estimates of the marginal tax rate effect on debt shares provided by the literature. The meta-regression we estimate takes the linear form depicted in equation (6.2), where $\boldsymbol{y}$ corresponds to the vector of estimated marginal tax effects drawn from primary analyses and $\boldsymbol{X}$ is a matrix of predominantly dummy variables that reflect various study or model characteristics.

$$\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\varepsilon} \tag{6.2}$$

To analyze whether study characteristics systematically explain differences in reported tax coefficients, we thus regress marginal tax effects found in a primary empirical study on a set of meta-variables. These dummy variable regressions implicitly define an underlying benchmark study. The coefficients for each dummy variable reflect the average impact on reported tax effects if the study design deviates from the benchmark in that specific aspect. Respective benchmark characteristics are indicated in brackets for every control dummy in Table 6.2.

Since $\boldsymbol{y}$ includes estimated coefficients which are derived from models which in their great majority conform to the assumptions of the classical linear model, the meta-regression errors $\boldsymbol{\varepsilon}$ should be normally distributed. Equation (6.2) is, however, clearly heteroskedastic as the variance of the primary estimates is related to the characteristics of a study.

One approach in the literature to deal with the presence of heteroskedasticity is to use OLS with robust standard errors; but, in the clear presence of heteroskedasticity - as it is the case in meta-regression analysis - least squares can be extremely inefficient (Greene, 2003: 226). Fortunately, in the case of meta-regression, a measure of the heteroskedasticity is readily available: Coefficient standard errors are given in nearly all primary results tables. Thus, weighted least squares (WLS) with inverse squared primary standard errors as analytic weights is the obvious method of obtaining efficient meta-regression estimates (Stanley, 2008; Greene, 2003; Hedges and Olkin, 1985). Technically, efficiency is obtained by giving those reliable primary estimates of the marginal tax effect a greater influence, which are less affected by sampling error and thus show small variances.[75]

Column (1) shows results of a baseline regression using ordinary least squares (OLS). Significant meta-regression coefficients suggest that econometric specification and control variables included in primary studies indeed affect the reported marginal tax effect. In column (2), we thoroughly analyze the impact of distinct tax rate measures which are frequently used in the literature. We include two dummy variables marking primary estimates referring either to simulated marginal tax rate or the average tax rate. Our benchmark is the statutory tax rate.

[75] For more details, please refer to Chapter 4.

Table 6.2: Meta-Regression of Reported Marginal Tax Effects on Debt Ratios, Base Sample

Regressions of the marginal tax effect found in primary studies on respective study characteristics. All study/model characteristics are coded as dummy variables (except Average Sample Year and Primary Standard Error). Thus, a base model represents the characteristics redundant to the variables explicitly included. The benchmark characteristics are indicated in parentheses for each study dimension. Estimated coefficients of the dummies indicate the effect on primary marginal effects of choosing a characteristic in lieu of the base specification. All regressions include a constant (not reported). The regressions are based on Sample A. Columns (1) – (4) of Table 6.2show OLS-regression results; columns (5) and (6) are from WLS estimation. Heteroskedasticity robust standard errors in parentheses; ***/**/* denotes significance at the 1%/5% /10% level.

	OLS				WLS	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Proxies for the Marginal Tax Incentive						
SMTR (Statutory Tax Rate)		0.2856***	0.2607***	0.1138	0.1069***	0.0567***
		(0.0743)	(0.0707)	(0.0906)	(0.0176)	(0.0174)
ATR (Statutory Tax Rate)		0.0440	0.0488	0.0320	-0.0055	-0.0310***
		(0.0380)	(0.0337)	(0.0668)	(0.0083)	(0.0085)
Debt Characteristics						
Long-Term Debt (Maturity not Specified or Short-Term)	0.1371**	0.2115***	0.1576***	-0.0024	-0.0054	0.0078*
	(0.0662)	(0.0707)	(0.0581)	(0.0356)	(0.0086)	(0.0044)
Debt Measured at Book Values (Market Values)	-0.0449	0.0511	0.0746*	0.0038	-0.0064**	-0.0006
	(0.0355)	(0.0456)	(0.0450)	(0.0276)	(0.0029)	(0.0013)
Econometric Specification of Primary Studies						
Dynamic Specification (Static Specification)	-0.1558***	-0.0926**	-0.0831*	-0.1864***	-0.0559***	-0.1210***
	(0.0395)	(0.0454)	(0.0451)	(0.0682)	(0.0102)	(0.0132)
Firm Fixed Effects Included (no)	-0.0340	-0.0232	-0.0044	-0.0019	-0.0062***	0.0166
	(0.0242)	(0.0262)	(0.0186)	(0.0221)	(0.0020)	(0.0124)
Time Fixed Effects Included (no)	0.0742*	0.0783**	0.1049***	0.0418	0.0330***	0.0378***
	(0.0382)	(0.0386)	(0.0332)	(0.0453)	(0.0100)	(0.0130)

Table 6.2 (Continued)

	(1)	(2)	(3)	(4)	(5)	(6)
Control Variables in Primary Studies						
Control for Profitability (no)	0.1238***	0.1123***	0.1529***	0.0723**	0.1077***	0.1220***
	(0.0410)	(0.0432)	(0.0429)	(0.0347)	(0.0208)	(0.0206)
Control for Size (no)	0.1568***	0.1537***	0.1054*	0.0516	-0.0700***	-0.0137
	(0.0573)	(0.0580)	(0.0539)	(0.0503)	(0.0124)	(0.0168)
Control for Firm Growth (no)	-0.1817***	-0.2306***	-0.2319***	-0.1390***	-0.1317***	-0.1652***
	(0.0321)	(0.0421)	(0.0404)	(0.0301)	(0.0198)	(0.0232)
Control for Collateral (no)	-0.2666***	-0.2826***	-0.2257***	-0.1206**	-0.0061***	-0.0574**
	(0.0596)	(0.0604)	(0.0540)	(0.0574)	(0.0020)	(0.0285)
Control for Inflation (no)	0.1047***	0.1405***	0.1219***	0.1116**	0.0332***	0.0380***
	(0.0370)	(0.0430)	(0.0383)	(0.0525)	(0.0100)	(0.0130)
Control for Industry-Typical Leverage (no)	0.2226***	0.2356***	0.2149***	0.1184***	0.0984***	0.0867***
	(0.0396)	(0.0385)	(0.0372)	(0.0325)	(0.0131)	(0.0150)
Data Sample Characteristics						
Average Sample Year			-0.000997	-0.00302	7.11e-05	0.000118***
			(0.00171)	(0.00473)	(5.75e-05)	(3.33e-05)
Publication Selection						
Primary Standard Error			0.3911	0.1426	1.1496***	0.9614***
			(0.3089)	(0.3264)	(0.2267)	(0.2055)
Database dummies included in meta-regression	No	No	No	Yes	No	Yes
Number of primary estimations	1012	1012	1012	1012	984	984
Adj. R^2	0.144	0.162	0.194	0.318	0.470	0.660

Specification (3) is augmented by the average sample year and the standard error of the tax coefficient in the primary study. Unlike the other variables used in our meta-regressions, the variables *Average Sample Year* and *Primary Standard Error* are no dummy variables. Consequently, no benchmark case can be denoted. In specification (4) we include database fixed effects. We presume that not only different econometric specifications and definitions of variables but also the type of data used in primary studies should affect the estimated tax response of capital structures. The increase in the R^2 in column (4) compared to that reported in column (3) highlights the additional explanatory power of a specification including database fixed effects. There is a slight change in the magnitude of the coefficients in our meta-regression. Even so, inferences are affected for some variables. This does not come as a surprise because several databases are used by only one primary study. As some study characteristics vary only rarely within studies, database effects remove an important share of variation from our meta-data.

It seems obvious to exploit potential efficiency gains in the meta-regression estimation. A starting point is the appropriate treatment of the heteroskedasticity inherent to meta-analyses. Inferences in specifications (1) – (4) are based on OLS estimation with standard errors robust against heteroskedasticity using the Huber-White sandwich formula. Although this technique generally produces consistent coefficient estimates with correctly estimated standard errors, it is not at all the most efficient technique feasible given that information on the nature of the heteroskedasticity is readily available. In our meta-sample, the variance of reported primary marginal tax effects is generally known. This information is the natural candidate to define a more efficient weighting scheme for the meta-regression.

Therefore, as it is the standard in meta-studies (cf. Stanley, 2008); we directly address the heteroskedasticity by using weighted least squares (WLS) techniques. Precisely, in columns (5) and (6) of Table 6.2, observed primary estimates, i.e. the meta-regression observations, are weighted with the inverse of their standard error before applying standard OLS.[76] By giving precise and reliable observations a greater influence, the meta-regression estimation becomes much more precise (in this line of reasoning, see, e.g., Greene, 2003: 225). For this reason, columns (5) and (6) are our most preferred specification. For most of our explanatory variables, we find an impact on the

[76] The number of observations falls slightly because in a few cases primary studies do not provide information on standard errors.

marginal tax rate effect of debt financing, which is qualitatively very similar to what we found in the OLS estimations.

The results in column (6) show that we are able to identify statistically significant effects of various study characteristics, even in the presence of database fixed effects. Identification of the impact of study features that do rarely vary across studies using the same database, however, remains weak. Furthermore, database effects also remove an important share of between-study variation. Because the variation in empirical specifications between studies is an important information source in a meta-analysis, we subsequently discuss results of both specifications with and without control for database fixed effects.

For a detailed discussion of the results, it is helpful to begin with the benchmark study, which is implicitly defined by the specification of our meta-regression equation. The benchmark study is a hypothetical primary analysis of the tax effect on corporate debt policy, and the explanatory dummy variables included in the meta-regression reflect deviations from this particular benchmark specification. Accordingly, we are able to carefully predict a typical marginal tax effect for such a hypothetical benchmark analysis (and any possible enhancements). For this purpose, we further take into account the constant of the meta-regression equation and the sample mean of the two continuously defined variables *Average Sample Year* and *Primary Standard Error*. Considering, for example, specification (5), we finally get a predicted marginal tax effect of about 0.143.[77] Hence, the hypothetical benchmark study predicts the debt-to-asset ratio to increase by 0.143 percentage points if the tax rate rises by one percentage point. Note that the benchmark specification expected to yield such a result displays the study characteristics denoted in brackets on the left hand side of Table 6.2. While almost no specific primary study in our meta-sample fulfills all characteristics of the benchmark case, the predicted marginal tax effect for this hypothetical case, however, is a good starting point for a systematic discussion of the meta-regression results.

We begin the discussion of the meta-regression results depicted in columns (5) and (6) of Table 6.2 with a look at the definition of the tax measure. We distinguish the three common proxies for the marginal tax incentive. In comparison to the use of the statutory tax rate, reported tax effects are significantly higher if simulated marginal tax rates are used. In comparison to, for example, the marginal tax effect of about 0.143

[77] For specification (5), a constant of about -0.1059 is estimated.The mean value of the *Average Sample Year* amounts to 1995.088 and the mean value of the *Primary Standard Error* is 0.093.

predicted for the hypothetical benchmark study, the simulated marginal tax rates yields estimates that almost double the benchmark values. By contrast, the estimates are smaller if primary capital structure regressions employ average tax rates as opposed to statutory tax rates. These apparent differences highlight the importance of a thoughtful selection of the tax measure to be used. Because they at best approximate the truly perceived marginal tax incentive to finance with debt, simulated tax rates identify the most pronounced empirical impact. Conceptually, average tax rates are less sophisticated than simulated tax rates. Nevertheless, they are still more refined as compared to statutory tax rates. But without further precautions, average tax rates introduce serious endogeneity into capital structure regressions as they are directly affected by past and current financial decisions. We interpret the significantly negative *ATR* dummy coefficient in column (6) to reflect the downward bias in reported tax coefficients due to endogeneity, which remains unaddressed in many primary studies.[78]

Moreover, we consider the influence of characteristics of the debt items. In column (6), we observe higher marginal tax effects if primary estimates refer to long-term debt. An explanation might be that such long-term debt carries higher amounts of tax-deductible interest. There are, however, arguments for long term debt to be more sluggish and thus less sensitive to temporarily changing tax incentives.[79] Still, the additional tax sensitivity of long-term debt which we identify is very small and almost economically insignificant. Furthermore, we find that the tax effect is slightly smaller if debt is measured at book values rather than at market values. This result however is not robust if unobserved heterogeneity between databases is controlled for.

Regarding the influence of the econometric specification of the primary analyses, our meta-regression confirms that estimated tax coefficients are significantly smaller if a dynamic specification is chosen. This is in accordance with our prediction because the tax coefficient found in a dynamic specification reflects only the short-term response to taxes. However, in the presence of adjustment costs, the total effect will be higher in the long-term. When taking into account recent evidence on the adjustment speed of capital

[78] Rather than taking into account future profitability, average tax rates are affected by current profitability. Accordingly, Booth et al. (2001: 118) point out that the average tax rate might be an alternative measure of profitability. This can also explain why the average tax rate tends to have a negative effect on debt ratios.

[79] Some studies, e.g. Gordon and Lee (2001), indeed identify stronger tax effects for short term debt, but their findings do not translate into our meta-regression results, which reflect evidence from a large number of estimates.

structures, our results suggest that long-term tax effects estimated in dynamic specifications are higher compared to evidence based on static specifications.[80]

Furthermore, we find that reported tax coefficients are generally only slightly affected by the inclusion of firm fixed effects in capital structure regressions. While column (5) suggests that controlling for firm fixed effects is associated with a statistically significant but small reduction of marginal tax effects, this finding is not robust against control for database fixed effects. Apparently, in numerous studies, the identifying variation in tax rates is not exclusively between firms. Accounting for unobserved time constant firm heterogeneity does not necessarily prevent or significantly hamper the isolation of partial tax effects on the corporate debt ratio. At the same time, there is no evidence for important omitted variable bias, if the fixed firm effects are not modeled. This is a somewhat comforting result for empirical researchers dealing with tax effects on corporate debt policy. The qualifications made by Lemmon et al. (2008) on the time persistence of corporate capital structures appear less discouraging, given that there seems to be sufficient "space" left for reliably identifiable tax effects.

Instead, the effect of leaving common time trends unmodeled in capital structure regressions turns out to be much more important for reported tax coefficients. Column (5) suggests that holding time series influences constant significantly increases the identified marginal tax effect on the debt ratio by 0.033 percentage points on average. The cross-sectional variation in tax rates between firms or countries not only allows for the identification of tax effects when time-series effects are held constant: Not taking these time effects into account seems, on average, to abet an underestimation of the partial tax effect on corporate capital structure. Interestingly, direction and magnitude of this bias as identified in our meta-regression in column (5) almost exactly correspond to earlier findings reported by Graham (1999).

Generally, empirical studies include a rich set of explanatory variables to isolate unbiased partial effects on the debt ratio. Six important non-tax determinants of capital structure are identified by Frank and Goyal (2007). Our meta-regression results in columns (5) and (6) suggest that the selection of non-tax control variables is indeed important for reported tax effects on corporate debt policy. We find that disregarding one

[80] Let us, for example, assume the typical marginal tax effect predicted for our benchmark case of about 0.143. In the case of a dynamic specification, the short-run effect is predicted to amount to only 0.087, but the long-run tax effect is significantly higher. Take, for example, the speed of adjustment found by Huang and Ritter (2009) of about 17 – 23%. Accordingly, the long-run tax effect is approximately 4.4-5.9 times higher than the short-run effect. Then, in our case, the long-run tax effect ranges between 0.38 - 0.51.

of the six core variables listed in Frank and Goyal (2007) significantly affects reported tax effects. Controlling for firm size, collateral or firm growth is associated with smaller primary estimates of the marginal tax effects on the corporate debt ratio. The inclusion of indicators for firm profit, inflation and industry-specific leverage into the capital structure regressions raises reported tax effects. In particular, the positive impact of including profitability as a control variable does not come unexpected. Assuming that profit is negatively related to leverage (see, e.g., Titman and Wessels, 1988; Rajan and Zingales, 1995) but generally correlates positively with the firm-specific tax rate, there should be a downward bias in reported tax effects if firm profitability is omitted. That is exactly what the respective meta-regression coefficient indicates.

Regarding the remaining five determinants identified in Frank and Goyal (2007), we refrain from generalizing on the identified meta-dummy coefficients and do not confront them with any expected effects of variable inclusion or omission because either the sign of the determinants' effect on debt policy is ambiguous and empirically uncertain ex-ante, or the way these variables correlate with the tax rate is rather unclear. Furthermore, a qualification might apply: The meta-dummy coefficients in Table 6.2 implicitly assume that the effect of controlling for a determinant is fully independent of the set of controls already included in the capital structure regression. This, however, need not necessarily be the case. While we therefore tend to interpret these specific results with adequate caution, we are still convinced that the identified meta-coefficients yield valuable insight on the importance of selected non-tax controls. In particular, we take note of the empirical finding that controlling for the core determinants ceteris paribus has significant consequences for the isolated tax effects. The effects are also qualitatively quite important. Controlling, e.g., for profitability leads to reported tax effects that are 75% higher compared to the benchmark case in column (5).

In regard to underlying data characteristics, the respective coefficient in column (6) suggests that reported marginal tax effects seem to rise with an increasing average sample year. The effect size, however, is very small. Furthermore, the significantly positive relationship between primary tax coefficients and their associated standard error indeed hints at the presence of publication selection for significantly positive tax effects on debt. Put differently, to a certain extent, specification-searching and publication bias, induced by editors' and authors' tendencies to look for positive and statistically significant estimates of the tax effect on the corporate debt ratio, seems to be present in the literature.

Generally, the regression results depict significant influence of study characteristics on estimates for the marginal tax effect. While the marginal tax effect for the hypothetical benchmark case assumed in column (5) amounts to 0.143, the results differ significantly, if more refined specifications are chosen. Let us, for example, assume a study that deviates from the benchmark case with respect to all study characteristics that prove to be significant in regression (5) of Table 6.2, with the exception of keeping a statutory tax rate and a static specification. Then, the predicted marginal tax effect is 0.195. Now, let us vary the proxy for the tax incentive. If a simulated marginal tax rate is substituted for the statutory tax rate, the predicted tax effect rises to 0.302.

6.5.2 Robustness Analyses

In Table 6.3 we provide some robustness checks. While specifications (4) and (6) of Table 6.2 controlled for database effects, in column (1) of Table 6.3 we consider a full set of study fixed effects to capture unobserved characteristics that have affected all estimates taken from the same study. For example, estimates from a certain study might share the same data sampling procedure. The results in column (1) show that including study fixed effects in our meta-regression has consequences for the identification of some study characteristics. While the results on the impact of the different proxies for the marginal tax incentive are qualitatively unaffected, the impact of econometric specifications and control variables used in primary studies is no longer significant at conventional levels. Meanwhile, the signs of the coefficients remain mostly unchanged. This hints at identification difficulties that arise if study characteristics vary indeed between studies, but only rarely within studies. Carefully considering our results, we argue that the study fixed effects are associated with identification difficulties while we do not, however, feel that the results point at serious omitted variable biases in estimations with unmodeled study fixed effects.

In column (2) of Table 6.3 we take into account the dependency of primary estimates taken from the same study by using standard errors clustered at the study level. Results turn out to be, again, quite robust.

Table 6.3: Meta-Regression of Reported Marginal Tax Effects on Debt Ratios, Robustness Analyses

Regressions of the marginal tax effect found in primary studies on respective study characteristics. All study/model characteristics are coded as dummy variables (except Average Sample Year and Primary Standard Error). Thus, a base model represents the characteristics redundant to the variables explicitly included. The benchmark characteristics are indicated in parentheses for each study dimension. Estimated coefficients of the dummies indicate the effect on primary marginal effects of choosing a characteristic in lieu of the base specification. All regressions include a constant (not reported). The regressions are based on Sample A. All regressions are from WLS estimation. Heteroskedasticity robust standard errors in parentheses; ***/**/* denotes significance at the 1%/5% /10% level. Column (1) includes a full set of study dummies. In column (2) standard errors are clustered at the study level. Columns (3) and (4) consider only primary estimates from studies published in journals or books. Columns (5) and (6) include only primary tax effects that are significant at the five percent level.

	Study Dummies	Clustered Standard Errors	Published Studies		Significant Estimates	
	(1)	(2)	(3)	(4)	(5)	(6)
Proxies for the Marginal Tax Incentive						
SMTR (Statutory Tax Rate)	0.1325***	0.0567**	0.1109***	0.2629***	0.1346***	0.0753***
	(0.0312)	(0.0268)	(0.0203)	(0.0293)	(0.0279)	(0.0165)
ATR (Statutory Tax Rate)	-0.0132***	-0.0310*	0.0207	0.0813**	-0.0119	-0.0332***
	(0.0038)	(0.0180)	(0.0133)	(0.0407)	(0.0132)	(0.0103)
Debt Characteristics						
Long-Term Debt (Maturity not Specified or Short-Term)	0.0114***	0.0078*	0.0059	0.0105***	-0.0145	0.0100***
	(0.0025)	(0.0045)	(0.0051)	(0.0027)	(0.0109)	(0.0033)
Debt Measured at Book Values (Market Values)	0.0003	-0.0006	-0.0090	0.0030	-0.0041	-0.0001
	(0.0012)	(0.0010)	(0.0108)	(0.0085)	(0.0041)	(0.0019)
Econometric Specification of Primary Studies						
Dynamic Specification (Static Specification)	-0.0084	-0.1210***	-0.0265*	0.0567**	-0.0813***	-0.1244***
	(0.0157)	(0.0202)	(0.0144)	(0.0265)	(0.0150)	(0.0135)
Firm Fixed Effects Included (no)	-0.0037	0.0166	-0.0184*	-0.0199	-0.0071**	0.0299**
	(0.0123)	(0.0156)	(0.0108)	(0.0162)	(0.0031)	(0.0125)
Time Fixed Effects Included (no)	0.0132	0.0378**	0.0185*	0.0438**	0.0568***	0.0285*
	(0.0127)	(0.0154)	(0.0102)	(0.0216)	(0.0137)	(0.0145)

Table 6.3 (Continued)

	(1)	(2)	(3)	(4)	(5)	(6)
Control Variables in Primary Studies						
Control for Profitability (no)	0.0138	0.1220***	0.0462**	0.1485***	0.1774***	0.1180***
	(0.0259)	(0.0324)	(0.0188)	(0.0236)	(0.0218)	(0.0172)
Control for Size (no)	0.0343	-0.0137	-0.0411***	-0.0650***	0.0132	-0.0694**
	(0.0274)	(0.0218)	(0.0134)	(0.0237)	(0.0210)	(0.0285)
Control for Firm Growth (no)	-0.0199	-0.1652***	-0.0415***	-0.0249*	-0.1523***	-0.1640***
	(0.0147)	(0.0544)	(0.0124)	(0.0147)	(0.0274)	(0.0259)
Control for Collateral (no)	0.0018	-0.0574	-0.0089	-0.0648*	-0.0480*	0.0470
	(0.0158)	(0.0500)	(0.0130)	(0.0349)	(0.0250)	(0.0350)
Control for Inflation (no)	0.0134	0.0380**	0.0906***	0.0564**	0.0570***	0.0288**
	(0.0127)	(0.0154)	(0.0136)	(0.0235)	(0.0137)	(0.0145)
Control for Industry-Typical Leverage (no)	-0.0112	0.0867***	0.0476***	0.0869***	0.1504***	0.0891***
	(0.0151)	(0.0250)	(0.0115)	(0.0178)	(0.0217)	(0.0152)
Data Sample Characteristics						
Average Sample Year	0.000118***	0.000118***	0.00105	-0.000391	0.000102**	0.000148***
	(3.38e-05)	(2.73e-06)	(0.000720)	(0.00233)	(5.04e-05)	(9.44e-06)
Publication Selection						
Primary Standard Error	1.0186***	0.9614**	0.8908***	0.3955**	2.3259***	2.0153***
	(0.2197)	(0.4352)	(0.1987)	(0.1802)	(0.4060)	(0.3802)
Database Dummies Included in Meta-Regression	No	Yes	No	Yes	No	Yes
Study Dummies Included in Meta-Regression	Yes	No	No	No	No	No
Number of Primary Estimations	984	984	581	581	589	589
Adj. R^2	0.745	0.660	0.495	0.623	0.593	0.726

In column (3) and (4) of Table 6.3 the focus is exclusively on published studies. These regressions might give some further indication about the possible presence of publication biases. Furthermore, as most of the published articles in the meta-sample appeared in high-quality journals, selecting only published estimates into the meta-sample is also an effective quality filter. In columns (5) and (6) we consider only primary tax estimates that were statistically significant at the five percent level. Still, looking exclusively at published studies or respectively at significant primary estimates implies a sharp reduction of the meta-sample which drops by about 40%.

Generally, the regression results presented in columns (3) - (6) confirm most of our findings based on the full sample. Regarding the influence of the tax measures, the results confirm a significantly higher tax coefficient if simulated marginal tax rates are used. Interestingly, based on the estimates taken from the published studies, we do not find any negative effect on reported tax coefficients if average tax rates are employed. By contrast in column (4), where we include database fixed effects in the meta-regression, the meta-coefficient for the average tax rate suggests that identified tax effects are even significantly higher as compared to statutory tax rates. One may speculate that the review process in the run-up to publication often forces a more careful treatment of the endogeneity problems associated with average tax rates, thereby eliminating downwardly biased tax effect estimates.

6.5.3 Exclusion of Multinational Subsidiaries

The tax incentives and determinants of capital structures might be very distinct for foreign subsidiaries as compared to domestic firms. In this section, we therefore exclude all 352 primary tax effect estimates that exclusively refer to subsidiaries of multinational firms from the meta-regression analysis. We are thus left with Sample B as described in Section 6.3, containing 632 observations. Table 6.4 presents regression results using this subsample of primary estimates. Specification (1) in Table 6.4 considers our basic set of meta-variables, in column (2) we also control for database fixed effects. Generally, the results are very similar to those found for the full meta-sample in columns (6) and (7) of Table 6.2.

Table 6.4: Meta-Regression of Reported Tax Effect on Debt Ratios, Excluding Multinational Subsidiaries

Regressions of the marginal tax effect found in primary studies on respective study characteristics. All study/model characteristics are coded as dummy variables (except Average Sample Year and Primary Standard Error). Thus, a base model represents the characteristics redundant to the variables explicitly included. The benchmark characteristics are indicated in parentheses for each study dimension. Estimated coefficients of the dummies indicate the effect on primary marginal effects of choosing a characteristic in lieu of the base specification. All regressions include a constant (not reported). The regressions are based on Sample B (primary estimates referring to multinational subsidiaries are excluded). All regressions are from WLS estimation. Heteroskedasticity robust standard errors in parentheses; ***/**/* denotes significance at the 1%/5% /10% level.

	(1)	(2)	(3)	(4)	(5)
Proxies for the Marginal Tax Incentive					
SMTR (Statutory Tax Rate)	0.0838***	0.0655***	0.0974***	0.1153***	0.1115***
	(0.0211)	(0.0183)	(0.0177)	(0.0206)	(0.0353)
ATR (Statutory Tax Rate)	-0.0140	-0.0389***	-0.0333***		
	(0.0101)	(0.0101)	(0.0088)		
ATR is Immune to Endogeneity (Statutory Tax Rate)				0.0042	0.0042
				(0.0355)	(0.0357)
ATR is Potentially Endogenous (Statutory Tax Rate)				-0.0392***	-0.0392***
				(0.0086)	(0.0086)
Personal Taxes Included (Only Corporate Taxes)					0.0067
					(0.0413)
Debt Characteristics					
Long-Term Debt (Maturity not Specified)	-0.0107	0.0111***	0.0096**	0.0102***	0.0103***
	(0.0097)	(0.0040)	(0.0039)	(0.00383)	(0.0038)
Debt Measured at Book Values (Market Values)	-0.0074**	-0.0004	-0.0005	-0.0005	-0.0005
	(0.0031)	(0.0012)	(0.0012)	(0.0012)	(0.0012)
Econometric Specification of Primary Studies					
Dynamic Specification (Static Specification)	-0.0680***	-0.1223***	-0.1487***	-0.1382***	-0.1387***
	(0.0133)	(0.0172)	(0.0166)	(0.0209)	(0.0211)

Table 6.4 (Continued)

	(1)	(2)	(3)	(4)	(5)
Firm Fixed Effects Included (no)	-0.0057***	0.0229*	0.0021	-0.0100	-0.0106
	(0.0020)	(0.0136)	(0.0125)	(0.0153)	(0.0161)
Time Fixed Effects Included (no)	0.0439***	0.0330**	0.0469***	0.0586***	0.0583***
	(0.0124)	(0.0154)	(0.0151)	(0.0187)	(0.0184)
Control Variables in Primary Studies					
Control for Profitability (no)	0.0864***	0.1588***	0.1966***	0.1958***	0.1925***
	(0.0275)	(0.0272)	(0.0295)	(0.0276)	(0.0367)
Control for Size (no)	-0.0639***	0.0023	0.2207***	0.2264***	0.2275***
	(0.0148)	(0.0306)	(0.0609)	(0.0584)	(0.0594)
Control for Firm Growth (no)	-0.1328***	-0.1669***	-0.1482***	-0.1510***	-0.1504***
	(0.0218)	(0.0308)	(0.0273)	(0.0272)	(0.0274)
Control for Collateral (no)	-0.0057***	-0.0974**	-0.1826***	-0.1699***	-0.1676***
	(0.0020)	(0.0480)	(0.0479)	(0.0491)	(0.0519)
Control for Inflation (no)	0.0440***	0.0332**	0.0471***	0.0588***	0.0585***
	(0.0124)	(0.0154)	(0.0151)	(0.0187)	(0.0184)
Control for Industry-Typical Leverage (no)	0.0906***	0.0857***	0.1402***	0.1381***	0.1395***
	(0.0150)	(0.0215)	(0.0225)	(0.0225)	(0.0250)
Data Sample Characteristics					
Average Sample Year	7.73e-05	0.000118***	0.000117***	0.000117***	0.000117***
	(5.47e-05)	(3.34e-05)	(3.38e-05)	(3.36e-05)	(3.36e-05)
Loss-Making Firms Excluded (not excluded)			0.2595***	0.2657***	0.2669***
			(0.0571)	(0.0539)	(0.0552)
Publication Selection					
Primary Standard Error	0.7651***	0.7200***	0.6713***	0.5888**	0.5898**
	(0.2675)	(0.2588)	(0.2512)	(0.2491)	(0.2503)
Database Dummies Included in Meta-Regression	No	Yes	Yes	Yes	Yes
Number of Primary Estimations	632	632	632	632	632
Adj. R^2	0.457	0.657	0.684	0.684	0.684

The meta-regression results again allow predicting marginal tax effects that account for potential misspecification biases. Let us, for example, consider the results of column (1) of Table 6.4. Then, a marginal tax effect of 0.201 is predicted for a hypothetical study where the statutory tax rate, a static econometric specification and all other characteristics that prove to be statistically significant are chosen. However, if a simulated marginal tax rate is considered, we obtain a significantly larger predicted marginal tax effect on debt financing of about 0.285.

Given the clear focus of the subsample, we proceed with a thorough analysis of how the approximation of the marginal tax incentive affects tax effects estimated in the literature. For this purpose, we define some extra dummy variables. First, in column (3) we consider an additional dummy *Loss-Making Firms Excluded* that marks those primary analyses which rely on statutory rates but try to overcome related shortcomings by excluding loss-making companies from the data sample used by the respective study. Put differently, we identify primary studies that do not consider firms that are likely to be tax-exhausted. Our regression results provide striking evidence that, in fact, marginal tax effects are more pronounced if loss making firms are excluded from the sample considered by the primary analysis.

Second, in column (4) we distinguish between studies using effective average tax rates that explicitly cope with endogeneity concerns (ATR Immune to Endogeneity) and others that do not address this problem (ATR is Potentially Endogenous).[81] Our results support the view that the negative effect found for average tax rates is driven by a negative downward bias due to endogeneity. While we find a statistically smaller tax effect if average tax rates are potentially endogenous, average tax rates immune to endogeneity do not exert significant differences in tax effects, compared to statutory tax rates.

Finally, we code a dummy *Personal Taxes* which takes on a value of one, if personal taxes are included in the tax term and zero otherwise. While the interest deductibility creates the corporate tax incentive to use debt, shareholder taxation often differentiates between the types of capital as well. Still, the tax data used in the primary literature mostly reflects the pure corporate tax advantage of debt. The seminal work by Miller (1977), however, suggests that both corporate profit taxes and personal capital income taxes affect capital structure choices. If the personal tax status of capital providers is

[81] Some studies employing average tax rates (e.g. Lasfer, 1995; Charalambakis et al., 2008) neutralize the impact of interest deductions by putting tax payments derived from pre-interest profits in the numerator and by consistently relating it to those before financing profits.

known, capital structures are supposed to adjust to the after-personal-tax benefit of debt.[82] Some studies have included personal taxes in the measure for the marginal tax incentive to use debt financing. In column (5) we test whether estimated tax effects differ if the tax measure also includes personal taxes imposed on capital income. However, we do not find any statistically significant impact of the inclusion of personal taxes in the tax rate proxy.

6.5.4 Tax Response of Multinational Firms

In recent years, the debt policy of multinational firms has attracted increasing attention in the literature. Therefore, we run some further meta-regressions on Sample C of our meta-data, containing tax effect estimates derived on the basis of pure multinational subsidiary data. Table 6.5 shows the respective meta-regression results. In columns (1) to (4), we again regress the marginal tax effects found in primary studies on a set of study characteristics.[83] While regressions shown in columns (1) and (2) do not include the 101 pure profit shifting effects, they are additionally considered in columns (3) and (4), which themselves only differ with respect to the inclusion of database effects. To conclude, columns (3) and (4) present the most extended and complete meta-regression specifications. We rely primarily on these results when turning to interpretations. However, most coefficients are robust in sign and significance across columns (1) to (4) in Table 6.5.

Interestingly, in the case of multinational firms, we find that identified tax effects on debt policy are more pronounced if an average tax rate is considered instead of a statutory tax rate. An explanation for this finding might be that, in this Sample C, most primary estimates which refer to average tax rates successfully cope with the endogeneity concern.[84] Moreover, the important cross-country tax code differences are implicitly captured by average tax rates.

---

[82] Since in most countries personal taxes imposed on interest income are equal or even higher than the taxes on dividends or capital gains, personal taxes are typically associated with a tax penalty of debt (Graham, 1999).

[83] Compared to the specifications run on Samples A and B in subsections A to C, we generally cannot control for debt-maturity, the measurement of debt, and the implications of a dynamic specification. There is almost no variation with respect to these properties in analyses focusing on multinational subsidiaries. For the same reason, we are not able to test whether a simulated tax rate would be associated with higher tax effects.

[84] In Sample C, the lion's share of primary estimates using average tax rates is from Desai et al. (2004b) and Aggarwal and Kyaw (2008), who in fact have dealt with endogeneity concerns by considering host country median average tax rates.

Table 6.5: Meta Regression of Reported Tax Effects on Debt Ratios, Multinational Subsidiaries

Regressions of the tax effect found in primary studies on respective study characteristics. All study/model characteristics are coded as dummy variables (except Average Sample Year and Primary Standard Error). Thus, a base model represents the characteristics redundant to the variables explicitly included. The benchmark characteristics are indicated in parentheses for each study dimension. Estimated coefficients of the dummies indicate the effect on primary marginal effects of choosing a characteristic in lieu of the base specification. All regressions include a constant (not reported). All regressions are from WLS estimation. Heteroskedasticity robust standard errors in parentheses; ***/**/* denotes significance at the 1%/5% /10% level. The regressions are based on Sample C (only primary estimates referring to multinational subsidiaries). In columns (1) and (2) primary estimates are excluded that reflect a pure tax effect due to cross-border profit shifting. In columns (1) – (4) the dependent variable is the marginal tax effect found in primary studies; in columns (5) – (6) the dependent variable is the tax semi-elasticity of the debt ratio.

	Marginal Tax Effects				Tax Semi-Elasticities	
	(1)	(2)	(3)	(4)	(5)	(6)
Proxies for the Marginal Tax Incentive						
ATR (Statutory Tax Rate)	0.1829***	0.2133***	0.1301***	0.2177***	0.7667***	1.0232***
	(0.0285)	(0.0370)	(0.0293)	(0.0426)	(0.1160)	(0.1908)
Tax Effect Controlled for Profit-Shifting (Total Tax Incentive)			-0.0340**	-0.0478***	0.0291	-0.0159
			(0.0134)	(0.0133)	(0.0452)	(0.0503)
Profit-Shifting Tax Effect (Total Tax Incentive)			-0.0074	-0.0259**	-0.1677***	-0.2147***
			(0.0118)	(0.0115)	(0.0313)	(0.0384)
Credit System (Exemption System)			-0.0017	-0.0008	-0.0896	-0.0459
			(0.0047)	(0.0044)	(0.0609)	(0.0287)
Debt Characteristics						
Intra-Company Debt (Total Debt)	-0.0920***	-0.0919***	-0.0784***	-0.0681***	0.1563**	0.2879***
	(0.0166)	(0.0173)	(0.0161)	(0.0164)	(0.0615)	(0.0686)
Econometric Specification of Primary Studies						
Subsidiary Fixed Effects Included (no)	-0.0600*	-0.0226	-0.0540	0.0014	-0.4895***	-0.0931
	(0.0349)	(0.0436)	(0.0348)	(0.0364)	(0.1296)	(0.1322)
Parent Fixed Effects Included (no)	-0.0736**	-0.0693*	0.0015	0.0248	0.0366	0.0441
	(0.0329)	(0.0411)	(0.0322)	(0.0329)	(0.1304)	(0.1593)
Time Fixed Effects Included (no)	0.1709***	0.1837***	0.1250***	0.1422***	0.5814***	0.4782***
	(0.0405)	(0.0431)	(0.0426)	(0.0420)	(0.1788)	(0.1775)

Table 6.5 (Continued)

	(1)	(2)	(3)	(4)	(5)	(6)
Control Variables in Primary Studies						
Control for Profitability (no)	-0.0047	-0.0206	-0.0167	-0.0328**	-0.0207	-0.0179
	(0.0166)	(0.0198)	(0.0117)	(0.0129)	(0.0233)	(0.0245)
Control for Size (no)	0.0236	0.0073	-0.0014	-0.0011	0.1029	-0.0717
	(0.0156)	(0.0167)	(0.0112)	(0.0112)	(0.0839)	(0.0872)
Control for Firm Growth (no)	-0.2211***	-0.0921**	-0.1327***	-0.0449	-0.0477	0.1007
	(0.0303)	(0.0435)	(0.0224)	(0.0409)	(0.0565)	(0.1069)
Control for Collateral (no)	-0.0297	-0.0201	-0.0226*	-0.0237*	-0.4147***	-0.1902**
	(0.0182)	(0.0172)	(0.0134)	(0.0127)	(0.0719)	(0.0843)
Control for Inflation (no)	-0.0139	-0.0021	-0.0026	-0.0013	-0.0200	-0.0299
	(0.0225)	(0.0279)	(0.0175)	(0.0188)	(0.0318)	(0.0335)
Control for Industry Typical-Leverage (no)	-0.0348*	-0.0024	0.0030	0.0121	-0.0930	0.1065
	(0.0180)	(0.0177)	(0.0142)	(0.0132)	(0.0703)	(0.0735)
Control for Capital Market Conditions (no)	-0.0342*	-0.0054	-0.0348*	-0.0083	-0.0887*	-0.0378
	(0.0194)	(0.0206)	(0.0185)	(0.0220)	(0.0486)	ÿ0.0422)
Control for Political Risk (no)	0.2128***	0.1327***	0.1434***	0.1017***	0.2887***	0.1472
	(0.0345)	(0.0387)	(0.0278)	(0.0315)	(0.0624)	(0.0932)
Control for Market Growth (no)	0.0461	0.0614	0.0079	0.0077	0.1567*	0.2691***
	(0.0462)	(0.0505)	(0.0468)	(0.0533)	(0.0802)	(0.0851)
Data Sample Characteristics						
Average Sample Year	0.00255	0.000843	0.00484***	0.00371*	0.0499***	0.0434
	(0.00188)	(0.00281)	(0.00186)	(0.00200)	(0.00921)	(0.0293)
Publication Selection						
Primary Standard Error	1.8541***	0.9491***	1.8187***	1.2863***		
	(0.2038)	(0.2450)	(0.1839)	(0.1951)		
Database Dummies Included in Meta-Regression	No	Yes	No	Yes	No	Yes
Number of Primary Estimations	352	352	453	453	428	428
Adj. R^2	0.777	0.807	0.726	0.754	0.568	0.649

Generally, the observed international differences in corporate tax levels should affect the allocation of debt within a multinational firm.[85] Multinational firms can issue bonds preferentially in high tax countries (Newberry and Dhaliwal, 2001). They might, in addition, fine-tune taxable profits of high-taxed subsidiaries by using intra-company loans (Desai et al., 2004b). To capture the distinctive features of multinational debt financing, we again extend the basic set of meta-regressors and consider some extra dummy variables.

First, we code an additional dummy variable *Intra-Company Debt* that marks tax effect estimates exclusively referring to inter-company loans, as opposed to third-party or total debt.[86] By definition, the marginal tax effect on total debt is most pronounced, as the marginal tax effects on the two debt components, intra-company and external debt, add up. Consistently, in columns (1) to (4), the coefficient for *Intra-Company Debt* is significant with a negative sign.

Second, we consider the way primary studies model unobserved cross-sectional firm effects in more detail. Precisely, we distinguish whether unobserved subsidiary-fixed effects or unobserved parent-fixed effects are considered. According to the results, however, the inclusion of neither of these two types of fixed effects seems to have an impact on the identification of marginal tax effects. Instead, in accordance with our former results, we find that a careful modeling of unobservable time-effects drives identified tax effects upward. Interestingly, the magnitude of this effect seems to be particularly pronounced in the case of multinational debt financing.

Primary studies using cross-country data must control for the various differences in the economic and institutional environment possibly affecting capital structures of subsidiaries. We identify three main groups of extra control variables which are used in international studies. These capture the conditions of the host country capital market, political risk, and market growth. We code three additional dummy variables respectively indicating if these aspects are included in primary studies. However, the meta-regressions in columns (3) and (4) of Table 6.5 suggest that only the inclusion of political risk has a particular influence on identified tax effects in international capital structure regressions. This finding is very reasonable if political risk and host country tax

[85] While in 2009, for example, the statutory tax rate of the federal corporate income tax was 35% in the US, the corresponding tax rate was below 25% in several European countries. The corporate tax rate in, e.g., Ireland was as low as 12.5%.

[86] By far most estimates in Sample C refer to total debt or intra-company debt, only 35 primary tax effects are derived on the basis of external debt. We therefore abstain from considering a dummy for external debt.

levels are supposed to be negatively correlated. More risky host countries, e.g., in Eastern Europe, indeed tend to have lower tax rates in order to attract FDI. Furthermore, recent studies suggest that multinationals finance subsidiaries in high risk countries particularly with heavy debt (Desai et al., 2008; Kesternich and Schnitzer, 2010). Disregarding political risk in capital structure regressions should thus be associated with a downward bias of the identified tax effect. Consistently, the meta-coefficient for controlling for political risk in columns (3) and (4) is significant and positive. The effect of 0.143, for example, in column (3) is also qualitatively important.

Regarding the magnitudes of the reported tax effects, let us, for example, consider specification (3) of Table 6.5. If we consider a hypothetical study that considers total debt and simply employs the statutory tax rate but at the same time takes on all other characteristics that are statistically significant in column (3), a marginal tax effect of about 0.198 is predicted. If an average tax rate is considered, the predicted tax effect is even higher and amounts to 0.327.

The nature of the tax influence on capital structures of multinational subsidiaries however is complex. To be precise, primary estimates of the tax effect on debt policy differ in capturing either the incentives coming from the domestic tax system or, in addition, from the interplay of domestic and potentially numerous foreign tax regimes. In a purely domestic context, the marginal tax rate reflects the tax advantage of debt over equity financing. Its variation thus implies changes in the value of the corporate interest tax shield, prompting the firm to rebalance debt and equity financing. If multinational firms are involved, they might, in addition, adjust the intra-company allocation of internal funds in response to the shift in the relative tax attractiveness of a location. This international tax effect on a subsidiary's debt ratio then adds to the domestically motivated adjustment of corporate debt policy.[87]

By sample composition or by matter of econometric specification, a few primary studies empirically split up the overall tax effect on debt. In other words, they isolate what is called the international tax effect from the pure impact of the domestic tax system on debt ratios. To gain insight on the relative importance of both effects constituting the overall tax impact, we code a dummy variable *Profit-Shifting Tax Effect* which takes on the value of one if estimates refer to purely profit-shifting incentives and a value of zero if the total tax effect is reflected. We also consider an additional dummy *Tax*

[87] For a thorough discussion see Huizinga et al. (2008).

Effect Controlled for Profit-Shifting Effect that marks estimates reflecting the tax effect of the domestic tax system, i.e. the remaining tax effect if the profit-shifting effect is already controlled for. The two respective meta-regression coefficients in columns (3) and (4) of Table 6.5 show a negative sign but the effect for the profit-shifting activity is only statistically significant if database fixed effects are considered. The estimated effects are also rather small. Consequently, each effect deviates only slightly from the tax effect found in studies that less carefully model the complex tax incentives in multinationals. This means that the total tax effect almost doubles if a study carefully accounts for the international tax incentive, because a subsidiary is simultaneously confronted with both incentives from the host-country tax and from cross-border profit-shifting opportunities.

An example helps to clarify the complex nature of tax incentives associated with multinational activity. Let us, once again, consider column (3) and look at the aforementioned hypothetical study taking on all significant study characteristics except elaborate tax variables and intra-company debt. First, the results suggest that a rising host country tax rate exerts a marginal effect on debt-to-asset ratios of about 0.164. Secondly, due to cross-border profit shifting incentives, the tax-rate differential between the host-country tax level and the tax level at other locations of the multinational firm entails an additional marginal tax effect of about 0.198. Consequently, the debt ratio of a multinational subsidiary is affected by variation in both the host country tax level and the tax level at the other locations of the multinational group. If the host country tax rate rises by one percentage point, the regression results suggest an increase of the debt ratio by 0.362 because the internal reallocation of debt financing within the multinational group adds to the generally higher attractiveness of debt financing. Not surprisingly, this predicted marginal tax effect for the tax response of multinational subsidiaries is much higher than marginal tax effects predicted for estimates excluding multinational firms.

We can compare our results, for example, with predicted effects using regression results found for the sample that excludes studies focusing exclusively on multinational subsidiaries (see subsection C). The marginal tax effect predicted for a corresponding specification is 0.201.[88] This effect size is surprisingly close to what can be expected to be found in multinational firm data analyses (0.198) if they do not adequately account

88 We refer to column (1) of Table 6.4 and consider a case where the statutory tax rate, a static econometric specification and all other characteristics that prove to be statistically significant are chosen.

for the complex tax incentives at work in a multinational. Thus, our findings support the view that the complex nature of the tax incentives associated with multinational activities needs very careful consideration in an empirical analysis of capital structures. Taking our numerical examples seriously, a study that does not disentangle the different tax incentives of multinational subsidiaries tends to significantly underreport the tax response of capital structures.

The international tax system entails an additional impact on financial policy within multinational firms. Generally, two different systems of double taxation avoidance are applied. One group of countries simply exempts foreign dividends (exemption system). In this case, a multinational firm immediately benefits from reductions in foreign tax payments due to tax optimal debt financing. By contrast, in some countries, e.g. the US, foreign source income is taxed but foreign tax payments can be deducted from domestic tax liabilities (credit system). Under the credit system, benefits from tax avoidance abroad are offset by tax payments at the parent-company level when profits are repatriated. Therefore, we construct a dummy variable *Credit System* to identify estimates which rely on data of parent firms resident in home countries that apply the credit system. Our regression results, however, do not confirm that tax effects differ across different systems of international taxation.

If a primary study only refers to intra-company debt, the results of column (3) suggest that the marginal tax effect is reduced by 0.078. However, there are sound reasons to expect that intra-company debt reacts more intensively to tax rate changes. Desai et al. (2004b) point out that tapping internal capital markets might come along with significant cost advantages as compared to external funding if local capital market conditions are weak. Furthermore, for multinational firms, the fine-tuning of internal finances can serve as an important tax planning tool, used to minimize companywide tax payments. Yet, Desai et al. (2004b) carefully hint at external debt generally taking up a larger share in total debt than intra-company borrowing. The meta-regressions in columns (1) to (4) suggest that the arguments discussed above have not translated into larger marginal tax effects on intra-company debt ratios. However, marginal tax effects are not normalized with respect to initial debt shares and potentially hidden build-up costs. By contrast, the semi-elasticity is an instructive indicator if the interest does not lie in the absolute response of debt ratios but in relative response intensities.

Therefore, we consistently transform the marginal tax effect found in primary studies into a semi-elasticity of the debt ratio. The latter reflects the percentage change in the debt ratio in response to a one percentage point change in the tax rate. As almost all primary estimates sampled from the literature represent marginal tax effects, we can only evaluate the semi-elasticities at the respective sample means of the debt ratio. Equation (6.3) illustrates the semi-elasticity (semi) more formally, where *d* represents the corporate debt ratio and τ is the tax rate:

$$\text{semi} = \frac{\partial \, \text{d}}{\text{d}} \cdot \frac{1}{\partial \, \tau} \tag{6.3}$$

In columns (5) and (6) of Table 6.5 the dependent variable of the meta-regressions is now the tax semi-elasticity as defined in equation (6.3).[89] The regression results suggest that the relative response of intra-company debt to taxes is indeed significantly more intense as compared to other debt items.

With regard to the magnitudes of the estimated effects, let us consider column (5) of Table 6.5. If we begin, once again, by assuming the aforementioned hypothetical study that produces a marginal effect of 0.164, the semi-elasticity of the debt ratio to a rising host country tax rate is predicted to be 0.313. The corresponding semi-elasticity for a fall in the tax level at other locations of the multinational group is 0.146. If however only intra-company debt is considered, predicted semi-elasticities are significantly higher and amount to 0.470 or 0.302, respectively. Generally, on the basis of all primary evidence, intra-company debt is confirmed to be a flexibly-used tax planning device.

6.6 Conclusions

The empirical evidence with regard to the tax impact on corporate debt policy is strongly varied. This gives reason to provide a first quantitative survey of the literature. Taking recourse to meta-regression analysis, we offered explanations for why reported tax effects appear heterogeneous. After we have synthesized the evidence from 1,143 point estimates of marginal tax effect on the corporate debt ratio sampled out of 46 primary analyses, we conclude that capital structure choices are indeed positively affected through taxes. The effect is also quantitatively important.

Our findings suggest that very small or even negative tax estimates found in a couple of studies do not reflect the true debt response to taxes. By contrast, accounting for all potential misspecification biases, we predict a marginal tax effect on the debt ratio of

[89] In columns (5) and (6) of Table 6.5, the number of observations falls slightly because information provided in the study by Jog and Tang (2001) does not allow to calculate semi-elasticities of debt ratios.

0.30, based on results in column (6) of Table 6.2. Hence, the debt-to-assets ratio rises by 3 percentage points if the simulated marginal tax rate increases by 10 percentage points.

A comparison with other capital structure determinants puts the magnitude of the predicted tax effect into perspective. Let us, for example, consider tangibility which is usually defined as the ratio of tangible assets to total assets. According to a recent study by Frank and Goyal (2007) the marginal response of capital structures to tangibility oscillates around 0.126. Accordingly, the debt response to tangibility is only one-third of the response to taxes. The empirical results of our meta-study thus support the view that taxes are quite an important determinant of capital structure choices.

Furthermore, our meta-regression results show that the point estimates of tax effects are, in particular, affected by the tax rate proxy used for identification. We find very robust evidence that, as compared to statutory tax rates, simulated marginal tax rates are associated with significantly higher estimates for the tax coefficient. Average tax rates instead may introduce a significant downward bias in primary estimates which is due to endogeneity. In general, we can conclude that a careful consideration of the firm-specific tax status raises the magnitude of identified tax effects on corporate debt policy.

Moreover, the results of the meta-analysis suggest that the set of explanatory variables considered in a primary study significantly affect reported tax effects. Disregarding one type of control variable is indeed quantitatively important. In addition, the long-term response of capital structures to taxes identified in dynamic models exceeds in magnitude the response estimated in static models. Interestingly, we find that unobserved firm effects do not affect isolated tax effects on debt policy.

In additional regressions, we focused on tax effect estimates with regard to multinational debt financing. We document that, due to the complex nature of tax incentives associated with multinational activity, an empirical analysis must carefully model the additional effect arising from cross-border profit shifting opportunities. Moreover, our results suggest that the relative tax sensitivity of intercompany debt financing is particularly strong. Interestingly, our meta-analysis does not corroborate the view that the international tax system affects the tax effect on debt financing of multinational firms.

Finally, the results of our meta-analysis may guide further empirical research: For the fast growing literature on multinationals' debt financing, it might be an interesting challenge to consider the firm's tax status more carefully, e.g., by using simulated marginal tax rates. Since previous dynamic estimations have predominantly referred to potentially endogenous average tax rates, another challenge could be to estimate a dynamic model with a better proxy for the marginal tax incentive. Generally, future research can benefit from the insights on how various study characteristics quantitatively affect estimated tax effects.

Chapter 7

A Meta-Study on the Tax-Responsiveness of Profit Shifting

7.1 Introduction

A wealth of empirical literature deals with corporate profit shifting behavior. Several strands of research have emerged. Numerous studies provide indirect evidence for profit shifting by investigating the correlation between reported profits and tax levels. Some research focuses on profit shifting via the route of inter-company transactions, in particular the manipulation of transfer prices. Another strand of literature examines shifting via financial decisions, therefore dealing with capital structures and the allocation of internal debt.

Surprisingly, no attempt has so far been made to systematically compare the distinct shifting channels with regard to their economic significance. To fill in this gap in the literature, we present a meta-study of the research results from 40 primary studies on corporate profit shifting behavior. We first transform the reported empirical results into a uniformly defined effect size index. Then we regress reported tax effect sizes on different sets of mostly dummy variables which mark, inter alia, the distinct shifting channels, the explained proxy variables for profit shifting activity, and the different econometric approaches.

Meta-regression analysis will help us to answer interesting and important questions:

- Do the strands of empirical research on profit shifting differ with regard to the reported tax sensitivity of their main dependent variable?
- If there are systematic differences, are these due to the nature of the employed dependent variable and the chosen econometric approaches?

- Do the empirical results hint at fundamental differences in the economic significance of the distinct profit shifting channels? If so, how large are these differences?

Based on our meta-regressions, we predict affiliate pre-tax profit to decline by 1.71% in response to a one percentage point increase in the profit shifting incentive. Meanwhile, EBIT is predicted to decrease by 1.28%. Moreover, we find that the tax-responsiveness of pure paper profit shifting is overestimated by 20% if real economic location effects are left uncontrolled for in the econometric analysis. Furthermore, our results provide some tentative evidence that tax-motivated financial decisions explain around 20% of the overall profit response to international income shifting incentives. Inter-company transfer pricing and adjustments of transaction volumes instead seem to account for the larger share in shifting volumes.

The remainder of this chapter is organized as follows. In Section 7.2, we survey the empirical evidence on the impact of tax incentives on profit shifting activity. A detailed description of the assembled meta-dataset is provided in Section 7.3. Thereafter, Section 7.4 presents the results of the meta-regression estimations. Section 7.5 concludes.

7.2 Qualitative Literature Review

The extent of profit shifting activity is influenced by numerous factors, including anti-tax avoidance rules and the interdependence of financial, operational, and tax decisions. The relative importance of the associated costs that offset the tax benefits at the margin is, however, unknown a priori. While there is agreement that income shifting takes place, its sensitivity to a variation in shifting incentives is thus an empirical issue. In the following, we survey the insights gained from primary research on the profit shifting behavior of multinational firms.[90]

General Evidence for Profit Shifting

General evidence of profit shifting activity is provided by Egger et al. (2010). In this study, multinational subsidiaries are matched with comparable domestic firms. The

[90] In his representation of the essential choices facing multinational firms, Devereux (2007) refers to the reallocation of profit among locations as the final stage of the transnational investment decision tree. Please note, however, that tax planning can be associated with real economic decisions on, for example, group structure and intra-group trade quantities. Thus, there is often only a fine line between pure tax planning and the real economic sphere. This meta-analysis, however, restricts the focus, as far as possible, on tax planning with regard to so-called paper profit shifting, and ignores the real economic dimension. For a more detailed discussion of the interrelation of tax planning and real economic consequences for, e.g., group structures, please refer to a survey put forward by Heckemeyer and Overesch (2012).

findings, based on European company data from the Amadeus database (Bureau van Dijk) averaged over the period 1999 to 2006, are consistent with tax planning: in high-tax countries, multinational affiliates tend to be relatively unprofitable while in low-tax jurisdictions their profitability is increased.

Another innovative investigation approach is put forward by Dharmapala and Riedel (2011). Again based on European Amadeus firm data from 1995 to 2005, the paper traces how exogenous earnings shocks at the parent firm propagate within the group. The results show that positive earning shocks lead to a significantly positive increase of pre-tax profits in low-tax affiliates, relative to the effect on high-tax subsidiaries.

An important strand of the empirical research directly exploits tax rate variation. The 1986 US Tax Reform Act (TRA 86) offers a natural experiment here. With the US statutory corporate income tax rate brought down from 45% to 34%, the US tax difference vis-à-vis many foreign locations switched sign, accordingly reversing income shifting incentives. Based on US firm-level data for the period from 1984 to 1990, Harris (1993) and Klassen et al. (1993) show that US multinational corporations shifted considerable amounts of income into the United States as a result of the TRA 86.

The Tax-Rate Elasticity of Reported Profits and EBIT

Grubert and Mutti (1991) and Hines and Rice (1994) directly estimate the tax elasticity of reported profitability. They aggregate 1982 Bureau of Economic Analysis (BEA) data of foreign subsidiaries of US corporations to the respective host country levels. The econometric analysis regresses measures of pre-tax profitability on local tax rates. In particular, Hines and Rice (1994) employ earnings before interest and taxes (EBIT) as a dependent variable instead of using after-financing profits. Identified effects thus must be caused by tax planning strategies built around intra-group transactions because EBIT is unaffected by financial policy.

Numerous studies follow up on this early literature. Recent contributions, equally based on BEA foreign subsidiary data of US multinationals, include Clausing (2009) and Schwarz (2009). In line with Hines and Rice (1994), many analyses focus on the tax sensitivity of EBIT to investigate shifting via related-party transactions (Huizinga and Laeven, 2008; Markle, 2010; Blouin et al., 2011).

Markle (2010) investigates the role of tax deferral for the profit shifting behavior of multinationals subject to worldwide taxation. Exploiting a 2006 cross-country sample, he finds that shifting behavior is no different from what is observed under territorial tax regimes if the residential tax system allows for the deferral of home country taxes on foreign income.

Blouin et al. (2011) investigate the role of tariffs. Using a BEA sample of foreign affiliates engaging in related-party trade with their U.S. parents between 1982 and 2005, they show that tariff minimization dominates the influence of income tax rates on pre-tax profitability.

While the above studies focus on US outbound subsidiaries, Mills and Newberry (2004) examine whether the tax reporting of US inbound subsidiaries is equally affected by shifting incentives. Based on confidential data provided by the US Internal Revenue Service (IRS) for 1987 through 1996, US affiliates of foreign multinationals with low average foreign tax rates are shown to report less taxable income than subsidiaries paying high foreign taxes.

Improved availability of non-US firm-level data led to an increasing number of studies with a more international focus. Huizinga and Laeven (2008) use European subsidiary data of 1999 from the Amadeus database. They employ a composite tax variable that weighs bilateral tax rate differences vis-à-vis all other firm locations with weights given by the relative importance of the firm's local operations. The results of the econometric analysis substantiate the profit shifting hypothesis.

Dischinger (2007) exploits a panel of European subsidiary-level data from 1995 through 2005. Controlling for unobserved affiliate effects, he documents a negative relationship between a subsidiary's reported pre-tax profits and the statutory tax difference vis-à-vis the parent company.

Using a comprehensive dataset on German FDI (Midi) provided by Deutsche Bundesbank, Weichenrieder (2009) offers some evidence that wholly owned affiliates' shifting response to local tax rate changes is particularly pronounced.

The evidence described so far is generally of an indirect type. Profit is clearly influenced by cross-border shifting activity. Nonetheless, it gives no indication about the immediate response and relevance of the distinct shifting channels. Similarly, tax-induced variation in reported EBIT can only provide indirect evidence. However, here we know that the underlying shifting activity must be related to inter-company trade rather than financial structure. It thus seems to be a good idea to compare the tax sensitivity of after-financing profit and EBIT. Differences in the tax-responsiveness of these two indirect indicators for income shifting could shed light on the economic significance of the two shifting channels. We will return to this question in Section 7.4.

The Tax Sensitivity of Related-Party Trade

In addition to the indirect evidence, important strands of literature directly focus on the shifting mechanisms. A number of these more direct approaches deal with related-party transactions.

Based on aggregate BEA transaction data of US outbound investments, Grubert and Mutti (1991) find an empirical effect of foreign host country taxes on the volume of trade with the US. Still, the investigation does not control for the capital location effect of taxes, which could also drive the observed trade patterns. Clausing (2001, 2006) therefore isolates the distinct tax effects on US trade patterns. One the one hand, this is the tax effect on real capital location. On the other hand, there are the tax effects on transfer prices and the tax motivated deviation from otherwise optimal trade quantities. Regressions run on aggregate BEA data confirm the significance of all three tax effects.

Grubert (2003) explains variation in related-party sales and purchases with profit-shifting incentives at the firm-level. Based on 1996 tax return data for US outbound subsidiaries, he provides evidence that intangibles produced by R&D activity play an important role in profit shifting strategies.

Overesch and Schreiber (2010) substantiate these findings. Analyzing the claims on affiliated enterprises reported by German outbound subsidiaries, they show that firms with a strong focus on R&D have additional income shifting opportunities.

The Tax Sensitivity of Transfer Prices

Some studies directly exploit price data to investigate tax-motivated transfer price manipulation. Bernard and Weiner (1990) use US petroleum price data for the years from 1973 to 1984. They regress the price gap between arm's length and related-party transactions on the difference between the industry-specific average tax rate in the host country and the US. However, their results do not back the hypothesis that US petroleum multinationals underinvoice oil exports from high-tax source countries.

Another study dealing with US import prices is put forward by Swenson (2001b). Studying the prices of US imports from countries holding major direct investments in the US (Canada, France, Germany, Japan, UK), the empirical evidence indeed suggests that transfer prices for related-party transactions between parents and US affiliates are manipulated according to tax incentives. For the sample period from 1981 through 1988, the regression analysis shows that reported prices rise when the combined effect of taxes and tariffs provides an incentive for firms to overstate their prices.

Clausing (2003) exploits monthly price data for both arm's length and related-party US imports and exports. In line with the theoretical prediction, a significant reaction to international tax incentives is only identified for intra-firm transfer prices.

Bernard et al. (2006) report an economically small but statistically highly significant tax and tariff sensitivity of the gap between related-party and arm's length prices of US exports during the 1990s.

The Tax Sensitivity of Corporate Financial Policy

Multinational firms are able to shift income via a second major channel. This route relates to financial decisions. Multinationals can geographically reallocate internal debt, lent and borrowed between affiliates, in a way that the overall company tax burden is reduced.[91]

Altshuler and Grubert (2003) and Desai et al. (2004b) were the first to examine balance sheet data of foreign subsidiaries of multinational corporations. Altshuler and Grubert (2003) use corporate tax files of US controlled foreign companies (CFC) compiled by the US IRS for the year 1996 and find significant tax effects exclusively on internal debt ratios. Desai et al. (2004b) analyze BEA firm-level data for the years 1982, 1989 and 1994 on US affiliated operating abroad. They confirm significant tax influences on internal debt ratios. Furthermore, some empirical studies focus on the tax asymmetries between subsidiary and parent company.

Mills and Newberry (2004) find a negative impact of the tax level of parent companies on debt financing of foreign controlled subsidiaries in the US.

More recently, improved data availability favored the assessment of tax effects on capital structures within European multinationals (Huizinga et al., 2008; Buettner et al., 2009; Mintz and Weichenrieder, 2010). All studies find a significant empirical correlation between internal debt ratios and tax levels. In particular, the tax elasticity turns out to be more pronounced for intra-company debt than for third-party debt (Desai et al., 2004b; Feld et al., 2011).

Given the role of debt financing in tax planning strategies, there are attempts to restrict the use of inter-company loans by introducing what is called thin-capitalization or earning stripping rules. The effects of thin-capitalization rules are assessed by Buettner

[91] Debt financing can also be motivated by the domestic tax system which in most countries provides for a tax advantage of debt over equity. Here, we are only interested in the effect of the international profit shifting incentives and exclude research results which relate to the purely domestic context. For a comprehensive meta-analysis of all tax effects influencing corporate debt policy, see Chapter 6.

et al. (2008) and Overesch and Wamser (2010b). Based on data for German outbound subsidiaries from 1996 through 2004, Buettner et al. (2008) provide evidence for considerable effectiveness of thin capitalization rules in curbing tax planning via intercompany loans. Overesch and Wamser (2010b) infer the same result from their analysis of German inbound investment data when taking reforms of the German thin-capitalization rules as natural experiments.

This qualitative literature survey shows that numerous studies provide estimates for the tax sensitivity of multinationals' profit shifting behavior. The different strands of literature put their emphases on either indirect evidence for profit shifting or on the direct analysis of profit shifting channels. Depending on the key points of analysis, the employed proxies for profit shifting activity differ. In the following sections, we analyze whether and to what extent these different study characteristics systematically explain differences in the reported tax-responsiveness of profit shifting behavior.

7.3 The Meta-Dataset

To assemble the meta-database of primary tax effect estimates, we comprehensively searched the empirical literature on corporate profit shifting behavior. In particular, we scanned the Econ-Lit and the SSRN working paper database for the central keywords "Tax", "Income Shifting" and "Profit Shifting". Furthermore, we conducted additional internet searches and screened relevant journals as well as working paper series.[92] In total, we found 47 studies to match our search criteria.

To compare the primary estimates of the tax effect on profit shifting activity, these must be transformed into a uniformly defined effect size index. In this meta-study, we refer to the semi-elasticity of profit shifting activity. The semi-elasticity indicates the percentage change of the respectively employed profit shifting indicator in response to a one percentage point change in the tax incentive to shift profits abroad. Equation (7.1) generally defines a semi-elasticity (e^{PS}) for a given dependent variable DV used as an

[92] We particularly searched through the Journal of Finance, Journal of Financial Economics, Journal of Quantitative and Financial Analysis, Journal of Public Economics, Journal of International Economics, National Tax Journal, International Tax and Public Finance, Journal of Accounting Research, Journal of Accounting and Economics, Accounting Review, Contemporary Accounting Research, European Accounting Review, Journal of Business Finance and Accounting, and the Econ-Lit and the SSRN working paper database.

indicator for profit shifting behavior and endogenous to the international tax rate difference $diff = \tau^{H} - \tau^{F}$.[93]

$$e^{PS} = \frac{\partial \ln DV}{\partial\, diff} \approx \frac{\partial DV}{DV} \cdot \frac{1}{\partial\, diff} \tag{7.1}$$

Linear models with a log-level specification produce point estimates of semi-elasticities. Other specifications yield coefficients which represent, for example, marginal effects or elasticities. If the semi-elasticity is not reported as point estimate, we use the sample mean value of the tax rate and/or the dependent variable to transform the tax coefficient into a semi-elasticity.[94] If the required sample means are not available, we have to exclude the study from our meta-analysis. Excluded studies are Bernard and Weiner (1990), Grubert and Mutti (1991), Jacob (1996), Grubert (1998), Conover and Nichols (2000) and Klassen and Laplante (2010). After all, 40 studies enter our meta-dataset.

Eventually, the sign of the semi-elasticities must be uniformly aligned. Otherwise the semi-elasticity of, for example, related-party import prices with regard to the local tax rates of a given country would show the opposite sign of the semi-elasticity of related-party export prices. Pooling these results would be misleading because the two effects cancel out. Where required, we therefore multiply the elasticity values by (-1). In the end, semi-elasticities are aligned so that a higher positive value of the semi-elasticity indicates a higher tax-responsiveness of the underlying profit shifting activity.

Table 7.1 lists the results of the literature sampling procedure and shows some descriptive statistics for each study included in the meta-dataset.[95] It also indicates which type of evidence or, respectively, profit shifting channel is analyzed. At the bottom of Table 7.1, some summary statistics are provided.

---

93 This difference can be empirically captured in manifold ways. If foreign taxes are controlled for, e.g. by looking at inbound subsidiaries from one single foreign home country, only the local tax rate matters. If the differential must be fully included, its empirical design depends on the number of locations involved and on whether a weighting scheme is applied that accounts for the importance of locations.

94 See the Appendix for details.

95 Note that we use all reported tax effect estimates instead of picking just one result from each primary study. Selecting one single estimate from each study would require predefined and - most importantly - objective sampling rules, which can hardly be justified. Moreover, the additional heterogeneity obtained from considering all robustness checks reported in a study is welcome in statistical meta-analyses.

Table 7.1: Studies on Profit Shifting Behavior Included in the Meta-Analysis

	Study	Dep. Variable	No. of effects	Semi-Elasticities				
				Mean	Median	Min	Max	Std.
1	Azemar, 2010	Profit	3	2.75	1.60	1.02	5.62	2.51
2	Blouin et al., 2011	Profit	4	0.47	0.39	0.21	0.89	0.32
3	Clausing, 2009	Profit	4	3.39	3.50	1.05	5.52	1.83
4	Collins et al., 1998	Profit	2	0.32	0.32	-0.32	0.95	0.90
5	Dharmapala and Riedel, 2011	Profit	3	1.02	1.04	0.90	1.13	0.11
6	Dischinger, 2007	Profit	26	1.38	1.31	0.40	3.05	0.70
7	Dischinger and Riedel, 2011	Profit	4	3.20	3.18	2.14	4.29	1.11
8	Grubert, 2003	Profit	5	0.78	0.79	0.38	1.05	0.26
9	Markle, 2010	Profit	15	0.98	0.94	-0.41	2.04	0.67
10	Mills and Newberry, 2004	Profit	4	1.94	1.03	-1.16	6.86	3.79
11	Rousslang, 1997	Profit	12	4.74	5.00	3.63	5.63	0.64
12	Schwarz, 2009	Profit	9	2.27	2.16	-1.33	4.81	2.01
13	Weichenrieder, 2009	Profit	0	0.83	0.90	0.44	1.16	0.29
14	Bartelsmannv and Beemtsma, 2003	EBIT	4	0.37	0.35	-3.24	2.89	0.75
15	Beuselinck et al., 2009	EBIT	4	0.65	0.74	0.21	0.89	瘬
16	Hines and Rice, 1994	EBIT	8	4.85	3.31	-2.25	12.99	3.61
17	Hoonsawat, 2007	EBIT	2	0.61	0.61	0.60	0.61	0.01
18	Huizinga and Laeven, 2008	EBIT	24	1.25	0.92	0.49	3.71	0.70
19	Maffini and Mokas, 2011	EBIT	22	1.21	1.03	0.23	4.87	0.96
20	McDonald, 2008	EBIT	9	1.15	1.03	0.60	2.14	0.44
21	Clausing, 2001	Trade	20	1.98	1.81	-0.88	4.26	1.27
22	Clausing, 2006	Trade	9	3.70	4.08	0.80	7.32	2.14
23	Overesch, 2006	Trade	28	1.73	1.94	-0.85	3.38	1.14
24	Overesch and Schreiber, 2010	Trade	4	0.84	0.85	0.63	1.04	0.23
25	Bernard et al., 2006	Price	15	1.25	0.66	0.39	4.18	1.22
26	Clausing, 2003	Price	10	4.00	2.92	1.99	7.91	2.05
27	Swenson, 2001b	Price	7	1.20	0.72	0.00	4.50	1.51
28	Aggarwal and Kyaw, 2008	Debt	3	2.57	3.30	1.08	3.33	1.29
29	Altshuler and Grubert, 2003	Debt	2	1.04	1.04	0.66	1.42	0.54
30	Barion et al., 2010	Debt	4	0.18	0.19	-0.15	0.50	0.32
31	Buettner and Wamser, 2009b	Debt	115	0.61	0.77	-0.63	1.29	0.47
32	Buettner et al., 2008	Debt	9	0.41	0.66	-0.39	0.82	0.49
33	Buettner et al., 2009	Debt	3	0.65	0.62	0.54	0.77	0.12

Table 7.1 (continued)

	Study	Dep. Variable	No. of effects	Semi-Elasticities				
				Mean	Median	Min	Max	Std.
34	Desai et al., 2004b	Debt	13	1.66	1.11	0.63	5.00	1.24
35	Dischinger et al., 2010	Debt	22	0.11	0.09	0.03	0.38	0.09
36	Hebous and Weichenrieder, 2009	Debt	22	2.01	1.04	-8.00	33.00	7.98
37	Huizinga et al., 2008	Debt	28	0.13	0.13	0.01	0.30	0.05
38	Mintz and Weichenrieder, 2010	Debt	24	1.18	1.22	-0.33	2.89	0.90
39	Overesch and Wamser, 2010b	Debt	15	1.22	0.76	0.67	2.80	0.81
40	Ramb and Weichenrieder, 2005	Debt	8	0.09	0.04	-0.22	0.70	0.30
	Profit		**104**	**1.84**	**1.18**	**-1.33**	**6.86**	**1.70**
	EBIT		**123**	**1.05**	**0.73**	**-3.24**	**12.99**	**1.56**
	Trade		**61**	**2.04**	**1.88**	**-0.88**	**7.32**	**1.51**
	Price		**32**	**2.10**	**1.30**	**0.00**	**7.91**	**2.01**
	Debt		**268**	**0.77**	**0.67**	**-8.00**	**33.00**	**2.38**
	Full Sample		**588**	**1.22**	**0.82**	**-8.00**	**33.00**	**2.08**

Among the 40 studies contained in the meta-dataset, 13 studies provide indirect evidence on profit shifting behavior by estimating the sensitivity of affiliate profit to international tax differences. These studies contribute 104 semi-elasticities to the meta-sample, ranging from -1.33 to 6.85. The mean of this group of semi-elasticities is 1.84, with a median effect size of 1.18. The maximum value of 6.86 is reported by Mills and Newberry (2004) and the smallest responsiveness is found in Schwarz (2009).

Furthermore, Table 7.1 lists seven studies employing EBIT on the left-hand side of their regression equations. These analyses produce 123 semi-elasticities. The mean amounts to 1.05, with a slightly lower median value of 0.73. Extreme values are -3.24 and 12.99, reported respectively by Bartelsmann and Beemtsma (2003) and Hines and Rice (1994).

In addition, four studies included in our meta-dataset regress trade variables on profit shifting incentives. The mean effect of 61 reported empirical results, again measured in terms of semi-elasticities, is 2.04 (median: 1.88). The range of values is relatively small with a minimum semi-elasticity of -0.88, derived from Clausing (2001), and a maximum amounting to 7.32, inferred from Clausing (2006).

The next category of literature uses detailed transaction price data. This type of data, however, is only scarcely available to empirical researchers. Accordingly, the number of price data studies is small. The 32 estimates extracted from three studies show a mean semi-elasticity of 2.10 and a median of 1.30. The range of semi-elasticities computed from price data studies goes from 0 to 7.91.

The literature dealing with debt policies of multinational firms has grown to a considerable size in recent years. In this paper, we only refer to those studies which either empirically isolate the effect of shifting incentives on the affiliate debt ratio or use internal debt as dependent variable. We are not interested in the effects arising from the general tax advantage of debt over equity, as present under most domestic tax systems.[96] Eventually, we include thirteen capital structure studies in our meta-sample. On average, the 268 primary semi-elasticities computed on the basis of these studies amount to a value of 0.77 (median: 0.67). Extreme values are as low as -8 and reach up to 33.

Accordingly, the standard deviation of the reported tax sensitivity of profit shifting via the route of internal debt allocation is relatively high with a value of 2.38. Also for the other strands of literature, with the exception of trade data studies, the coefficients of variation (= standard deviation/mean) reach or even exceed the value one, hinting at considerable variation between studies. Moreover, the statistics shown in Table 7.1 also show high standard deviations within individual studies. The standard deviation in the full sample of all 588 primary estimates amounts to 2.08. The mean semi-elasticity across all strands of literature is 1.22 and the median value turns out to be 0.82.

To shed further light on the entire sample distribution of the semi-elasticities, Figure 7.1 shows six histograms. One is for the full sample and the remaining five represent, respectively, the distribution of estimates within each class of the empirical profit shifting literature. In all six histograms, the mass of the sample distribution of semi-elasticities lies within the range of 0 to 5. Empirical results for the tax sensitivity of affiliate profit, trade variables, and transfer prices are more widely dispersed and the range of values is larger as compared to the other stands of literature. All sample distributions of the different types of semi-elasticities are positively skewed, i.e. the right tails of the histogram document relatively infrequent but high effect estimates. Only a few semi-elasticities contradict the proposition of profit shifting activities increasing in the exploitable tax differences.

[96] For a more comprehensive meta-analysis of the literature investigating the relationship between corporate capital structure choice and taxes, including domestic tax incentives to finance with debt, please refer to Chapter 6.

Figure 7.1: Histograms of Estimated Tax Semi-Elasticities as a Fraction of Respective Meta-Subsamples

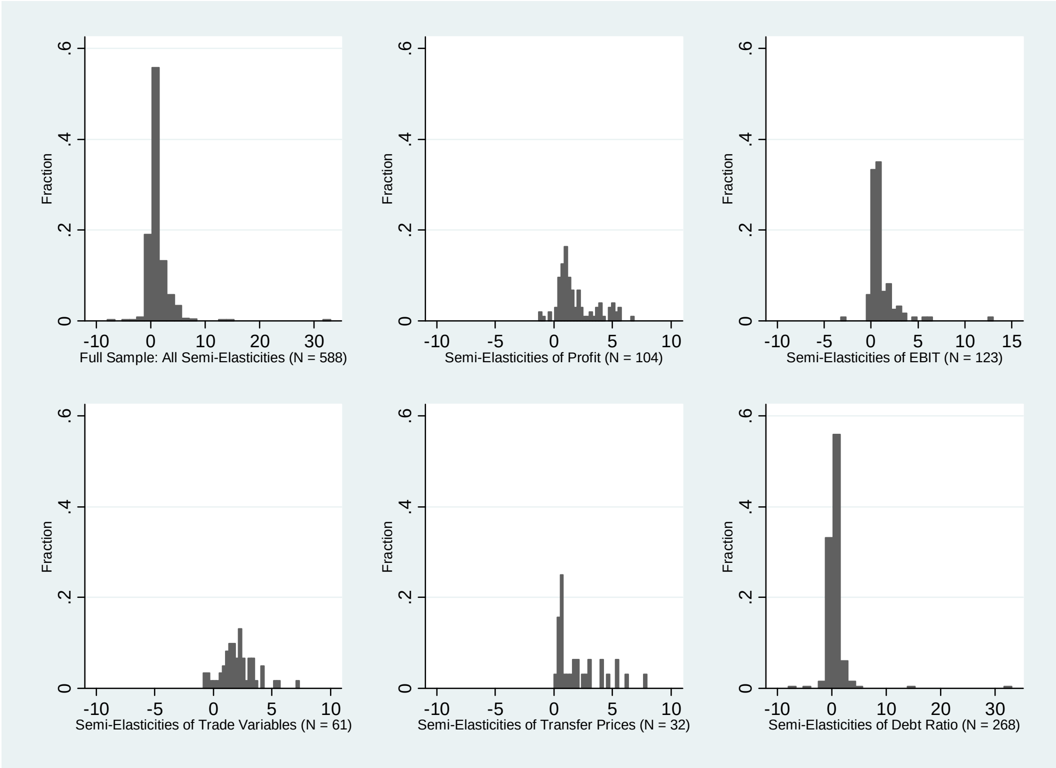


Table 7.2 shows the distribution of our sample of semi-elasticities by publication year (Panel A) and by parent country of the multinationals covered in the study data (Panel B).[97]

The figures shown in Table 7.2 (Panel A) reveal that 77% of the sampled estimates on corporate profit shifting behavior are dated 2005 or after. 39% of the sampled empirical results provide indirect evidence for profit shifting by referring to tax-induced variation in profit or EBIT. 46% of the semi-elasticities refer to income shifting via the route of internal debt allocation. By contrast, direct evidence for profit shifting via the channel of related-party transactions is relatively scarce with only 16% of the semi-elasticities. The two parent countries mostly referred to are the United States and Germany (see Table 7.2, Panel B). 21% of the sampled evidence refers to US multinationals, while 36% of the estimates in the meta-dataset are based on German outbound data. The share of German data is particularly high in the strand of literature dealing with tax-motivated capital structure adjustments. Studies focused on German multinationals use the MiDi database provided by Deutsche Bundesbank. The most important data sources for studies dealing with profit shifting behavior of US multinational activity are provid-

[97] By publication year we mean the date of the study, no matter whether it is already published or only available as a working paper.

ed by BEA and US IRS. Empirical analyses referring to diverse parent countries make up 43% of the meta-sample.

Table 7.2: Distribution of Semi-Elasticities by Publication Year and by Parent Country

	All Routes	Related-Party Transactions			Internal Debt Allo-cation	Total	
	Profit	EBIT	Trade Data	Price Data	Debt Ratio	abs	in %
A. By Publication Date							
1994		8				**8**	**1,4**
1997	12					**12**	**2,0**
1998	2					**2**	**0,3**
2001			20	7		**27**	**4,6**
2003	5	54		10	2	**71**	**12,1**
2004	4				13	**17**	**2,9**
2005					8	**8**	**1,4**
2006			37	15		**52**	**8,8**
2007	26	2				**28**	**4,8**
2008	13	33			40	**86**	**14,6**
2009	13	4			140	**157**	**26,7**
2010	18		4		65	**87**	**14,8**
2011	11	22				**33**	**5,6**
Total	**104**	**123**	**61**	**32**	**268**	**588**	
in %	**17,7**	**20,9**	**10,4**	**5,4**	**45,6**		**100**
B. By Parent Country							
United States	*40*	*17*	*29*	*20*	*18*	***124***	***21,1***
BEA	17	8	29		16	**70**	**11,9**
Compustat	2					**2**	**0,3**
US IRS	20	9			2	**31**	**5,3**
Orbis	1					**1**	**0,2**
Other				20		**20**	**3,4**
Germany	*5*		*32*		*173*	***210***	***35,7***
MiDi	4		32		173	**209**	**35,5**
Orbis	1					**1**	**0,2**
Mixed	*59*	*106*		*12*	*77*	***254***	***43,2***
Amadeus	36	28			54	**118**	**20,1**
Midi (Inbound)	6				23	**29**	**4,9**
Orbis	13	22				**35**	**6,0**
US IRS (Inbound)	4					**4**	**0,7**
Other		56		12		**68**	**11,6**

7.4 Results of the Meta-Regression Analysis

We now turn to the meta-regression analysis. The meta-regression we estimate takes the linear form depicted in equation (7.2), where $\boldsymbol{y}$ corresponds to the vector of estimated semi-elasticities drawn from primary analyses and $\boldsymbol{X}$ is a matrix of predominantly dummy variables that reflect various study or model characteristics.

$$\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\varepsilon} \tag{7.2}$$

Since $\boldsymbol{y}$ includes estimated coefficients derived from models which in their great majority conform to the assumptions of the classical linear model, the meta-regression errors $\boldsymbol{\varepsilon}$ should be normally distributed. Equation (7.2) is, however, clearly heteroskedastic as the variance of the primary estimates is related to the characteristics of a study.

One approach in the literature to deal with the presence of heteroskedasticity is to use OLS with robust standard errors; but in the clear presence of heteroskedasticity - as is the case in meta-regression analysis - ordinary least squares can be extremely inefficient (Greene, 2003: 226). Fortunately, in the case of meta-regression, the pattern of heteroskedasticity is sufficiently known because coefficient standard errors are given in nearly all primary results tables. Thus, weighted least squares (WLS) estimation with inverse primary standard errors in squares as analytic weight is the obvious method to obtain efficient meta-regression estimates (Stanley, 2008; Greene, 2003; Hedges and Olkin, 1985).[98] Technically, efficiency is obtained by assigning greater influence to those reliable primary estimates of the marginal tax effect which are less affected by sampling error and, thus, show small variances.

Our meta-regression results are displayed in Table 7.3 and Table 7.4.

7.4.1 Pooling the Fundamental Strands of Profit Shifting Literature

The regressions in Table 7.3 are based on the full sample as described in Section 7.3. That is, we consider 588 estimates of the semi-elasticity of profit shifting activity. To analyze whether study characteristics beyond differences in the employed dependent variable and the respective shifting routes systematically explain the variation in the reported tax sensitivity of profit shifting behavior, we regress the semi-elasticities on an extended set of meta-regressors.

---

98 See Chapter 4 for details.

Type of Dependent Variable

Regarding the different categories of dependent variables employed in the literature, we regroup the relatively small numbers of studies using price and trade variables into one larger category of literature on related-party transactions. The literature on the EBIT response to international shifting incentives is also assigned to this category. Eventually, we will thus compare three major types of research on profit shifting behavior by means of the meta-regression analysis depicted in Table 7.3.

Type of Employed Tax Measure

Besides the employed dependent variables considered in the primary literature, a focus is put on the tax measure used for analysis. Studies can rely on exploitable statutory tax rate differences to capture profit shifting incentives. By contrast, they can also resort to average tax rates, defined as (foreign) taxes paid divided by corresponding pre-tax income. Whether average tax rates reflect the incentives at work better than a mere statutory tax rate is basically an empirical question. In principle, the tax incentive to shift paper profits between jurisdictions should indeed be driven by tax savings associated with one additional unit of shifted income. The statutory tax rate should thus reflect the marginal tax incentive to shift profits. However, special tax regimes like tax holidays or firm-specific characteristics like loss carry-forwards are not considered by statutory tax measures. While an average tax rate based on actual tax payments entirely includes these impacts, it might be biased by tax exempt profits and tax allowances that do not affect the marginal unit of shifted income.

The Level of Aggregation

Furthermore, the primary literature shows considerable variation with respect to the level of aggregation of the analyzed data. Many studies focus on the micro-level and exploit original firm-level information. An important strand of mainly US literature, however, uses data aggregated at the country level. Becker et al. (2006) explain that, particularly in the case of aggregate data analyses, unobserved variables correlated with taxes can lead to biased empirical results because they are more difficult to control at the aggregate level.

Average Sample Year

Moreover, the data used in primary empirical studies is disclosed at very different dates. Hines and Rice (1994) estimate tax coefficients based on cross-sectional data for 1982. Huizinga and Laeven (2008) provide evidence based on year 1999 data. Dischinger and

Riedel (2011) again use panel data for the period from 1995 through 2005. The intensity of the behavioral response to taxes might vary over time because tax advisors are always searching for new tax planning strategies. Still, it is an empirical question whether the refinement in potential profit shifting strategies is offset by the introduction of specific anti-avoidance rules. We therefore take into account a variable *Average Sample Year*, which is the average disclosure year of the data used in the underlying estimation.

Publication Selection

In addition to these new meta-regressor variables, we again include the standard error as a control for publication selection.

Column (1) of Table 7.3 shows results of a baseline regression using ordinary least squares (OLS). Concerning the interpretation of results, please note that dummy variable regressions implicitly define an underlying benchmark study. The coefficients for each dummy variable reflect the average impact on reported tax effects if the study design deviates from the benchmark in that specific aspect. Respective benchmark characteristics are indicated in brackets for every control dummy in Table 7.3.

Significant meta-regression coefficients confirm that studies dealing with affiliate debt policy as a route to shift profits abroad identify semi-elasticities of affiliate debt ratios which are significantly lower than the semi-elasticities of after-financing profit. On the one hand, this difference in the response intensities could be due to the fact that accumulated measures of debt policy, such as the debt ratio, by definition react less intensively to changes in tax as compared to contemporaneous flow measures of profit. On the other hand, the difference could be due to the fact that the response in after-financing profits is the consequence of adjustments in profit shifting activities running both via the route of financial policy and related-party transactions. If related-party transactions play an important role, we should indeed see a considerable difference in the tax sensitivity of overall profits and a measure of tax-motivated adjustments in affiliate capital structures. Interestingly enough, the response intensity of related-party transactions is, in contrast to the response of debt ratios, not significantly different from the tax sensitivity of profits. This result is consistent with the proposition that the tax-responsiveness of profits is primarily driven by underlying adjustments in related party transactions rather than financial policies. These findings are robust to the introduction of the additional meta-regressor variables (columns (3) to (8)) and a switch to more efficient WLS estimation with primary coefficient variances as analytical weights (specifications (5) to (8) in Table 7.3). The introduction of a precision weighting scheme enhances estimation efficiency because it directly remedies heteroskedasticity in the meta-regression error term which is caused by different degrees of sampling error in the primary estimates. Since the Q test (see Chapter 4) hints at excess heterogeneity (Q = 11647.3, Pr > Q = 0.00), we additionally run a mixed effects WLS meta-regression with results displayed in Column (8). In Column (7), we use WLS estimation for the same specification as in Column (6), but we restrict the exploited meta-data to empirical findings which have already been published in academic journals.

Furthermore, in specifications (6) to (8) in Table 7.3, we change the benchmark type of the dependent variable used in primary studies from profit to affiliate debt policy. This allows us to directly compare the semi-elasticities of affiliate debt ratios and related-party trade variables, while in specifications (1) to (5) we compare the two single-channel semi-elasticities of debt and internal transactions to the responsiveness of profits as the indicator for the joint tax sensitivity of both profit shifting channels. This direct comparison in columns (6) and (8) of Table 7.3 reveals that related-party transaction parameters indeed seem to be more sensitive to profit shifting incentives than affiliate capital structures.

Moreover, we find no evidence, based on the results in Table 7.3, that the level of aggregation impacts on reported empirical findings. By contrast, there is robust evidence for the presence of publication selection bias in the literature on profit shifting behavior.

With regards to the average sample year, there is a clearly positive coefficient in all of the respective specifications (columns (4) to (8) in Table 7.3). Statistical significance at all standard levels is found for the (equivalent) specifications (5) and (6) and, at the 10% level, for the meta-regression on published primary results in column (7).

Concerning the influence of the type of tax rate employed to capture the international shifting incentives at work, we generally identify no significant impact.

Table 7.3:Meta-Regression of Reported Semi-Elasticities of Profit Shifting Activities, Fundamental Strands of Literature

Regressions of the semi-elasticity found in primary studies on respective study characteristics. All study/model characteristics are coded as dummy variables (except Average Sample Year and Primary Standard Error). Thus, a base model represents the characteristics redundant to the variables explicitly included. The benchmark characteristics are indicated in parentheses for each study dimension. Columns (1) – (4) of Table 7.3show OLS-regression results; columns (5) -(7) are from simple WLS estimation and column (8) is from mixed effect WLS. Standard errors robust to heteroskedasticity and arbitrary within-study correlation in parentheses; ***/**/* denotes significance at the 1%/5% /10% level.

	OLS				**WLS**			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Type of analyzed profit shifting variable/channel Benchmark characteristic: Spec. (1) to (5): After-Financing Profitability Spec. (6) to (7): Affiliate Debt Policy								
Affiliate debt policy	-1.073**	-1.073**	-0.698***	-0.728**	-0.715***			
	(0.446)	(0.446)	(0.251)	(0.280)	(0.184)			
Related-Party Transactions	-0.355	-0.355	-0.160	-0.0674	0.112	0.826***	0.918	0.748**
	(0.543)	(0.543)	(0.319)	(0.396)	(0.185)	(0.186)	(0.557)	(0.291)
After-Financing Profitability						0.715***	0.786**	0.795***
						(0.184)	(0.367)	(0.220)
Proxy for the Tax Incentive								
Average Tax Rates (Statutory Tax Rates)			0.294	0.408	-0.0941	-0.0941	0.516	0.489*
			(0.304)	(0.295)	(0.105)	(0.105)	(0.328)	(0.248)
Data Sample Characteristics								
Aggregate Data (Firm-Level Data)				-0.140	0.00136	0.00136	-0.0558	-0.185
				(0.457)	(0.0687)	(0.0687)	(0.137)	(0.391)
Average Sample Year				0.0129	0.0582***	0.0582***	0.0679*	0.00376
				(0.0291)	(0.0138)	(0.0138)	(0.0397)	(0.0212)
			(0.425)	(0.423)	(0.452)	(0.452)	(0.450)	(0.217)
Constant	1.842***	1.842***	0.536*	-25.20	-115.7***	-116.4***	-135.6	-7.560
	(0.413)	(0.413)	(0.311)	(58.40)	(27.40)	(27.50)	(79.39)	(42.29)
Number of primary estimations	588	588	588	588	588	588	310	588
adjusted R^2	0.0403	0.0403	0.558	0.558	0.489	0.489	0.542	0.282

In sum, the most prominent result of the our meta-regressions on the overall meta-sample of 588 primary estimates is the remarkably low semi-elasticity of affiliate debt ratios relative to the semi-elasticities of variables involving related party transactions. Furthermore, there seems to be some evidence for profit shifting activity to have increased over time. This is interesting given that efforts to contain such activity by means of anti-avoidance rules have also increased in recent years.[99]

7.4.2 A Detailed Analysis of the Indirect Evidence on Profit Shifting

The analysis presented in Table 7.4 aims at providing further insight into whether the observed difference in tax sensitivities indeed reflects differences in the economic significance of financial versus non-financial profit shifting mechanisms. We now restrict the analysis to two rather similar types of primary dependent variables. These mainly differ with respect to the inclusion of interest expenses: EBIT and profits after financing costs. By means of meta-regressions, we can isolate the variation in empirical results caused by the inclusion of financial policy on the left-hand side of the primary regression equations, given that all other major study characteristics are held constant. In this analysis, the findings thus cannot be blurred by differences in the nature of the endogenous variables beyond the mere effect of capital structure policy.

In addition to the type of profitability measure, the meta-regression specifications will be augmented to control for other study characteristics possibly driving the reported empirical results. The set of meta-regressors again includes the primary standard error to control for publication bias, the average sample year, the type of proxy for the tax incentive to shift profits, and, in particular, three meta-regressors reflecting the econometric specification employed in primary analyses.[100]

The first of these three specification dummies marks those primary estimates derived from regressions which control for unobserved time fixed effects. The second dummy takes on the value one if unobserved affiliate effects have been modeled in the empirical approach and zero otherwise. The third specification dummy takes into account whether the primary empirical investigation was designed to isolate pure profit shifting effects from capital location effects induced by international tax differences. So the dummy

---

99 Interest deductions ceilings have, for example, been introduced in Germany and Italy. Other countries follow suit.

100 We introduce these fine controls only now because the econometric settings underlying the different strands of literature included into our previous broader assessment are too diverse. For example, price data, by definition, contain no information on affiliates. As a consequence, any meta-dummy for the control of affiliate fixed effects would always be zero for price data studies and thus be highly correlated with the respective dummy variable marking this type of studies.

takes on the value one either if profit is scaled by the size of local business activity, i.e. sales or assets, to give a consistent measure of local profitability as left-hand side variable, or if the size of local economic activity is controlled for on the right-hand side of the primary estimation equation. If neither is the case and the identified tax effect on local profits might thus reflect both the tax-motivated geographical allocation of economic activity and paper profit shifting, the dummy is set to zero.

Column (1) and (2) of Table 7.4 show the results of two baseline regressions using ordinary least squares (OLS). Columns (3) to (7) are from simple WLS estimation and column (8) is from mixed effect WLS ($Q = 934.9$, $Pr > Q = 0.00$). The results are generally robust across specifications and estimation methods.

The coefficient for the after-financing dummy, which marks primary estimates of the tax-motivated shifting effect on affiliate after-financing profitability, is clearly positive in all specifications and, with the exception of column (1), significantly different from zero. We thus conclude that there is indeed robust evidence for a significant difference in the responsiveness of after-financing and before-financing profitability to international profit shifting incentives.

Table 7.4 also displays robust evidence that estimates which result from empirical approaches not controlling for the size of the local affiliate overestimate multinationals' efforts to shift paper profits towards low-tax jurisdictions. Controlling for local affiliate capital significantly reduces reported semi-elasticities according to results shown in columns (2) through (8). Mixing location and shifting effects of international tax rate differences can thus be quite misleading with regard to identified effect sizes.

As for the remaining meta-coefficients, the results in Table 7.4 show that modeling time fixed effects reduces the reported tax-responsiveness of profit shifting behavior. The same holds for the inclusion of firm fixed effects into primary regressions; however, the effect is not robust throughout all specifications. Furthermore, we augment the specification shown in column (6) of Table 7.4 with the average tax rate dummy but again there is no significant difference relative to the use of statutory rates. Eventually, publication selection again turns out to be present according to the significantly positive coefficients of the primary standard errors.

Table 7.4: Meta-Regression of Reported Semi-Elasticities of Profit versus EBIT

Regressions of the semi-elasticity found in primary studies on respective study characteristics. All study/model characteristics are coded as dummy variables (except Average Sample Year and Primary Standard Error). Thus, a base model represents the characteristics redundant to the variables explicitly included. The benchmark characteristics are indicated in parentheses for each study dimension. Columns (1) – (2) of Table 7.4show OLS-regression results; columns (5) -(7) are from simple WLS estimation and column (8) is from mixed effect WLS. Standard errors robust to heteroskedasticity and arbitrary within-study correlation in parentheses; ***/**/* denotes significance at the 1%/5% /10% level.

	OLS		WLS					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Type of Profit Variable								
After-Financing Profitability (Before-Financing Profitability, EBIT)	0.486	0.712*	0.406***	0.425***	0.425***	0.411***	0.423***	0.410*
	(0.276)	(0.312)	(0.0770)	(0.0754)	(0.0802)	(0.107)	(0.0840)	(0.176)
Econometric Specification and Control Variables								
Control for Affiliate Capital (no)		-0.532	-0.181*	-0.175*	-0.342***	-0.174*	-0.343***	-0.379**
		(0.425)	(0.0857)	(0.0832)	(0.0863)	(0.0826)	(0.0875)	(0.135)
Time Fixed Effects Modeled (no)				-0.219**	-0.198***	-0.219***	-0.196***	-0.102
				(0.0629)	(0.0311)	(0.0619)	(0.0264)	(0.180)
Firm Fixed Effects Modeled (no)				-0.130**	-0.169**	-0.117	-0.166**	-0.105
				(0.0504)	(0.0589)	(0.0981)	(0.0685)	(0.140)
Proxy for the Tax Incentive								
Average Tax Rates (Statutory Tax Rates)						0.0187		
						(0.110)		
Data Sample Characteristics								
Average Sample Year					0.0219**		0.0224**	0.0202
					(0.00653)		(0.00785)	(0.0112)

Table 7.4 (Continued)

	OLS		WLS					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Publication Bias								
Primary Standard Error	1.416***	1.379***	2.304***	2.341***	1.971***	2.358***	1.913**	2.378***
	(0.253)	(0.291)	(0.347)	(0.363)	(0.422)	(0.400)	(0.733)	(0.215)
Primary Standard Error in Squares							0.0575	
							(0.331)	
Constant	0.460*	0.631	0.188***	0.389***	-43.25**	0.387***	-44.07**	-40.04
	(0.234)	(0.415)	(0.0523)	(0.0483)	(12.97)	(0.0501)	(15.58)	(22.22)
Number of Primary Estimations	227	227	227	227	227	227	227	227
adjusted R^2	0.342	0.360	0.382	0.387	0.423	0.385	0.421	0.419

Internal Transactions versus Financial Structure: Which Route is More Important? We finally want to discuss the quantitative implications of the meta-regression results depicted in Table 7.4. The estimation results allow predicting semi-elasticities for a hypothetical study. We define this study to take on all significant study characteristics as identified in the meta-regressions. Consider column (7) of Table 7.4: Based on this comprehensive specification, we predict a semi-elasticity of -1.71 for profits after financing cost, while EBIT is predicted to react with a semi-elasticity of -1.28.[101]

Clearly, these elasticities differ primarily with regard to whether they reflect corporate financial policy or not. It is therefore tempting to infer some conclusions on the proportions between profit shifting via the route of internal debt allocation and shifting via inter-company transactions. The relation between the two elasticities is more complex than it seems at first glance. Any interpretation must account for the underlying relation between EBIT and the profits after financing costs (i.e. earnings before taxes, EBT).

First, we start off with the assumption that interest income and interest expense, on average, net to zero. In this case, the two elasticities would reveal that internal debt policy explains around 25%[102] of the affiliate profit response to a change in shifting incentives. However, taking an exemplary look at the consolidated accounts of globally operating non-financial multinationals, these generally show significant debt-to-assets ratios and, in particular, negative net interest income. For the financial year 2010, we find, for example, negative net interest income in the consolidated statements of some of the largest German multinationals: BASF SE, EUR -623 million; Bayer AG, EUR -499 million; Daimler AG, EUR -646 million; Lufthansa AG, EUR -357 million; MAN SE, EUR -112 million; ThyssenKrupp AG, EUR -652 million.[103]

It therefore seems necessary to account for the fact that the consolidated external debt must somehow be allocated across the unconsolidated affiliate accounts. Thus, we now assume that EBIT and EBT differ. Technically, the relation of EBIT and EBT is determined by the affiliate's capital structure, the average borrowing rate, and the firm's pre-tax return on assets (RoA).[104] In order to uncover the quantitative implications of

---

[101] We put a minus sign in front of the semi-elasticity values. The meta-data underlying the results shown in Table 7.4 have been pre-mulitplied by (-1). This must be kept in mind when considering the coefficients.

[102] 0.25 = (1.71-1.28)/1.71

[103] All cited figures are reference at the end of the bibliography of this dissertation.

[104] We define RoA as the ratio of EBIT over total assets.

the two identified semi-elasticities of EBIT and EBT, we will discuss some plausible assumptions on these parameters. The results calculated on the basis of the assumed parameters can then be cross-checked with the empirical evidence.

Unfortunately, we cannot test all conceivable parameter constellations. To begin with, we focus on assumptions which we deem to be the most plausible. With respect to the ratio of interest-bearing debt to total assets, we assume a value of 35%. This debt share in the overall financing mix is empirically well-proven and also taken as the basis for sophisticated cross-country assessments of the costs of capital (e.g. Devereux et al., 2009). Furthermore, we will apply an average borrowing rate of 5% to calculate the (net) interest expense. We do not explicitly infer any positive interest income. Consequently, the net interest expense we derive would also be consistent with some moderately higher debt share of firms given that there was some positive interest income.[105] Finally, we have to discuss the assumptions with regard to affiliate profitability: Given a borrowing rate of 5%, a debt ratio of 35% and, say, a statutory tax rate of 30%,[106] the weighted average costs of capital (WACC) before taxes roughly amount to 6.4%.[107] For the purpose of our primary calculations, we vary the assumed rate of return on assets between these 6.4% and a value of 18.5%.

Starting from this first plausible but still tentative set of assumptions, we cross-check whether the semi-elasticities of EBIT and EBT are consistent with the general size of the internal debt response known, in particular, from the meta-analysis in Chapter 6.

Table 7.5 shows the results of our calculations.[108] We use the semi-elasticities of EBIT, -1.28, and EBT, -1.71, identified by the meta-regression in Column (7) of Table 7.4 to simulate the effects from a one percentage point tax shock. The first striking result shown in Table 7.5 is that the independent strands of research directly and indirectly investigating the mechanisms of profit shifting behavior are indeed consistent under plausible economic parameterization.

---

[105] Considering the data underlying the microsimulation analysis in Chapter 9, the average debt ratio of 43.7% of multinational firms located in Germany (see Table D.2 in the Appendix) thus seems to be consistent with our setting.

[106] The tax rate of 30% is rather an upper bound given that the average statutory tax rate on profits, for example, in the EU is 23.6% (Devereux et. al, 2009). However, most studies investigating profit shifting behavior look at the behavior of multinational affiliates in high tax countries such as Germany or the US.

[107] $0.06 = 0.35 * 0.05 + (1-0.35) * 0.05/(1-0.3)$

[108] Note that, for expository purposes, we set the capital stock to EUR 1,000. All insights gained from Table 7.5 are quantitatively unaffected by the actual size of the capital stock.

Table 7.5: Quantitative Implications of the Meta-Regression Results: Bringing in Line the Empirical Evidence

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Economic Assumptions										
1.	Total Assets (in EUR)	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
2.	Debt-to-Assets Ratio	35%	35%	35%	35%	35%	35%	35%	50%	50%	35%
3.	Borrowing Rate	5%	5%	5%	5%	5%	5%	5%	5%	5%	8%
4.	Return on Assets (RoA)	6.5%	8.5%	10.5%	12.5%	14.5%	16.5%	18.5%	12.5%	14.5%	16.5%
5.	Return on Equity (RoE)	7.3%	10.4%	13.5%	16.5%	19.6%	22.7%	25.8%	20%	24%	21.1%
	Profit Implications										
6.= 1.x 4.	Earnings before Interest and Tax , EBIT (in EUR)	65	85	105	125	145	165	185	125	145	165
7.= 1. x 2. x 3.	Interest expense (in EUR)	17.5	17.5	17.5	17.5	17.5	17.5	17.5	25	25	28
8.= 6. - 7.	Earnings before Tax, EBT (in EUR)	47.5	67.5	87.5	107.5	127.5	147.5	167.5	100	120	137
	Tax Shock: + 1 percentage point										
9. = 6. x **-0.0128**	Induced Change in EBIT (in EUR)	-0.83	-1.09	-1.34	-1.60	-1.86	-2.11	-2.37	-1.6	-1.86	-2.11
10. = 8. x **-0.0171**	Induced Change in EBT (in EUR)	-0.81	-1.15	-1.50	-1.84	-2.18	-2.52	-2.86	-1.71	-2.05	-2.34
11. = 9. - 10.	Induced Change in Interest Expense (in EUR)	-0.02	0.06	0.16	0.24	0.32	0.41	0.49	0.11	0.02	0.23
12. = 11./(1. x 3.)	Change in the Debt Ratio (in pp)	-0.04	0.13	0.30	0.48	0.65	0.82	0.99	0.22	0.39	0.28
13. = 2. + 12.	Debt Ratio after Response	34.96%	35.13%	35.30%	35.48%	35.65%	35.82%	35.99%	50.22%	50.39%	35.28%
14. =11./10.	Change in Interest Expense / Change in EBT	2.37%	6.09%	11.33%	14.89%	17.47%	19.42%	20.96%	6.43%	9.55%	9.85%

Note: The amount of total assets is irrelevant for the relative implications of the tax shock.

Remarkably, with the return on assets set to 10.5% the inferred increase in the debt ratio corresponds exactly to the marginal tax effect on the debt ratio of 0.30 found in Chapter 6 (see Row (12) of Column (3) in Table 7.5). Varying the assumed RoA in the plausible range from 8.5% (RoE: 10.4%) and 14.5% (RoE: 19.6%) yields effects which still bring in line the identified semi-elasticities of EBIT and EBT, and the literature on the debt response to tax (see Row (12), Columns (3) – (5) of Table 7.5). The higher the assumed RoA, the more pronounced the marginal effect on the debt ratio we calculate in our simple framework. From Chapter 6 we know that for multinational affiliates, marginal tax effects on the debt ratio can indeed reach values of up to 0.5.

In short, our first tentative parameterization yields plausible results which consistently reflect the empirical evidence on the semi-elasticity of EBIT, of EBT, and the marginal tax effect on the debt ratio.

The calculations in Table 7.5 hint at another interesting fact. We again use this simple framework which, under plausible economic parameters, was shown to comply with the empirical relationships found in the literature. We now calculate the weight of interest expenses in the overall volume of the shifted taxable base. We refer to the results in Columns (3) to (5) of Table 7.5 which at best bring in line realistic assumptions and the reported semi-elasticities of EBIT, EBT, and the marginal effect on the debt ratio. According to these calculations, the share of the induced interest expenses in the induced variation in EBT ranges between 11.33% and 17.47% (see Row (14) in Columns (3) to (5) of Table 7.5).

In a number of sensitivity analyses shown in Columns (8) to (10) of Table 7.5, we try to figure out whether the finding of a low share of interest in the overall shifting response is robust to a variation in the assumed economic parameters.[109] Independent of the assumptions made and the degree of fit of the different pieces of empirical evidence, none of the calculations presented in Table 7.5, and also done beyond, arrive at a share of interest in induced profit shifting volumes above 21% (found in Column (7) of Table 7.5). If we take the evidence found in the literature at face value and define semi-elasticities of -1.28 for EBIT, of -1.71 for EBT and expect the marginal tax effect on the

[109] In a first sensitivity analysis, we increase the assumed debt ratio to 50%. The return on assets, which makes all behavioral elasticities taken from the literature consistent, now amounts to 12.5% or 14.5% (see Column (8) and (9) of Table 7.5). Importantly, however, the interest expenses are of minor importance also under this setting. Second, we increase the assumed borrowing rate to 8%. The higher rate might indeed be relevant for firm data from previous decades. Our framework can still bring in line the different results from the previous literature (see Column (10) of Table 7.5). The return on assets which must be assumed, however, amounts to 16.5%. This is of considerable amount. Again, interest expenses continue to be of minor importance also under this setting.

debt ratio to be approximately 0.3, inter-company transactions are, under the assumption of plausible economic parameters, the primary dimension, in terms of volume, in multinational responses to profit shifting incentives. From the economic standpoint, this result is quite plausible. By manipulating inter-company transactions, multinational firms can, in principle, shift the full tax base, including the economic rents. The tax-efficient allocation of internal debt can only shield the marginal return from local taxation (De Mooij and Ederveen, 2008; Overesch and Schreiber, 2010).

7.5 Conclusion

In this study, we present a meta-analysis covering 40 studies on corporate profit shifting behavior. We first transform the reported empirical results into a uniformly defined semi-elasticity for the tax effect on the analyzed profit shifting indicator. We regress the assembled semi-elasticities on different sets of mostly dummy variables which mark, inter alia, the distinct shifting channels, the employed dependent variables serving as proxies for profit shifting activity, and the different econometric approaches.

A first interesting result of the meta-regression analysis is drawn from the full meta-sample of 588 primary estimates. We find that the semi-elasticity of affiliate debt ratios relative to the semi-elasticities of variables involving related party transactions is remarkably low.

We continue with a detailed analysis of the indirect evidence on profit shifting. This seems a promising approach to infer some insights on the relative economic importance of the distinct profit shifting channels which are either based on transfer pricing strategies or the financial policy of firms. Based on our meta-regressions, we predict a semi-elasticity of profit with regard to shifting incentives of -1.71. The semi-elasticity of EBIT is predicted to be -1.28. We show that econometric analyses leaving tax-induced real economic location effects unmodeled overestimate the tax-responsiveness of pure paper profit shifting by 20%.

Our main concern throughout all meta-regression estimations is to find out whether we can isolate the underlying economic significance of the different profit shifting mechanisms. Our results indeed provide evidence that the two main profit shifting channels, corporate financial policy and tax-motivated adjustments of related-party transactions, are not equally important. In particular, we find some tentative evidence that the volumes of shifted tax bases are to a large extent, i.e. approx.. 80%, driven by firms' inter-company transactions. From the point of view of national governments and tax administrations, this finding can have important implications. The extent of tax base erosion is not determined by the mere responsiveness of the shifting strategies, but also by the tax base volume effectively shifted via the respective channels. In this regard, flexible adjustments of intra-group financial structures seem to be, according to our findings, less of a concern than intra-firm trade. Regardless of whether anti-avoidance measures are at all desirable,[110] the discussion on multinational profit shifting and anti-avoidance legislation is very much centered on the financial strategies of firms. Given our findings, doubts remain as to whether this policy matches the true proportion, in terms of the lost taxable bases, of the two shifting channels. If policy makers want to effectively restrict profit shifting opportunities of multinational firms, restricting transfer pricing remains a challenging task in anti-tax-avoidance legislation.

[110] The effects of tight anti-avoidance legislation on real economic decisions are empirically analysed and discussed in Overesch (2009).

Part IV

An Application of the

Behavioral Microsimulation Model

Chapter 8

Parameterization of the Behavioral Response Algorithms

8.1 Introduction

Prior to a first research application of the extended ZEW TaxCoMM model, the main response parameters of the behavioral algorithms presented in Section 3.3.2 must be set to plausible values. In particular, information on the values of the partial response semi-elasticities is needed. As outlined in Chapter 3, the available data does not allow to directly estimate these parameters. We will therefore rely mainly on prior information reported in the literature comprehensively synthesized by the quantitative meta-analyses in Chapters 5, 6 and 7. Notably, for each distortion, we refrain from simply, and somewhat arbitrarily, picking one elasticity estimate value from the literature. There is often more than one plausible estimate in the large number of disparate studies, depending on countries, time, and methodological approach. As a consequence, the selective use of model parameters is considered a prevalent weakness of empirical models (Steiner, 2008).

For this reason, we resort to the three comprehensive meta-analyses presented in Chapter 5 on the tax semi-elasticity of foreign direct investment (FDI), in Chapter 6 on the marginal tax effect on the corporate debt ratio, and in Chapter 7 on the tax effect on corporate profit shifting behavior. These quantitative reviews complement narrative literature surveys and use econometric meta-regression analyses to identify the determining primary study characteristics which drive reported elasticity estimates. Conditional on a set of relevant study characteristics, we can identify a plausible consensus estimate of the considered behavioral parameter. On this basis, we can also decide whether different behavioral response intensities must be considered for different types of companies. Furthermore, by referring to meta-regression analyses, we can predict those elasticity values which are expected if primary analyses adhere to high methodological standards. Inferred elasticities are thus supposed to be plausible and reliable.

8.2 Parameterization of the Debt Policy Response to Tax Reform

During the last decades, numerous empirical studies have provided point estimates for the marginal tax effect on the corporate debt ratio. Reported effect sizes are indeed quite heterogeneous. The comprehensive quantitative survey of this literature in Chapter 6 shows that the documented effect size significantly depends on the refinement of the employed proxy for the marginal tax incentive to finance with debt. Particularly pronounced marginal tax effects are, conditional on all other study characteristics, identified if the proxy refers to the economic marginal tax rate in the sense of Scholes and Wolfson (1992), representing the present value of current and future taxes owed on an extra dollar of income earned today (see, e.g., Graham, 1999). Only then the tax benefit of debt is correctly captured as a function of various dynamic and non-linear features of the tax code (non-linear tax scales, investment tax credits or loss-offsetting rules). The predicted marginal tax effect on the corporate debt ratio according to meta-regression results in Chapter 6 amounts to a value of 0.30 if the marginal tax rate is consistently simulated and a sound econometric specification (e.g., no unmodeled time trends) is chosen. Hence, a one percentage point increase (decrease) in the marginal tax rate would increase (reduce) the corporate debt ratio by 0.30 percentage points.[111] Multinational firms, as compared to purely domestic companies, are additionally affected by cross-border profit shifting incentives. In particular, they can reallocate intra-company debt in order to reduce their overall worldwide tax burden. The meta-regression analysis put forward in Chapter 6 suggests that the international profit shifting incentive entails an additional marginal tax effect of about 0.20.[112] Thus, the marginal tax effect on the debt ratio of multinational firms amounts to approx. 0.50. We interpret these effects as long-term responses. In order to fully parameterize the partial adjustment model for capital structures implemented in ZEW TaxCoMM (see Chapter 3, Section 3.3.2.1.1)

[111] For the effect of the domestic tax incentive, we refer to the meta-regression in Table 6.4 (Column 1) on p. 113 in Chapter 6. Defining the hypothetical study to employ a simulated marginal tax rate to capture the tax incentive to finance with debt and a broad set of econometric controls preventing omitted variable bias (i.e., all significant controls which affect the identified tax effect are presumed to be controlled for, unobservable effects are controlled and debt is measured in book value). Estimation precision is set to the sample mean (0.106) and average sample year is assumed to be 2006.

[112] See Table 6.5 (Column 3) in Chapter 6, p. 117, and the corresponding discussion.

we have to define the speed of adjustment towards long-run capital structure targets. In a comprehensive and thorough study on partial adjustment models within the capital structure context, Huang and Ritter (2009) identify a speed of adjustment of 17% for debt measured in book values. This implies a half-life of 3.7 years.[113] We adopt this parameter value for the purpose of our simulations.

In sum, we partition the micro-simulation sample H into one subsample of domestic firms H_D and its complement, the subsample of multinational firms H_M, so that $H = \{H_D, H_M\}$.[114] Furthermore, we set the values for the (long-run) marginal tax effect on debt e_h^D for domestic firms to $e_{h|h\in H_D}^D = 0.30$ and for multinational firms to $e_{h|h\in H_M}^D = 0.50$. The speed of adjustment λ is set to 17%.

8.3 Parameterization of the Profit Shifting Response to Tax Reform

The capability of multinational firms to exploit certain leeway in assessing transfer prices may vary depending on their R&D intensity and the intra-group allocation of intangible assets (Overesch and Schreiber, 2010; Dischinger and Riedel, 2011; Karkinski and Riedel, 2009). Unfortunately, we cannot observe the allocation of intangible assets within the multinational firm due to the simulation input data being restricted to Germany. Still, we can make use of industry-specific information on R&D intensities. The information is obtained from the survey among German firms provided by the *Stifterverband für die Deutsche Wissenschaft* (2006) and exploited in Overesch and Schreiber (2010). From these statistics we take industry-specific R&D intensities, as measured by R&D expenditures to sales, and accordingly group all firms in the simulation sample into three categories. The first category ("low R&D intensity") is defined to contain firms active in industries with an R&D intensity more than one standard deviation below the average R&D intensity across all industries. The second category ("moderate R&D intensity") comprises firms belonging to industries with an R&D intensity ranging within the interval of one standard deviation around the average value. The third category ("high R&D intensity") consequently includes companies with an industry-specific R&D intensity which is at least one standard deviation above the average

[113] The half-life indicates the number of years after which 50% of the overall adjustment to a given shock is complete. Half-life = ln(0.5)/ln(1-SOA).

[114] To identify multinational firms we resort to ownership information provided in the DAFNE database. A firm is defined to be multinational if it is either directly or indirectly majority-owned by a foreign parent or if it directly or indirectly holds the majority in a foreign subsidiary.

for all industries.[115] From regression results documented in Overesch and Schreiber (2010), we infer that the tax semi-elasticity of intra-group transactions for firms in the "low R&D" category is significantly smaller than the value found for firms with moderate R&D intensity. Those firms categorized as being highly R&D intensive are instead predicted to show a semi-elasticity which exceeds the value for moderately R&D intensive companies by about 335%.[116] Since it is difficult to trace intra-group transactions in accounting data and, in particular, to disentangle their impact on taxable corporate income, we refrain from modeling the immediate response of internal transactions (see Section 3.3.2.1.3 in Chapter 3). Instead, we rely on a strand of literature, which focuses on the impact of international tax-rate differentials on measures of profitability. These studies provide indirect evidence of profit shifting activities. In the meta-analysis of the relevant empirical evidence in Chapter 7, we find that this literature documents a value of -1.28 for the tax semi-elasticity of EBIT.[117] This value is plausibly supposed to reflect the profit shifting abilities of an average, i.e. moderately R&D intensive multinational. We adjust this semi-elasticity for firms active in industries which show particularly low or high R&D intensities according to the categories defined above. Assuming that the difference in tax sensitivities of intra-group transactions fully translates into the ultimate response of reported EBIT, we cut the tax semi-elasticity of EBIT by 50% to -0.64 for firms with low R&D intensity and raise it, according to the findings by Overesch and Schreiber (2010), to -4.29 for firms in highly R&D intensive industries.

In sum, for the simulation of the profit shifting response we do not only differentiate between domestic firms $h \in H_D$ and multinational companies $h \in H_M$; but in addition we classify the multinationals according to whether they are active in an industry of low, moderate or high R&D intensity. We correspondingly partition the subsample of multinational firms into three subsamples, i.e. $H_M = \{H_{M1}, H_{M2}, H_{M3}\}$, reflecting, respectively, the three categories of R&D intensity. Following the empirical evidence, we set the values for the tax semi-elasticity of EBIT to $e^{PS}_{h|h \in H_{M1}} = -0.64$, $e^{PS}_{h|h \in H_{M2}} = -1.28$

[115] According to *Stifterverbandfür die Deutsche Wissenschaft (2006)*, the average R&D intensity across all industries in Germany is 5.6% with a standard deviation of 3.4 percentage-points. For the purpose of this simulation model, we thus define an R&D intensity < 2.2% as being low, an R&D intensity > 9% as being high, and an R&D intensity in between these values as being moderate.

[116] This value is inferred from regression results presented in column (3) of Table (4) in Overesch and Schreiber (2010).

[117] See Table 7.4 in Chapter 7, p. 153, and the related discussion.

and $e^{PS}_{h|h\in H_{M3}} = -4.29$. For purely domestic firms which, by definition, cannot shift profits abroad the semi-elasticity is set to $e^{PS}_{h|h\in H_D} = 0$.

8.4 Parameterization of the Marginal Investment Response to Tax Reform

In their seminal paper on the price sensitivity of business investment, Cummins et al. (1994) relate the investment-to-capital ratio to the user cost of capital and focus on times of major tax reform. Their results imply a long-run user cost elasticity of the capital stock within the range from -0.5 to -1, a span which has been referred to as a consensus in the literature (Hassett and Hubbard, 2002). Ad-hoc distributed lag (DL) models, however, have produced smaller elasticity estimates around -0.4 (Chirinko et al., 1999, 2004). This deviating result is surprising given that a user cost elasticity of -1 would indeed be consistent with the neoclassical benchmark, assuming a Cobb-Douglas production technology (Jorgenson, 1963, Hall and Jorgenson, 1967). In a recent study, Dwenger (2010) solves the puzzle and shows that prior DL models insufficiently account for existing co-integration between variables. Using German firm-level panel data and properly modeling the equilibrium relationship between capital and its user cost, she identifies a user cost elasticity of -1.3. For the purpose of simulating the investment response, we transform the empirically found user cost elasticities of the capital stock into a semi-elasticity with respect to the EMTR. Simple algebra shows that we just have to divide by $(1-EMTR)$. We evaluate the semi-elasticity of the capital stock at an EMTR level of 17.5%[118] and obtain a plausible range of values going from -0.6 to -1.6. We think a good compromise is to assume that the true value is in the middle of this range and set the semi-elasticity to -1.1.

It is important to acknowledge that investment undertaken domestically is not necessarily financed by domestic savings. In open economies there is access to the world capital market and investment can be financed by capital inflows. An important share of cross-border capital flows comes as foreign direct investment (FDI). Relative to the other channels of international capital flows, namely foreign portfolio investment and commercial loans, foreign direct investment brings about the most direct and most important increase in greenfield investment (Bosworth and Collins, 1999; Razin, 2004). If domestic saving is unaffected by cross-border capital flows, the tax sensitivity of FDI

[118] See Devereux et al. (2009). This is the average 2009 EMTR value for the EU 27 countries, Japan and the US.

should explain a major part of the overall capital response to tax. It therefore seems advisable to not just apply the aggregate elasticity of the overall capital stock to all firms across the board, but to separately consider the marginal response of multinational companies.

Based on results of the quantitative meta-study in Chapter 5 covering 45 studies on the tax-responsiveness of FDI, we predict a tax semi-elasticity of multinationals' stock of property, plant, and equipment (PPE) of -2.59.[119] However, there is evidence that the tax-responsiveness of foreign investment depends on multinationals' profit shifting opportunities. If firms have sufficient leeway to shift profits to lower taxing jurisdictions, local host country tax rates indeed become less important for the investment decision. From regression results[120] presented in Overesch and Schreiber (2010) we infer that the investment response for firms in industries characterized by low R&D intensity exceeds the one observed for moderately R&D intensive firms by approx. 50%. The effect is instead considerably dampened if firms are highly R&D intensive and, thus, in a particularly good position to shift profits abroad.

In sum, we set the semi-elasticity of FDI for moderately R&D intensive multinational firms to $e^{INV}_{h|h \in H_{M2}} = -2.59$. Values for multinationals with low and high R&D intensity are, respectively, $e^{INV}_{h|h \in H_{M1}} = -3.89$ and $e^{INV}_{h|h \in H_{M3}} = -0.5$. In accordance with a semi-elasticity of total investment of -1 and an FDI share in total investment of 20%, we define domestic firms to respond with $e^{INV}_{h|h \in D} = -0.7$.[121] Moreover, holding companies do not usually engage in real investment and, hence, do not react to the corresponding tax incentive either. We therefore set the semi-elasticity for this group of firms to zero.

As most primary studies use static models to analyze the relationship between local tax rates and FDI, we again interpret the above semi-elasticities to reflect rather long-term responses. In order to fully parameterize the partial adjustment model for the marginal investment response implemented in ZEW TaxCoMM (see Chapter 3, Section 3.3.2.2.1), we still have to define the adjustment speed towards long-run capital targets. We set this parameter to 50%; a value which is identified in recent dynamic panel re-

---

[119] The prediction is based on Table 5.5 (Column 8) in Chapter 5 where we assume the hypothetical study to use affiliates' fixed assets (PPE) as dependent variable and a bilateral EMTR as tax variable. It controls for all variables whose omission was identified to cause a significant bias in reported estimates. The assumed study precision is set to the respective sample mean value.

[120] See Table 6 in Overesch and Schreiber (2010).

[121] 20% is the average foreign ownership share of capital in European countries (Huizinga and Nicodème, 2006). $-0.7 = \left(-1 + 0.2 \cdot 2.59\right) / 0.8$.

gression analyses for German FDI by Overesch and Wamser (2009) as well as Buettner and Wamser (2009a). This speed of adjustment toward capital targets implies a half-life of one year. We adopt this parameter value for the purpose of our simulations. Furthermore, it may appear surprising that capital stock is found to adjust faster than capital structure (see Section 8.2). In order to test whether simulation results in Chapter 9 are sensitive to this assumption, we will provide sensitivity analyses with slower adjustment speeds of capital accumulation.

8.5 Parameterization of the Location Choice Response to Tax Reform

The intensity with which multinationals' location decisions respond to the reform-induced tax rate variation can also be inferred from the meta-regression analysis presented in Chapter 5. Based on the complete primary evidence on the response of the expected count of multinational affiliates to a change in local company tax levels, we predict an aggregate semi-elasticity of $e^{LOC}_{h|h\in H_M} = -3.17$.[122]

8.6 Parameterization of the Legal Form Choice Response to Tax Reform

Based on US state and industry data, Goolsbee (2004) finds that tax arbitrage considerably affects the share of incorporated firms in the retail sector. De Mooij and Nicodème (2008) also identify economically significant tax effects based on European firm data. They report a semi-elasticity of the number of incorporated firms of -2.9. Hence, in response to a one percentage point decrease in the tax difference between non-pass-through and pass-through entities, the number of incorporated firms is supposed to increase by 2.9%. From results reported in Goolsbee (2004), one can instead infer a semi-elasticity of -1.1. Moreover, De Mooij and Nicodème (2008) argue that the number of incorporated firms might still not be a good indicator for the corporate share of business. In particular, the probability of switching organizational form is not uniformly distributed across firms because larger firms are more likely to be incorporated than smaller firms. Alternatively, De Mooij and Nicodème (2008) suggest inferring the partial semi-elasticity of the corporate tax base from reform-induced employment changes in the corporate sector. The respective semi-elasticities of employment with regard to

[122] The prediction is again based on Table 5.5 (Column 8) in Chapter 5. This elasticity value supposes the same hypothetical study as assumed in footnote 119 to predict the response intensity of marginal investment, but now with the count of affiliates as dependent variable and the tax level expressed as effective average tax rate.

corporate tax changes amount to -0.4 according to regression results provided by Goolsbee (2004) and to -1 according to the findings in De Mooij and Nicodème (2008).[123] We follow the guide to empirical findings put forward by De Mooij and Ederveen (2008) and take the average of these two results for our simulation purposes and, thus, set the partial semi-elasticity of corporate taxable income referring to the choice of legal form to $e^{OF} = -0.7$.

8.7 Overview of the Behavioral Response Parameters

Table 8.1 lists the behavioral tax margins considered in ZEW TaxCoMM and provides an overview of the implemented response intensities. For each margin, Table 8.1

Table 8.1: Behavioral Response Parameters Implemented in ZEW TaxCoMM

	Response intensity with respect to												
	Debt Policy		Profit Shifting Activity				Marginal Investment					Location Choice	Legal Form Choice
Simulated at micro-level?	Yes											No	
Relevant tax rate	STR 1		STR 2				EMTR					STR2	STR 3
Type of firm	MNE	DO	MNE			DO	MNE			DO	HO	MNE	ALL
			1	2	3		1	2	3				
Response Intensity	0.50	0.30	-0.64	-1.28	-4.29	0.00	-3.89	-2.59	-0.50	-0.70	0.00	-3.17	-0.7
Speed of Adjustment	0.17	0.17	1	1	1	-	0.5	0.5	0.5	0.50	-	-	-

Notes:
Relevant tax rates are either a “refined dichotomous tax rate” (*STR 1*), a “combined statutory tax rate” (*STR 2*), the “statutory tax differential between non-pass-through and pass-through entities” (*STR 3*), or the “effective marginal tax rate” (*EMTR*).
Type of firm is either “multinational” (*MNE*), “domestic” (*DO*), “holding” (HO) or “all”. Multinational firms are classified according to R&D intensity. We categorize into “low R&D intensity (class *1*), “moderate R&D intensity” (class *2*) and “high R&D intensity” (class *3*).
Response Intensity of debt policy is measured as marginal effect. All other response intensities are measured as semi-elasticities.

provides details on whether the response is simulated at the micro or the macro level. Moreover, it indicates the relevant tax rate capturing the incentives which distort corporate decision making. Table 8.1 also shows whether response intensities are differentiat-

[123] Tax effects on the choice of organizational form identified by Elschner (2010) are considerably stronger. Her study, however, does not consider the general tax system but refers to very special tax regimes (tonnage taxes).

ed with regard to types of firms. All elasticities displayed in the table are distilled from quantitative surveys of the relevant literature.

Chapter 9

The EU Proposal for a Harmonized Tax Base: A Microsimulation Analysis for Germany*

9.1 Introduction

Multinational firms in the EU have to file separate accounts for up to 27 different tax regimes. This is not without consequences. Firms run the risk of double taxation if taxing rights conflict and losses cannot be transferred.[124] Moreover, in view of the tax rate differentials within the EU, some governments see their national tax base erode due to cross-border profit shifting.

Beginning in 2001, the European Commission has pushed for harmonized company taxation in the EU.[125] In March 2011, a precise draft Council Directive implementing a Common Consolidated Corporate Tax Base (CCCTB) was put on the table (European Commission, 2011). The CCCTB concept is based on three central elements:

i. The determination of the tax base according to common harmonized rules.
ii. A consolidation of cross-border income including loss compensation.

[124] For a discussion, see Spengel (2008).
[125] In 2001, the European Commission issued comprehensive proposals to harmonize company taxation in the EU (European Commission, 2001).

* This chapter is based on joint work with Katharina Finke.

iii. The apportionment of the tax base to the member states according to a predefined formula.

The statutory corporate tax rates remain at the discretion of the member states.

In this analysis, we evaluate the effects from the introduction of the common tax base definition in Germany. Consolidation and apportionment of profits is not part of the analysis.

We think that the effect from the harmonization of tax rules is of central interest. The German government has announced its reluctance to implement the CCCT in one single swoop (Bundestag Printed Paper 17/5748 of 5 May 2011). Further strong voices are expressing skepticism in this regard (e.g. Ireland, the Netherlands, or Sweden). The solution might thus be a two step approach. The first step includes the replacement of the 27 national tax accounting regulations across EU member states by a single set of harmonized tax rules. The second step of a CCCTB, consolidation and apportionment of the tax base, would be left to the future.[126] The predicted effect on Germany from the tax base harmonization could thus prove important for the prospect of seeing further policy steps being undertaken.

Our simulation analysis shows that, in the economic environment of the period from 2005 to 2007, a change from current German tax law to harmonized tax legislation particularly affects capital-intensive industries such as manufacturing, construction or energy. Smaller firms, on average, benefit less from the reform. On balance, the German tax base definition narrows considerably. Aggregate corporate[127] and trade tax revenue is simulated to decline by 8.6%. We assume that the German federal government increases the corporate income tax rate to compensate for the first round revenue losses. As a result of the simulation, however, we learn that the behavioral responses of firms would prevent the reform from being effectively revenue-neutral. By contrast, the compensating increase in the CIT rate induces substantial adjustments at several behavioral margins. Considering the short term responses of corporate debt policies, marginal investment and profit shifting activity, aggregate tax revenue is simulated to decline by 1.2% relative to the benchmark levels under the current German tax regime. Taking a deeper look into the future, the tax revenue would decrease by 1.9%. If we, in addition, simulate the responses in the location decisions of multinational firms and also account

[126] Germany and France are already moving in this direction by making plans to promote convergence of their tax systems.
[127] Incl. the solidarity surcharge.

for the reform's impact on the decision to incorporate, the behavior-induced loss of tax revenue collected from the corporate share of business could rise to -7%.

The rest of this chapter is organized as follows. Section 9.2 briefly summarizes the related literature. The microsimulation sample is described in Section 9.3. The main changes introduced by the draft proposal on the common definition of the tax base are explained in Section 9.4. Section 9.5 presents the microsimulation results which, in a first step, abstract from behavioral responses of firms. These first round effects technically result from the introduction of the CCTB legislation. In Section 9.6, we consider the effects arising from behavioral responses triggered by these changes in tax legislation. Section 9.7 concludes.

9.2 Related Empirical Literature

To date, little evidence exists on the efficiency implications or aggregate tax revenue effects arising from the harmonization of tax rules. The tax revenue effects from the consolidation and apportionment of profits sourced within the EU have instead been examined by several pieces of research (Fuest et al., 2007; Devereux and Loretz, 2008; Oestreicher and Koch, 2011). A comprehensive evaluation of the welfare implications of a CCCTB is put forward by Bettendorf et al. (2010).

Based on a CGE analysis, Bettendorf et al. (2010) find positive but small aggregate welfare gains for the EU. Especially the new member states are shown to benefit from a CCCTB at the detriment of other countries, e.g. Germany and France. In a separate analysis of the efficiency effects arising only from the tax base harmonization, the study reveals a welfare loss amounting to 0.1-0.2% of GDP. With regard to the common tax base definition, however, the study only accounts for depreciation of assets.

Devereux and Loretz (2008), Fuest et al. (2007) and Oestreicher and Koch (2011) estimate the potential short term revenue effects of consolidation and formula apportionment under a CCCTB. Devereux and Loretz (2008) resort to financial and ownership data from the ORBIS database of Bureau van Dijk and simulate a hypothetical introduction of consolidation[128] and formula apportionment in the period from 2000 through 2004. They estimate an average reduction in corporate tax revenues of 2.5% for an optional switch to formula apportionment and an increase of 2% for an obligatory switch. Country specific effects vary according to the relative endowment with apportionment

[128] Consolidation in Devereux and Loretz (2008) is limited to cross-border loss-offset.

factors. For Germany, the study reveals revenue losses of about 13% if the CCCTB is optional and of about 5% for a compulsory CCCTB.

According to Fuest et al. (2007), the cross-border loss-offset with formula apportionment reduces the overall tax base in Europe by 20%. The reduction amounts to 17% for Germany. This analysis is based on German outward FDI data in the period from 1996 through 2001 (MiDi database provided by Deutsche Bundesbank).

With a tax revenue loss of 4.56% caused by a compulsory CCCTB, the results of Oestreicher and Koch (2011) lie in between the effects predicted by the two previous studies. For Germany, the authors predict a revenue loss of about 9%.

All three analyses abstract from behavioral responses and the consolidation of intra-firm profits beyond mere loss-offset. Furthermore, they do not consider the effect of switching from national tax base regulation to a common definition of taxable profit. The only study isolating the effect from a common tax base definition, irrespective of any formula apportionment, is presented by Oestreicher et al. (2009). On the basis of a model firm approach ("European Tax Analyzer"), they show that, for most EU countries, the proposed common tax rules as of 2007 (see European Commission, 2007) would imply a broadening of the tax base. This result is mostly attributed to less generous depreciation rules.

In short, some of the previous studies focus primarily on efficiency effects, thereby only roughly modeling the proposed common tax base regulation (Bettendorf et al., 2010). Other studies concentrate on the revenue implications of formula apportionment, which is conceptually the second step of CCCTB implementation (Devereux and Loretz, 2008; Fuest et al., 2007; Oestreicher and Koch, 2011). In those studies, the effects arising from tax base harmonization are largely ignored. The only study dealing with such effects centers on an average model firm without accounting for micro-level heterogeneity (Oestreicher et al., 2009).

Firm-level heterogeneity is, however, relevant in at least two regards. First, predicted revenue consequences should reflect that firms featuring tax losses under the national and the CCCTB regime do not pay taxes at all. Consequently, they do not affect the reform-induced change in tax revenue. Second, the viability of tax base harmonization might also depend on how its benefits or disadvantages are distributed across corporations and how they are related to firm characteristics. Furthermore, apart from the CGE analysis put forward by Bettendorf et al. (2010), all previous analyses ignore behavioral responses of firms. Thus, the overall revenue effect of the common tax base is still unclear.

We think that the tax revenue effect of a harmonized corporate tax base is best investigated on the basis of a microsimulation approach which fully accounts for the presence of firm-level heterogeneity. Furthermore, behavioral responses to a change in the tax regulation should be considered. Our study considers these important aspects. It thus fills in a gap in the literature on tax harmonization in Europe. While the analytical focus is put on Germany, the insights obtained from our study go far beyond the German context.

9.3 The Microsimulation Sample

Firm-specific financial accounting data used for simulation purposes is taken from the DAFNE database, which is provided by Bureau van Dijk. DAFNE contains detailed financial information on 900,000 German corporations, including public and private companies limited by shares and limited companies, for the years from 1999 to 2010. ZEW TaxCoMM requires a balanced firm data panel over three years. The financial data is complemented by data from additional sources provided by the Federal Statistical Office on municipal business tax rates.

Table 9.1 illustrates the structure of the simulation sample with regard to size and economic activity. The employed firm-level data covers the period from 2005 through 2007. We base our analysis on this time period because the data from years after 2007 would be considerably affected by the financial crisis. Furthermore, we do not age the data to reflect current or even future years because we do not want to blur simulation results with forecasting error. Consequently, our analyses and the results will be based on the overall economic environment of the years from 2005 to 2007.

In total, there are 25,626 corporations in our sample. Thus, our simulation is based on 76,878 firm-year observations. The sample includes small (34%), medium-sized (36%), and large corporations (29%).[129] They are active in six different economic sectors. The most important industry by numbers of firms is the manufacturing sector, in which 27% of our sample firms operate. The smallest business sector in the sample is

[129] Company size is defined according to annual balance sheet totals. Small corporations display an annual balance sheet total of no more than EUR 4,840,000. Corporations are classified as medium-sized if the annual balance sheet total ranges between EUR 4,840,000 and EUR 19,250,000. The balance sheet total of large corporations exceeds EUR 19,250,000.

the health care sector with 918 corporations (3.5%). "Other" economic activities include entertainment, education, arts, and recreation. These make up 3.58% of the sample.

Table 9.1: Number of Companies in the Original Sample Classified According to Economic Activity and Size

Economic activity	Small	Medium-sized	Large	Total
Mining and Manufacturing	1,551	3,055	2,328	6,934
Energy and Water Supply	179	306	723	1,208
Construction	1,135	615	302	2,052
Trade, Hotels and Restaurants	1,859	2,574	1,199	5,632
Transportation and Telecommunications	891	840	600	2,331
Business Services, R&D, Technical Services	2,587	1,307	1,689	5,583
Health	165	316	487	968
Other	391	300	227	918
Total	8,758	9,313	7,555	25,626
Share of companies in size range	34.18%	36.34%	29.48%	

Note: The table shows absolute numbers of corporations extracted from the DAFNE database. Proportions of company size ranges are displayed in the bottom row. Company size is defined according to annual balance sheet totals. Small corporations display an annual balance sheet total of no more than € 4,840,000. Corporations are classified as medium-sized if the annual balance sheet total ranges between € 4,840,000 and € 19,250,000. The balance sheet total of large corporations exceeds € 19,250,000.

To smooth out potential structural biases between our microsimulation sample and the population of all corporations in Germany, we extrapolate the results. For this purpose, we adopt the method employed by Deutsche Bundesbank (Deutsche Bundesbank, 1998) to extrapolate financial accounts data from a sample of German corporations. Deutsche Bundesbank resorts to official turnover statistics, whereas we employ the corporate income tax statistic of 2006 provided by the German Federal Statistical Office (Statistisches Bundesamt, 2011b)[130]. The official CIT statistic includes the full population of German corporations. For firm clusters defined by gross taxable corporate income and economic activity, we verify whether the number of firms included in our samples matches the number of firms indicated in the corporate income tax statistic. Sample observations in each activity income cluster are weighted by the reciprocal of the proportion of sample observations to population numbers. The weights are determined annually because firms can switch income classes. For each year, however, the sample data is aligned with the total business population as represented by the corporate income tax statistic of 2006. Table 9.2 illustrates the structure of the extrapolated sam-

[130] The Federal Statistical Office has provided us with a special evaluation of the corporate income tax statistic. For six industry clusters it contains respectively 14 intervals of negative income and 15 intervals of positive income.

ple, which by construction matches the population of German corporations. The share of large companies is reduced to 5.71%. According to their balance sheet totals, the large majority of firms classify as small (77.83%). 16.46% of firms are medium-sized. The most important economic activities are business services (44.28%), the hotel and restaurant industry (21.74%), and the manufacturing sector (13.44%). The smallest business sectors are again the health care industry with a share of 3.45% in the extrapolated sample and the catchall sector "other activities" (1.84%).

Table 9.2: Number of Companies in the Extrapolated Sample Classified According to Economic Activity and Size (3-year average)

Economic activity	Small	Medium-sized	Large	Total
Mining and Manufacturing	75,240	31,137	9,196	115,572
Energy and Water Supply	4,830	2,186	2,053	9,070
Construction	77,771	11,308	1,904	90,983
Trade, Hotels and Restaurants	134,870	44,528	7,467	186,865
Transportation and Telecommunications	24,695	4,781	1,486	30,961
Business Services, R&D, Technical Services	326,903	34,391	19,379	380,672
Health	13,284	10,215	6,180	29,679
Other	11,479	2,939	1,408	15,826
Total	669,071	141,484	49,073	859,628
Share of companies in size range	77.83%	16.46%	5.71%	

Note: The table shows absolute numbers of corporations considered by ZEW TaxCoMM after extrapolation on the basis of the corporate income tax statistic of 2006. Proportions of company size ranges are displayed in the bottom row. Company size is defined according to annual balance sheet totals. Small corporations display an annual balance sheet total of no more than € 4,840,000. Corporations are classified as medium-sized if the annual balance sheet total ranges between € 4,840,000 and € 19,250,000. The balance sheet total of large corporations exceeds € 19,250,000.

Table 9.3 highlights how the extrapolated sample divides into domestic and multinational firms and how multinational firms differ in the R&D intensity of their businesses. This classification is relevant for purposes of our simulation because multinationals' ability to shift profits abroad is assumed to depend on their R&D intensity (for details, see Chapter 8).

To identify multinational firms, we resort to ownership information provided by Bureau van Dijk. A firm is considered multinational if it directly or indirectly owns foreign subsidiaries or is itself directly or indirectly foreign owned. The capability of multinational firms to exploit certain leeway in assessing transfer prices may vary depending on their R&D intensity and the intra-group allocation of intangible assets (Overesch and Schreiber, 2010; Dischinger and Riedel, 2011; Karkinski and Riedel, 2009).

Table 9.3: Number of Companies According to Economic Activity, Regional Status and R&D Intensity

	Domestic Firms	Multinational Firms			
Economic Activity		R&D 1	R&D 2	R&D 3	Total
Mining and Manufacturing	111,681	1,883	1,662	346	3,891
Energy and Water Supply	9,001	69	-	-	69
Construction	90,532	451	-	-	451
Trade, Hotels and Restaurants	182,481	4,384	-	-	4,384
Transportation and Telecommunications	30,323	639	-	-	639
Business Services, R&D, Technical Services	371,813	2,854	5,839	166	8,859
Health	29,563	116	-	-	116
Other	15,678	148	-	-	148
Total	841,072	10,544	7,501	512	18,557
Share of companies	97.84%	1.23%	0.87%	0.06%	2.16%

Note: The table shows how the total number of firms splits up into domestic and multinational firms and how multinational firms split up according to R&D intensity. We categorize into "low R&D intensity" (class 1), "moderate R&D intensity" (class 2) and "high R&D intensity" (class 3).

We classify multinational firms into three categories according to whether they are active in industries with low, moderate or high R&D intensity (for details, see Section 8.3 in Chapter 8). Multinationals belonging to those industries with low R&D intensity account for 1.23% of all firms and can be found across all economic activities. Firms active in moderately R&D intensive industries, e.g., the manufacturing of chemicals, optical instruments or firms engaging in business services make up 0.87% of firms belong to that category. 0.06% of the firms in our sample are multinational companies with high industry-specific R&D intensity. They manufacture, e.g., pharmaceutical products and communication equipment, or they engage in research and development services.

9.4 The Draft Council Directive as of March 2011

In March 2011, the European Commission published a detailed proposal for a Council Directive governing the implementation of a CCCTB in the European Union (European Commission, 2011). It addresses the scope of application, the definition of harmonized tax base, the consolidation mechanism, the apportionment formula, and anti-avoidance regulations. According to the focus of this study, we only refer to the common corporate tax base definition.

The following paragraphs discuss the proposed common corporate tax base (CCTB) definition item by item and identify differences with respect to the German tax law of

2011.[131] We explain whether and sketch how the reform changes are considered in the simulation model. Table 9.4 provides an overview.

Please note the fine but important difference between the CCCTB concept which describes the full concept of a common tax base with consolidation and apportionment and, in contrast, the acronym CCTB which is used when referring only to the harmonized tax base definition.

The draft directive applies to corporations (Art. 2) resident in a member state for tax purposes and allows them to opt for the CCCTB regime or for national tax law (Art. 6). We consider the common corporate tax base regulations for all firms in our sample because the German government is strictly opposed to an optional system (Bundestag Printed Paper 17/5748 from 5 May 2011). In any case, the EU member states remain responsible for setting corporate income tax rates.[132]

General Principles for the Determination of Taxable Income

According to the directive, taxable income is determined as "revenues less exempt revenues, deductible expenses, and other deductible items" (Art. 10). The tax balance sheet, in contrast, constitutes the basis for deriving taxable income under German tax law. This difference in principles, however, does not necessarily result in different tax bases. Whether such difference exists can only be determined by closely looking at the precise definition of tax base items defined in the draft directive and according to the current German tax law of 2011.

Under both regimes, the taxable income includes trading income and financial income. The directive stipulates a number of non-deductible expenses, such as profit distribution, corporate income tax or 50% of entertainment and representation cost and fines (Art. 14). These restrictions are very similar to the German practice.

Depreciation

The draft directive includes detailed regulations governing depreciation and amortization of assets (Art. 32 - Art. 42). The CCTB regulations distinguish between short-/medium-lived tangible assets and long-lived tangible assets, buildings and intangibles. The directive stipulates that long-lived assets, such as buildings and tangibles with a

131 A thorough discussion of the issues raised in this Section is also put forward by Scheffler and Krebs (2011).

132 The 2011 German corporate income tax rate amounts to 15% (+ 5.5% solidarity surcharge).

useful life exceeding 15 years, are depreciated on an individual basis according to the straight-line method. The corresponding depreciation rates amount to 2.5% for buildings and 6.67% for long term tangible assets. Short- and medium-lived tangible assets are included in an asset pool which is depreciated at a declining balance rate of 25% annually. Purchased intangible assets are to be amortized individually over the period of legal protection or 15 years, using the straight line method.

Under the German tax system of 2011, buildings are depreciated at a linear rate of 3%. Movable tangible and intangible assets are depreciated according to their useful life as stipulated in a depreciation table issued by the Federal Ministry of Finance. With effect from January 2011, only straight-line depreciation is allowed.

For short/medium term assets with a lifetime of more than four years, the CCTB thus provides for faster depreciation. Depreciation allowances are higher in early periods of useful life. This effect is, however, reversed in later years. The same applies to long-lived assets. The more their useful life actually exceeds 15 years, the more generous the general CCTB depreciation rate of 6.67% for this class of assets. CCTB depreciation of buildings is instead slower relative to current German tax law.

The overall effect of the proposed depreciation rules for each firm depends on the relative weight of the different asset classes. Fortunately, we observe the value of each asset class (buildings, tangibles and intangibles) in the firms' balance sheet data. In order to account for the CCTB's different treatment of short/medium vs. long term assets, we resort to the following assumptions. We suppose an average useful life of seven years for short- and medium-lived assets and of 18 years for long-lived assets. We match this assumption to the industry-specific average useful lives of fixed tangible assets identified by Reister (2009) and infer consistent weights of short/medium and long-lived assets.

Provisions

The draft CCTB directive follows the accruals principle, under which transactions are recognized when they occur (Art. 17). Legal or likely legal obligations in respect of future payments are deductible if the amount can be reliably estimated and the eventual settlement would also result in a deductible expense, e.g. warranty claims.[133] Deduc-

[133] Under German tax law the provisions for contingent losses from pending transactions are disallowed. Since from the wording of the draft directive it is not clear whether contingent losses from pending transactions fit the requirements of Art. 25, we do not consider any change to German tax law in this regard. However, this issue is not beyond debate (Scheffler and Krebs, 2011).

tions should, however, be spread over time if the obligation persists for future years (Art. 25). Valuation is to be accomplished on an annual basis and appraisal should reflect past experience.

According to the draft directive, provisions exceeding one year are to be discounted at the yearly average of the Europe Inter Bank Offered Rate (EURIBOR) for a maturity of 12 months. This rate amounts to 4.45%, 3.44%, and 2.33% for the considered years from 2005 to 2007.

Pension provisions are explicitly governed by the directive (Art. 26). The discount rate to be applied is again the 12-month EURIBOR interest rate. The discount rate for pension provisions under German tax law instead amounts to 6%. Furthermore, the actuarial methods used to allocate the expenses for future pension benefits over the qualifying period differ between the two tax regimes. We consider these differences with regard to the discount rate and the actuarial method in the valuation of pension provisions.

The actuarial method applied in Germany requires that for each contract, the present value of pension entitlements at the beginning of the pension period is split into constant annuities allocated to each year of the qualifying period. According to the CCTB directive, in contrast, the share of pension costs that can be allocated to each year of the qualifying period is increasing over time. This is due to the fact that the present value of pension entitlements at the beginning of the pension period is first divided by number of years of the contribution period. Each share of the total present value is then discounted according to the number of periods remaining from the total qualifying period. Therefore in early years of the qualifying period, the allocated pension costs are lower since they have been discounted for a longer time. Correspondingly, the allocated pension costs are increasing over time.[134] Under both regimes, appropriations to pension provisions include the allocated pension costs and the interest on contributions accumulated in previous years.

For each firm and each of the considered periods, we observe the reported value of pension provisions, reflecting the current value of current and future obligations as an aggregate. We infer from the reported provision values and their change the value of new entitlements.[135] We then recalculate the present value of these entitlements under

[134] This method corresponds to the projected unit credit method (IAS 19).
[135] We assume a total qualifying period of 30 years, thereof remaining on average 15 years. Furthermore, we assume a total duration of the pension period of 20 years, thereof remaining on average 10 years.

CCTB.[136] The lower discount rate under CCTB results in an increase of the value of pension provisions, which is assumed to affect taxable income immediately. This effect is not compensated by the projected unit credit method applied under CCTB, which potentially delays appropriations to pension provisions.

With regard to provisions for warranty claims, current German tax law stipulates a discount rate of 5.5%. We account for the difference to 12-month EURIBOR interest rate applied under CCTB. Again, the resulting difference in provision value affects the tax base immediately.

Intra-Group Dividends and Income from Foreign Permanent Establishments

According to the draft directive, income from major shareholdings is 95% tax exempt.[137] Under the current German tax system of 2011, identical regulations apply. The dividend income observed in the firm data is therefore deducted from the profit of ordinary activity. The income earned from foreign permanent establishments is exempt under the draft directive and also according to the German double tax treaty policy. Since income from foreign permanent establishments is not reported separately in the data, we resort to the corporate income tax statistic which reports the share of tax exempt income from foreign permanent establishments in total taxable income and the share of companies concerned (Reister (2009)).

Deductibility of Interest Expenses

According to the Commission's draft directive, interest expenses are generally deductible.[138] Under the German tax system, however, the deduction of net interest expenses is limited to 30% of the earnings before interest, taxes, depreciation and amortization (EBITDA) whereas certain escape clauses exist.[139] Non-deductible net interest payments can be carried forward indefinitely. Unused EBITDA may be carried forward five

---

136 The entitlement itself is held constant under both regimes.

137 5% of the income is considered as non-deductible costs (Art. 14).

138 Anti-abuse regulations apply. According to Art. 81, the deduction of interest expenses is denied in case the interest is paid to an associated enterprise resident in a third country where no agreement on the exchange of information applies and where the corporate tax rate is lower than 40% of the average statutory corporate tax rate applicable in the member states or a special beneficial system applies. These rules are much less tight than current thin-capitalization rules.

139 Interest expenses can be deducted without limitation if one of the following three conditions is met. The total amount of net interest expenses does not exceed EUR 3 million for financial years. The company is a stand-alone business that does not belong to a group. The company belongs to a group but its equity ratio does not fall below the overall equity ratio of the group by more than two percentage points for financial years ending after 31 December 2009.

years. We account for this difference between CCTB and current German Tax Law in the computation of the respective tax base.

Losses

Regarding the treatment of losses, the draft CCTB directive allows for an indefinite loss carry-forward (Art.43). No loss carry-back is granted. According to the recent tax law practice in Germany, in contrast, losses up to EUR 511,500 may be carried back to the preceding year if the tax base had been positive in that year. Any excess losses may be carried forward. The loss carry-forward is unlimited in time but only the first EUR 1 million is fully deductible. Any remaining loss may be offset against 60% of the net income exceeding this limit.

ZEW TaxCoMM derives current losses endogenously in the course of the firm-specific tax assessment. The CCTB denial of a loss carry-back used under current German law would increase the tax due in a given period. Unused losses can be carried forward and potentially reduce the tax burden in subsequent years. This however presupposes sufficiently high taxable profits in future years (of simulation). In addition, the loss-offset is not denied or restricted if substantial changes in the shareholding structure take place. The German tax law, in contrast, stipulates such limitations. Consequently, under this special condition, the tax burden under CCTB would even be reduced relative to the current law.

Local Business Tax

According to the CCTB proposal, local business taxes remain under the discretion of the member states. The federal basic rate for the German local business tax is 3.5%. It is then multiplied by a municipal coefficient varying between 200% and 490%. The tax base is, in principle, determined according to the same rules as for income tax purposes but some adjustments are required. These adjustments include, for instance, the add-back of 25% of all interest expenses exceeding EUR 100,000. Since 2008, the local business tax is no longer deductible as a business expense. We assume that the German local trade tax system, in principle, remains unchanged under the CCTB regime. This means that the same adjustments of the CIT base which currently apply for trade tax purposes will be applied to the new CIT tax base definition.

Table 9.4 provides an overview of the regulations that would be affected if the common tax base definition was introduced in Germany. It marks whether these changes are captured by the simulation model. In addition, it shows expected consequences for firms' tax burden.

Table 9.4: CCTB Regulations: Their Consideration in ZEW TaxCoMM and Expected Effects on the Tax Burden

CCTB innovations	Considered in ZEW Tax-CoMM	Expected effect on the tax burden
Depreciation		
of buildings	✓	↑
of long term tangibles	✓	↓
of short/medium term tangibles	✓	↓[1]
of purchased intangibles	✓	-
Loss Treatment		
Unlimited loss carry-forward	✓	↓
No loss carry-back	✓	↑[2]
No restriction in loss-trafficking	✓	↓
Provisions		
Provisions from Legal Obligations	✓	↓
Pension Provisions	✓	↓
Interest expenses fully deductible	✓	↓
Dividend Income	✓	-
Income from permanent establishments	✓	-
Bad debt receivables	✓	-
Definition of production cost	×	(-)
Simplified Valuation of Inventories	×	(↑,-)[3]
Instant deduction of cost for low-value goods	×	(↓)
Long-term contracts	×	(↑)
Financial assets held for trading	×	(↑)

Note: The table displays the CCTB regulations for a common definition of the tax base, their consideration in ZEW TaxCoMM and the expected impact on the tax burden. (1) The tax burden decreases in the early years captured by ZEW TaxCoMM since 25% declining balance induces an earlier consideration of allowances. The effect on the tax burden is reversed later on. (2) The denial of loss carry-back increases the tax burden in the period in which the loss carry-back was originally offset against positive taxable income. Since losses can instead be carried forward indefinitely, they reduce the tax burden in those periods in which they can effectively be used. (3) The switch from last-in-first-out or weighted average to first-in-first-out increases the tax burden in times of increasing prices. The burden remains unchanged if company applies weighted average under both tax regimes.

As becomes clear from Table 9.4, there are only five aspects which are not modeled. First, we are unable to consider reform changes in the threshold for immediate depreciation of low-value goods. According to the proposed CCTB regulation, assets are immediately written-off if the acquisition costs do not exceed EUR 1,000. Under German tax law, the threshold for immediate deduction amounts to EUR 450. Given their immediate write-off, low-value items are not reported in the balance sheet. Hence, we are unable to consider reform changes in the threshold for immediate depreciation of low-value goods.

Furthermore, reform changes in the simplified valuation of inventories remain unconsidered by the simulation. The CCTB working group proposes the first-in-first-out or weighted average cost methods. German tax law allows the weighted average cost method as well as the last-in-first-out method. We cannot model any of the potential effects because the consumption of inventories is unobserved in the accounting data. There might be no reform impact anyway if companies apply the weighted average method under both regimes. With regard to the definition of production costs of stock items, these costs would generally comprise all costs of purchase and direct costs incurred in bringing the stock item into present location and condition (Art. 29). Indirect costs might be included as far as the taxpayer included them in the past. According to German tax practice, the costs of stock items include direct costs and also indirect costs related to production. Even though we are unable to explicitly model production cost because the required information is unobserved, this should not matter for the simulation results.

Regarding the accrual of revenues relating to long-term contracts exceeding 12 months (Art. 24), the draft directive proposes the percentage of completion method which results in earlier profit realization compared to German tax law. Under German tax law, according to the completed-contract method, profit is realized when the project is finalized. Our model does not capture this difference. Still, this regulation should only affect few industries, e.g. the construction industry.

Moreover, the valuation of financial assets held for trading differs with respect to a risk deduction from the fair value which is necessary under German tax law but not under CCTB.

Finally, it is important to recognize that the draft directive is still rather unclear as to the definition of transitional rules governing the transition from national tax law to the new CCTB system (Spengel and Zoellkau, 2012). The following analysis assumes that the CCTB rules governing provisions or the depreciation of assets, respectively, apply to appropriations or investments made after the date on which the CCTB system has entered into force.

9.5 First Round Results: Ignoring Behavioral Responses of Firms

We analyze the first round effects in two main steps. First, firm-specific taxes due and aggregate short-term tax revenue are computed for the reference tax system of 2011. We derive how taxes due and aggregate revenue change if CCTB regulations are introduced. We also calculate the CIT rate required to keep the overall revenue constant. Second, in a variation of the CCTB scenario, we suppose that the German federal government follows a balanced budget rule and immediately adjusts the CIT rate to keep the CCTB reform revenue-neutral.[140] In the following discussion of first round results we consider both variations of the CCTB implementation in Germany.

Table 9.5 shows the aggregate revenue effect of a non-neutral CCTB introduction replacing 2011 tax law in Germany. The underlying firm data and, thus, the reflected economic environment is from the period 2005 to 2007. We find that, according to our simulation results, the introduction of the proposed CCTB regulation would reduce collected corporate income tax (incl. solidarity surcharge) and trade tax revenue altogether by 8.6%. The CIT rate increase required to neutralize this effect amounts to 3.1 percentage points. Given the current German CIT rate of 15%, the revenue-neutral CCTB would thus require a CIT rate of 18.1%. Please keep in mind that, at this point, behavioral responses to the reform are ignored.

Table 9.5: Revenue Consequences (in bn €) Induced by the Introduction of a CCTB and CIT Rate Required for Balancing the Revenue Deficit (sum over 3 years)

	Total tax revenue	Absolute Change	Relative Change	CIT Rate
2011	189.833			15%
CCTB	173.585	16.248	-8.6%	15%
CIT rate required to keep revenue unchanged				**18.1%**

Note: The table displays simulated tax revenues in billion EUR for the reference and reform tax systems on the basis of the extrapolated sample and corresponding deviation in bn EUR and percent. Tax revenue is calculated by aggregation of firm-level annual taxes due (over 3 years) and includes corporate income tax, solidarity surcharge, and trade tax. The revenue-neutral corporate income tax rate required to keep the tax revenue stable is displayed in the bottom row. Source: ZEW TaxCoMM

The result of declining tax revenue hints at considerable tax base narrowing brought about by the CCTB regulation. At first glance, this might seem surprising. In particular, the European Commission repeatedly pushed for a rather broad definition of the tax base (European Commission, 2011).[141] It is important to note that Germany has already gone through base broadening reforms in recent years. In the 2008 major business tax reform, declining balance depreciation was abolished and interest ceiling rules were significantly sharpened. As a consequence, the CCTB with its 25% pool depreciation

[140] Analyzing the efficiency effects of a CCCTB introduction, Bettendorf et al. (2009) also assume that governments apply a balanced budget rule, thus adjusting the tax rates to compensate revenue changes.

[141] Our results contrast with findings reported by Oestreicher et al. (2009) who find that the CCTB comes along with a broadening of German tax base. However, their analysis departs from 2006 German tax law and applies an old, now-obsolete CCTB proposal (European Commission, 2007) which has been revised with the new version in March 2011. The old proposal included a pool depreciation of only 20% and the study itself disregards loss-offset regulations by looking at a profitable firm. Altogether, this explains our new and deviating results.

for short- and medium-lived assets, the decrease of the discount rate for pension provisions, the unrestricted loss carry-forward and the more generous deductibility of interest expenses would rather attenuate the current regulation in Germany and, on balance, narrow the tax base.[142]

Moreover, it must be kept in mind that the simulation analysis is focused on rather short-term revenue effects in the first three years after introducing CCTB regulations. The accelerated CCTB depreciation rules applying to some types of newly invested assets come along with a frontload of tax depreciation which is reversed in later years.

Assessing Heterogeneous Reform Impacts at Firm Level

While Table 9.5 illustrates the aggregate revenue impact of a CCTB in Germany, the degree to which firms are affected depends on their respective economic and financial characteristics. Hence, the simulated reform consequences vary between firms. Table 9.6 displays percentiles of the distribution of the relative change in taxes due across our extrapolated simulation sample.

Table 9.6: Change in Taxes Due at Different Percentiles of the Distribution when Switching from 2011 to CCTB or CCTB + Adjusted CIT Rate (3-years average)

Percentile	1%	5%	10%	25%	50%	75%	90%	95%	99%
Relative change in taxes due in % (Introduction of CCTB)	-63.1	-34.0	-28.0	-6.1	-0.35	0	3.3	23.0	43.1
Relative change in taxes due in % (Introduction of CCTB + CIT rate adjustment)	-60.5	-33.3	-22.4	0	4.1	10.3	12.9	34.0	53.6

Note: This table displays the reform-induced change in taxes due in percent compared to the reference tax regime of 2011 at different percentiles of the distribution. The results are based on the extrapolated sample. In order to achieve revenue-neutrality, the tax rate is raised to 18.1% in the CCTB + CIT rate adjustment scenario. The tax base definition is the same under both reform scenarios. Changes in taxes due refer to corporate income tax, solidarity surcharge, and trade tax. Source: ZEW TaxCoMM

The percentile values shown in the upper row of Table 9.6 reveal the distribution of the relative CCTB impact on taxes due if the German CIT rate is held constant. The lower row shows the distribution percentiles if the CCTB is kept revenue-neutral by raising the German CIT rate to 18.1%. Under the non-neutral scenario, firms at the third quartile are still indifferent between the CCTB and German benchmark tax law. The median corporation clearly experiences a decrease in taxes due of 0.35%. For 25% of all

[142] Notwithstanding this general tendency, there are some regulations under the draft CCTB directive which actually have a broadening effect on the tax base also for Germany. In particular, the CCTB does no longer allow for a loss carry-back and employs a slightly stricter depreciation for buildings. For an overview of the reform elements and their impact on the tax burden see Table 9.4.

corporations, simulated tax payments even go down by more than 6%. However, there are also firms which are simulated to lose from the harmonized tax base. At the tails of the distribution, we find firms which switch their profit status. Firms with very high reductions in taxes due do pay corporate income tax under the current regime but show zero taxable profit for CIT purposes, at least in some of the three considered assessment years, under the new tax base definition. On the other hand, firms featuring very high increases in tax burden often show low investment activity and therefore do not benefit from the new depreciation regulation. In addition, these firms are often rather unprofitable and used available loss carry-backs under the 2011 regime.

A detailed sample split into reform winners and losers is shown in Table 9.7. Figures in the upper row of Table 9.7 refer again to the non-neutral CCTB reform while figures in the lower row refer to the revenue-neutral CCTB reform.

Table 9.7: Share of Winners and Losers under CCTB and CCTB + Adjusted CIT Rate

Reform Scenario	Winner	Loser	Indifferent
Introduction of CCTB	64%	19%	17%
Introduction of CCTB + CIT rate adjustment	23%	60%	17%

Note: This table displays the share of companies which are “winner” or “loser” of the respective reform scenario or indifferent between the two systems because they make permanent losses under both regimes. The results are based on the extrapolated sample. In order to achieve revenue-neutrality, the tax rate is raised to 18.1% in the CCTB + CIT rate adjustment scenario. The tax base definition is the same under both scenarios. Changes in taxes due refer to corporate income tax, solidarity surcharge, and trade tax. Source: ZEW TaxCoMM

Under the non-neutral CCTB scenario, the share of losing firms in the extrapolated sample amounts to 19%. The increase in tax burdens observed for this part of the sample is predominantly due to the abolishment of the tax loss carry-back available under 2011 German tax law. Corporations negatively affected by the CCTB indeed turn out to have made use of loss carry-backs under the 2011 German tax regime. The carry-back is no longer available and, for these losing firms, losses effectively become non-deductible because they have insufficient profits available for loss-offset in future simulation periods.[143] Finally, the tax burden is unchanged for companies making permanent tax losses under both the 2011 benchmark tax law and the CCTB scenario in all considered simulation periods. These companies make up 17% of all corporations (see Table 9.7). Again, in the long term, this share might vary at least slightly.

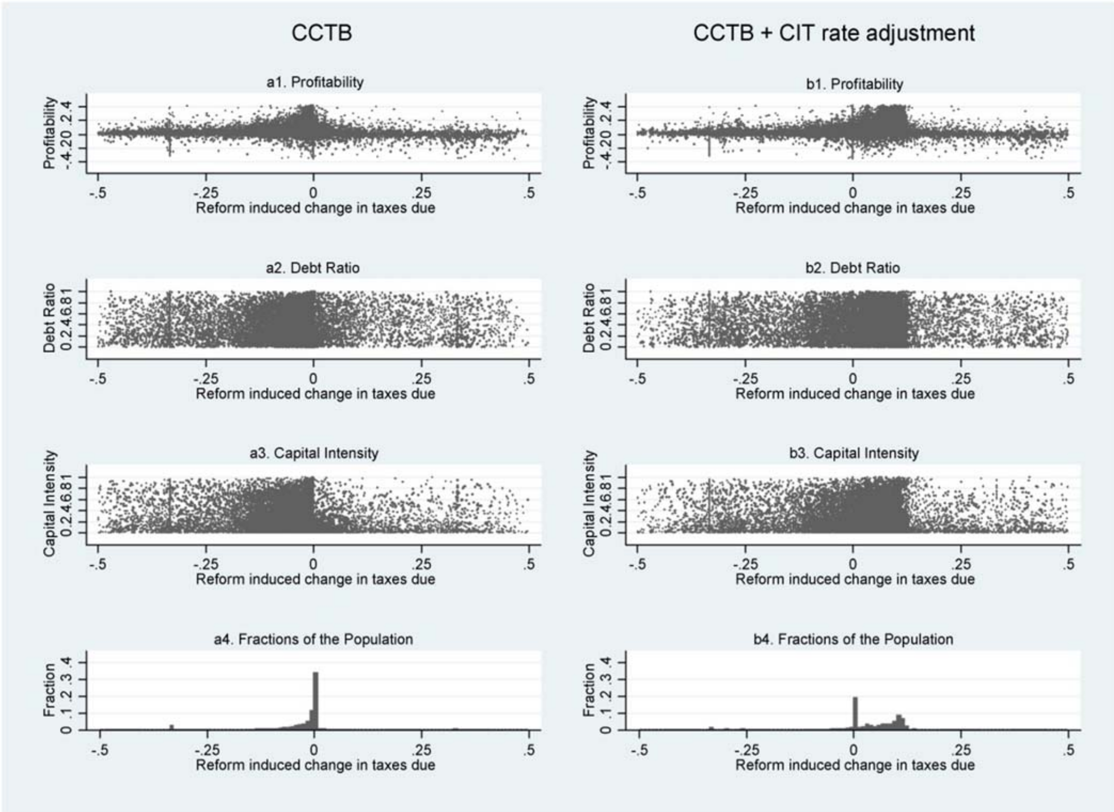
[143] A qualification, however, applies with respect to the identification of losing companies. The number of losing companies is not independent of the number of simulation periods covered by our model. Profits to set losses off against might arise in future periods not included in our three period simulation. The share of reform losers can thus be considered as an upper bound which could be undercut in the long term.

The discussion of Table 9.6 and Table 9.7 so far relates to a CCTB introduction which is non-neutral in terms of aggregate tax revenue. When the corporate tax rate is instead assumed to increase from 15% to 18.1% in order to balance the revenue losses incurred under a CCTB, results are changing (see the lower rows of Table 9.6 and Table 9.7). On average, the increase in the corporate income tax rate offsets the tax base reducing impact of the CCTB. At firm level, the impact again varies considerably. For 23% of corporations, the revenue-neutral CCTB reform is still beneficial in terms of assessed taxes due (Table 9.7). For these firms, the tax rate increase only partly outweighs the narrowing of the tax base associated with the harmonized rules. According to Table 9.6, firms at the third quartile of the distribution of the relative reform impact are no longer indifferent, but instead experience a considerable increase of 10.3% in taxes due. Even the median corporation is faced with a 4.1% increase of its tax burden if the statutory tax rate is adjusted to balance any revenue losses from the tax base reform. While firms at the first quartile have their tax burden reduced by 6.1% in case of the non-compensated CCTB reform, they are barely indifferent if the government opts for a CIT rate increase.

Relating Heterogeneous Reform Impacts to Firm Characteristics

The observed between-firm heterogeneity of the CCTB implications raises the question of which firm characteristics actually drive the reform impact on the amount of taxes due. In other words, which are the characteristics that make firms benefit from the reform and which turn them into losers? To shed light on this issue, Figure 9.1 plots the reform-induced change in taxes due against the firms' key financial ratios. Profitability is defined as the three-year average ratio of profit of ordinary activity to balance sheet total. It captures both the relevance of regulations governing loss-offset and the exposure to a tax rate increase. The firms' capital structure is captured by the three-year average of their debt-to-assets ratio. It hints at whether limitations in interest deductibility might actually be binding in the reference tax system of 2011. The capital intensity is defined as the three-year average ratio of tangible fixed assets to annual balance sheet total. The capital intensity reflects the importance of depreciation regulations. The left side of Figure 9.1 (plots a.1 to a.4) refers to the non-compensated CCTB scenario whereas the right side (plots b.1 to b.4) relates to the revenue-neutral CCTB implementation.

Figure 9.1: Change in Taxes Due (3-years average) Plotted against Key Financial Ratios



Note: All percentages are expressed in decimal form. In the first three rows of the figure, the reform-induced change in taxes due under CCTB (left column) and under CCTB with adjusted CIT rate balancing the revenue deficit is plotted against key financial ratios. The bottom row shows the reform-induced change in taxes due for fractions of the population. Profitability is defined as the 3- year average ratio of profit of ordinary activity to balance sheet total. The firm's capital structure is captured by the 3-year average debt-to-assets ratio. The capital intensity is given by the 3-year average ratio of tangible fixed assets to annual balance sheet total. Changes in taxes due refer to corporate income tax, solidarity surcharge, and trade tax. Source: ZEW TaxCoMM

Figure 9.1, plot a.1 shows that the reform-induced reduction in taxes due is to some extent decreasing with profitability under the non-compensated CCTB scenario. The relationship is, however, highly nonlinear. The reason for this is clear. In highly profitable firms, receipts exceed expenses by far and any tax base regulation, such as the path of tax depreciation allowances, becomes less important. Furthermore, firms reporting high profits throughout all simulation periods are not at all affected by the reform changes in loss-offset regulation. By contrast, for less profitable firms, more generous allowances can have a quite considerable impact on the tax burden. This is especially true for the first years following the reform since the declining balance method by definition yields gradually decreasing allowances for a given asset pool. Moreover, as discussed above, for less profitable firms the abolition of the tax loss carry-back under CCTB might lead to non-deductible tax losses, which thus remain unused for tax purposes.

Hence, highly profitable companies tend to experience a very moderate change in tax burden. Rather unprofitable firms might significantly benefit from the reform due to tax base narrowing. At the same time, however, they can also find themselves among the biggest losers if tax losses become effectively non-deductible.

This latter finding still holds true if we look at the scenario of a revenue-neutral CCTB. By contrast, profitable firms now are hit particularly hard by the compensating increase in the CIT rate. Plot b.1 in Figure 9.1 shows that firms with high rates of return on capital center at far more positive tax burden changes.

In Figure 9.1, plots a.2 and b.2, the reduction in the tax burden is plotted against the debt ratio. No clear relation can be derived since the change in interest deductibility, i.e. full deductibility under CCTB in contrast to limited deduction under the German interest deduction ceiling regulation only affects about 1% of firms.

Figure 9.1, plot a.3, illustrates the partial impact of firms' capital intensity on how they are affected by the harmonized tax base. Capital-intensive firms clearly benefit from the introduction of a CCTB. Under the revenue-neutral CCTB (Figure 9.1, plot b.3), they can hardly be found on the "losing side". High capital intensity seems to prevent companies from a substantial increase in taxes due. In the first years after a reform, they clearly benefit from the faster depreciation write-offs of newly acquired long-lived tangibles and the 25% declining balance pooled depreciation for short-lived tangibles. Again, it must be kept in mind that the simulation analysis is focused on rather short-term revenue effects in the first three years after introducing CCTB regulations. The frontload of tax depreciation is reversed in later years.

The effect from faster depreciation of tangibles is also present under the revenue-neutral CCTB scenario. Still, the mass of firms now shifts towards higher tax burdens because the CIT rate increase outweighs the narrow tax base definition.

The plots in Figure 9.1 illustrate the entire distribution of combinations of key ratios and relative tax burden change. In particular, at the center of each plot, the dots scatter very densely. In order to illustrate at which relative reform impact the mass of the distribution of firms actually centers, we include in Figure 9.1, a4 and b4, two histograms which show how firms are distributed along the full range of relative reform impacts. In the non-compensated CCTB scenario (histogram a4), the mass of the distribution clearly experiences moderate reductions in taxes due. With the compensating CIT rate increase this mass is shifted to less favorable reform impacts (histogram b4). This again reflects the insights gained from Table 9.6.

Characterizing Firms along the Distribution of the Relative Tax Burden Change

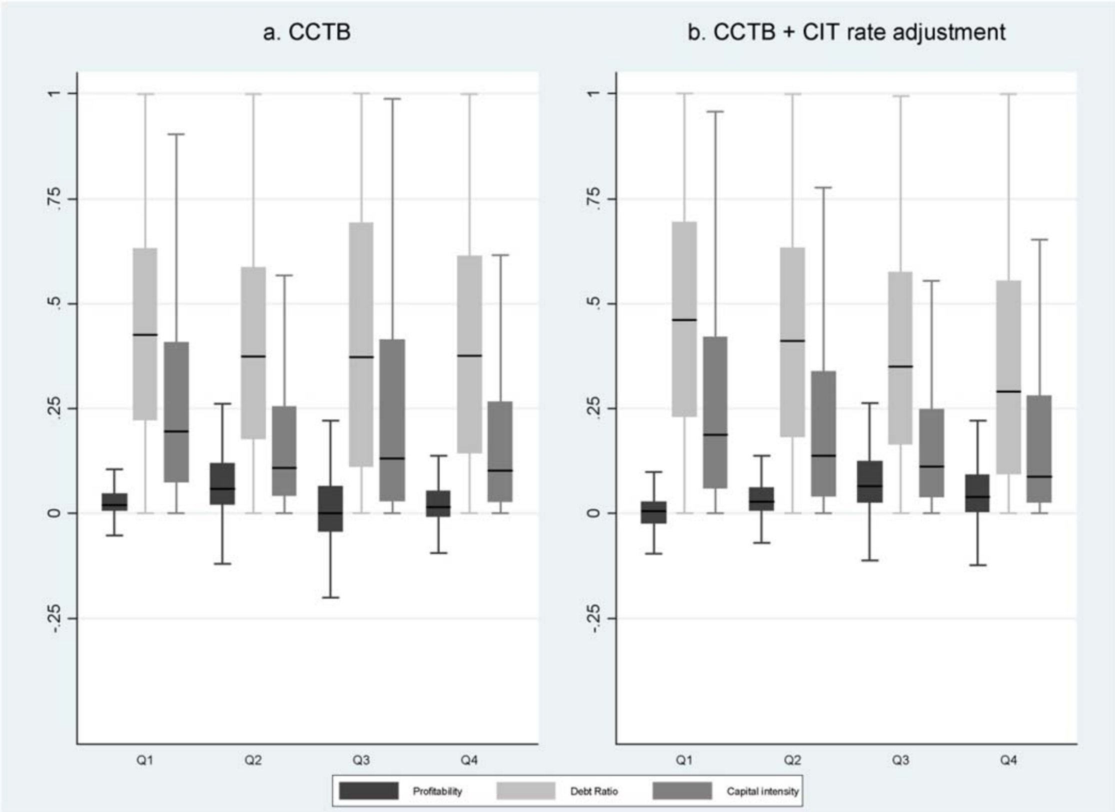
For each quartile of the CCTB triggered relative change in tax payments, Figure 9.2 shows the distribution of the key financial ratios across firms within that specific quartile. Please note that Figure 9.2a refers to the non-neutral CCTB introduction while Figure 9.2b relates to the revenue-neutral policy scenario.

The first quartile (Q1) includes the 25% of firms with the highest relative reduction in tax payments. The fourth quartile (Q4), includes the 25% of firms with the highest relative increase in tax payments. The second and third quartile (Q2 and Q3) partition the remaining 50% of firms.

We employ box plots to depict the differences in profitability, debt ratio, and capital intensity between companies falling into different quartiles of the change in tax burden. Given the three characteristics we look at and the four groups of companies, the box plot is more convenient than histograms. The box plot for profitability is colored in dark gray, the plot for capital intensity is medium gray and the one for debt ratio has a light gray color. The boxes border at the 25^{th} and 75^{th} percentile of the considered financial ratio. The black horizontal lines mark, respectively for each box plot, the median ratio.

Looking at Figure 9.2a, the conclusions drawn from the analysis of Figure 9.1 are corroborated. Companies with the highest reduction in tax burden (Q1) indeed feature a relatively low profitability (median 1.9%) and high capital intensity (median 4.3%). Companies moderately benefitting from the reform (Q2) are characterized by substantially higher returns on capital (median 5.7%) and lower capital intensity (median 37.4%). Companies facing zero change or even an increase in taxes due fall into the third and fourth quarter (see Table 9.6). They again show a lower profitability and feature losses throughout all years of simulation or are just too unprofitable to offset those losses which were under 2011 German tax law deducted as tax loss carry-backs. Similar to Figure 9.1, we find no remarkable differences in the distribution of the debt ratio between quartiles due to the small number of firms affected by a change in interest deductibility.

Figure 9.2: Distribution of Key Financial Ratios Grouped According to the Quartiles of the Reform-Induced Relative Change in Taxes Due (3-years average)



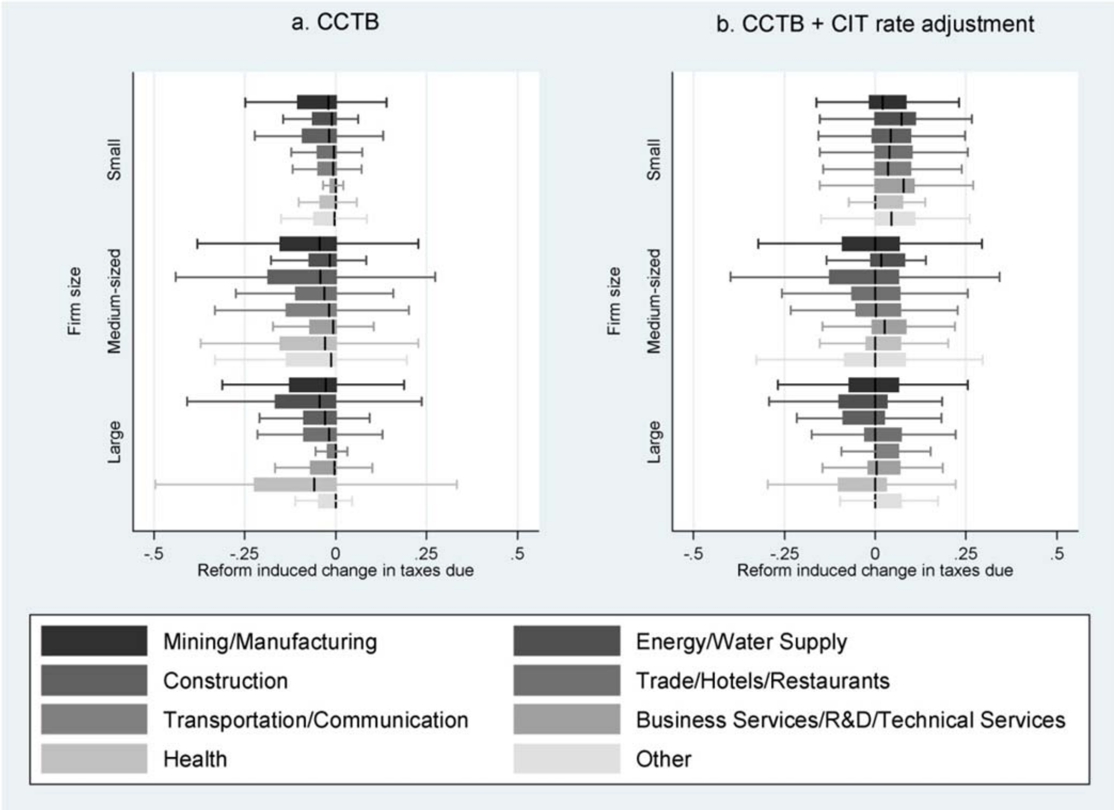
Note: For each quartile of the distribution (Q1-Q4) of the relative change in taxes due, the box plot displays a box bordered at the 25th and 75th percentile of the key financial ratios. A median line indicates the 50th percentile. Adjacent lines mark the lowest/highest observation still lying within 1.5times interquartile range. Changes in taxes due refer to corporate income tax, solidarity surcharge, and trade tax. Key financial ratios are defined as explained in footnote of Table 9.1. Source: ZEW TaxCoMM

Turning to the revenue-neutral CCTB reform (Figure 9.2b), the picture changes. Companies experiencing zero change or even an increase in taxes burden now show up in the second quarter (see Table 9.6). A look at the respective box plots reveals that those firms hit particularly hard by the reform (Q3 and Q4) are indeed the ones with high returns on capital. The median return on capital in these quarters amounts to 6.3% (Q3) and 4.8% (Q4) whereas it reaches only 0.2% in Q1 and 2.7% in Q2. Still, some firms benefit from the compensated CCTB reform despite the substantial increase in the CIT rate (Q1). They are characterized by high capital intensity (median 45.1%) but relatively low returns on capital (median 0.2%) and a high debt ratio. Thus, they are less affected by the increased CIT rate and, at the same time, fully benefit from favorable depreciation.

Reform Implications According to Firm Size and Economic Activity

Financial ratios represent important dimensions in which corporations differ. Two further important firm characteristics are size and economic activity. Figure 9.3 summarizes the reform-induced change in tax payments according to firm size and economic activity.

Figure 9.3: Reform-Induced Changes in Firm-Specific Taxes Due (3-years average) According to Firm Size and Economic Activity



Note: For each class of firm size and economic activity, the box plot displays a box bordered at the 25th and 75th percentile of the reform-induced change in taxes due. A median line indicates the 50th percentile. Adjacent lines mark the lowest/highest observation still lying within 1.5times interquartile range. Changes in taxes due refer to corporate income tax, solidarity surcharge, and trade tax. Company size categories are defined as explained in footnote 129. Source: ZEW TaxCoMM

The distribution of the relative change in firms' tax burden is again represented by box plots bordering at the 25th and 75th percentiles. The horizontal lines mark the lowest and highest observation still lying within 1.5 times the inter-quartile range. For each box plot, the median reform impact is marked by a vertical black line. We choose this form of representing the distribution of the reform impact across firms because it again allows us to conveniently illustrate important features of the distribution for a high number of subpopulations at one glance. The box plots are colored in different shades of gray according to the represented type of economic activity. Furthermore, the plots are regrouped according to firm size. The plots for large firms are found below those for medium and small corporations.[144] Figure 9.3a refers to the non-neutral CCTB scenario.

[144] Company size is again defined according to annual balance sheet totals (see the definition in footnote 129).

Figure 9.3b relates to the CCTB introduction with compensating CIT rate adjustment. Figure 9.3a reveals that for each firm cluster defined by size and economic activity the distribution of the reform impact is skewed. The median change marked by the black lines is generally small because of a high share of firms experiencing only minor or no changes in tax burden independent of firm size and type of business activity (see also Table 9.6 and the related discussion). Still, there are important differences between size-activity clusters. First, the capital-intensive industries, such as manufacturing, construction, as well as large corporations in the energy and water supply, show the highest reform-induced reduction in tax payments after introducing the CCTB. In these industries, companies in the second and third quartiles of the impact distribution experience a reduction of taxes due of up to 20% (Figure 9.3a). We know from Table 9.6 that the reduction is around 6.1% for the corresponding fraction of all corporations. Moreover, large companies in the health sector show a relatively high median reduction in taxes due. Those companies have a very low average profitability and benefit from the unlimited loss carry-forward. Furthermore, the box plot reaches reductions in tax burden of up to almost 25%. Small corporations with economic activity in business services, R&D or technical services show hardly any change in taxes due since they feature a high share of intangible assets and are, thus, benefitting to a smaller extent from alleviated depreciation.

We now turn to the revenue-neutral scenario (Figure 9.3b). Across almost all economic activities, small firms within the 25th and the 75th percentile of the CCTB-induced tax burden change are actually confronted with a higher tax burden as compared to the 2011 benchmark law. The median change for small firms is generally positive whereas it is around zero for medium-sized and large corporations. In almost all industries, small companies feature a much lower capital intensity than their medium-sized or large counterparts (see Table D.1 in Appendix D) and therefore benefit less from faster depreciation. Among small corporations, the increase in tax payments is especially pronounced for those active in business services, R&D or technical services. Comparing the distributions depicted in Figure 9.3a and Figure 9.3b, it is clear that these firms benefitted little from the harmonized tax base. They thus cannot offset any important benefits from the new tax base definition against the statutory tax rate increase.

An Interim Conclusion on the CCTB's First Round Implications

Relative to the German Tax Law of 2011, the proposed CCTB regulation narrows the tax base. The associated revenue loss is simulated to amount to 8.6% in the short term, based on the economic environment of 2005-2007. We find that, in this case, 64% of firms in the sample benefit from the harmonization of the tax base. The revenue loss can be immediately compensated by increasing the corporate income tax rate from 15% to 18.1%. If the tax rate is adjusted, however, the share of "winners" of the compensated reform scenario goes down to 23%.

Both policy scenarios reveal substantial variation of reform consequences at firm level. These are mainly driven by the profitability and capital intensity of firms. Capital-intensive firms benefit to a larger extent from the faster depreciation. Highly profitable companies tend to experience a very moderate change in tax burden due to the introduction of the CCTB regulations. At the same time, these firms are hit particularly hard if the corporate income tax rate is increased.

Comparing the reform implications according to firm size and economic activity, we find that small firms benefit to a smaller extent from the introduction of a CCTB. Hence, under the revenue-neutral scenario they mostly experience an increase in tax burden. Firms in the capital-intensive industries such as manufacturing, construction and energy benefit considerably from the introduction of a CCTB. Firms in these industries therefore still belong to the "winners" of the reform even under the revenue-neutral reform scenario.

9.6 Second Round Results: Accounting for Behavioral Responses of Firms

The analysis in the previous section ignored that firms react to a change in the tax regime. The ZEW TaxCoMM microsimulation model is able to account for behavioral responses at five margins of decision (see Chapters 3 and 8). We will now present results including the simulation of corporate responses in financing, investment, profit shifting, and legal form decisions. The presentation of results will focus on the policy scenario of a revenue-neutral CCTB introduction. The scenario was already discussed in detail in Section 9.5. We assume that the government acts according to a balanced budget rule and adjusts corporate tax rates ex-ante, i.e. before taking into account behavioral responses. Our first round results indicated that the common tax base is rather narrow as compared to 2011 German tax law. A compensating CIT rate increase must be at the order of 3.1 percentage points. The German CIT rate would thus go up to 18.1%.

9.6.1 Assessing Heterogeneous Behavioral Effects at the Firm-Level

The resulting "base narrowing cum tax rate increase" reform considerably affects the size of tax distortions at relevant margins of decision. Tax effects on corporate decisions run to an important extent via the statutory tax rate. The statutory tax rate, adjusted for the tax deductible fraction of interest, is a good indicator for the marginal tax incentive to finance with debt rather than equity. Furthermore, profit shifting is motivated by potential tax savings arising from international statutory tax rate differences. A change in the German statutory tax rate ceteris paribus reflects the change in these exploitable tax rate differences vis-à-vis foreign locations. The statutory corporate tax rate is also a valid proxy for the effective tax burden on profitable investment projects. Finally, for a given tax rate on pass-through entities, a change in the statutory tax rate on corporations reflects the change in the incentive to incorporate. These distortions are quite uniformly affected by the reform because the applicable CIT rate does not vary between firms.

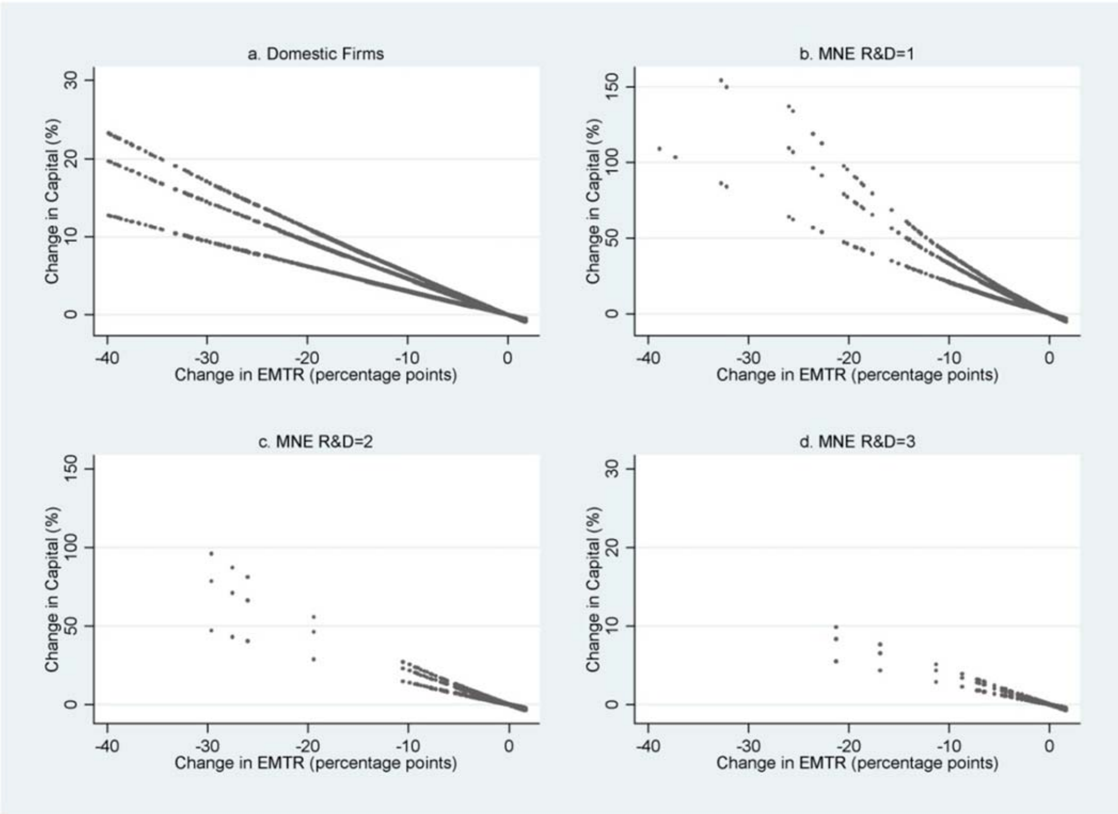
A Detailed Look at the Investment Response

When it comes to heterogeneity in the reform tax shock, it is particularly interesting to take a closer look at the dynamic capital adjustment process. Relative to the other decision margins, the tax distortion on investment is much more uneven across firms. The effective marginal tax rate (EMTR), which, according to neoclassical theory, captures the tax impact on investment decisions at the margin, is mainly determined by the asset structure, the respective paths of depreciation allowances, and the sources of financing (equity and/or debt) of the marginal investment project. If the marginal investment is to a large extent debt financed, the associated interest expense will shield the normal return from taxation and, thus, considerably reduce the effective tax rate. Current losses or tax loss carry-forwards may provide further non-debt tax shields. In order to approximate the firm-specific tax disincentive to invest at the margin, we compute firm-specific EMTRs. For this purpose, we assume that the reported financial and asset structure of each firm also applies to the marginal investment project. We consider three types of assets: buildings, long-lived movable tangibles, and short-lived movable tangibles.[145]

[145] The cost of capital c is calculated according to standard neoclassical definition in equation (3.11) in Chapter 3. Costs of financial distress are, however, ignored. The relevant economic parameters are as follows (for an overview see Table D.3 in Appendix D). We set the nominal interest rate at 4.3% accord-

Figure 9.4 illustrates the reform-induced adjustment of capital levels. For this specific analysis, we consider domestic corporations and the three types of multinational corporations classified according to their industry's R&D intensity.

Figure 9.4: Tax Shock in Terms of EMTR and Related Capital Response for the Three Simulation Periods



Note: This figure plots the percentage-change in capital levels relative to benchmark levels against the reform-induced EMTR-shock. The lowest line in each of the plots a-d shows the relationship for the first year after the reform. The two upper lines stand for simulation periods 2 and 3. Source: ZEW TaxCoMM

For each firm type, Figure 9.4 plots the percentage-change in capital levels relative to the respective benchmark levels against the reform-induced EMTR-shock in percentage points. In each plot, the dots fall on three distinct lines. Each line stands for one simulation period. Slopes are determined by the long-term semi-elasticity of investment, the speed of adjustment toward new capital targets, and the number of years passed since the reform. In each plot, the lowest line of dots shows the relationship between the re-

ing to the average yield on domestic bonds outstanding for the considered years 2005-2007 as published by the German Federal Bank (Deutsche Bundesbank, 2011). The average inflation rate for these years amounts to 1.8% (Statistisches Bundesamt, 2011a). Thus the real interest rate is 2.5%. Moreover, we assume economic depreciation to follow a declining-balance at rates of 3.1% for buildings, 17.5% for short-lived tangible fixed assets and 6.3% for long-lived tangible fixed assets. Results for the six types of investment (the three types of assets financed by equity or debt) are averaged according to weights reported in the firm's balance sheet. The EMTR, τ^{EMTR}, is defined as $\tau^{EMTR} = (c - r)/c$ with r as the real interest rate.

form impact on capital levels and the firm-specific EMTR change caused by the CCTB reform in the first year after the reform. The two upper lines stand for, respectively, simulation periods two and three.

The adjustment process towards new capital targets in the hypothetical CCTB scenario proceeds and reform capital levels move away from respective benchmark levels in each year. In other words, the plot illustrates how the reform trajectory of capital levels shifts away from the trajectory of observed capital stocks under the benchmark scenario.

The four types of firms represented in Figure 9.4 differ with regard to their response intensities. The behavioral elasticities implemented into the microsimulation model were shown in Table 8.1 in Chapter 8. The literature provides robust evidence that foreign direct investment is an essential and highly responsive channel of cross-border capital flows (see Chapters 5 and 8). Highly R&D intensive multinational affiliates are in a good position to shift profits into lower taxing jurisdictions. By contrast, less R&D intensive multinationals have fewer possibilities to avoid high local tax rates. As a result, real capital investment of multinationals with low or moderate R&D intensity is the most EMTR sensitive. Accordingly, Figure 9.4 shows that for a given change in EMTR, the induced change in capital is highest for multinationals with low R&D intensity (MNE 1).

The overall capital response to reform plotted on the y-axes of the four plots of Figure 9.4 is, however, not only determined by the behavioral response intensities but, equally important, by the firm-specific tax shocks triggering the response. These shocks are plotted on the x-axes of the plots in Figure 9.4.

Table 9.8 illustrates in more detail how the reform-induced change in EMTR is distributed across the sample of domestic and multinational firms. For 25% of firms, the compensated CCTB scenario results in a substantial reduction in EMTR. These firms exhibit comparably high debt ratios. Correspondingly, a high share of debt in their marginal sources of funds shields normal returns from taxation. These firms benefit fully from the faster depreciation under CCTB. Multinationals with a moderate R&D intensity (MNE 2) stand out with comparably small tax shocks. Firms in this cluster show a mean debt ratio of 31% compared to 48% for domestic firms or 53% for multinationals with low R&D intensity (see Table D.2 in Appendix D).

Table 9.8: Change in EMTR (3-years average) at Selected Percentiles of the Distribution (%-points)

Percentile	1%	5%	10%	25%	50%	75%	90%	95%	99%	mean
Domestic	-16.4	-11.9	-9.5	-5.0	-0.1	0.0	0.0	0.5	1.4	-2.9
MNE 1	-15.1	-10.6	-9.3	-5.0	-0.9	0.0	0.0	0.4	1.1	-2.9
MNE 2	-9.9	-6.1	-2.9	-0.1	0.0	0.0	0.7	1.3	1.4	-0.8
MNE 3	-21.3	-7.0	-5.5	-1.8	0.0	0.0	1.3	1.4	1.5	-1.4

Note: This table displays the change in EMTR for four types of firms at different percentiles of the distribution. Domestic: Domestic Firms. MNE1 (2, 3): Multinational firms/affiliates active in industries with low (moderate, high) R&D intensity.

Generally, corporations showing only a moderate EMTR decrease or an EMTR increase under the compensated CCTB scenario are highly profitable and, as a result, finance large part of their investments with equity. They are thus severely hit by the statutory tax rate increase. The asset composition of the marginal investment project also plays a role. In particular, movable tangibles benefit from a 15-year straight-line depreciation under CCTB or, if they are short-lived, from a very fast pooled depreciation. The effect on the EMTR can be substantial because the present value of depreciation allowances strongly increases. Actually, faster depreciation combines with higher tax savings from each unit of deducted allowance due to the tax rate increase. For 1% of domestic firms, the reduction in EMTR exceeds 16.4 percentage points. At the negative end of the spectrum, as illustrated in Figure 9.4, the reduction even reaches 40 percentage points. These outliers are characterized by a debt ratio close to 100% and mostly rely on short-lived tangible assets which are subject to the very fast pooled depreciation.

The tax shock is zero for holding companies and other firms if these show tax losses in at least two out of the three simulation periods under both scenarios (see Chapter 8). We assume that the latter firms have sufficient losses or accumulated loss carry-forwards to offset any return on marginal investment. Therefore, tax shocks were generally set to zero for this group of companies. On average, 34% of domestic firms and 36% of multinational firms are loss-making (see Table D.2 in the Appendix) and, thus, have no tax incentive to invest. Moreover, holding companies usually do not engage in real investment and, hence, do not react to the corresponding tax incentive either. The share of holding companies is 3.2% for domestic firms and 9.5% for multinationals (see Table D.2 in Appendix D).

Impact of Behavioral Response on Tax Base Components: EBIT

We now analyze the consequences for taxable profit, in absolute terms, arising from the behavioral responses to the compensated CCTB reform. Figure 9.4 illustrated the simulated behavioral adjustment using the example of firms' investment response. Now the focus will be on the full set of decision margins modeled at firm level. They all impact on earned profit.

As discussed in the previous chapters, almost all behavioral firm responses simulated in ZEW TaxCoMM are expressed in relative terms.[146] Accordingly, the main response parameters are the so-called semi-elasticties (see, e.g., Table 8.1 in Chapter 8 for an overview). They express the percentage-change in the endogenous decision variable in response to a one percentage point increase in the relevant tax rate.[147]

Considering the investment margin, the absolute gap between a firm's benchmark capital stock and the reform-adjusted target capital level is rising in the benchmark capital stock to which the relative response applies. So does the required marginal investment necessary to close it; and, evidently, it is the investment volume which again drives the associated absolute EBIT response to reform. The EBIT response to a change in the international shifting incentive is equally expressed in relative terms and, thus, dependent on benchmark EBIT levels. Capital stock and EBIT vary considerably between firms (see Table D.1 in Appendix D).

In particular, very large firms turn out to be important outliers which drive simulation results on reform-induced changes in taxable profit. Importantly, the simulation is able to cover the full distribution of firm characteristics and includes it into its micro-level and aggregate analyses.

Table 9.9 and Table 9.10 represent the distribution of the partial EBIT change induced, respectively, by the firms' marginal investment and multinationals' profit shifting responses. In Table 9.9, we take a separate look at the two fundamental types of corporations, i.e. domestic firms and multinationals.[148]

Table 9.9 shows that a minority of both domestic and multinational corporations actually reduces capital levels as well as associated EBIT relative to benchmark levels.

[146] The only exemption is the debt policy response where we refer to the absolute marginal tax effect on the debt ratio as it is standard in the literature on capital structure choice.

[147] Strictly speaking, the semi-elasticity gives the marginal tax effect on the log of the response variable.

[148] For clarity, we set aside the deeper classification of multinationals according to R&D intensity in this and further analyses. Detailed distributions are available upon request.

The highest percentile which takes on a negative value, i.e. signifies a decrease in EBIT relative to benchmark levels, is the 10th percentile in the case of multinational firms.

Table 9.9: Change in EBIT (3-years average) Induced by Investment (in EUR)

Percentile	1%	5%	10%	25%	50%	75%	90%	95%	99%	mean
Domestic	-222	-4	0	0	7	162	1,178	2,883	17,402	2,578
MNE	-8,558	-515	-48	0	38	3,253	21,977	50,776	475,132	74,201

Note: This table displays the change in EBIT induced by investment in EUR for domestic and multinational firms (MNE) at different percentiles of the distribution.

The respective EBIT reduction compared to benchmark levels is, however, small and amounts to EUR 48 (see Table 9.9, row 2). As discussed with Figure 9.4, firms under-investing relative to the benchmark actually experience an increase in EMTR. Furthermore, an important number of firms do not react to reform-induced changes in the tax distortion on investment. The 10th and 25th percentiles of the EBIT change from the investment response show a value of zero for domestic firms and the 25th percentile of the EBIT change from the capital response shows a value of zero for multinationals. As discussed before, these non-responding firms are either loss-making or qualified as holding companies and are thus experiencing no tax-induced incentive to invest. The absolute returns from induced marginal investment remain quite small up to the median.

Looking at Table D.1 in the Appendix, we see that the distribution of capital stock among German corporations is indeed highly skewed. As a result, this also holds for the consequences arising from reform-induced adjustments of capital input shown in Table 9.9. The important role of relatively few but large corporations with huge amounts of invested capital becomes clear if we take a look at the higher percentiles depicted in Table 9.9. For domestic firms, the 75th percentile shows a return from reform-induced investment of EUR 162. Going further to the right-hand side of the distribution, the percentile values increase steeply. Firms at the 99th percentile raise EBIT by EUR 17,402 by investing relative to the benchmark. This is six times the 95th percentile value and even 15 times the 90th percentile value.[149] High percentile values for multinationals skyrocket even more, going up to an induced EBIT of EUR 475,132 at the 99th percentile. The plain average EBIT increase of EUR 2,578 for domestic firms and of EUR 74,201 for multinationals thus hides substantial variation. Broadly capturing this heterogeneity

[149] Evidently, the additional investment brings about consequences for interest payments as soon as they are to a certain extent debt-financed. The reform impact on interest expenses is discussed below with Table 9.11.

prevents the analysis from, arbitrarily, looking at fragments of the distribution of reform consequences across firms. Furthermore, it appears that response implications are not the same between domestic corporations and firms with multinational affiliation. The effects from multinationals' marginal investment response are much more substantial. This is an important size effect revealed by the microsimulation analysis.

Table 9.10 shows the distribution of the partial change in EBIT caused by reform adjustments in multinationals' profit shifting activities.[150] Profit shifting responds to exploitable international tax rate differences. Our reform scenario assumes the German government increases the statutory CIT rate as a compensating fiscal measure. Thus, there is clearly an incentive to engage in more profit shifting because, ceteris paribus, the tax rate difference between Germany and other foreign locations increases.

Table 9.10: Reduction in EBIT (3-years average) Induced by Profit Shifting of Multinationals (in EUR)

%-tile	1%	5%	10%	25%	50%	75%	90%	95%	99%	mean
MNE	-3,929,903	-623,993	-221,538	-54,198	-11,528	-1,626	-124	-41	-37	-367,295

Note: This table shows the reduction in EBIT implied by the profit shifting response of multinational firms (MNE).
Source: ZEW TaxCoMM

Table 9.10 shows that the absolute amounts of EBIT shifted in response to the CIT rate increase are indeed substantial. As the induced EBIT change from shifting activity shows a negative sign, the most pronounced behavioral responses are now on the left-hand side of the distribution. Firms at the 1st percentile shift an additional amount of EUR 3,929,903, in terms of EBIT. The 5th and 10th percentile values are respectively EUR 623,993 and EUR 221,538. Going further to the right-hand side of the distribution, additional shifting effects decline but remain considerable. The median multinational affiliate still shifts an additional EUR 11,528 of EBIT towards lower taxing jurisdictions. The 4th quarter of the distribution shows minor values.

Table 9.10 thus reveals considerable variation across firms although the reform shock in the statutory CIT rate (+3.1pp) is the same for all firms. However, some sources of heterogeneity remain. In particular, benchmark EBIT to which induced relative responses apply varies significantly across firms (see Table D.2 in the Appendix). In line with the empirical literature, the behavioral response at the profit shifting margin is again modeled in relative terms (see equation (3.24) in Chapter 3). The economic reasoning is straightforward. Large multinational affiliates with high benchmark EBIT

[150] By definition, purely domestic corporations are not able to engage in paper profit shifting.

and important intra-group trade can minorly adjust transfer prices and still create a substantial impact on absolute EBIT. Small firms instead can show an intensive shifting response which still does not mean much in absolute terms.

In addition, our model does not simulate all multinationals to be equally responsive to international profit shifting incentives. As discussed earlier, we assume R&D intensity to be an indicator of the degree of discretion which firms have in setting tax-efficient transfer prices. The more a firm is engaged in R&D, the more firm-specific are the assets and the higher is the leeway to set transfer prices for these assets. Implemented response intensities are scaled accordingly for multinationals with low, moderate and high R&D intensity (see Table 8.1 in Chapter 8).

Impact of Behavioral Response on Tax Base Components: Interest Expense

EBIT is affected by two partial responses, investment and profit shifting. Investment is also one of the driving responses for the CCTB-induced change in interest expenses. In addition, the response in debt policy matters for the reform impact on interest expense. In short, the shift in a firm's interest expense relative to the benchmark scenario reflects its response with regard to capital input and capital structure. The debt response is driven by the marginal tax rate on the next unit of interest expense, approximated by the statutory tax rate adjusted for the tax-deductible fraction of interest.

The debt-to-assets ratio of a firm with sufficient non-debt tax shields clearly responds less to a change in the statutory tax rate. The marginal incentive to finance with debt can be zero in this case. Furthermore, the debt response might also be influenced by the fact that interest ceiling rules were binding under German 2011 tax law and are deductible under CCTB. This concerns about 1% of all corporations. Other sources of heterogeneity in the absolute shift in interest expenses are the same as for the investment response because the shift in capital stock, if to a certain extent debt-financed, also determines the shift in interest payments.

Table 9.11 shows the distribution of the absolute reform impact on firms' interest expenses. We again show percentile values for domestic firms (upper row) and for firms with multinational affiliation (lower row). Again, considerable variation between firms becomes apparent.

Up to the median, firms show no shift in interest expense. As discussed with Table 9.8 and Table 9.9, a considerable share of firms are loss-making and their investment and capital structure choices are thus not affected by tax considerations.

Table 9.11: Change in Interest Expense (3-years average, in EUR)

Percentile	1%	5%	10%	25%	50%	75%	90%	95%	99%	mean
Domestic	0	0	0	0	11	154	972	2,381	13,068	2,017
MNE	0	0	0	0	83	2,163	13,502	31,585	447,861	36,301

Note: This table displays the change in interest expenses due to capital structure choices and the financing of marginal investments for domestic and multinational firms.

Moreover, we know from the discussion of Table 9.8 that those firms which reduce capital input relative to the benchmark are primarily financing with equity. Thus, even on the left-hand side of the distribution in Table 9.11, we do not see negative values. Firms at the higher percentiles, however, show considerable increases in interest expense relative to the benchmark. These are the firms with high shares of debt in their capital structure and with high increases in capital investment. Domestic Firms at the 99th percentile show increases in interest expenses by EUR 13,068, which is 5.5 times the 95th percentile value and more than 13 times the change at the 90th percentile. The distribution of multinationals is even more skewed.

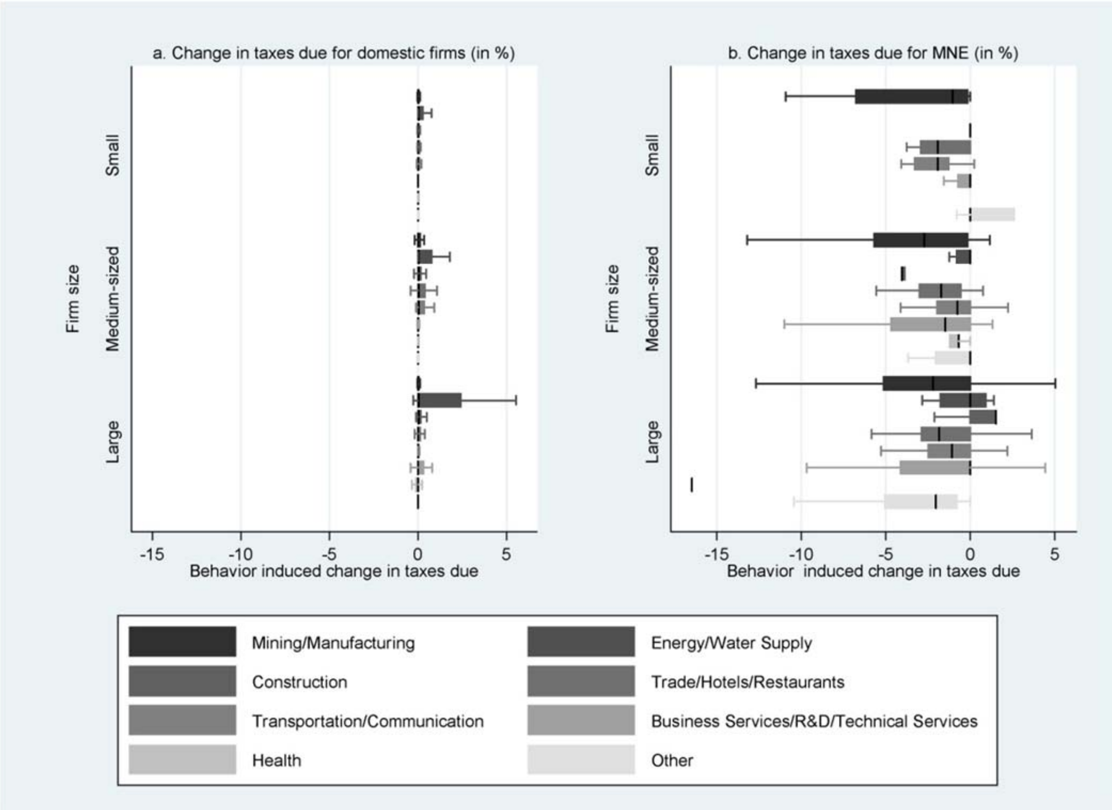
Taking the discussions with respect to the change in EBIT induced by investment (Table 9.9) and the change in interest expenses (Table 9.11) into account, it becomes obvious that the increase in EBIT is, to a considerable extent, shielded from taxation.

Impact of Behavioral Response on Firm-Specific Taxes Due

The assessed behavioral implications for the profit components EBIT and interest expense evidently have consequences with regard to taxes due. For each firm in each of the three simulation periods, the shifts in EBIT and interest expense are included in the tax assessment. In particular, after accounting for loss-offset, interest add-backs for local trade tax purposes, and integrated fiscal units, the tax base is finally derived. Applying local trade tax rates and a statutory CIT rate of 18.1% (+ 5.5% solidarity surcharge) to the respective tax bases gives the tax due for each firm in each year.

Similar to the comparison of changes in taxes due over firm and activity clusters with regard to first round effects (see Figure 9.3), we look at the second round effects with regard to tax payments for these clusters. Figure 9.5 summarizes the reform-induced change in tax payments according to firm size, economic activity, and regional status. We take the average over the three simulated assessment years.

Figure 9.5: Change in Taxes Due (3-years average) for Domestic and Multinational Firms (in %)



Note: This figure illustrates how behavioral responses affect the change in taxes due for domestic and multinational firms according to firm-size and economic activity. For each activity-size cluster, the box plot displays a box bordered at the 25th and 75th percentile of the change in taxes due. A median line indicates the 50th percentile. Adjacent lines mark the lowest/highest observation still lying within 1.5times interquartile range. Changes in taxes due refer to corporate income tax, solidarity surcharge, and trade tax.

Figure 9.5a shows that the behavioral responses at the investment and debt policy margins affect taxes due of domestic firms only to a minor extent. For domestic firms, we hardly observe any change in taxes due. Besides the share of loss-making firms, this result can be attributed to the fact that in most cases the increase in EBIT induced by investment (first row of Table 9.9) is largely compensated by an increase in interest expense (first row of Table 9.11). Due to high absolute values of capital and below-average debt ratios (see Table D.1 in the Appendix), the impact of the behavioral response on tax payments is higher for large and medium-sized firms in the energy and water supply sector.

Figure 9.5b shows much stronger relative reform effects on taxes due for multinationals. Clearly, the profit shifting margin comes in for this group of firms. Profit shifting via the route of related-party trade does not only affect marginal returns. Multinationals can effectively circumvent taxation of the economic rents. It is thus clear that this response margin has considerable impact on tax payments. Furthermore, our reform scenario, which supposes a CCTB introduction with a compensating CIT rate increase, produces a high incentive to engage in more profit shifting. Looking at differences between industries in Figure 9.5b, we see that sectors including firms with R&D intensive business stand out. For 25% of firms in the manufacturing sector, the reduction in tax burden even exceeds 5%. A similar magnitude can be observed for medium-sized and large firms in the service sector. The outlying value for the health sector can be explained by huge disinvestments due to an increase in EMTR. However, this concerns only a very small number of firms.

Some insights into long term implications

The benchmark accounting data on the basis of which taxes were assessed according to 2011 tax law parameters refers to the period from 2005 to 2007. In Section 9.5, we applied CCTB regulation – with and without compensating CIT rate increase - to the same input data. Thus far, we looked at the implications arising from behavioral responses to the CCTB (+ CIT rate adjustment). We accordingly adjusted the firms' decision variables (debt ratio, capital stock) and profit components (EBIT, interest expense) in these three assessed years of simulation. In short, we took the benchmark input data and added reform-induced changes.

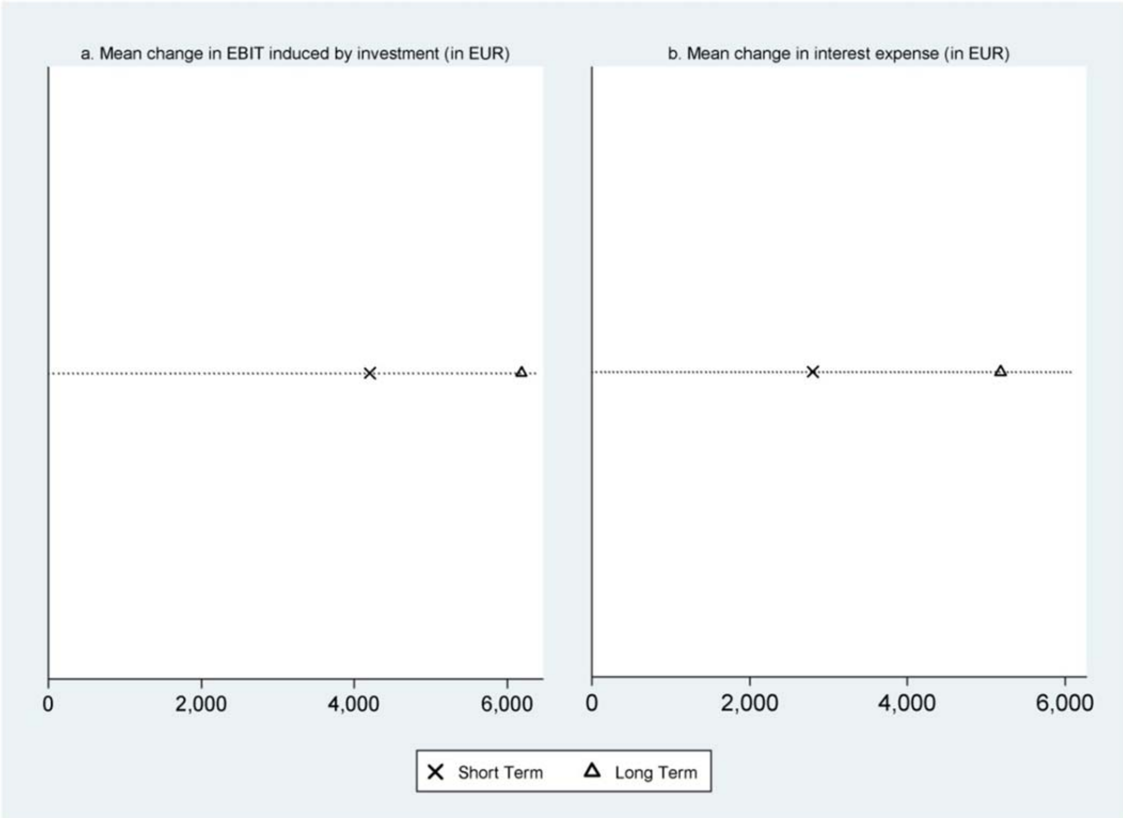
Moreover, the behavioral algorithms incorporated into the ZEW TaxCoMM model allow us to take a far deeper look into the future beyond the first three periods after introducing the reform.[151] We have no benchmark data available for the periods where capital input and capital structure adjustment to reform shocks would be complete. Still, some intuition as to how far our three-period microsimulation model traces reform consequences can be given. Assuming that under the benchmark scenario, i.e. with no CCTB being introduced, economic conditions of the period 2005 to 2007 persist into the far future, we take average firm-level accounting data for these years and apply the long-term behavioral responses to this data.[152]

We again derive the EBIT consequence from full adjustment in capital stocks and the consequence with respect to interest expense originating from adjustments in both capital levels and capital structures. To put the long-run implications into perspective, Figure 9.6a and Figure 9.6b map the average reform consequence of the simulated first three periods and the long-run implication on a horizontal line.

[151] The long-term elasticities materialize with after-reform periods t going to infinity. Just take the limit of equations (3.19) and (3.23).

[152] This assumption is generally consistent with the logic of the ZEW TaxCoMM model, which abstracts from non-tax influences on firm behavior.

Figure 9.6: Comparison of Short Term and Long Term Implications from Adjustments in Capital Stock and Capital Structure



Note: This figure illustrates the mean change in EBIT induced by investment and interest expense respectively for the short term and long term perspective. The long term perspective considers the case in which all adjustment is complete.

Since the ZEW TaxCoMM assumes a half-life[153] of 3.7 years for debt ratio adjustments of firms, the implications arising from the debt response in the first three years after the reform fall considerably short of the long-run implications. This is shown in Figure 9.6b. There is an 83%-distance between the average increase in interest expense within the first three years after the reform (EUR 2,800; marked with ×) and the long-term increase (EUR 5,100; marked with △). An important part of the interest response is determined by the investment response. Looking at Figure 9.6a, the long-term implication exceeds the short-term simulation results by 47%. The smaller distance between short-term and long-term values reflects higher speed of capital adjustment, with a half-life set to one year.

The focus will now turn to the aggregate tax revenue consequences arising from the behavioral adjustment at the firm-level plus those discrete decision margins modeled at the aggregate level, i.e. location choice and choice of legal form.

[153] The half-life gives the number of years after which 50% of the gap between actual pre-reform levels and reform-adjusted target levels is closed.

9.6.2 Tax Revenue Effects with Behavioral Responses

Table 9.12 recapitulates the revenue consequences of a compensated CCTB reform within the three simulated assessment years. The table shows the effect for each step of the analysis. In the first three years after the introduction of the common tax base regulation, aggregate corporate income tax, solidarity surcharge, and trade tax revenue collected from German corporations is predicted to drop by 8.6% on average. Based on the macroeconomic conditions of the period from 2005 to 2007, total CIT, solidarity surcharge, and trade tax revenue would, in sum over these three years, go down from EUR 189.833 bn to EUR 173.585 bn. Raising the CIT rate by 3.1 percentage points brings the aggregate tax revenue up to pre-reform benchmark levels.[154]

However, the required adjustment of the corporate tax rate is determined by pure first round reform effects. This assumption is generally deemed to realistically describe true government behavior (see Bettendorf et. al., 2010). Such a policy, however, neglects the revenue consequences arising from the behavioral response of firms.

Table 9.12 shows that a CCTB reform which would be revenue-neutral from a purely static first round perspective is no longer neutral if firms actually respond. In particular, the compensating increase of the statutory tax rate triggers behavioral adjustments at various corporate decision margins. We simulate short-term responses at the firm-level for corporate debt policy, marginal investment decisions, and profit shifting activity. Due to these behavioral responses, aggregate revenue of corporate income tax, solidarity surcharge, and trade tax decline by 1.2% relative to the benchmark. In addition, we determine the aggregate tax base elasticity in regard to the statutory tax rate implicit in our model. It amounts to a value of -0.1 (see Table 9.12). In order to disentangle the distinct revenue effects arising from each of the three margins considered at the firm-level, we compute the changes in each margin separately and hold the distortions at the other margins constant (result not shown in Table 9.12). The partial responses of corporate capital structure policies and profit shifting activity make aggregate tax revenue decrease, respectively, by 0.1% and 1.6%. In contrast, the marginal investment response makes aggregate tax revenue increase by 0.5%. Clearly, the effects from induced marginal investment on the one hand and, on the other hand, from profit shifting and the debt response partially compensate.

[154] As we model a compensating increase in the corporate income tax rate, this revenue-neutral reform would imply a redistribution of tax revenue from the local trade tax to the corporate income tax.

Table 9.12: Revenue Consequences in bn EUR (sum over 3 years)

Reform Scenario			Total tax revenue	%-change	Aggregate Tax Base Elasticity
Pure Regulation Change		2011	189.833		
		CCTB	173.585	-8.6%	
		CCTB + adjusted CIT rate	189.833	0%	
Behavioral Responses	Short term	Debt Policy, Marginal Investment Profit Shifting Activity	187.610	-1.2%	-0.1
	Long term	Debt Policy, Marginal Investment, Profit Shifting Activity	186.306	-1.9%	-0.2
	+ Location Choice, Legal Form Choice		176.583	-7.0%	-0.6

Note: This table shows the total tax revenue for different reform scenarios (CCTB; CCTB + adjusted CIT rate) and for different stages of behavioral responses. Tax revenue is calculated by aggregation of firm-level annual taxes due (over 3 years) and includes corporate income tax, trade tax, and solidarity surcharge. The percentage change is expressed in relation to constant benchmark tax revenue of 2011 German tax law simulated in the economic environment of 2005-2007. The total tax base elasticity is computed with respect to a change in the statutory tax rate.

Furthermore, we consider the aggregate revenue implications from the long-term adjustments in capital stock and capital structure discussed with Figure 9.6 in the previous Section 9.6.1. Before we elaborate on details, we again stress the qualification that we have no benchmark data available for the periods where capital input and capital structure adjustment to reform shocks would be complete. Therefore, we assume that under the benchmark scenario, i.e. with no CCTB being introduced, economic conditions of the period 2005 to 2007 persist into the future. This allows us to apply the long-term behavioral responses to the average firm-level benchmark data observed from 2005 to 2007.

With this caveat in mind, we can still see that, according to the simulation results shown in Table 9.12, the percentage loss in aggregate revenue of the corporate income tax, solidarity surcharge, and trade tax increases to 1.9% of the benchmark revenue. The corresponding aggregate tax base elasticity amounts to -0.2. If we add the discrete response margins of location choice and choice of legal form, the decline even amounts to 7% of pre-reform revenue under 2011 German tax law. With these two additional margins included, the tax base elasticity is, evidently, most pronounced and shows a value of -0.6. We also include the response of legal form choice in overall long-term results because we want to focus on the response of tax revenue collected from the corporate share of business. Still, the revenue effect from shifts between the incorporated and unincorporated sector are not completely final from the point of view of the government. Only the excess tax payments which make firms actually change their legal form would be finally lost. If we leave out the tax margin of legal form choice, the long-term revenue loss is only simulated to amount to 5.0% with an elasticity of -0.5 (not shown in the Table 9.12).

We now check whether the results obtained from the simulation of behavioral responses are in line with previous empirical evidence on behavioral tax base elasticities. To our knowledge, there are two empirical studies which have estimated the tax base elasticity on the basis of firm-level data. For the United States, Gruber and Rauh (2007) report an elasticity of taxable corporate income with respect to the effective marginal tax rate of -0.2. For Germany, Dwenger and Steiner (2008) document an elasticity of about -0.5. Not surprisingly, the short-term elasticity of -0.1 reported in Table 9.12 is below the values found by the previous studies. The simulated long-term elasticities, however, fall into the range defined by previous evidence. In particular, it is plausible to see that the simulated tax base elasticity of -0.2 reflecting rather long-term responses in debt policy, marginal investment and profit shifting (Table 9.12) corresponds to the results of Gruber and Rauh (2007). Both results ignore the infra-marginal decisions on location and organizational form. If we include these choices, our results closely approach those found by Dwenger and Steiner (2008) who also take infra-marginal decisions into account. We conclude that our simulation results with respect to the implied aggregate tax base elasticity and the underlying behavioral response patterns are very much in line with the previous evidence on the aggregate elasticity of the tax base.

9.6.3 Sensitivity Analyses

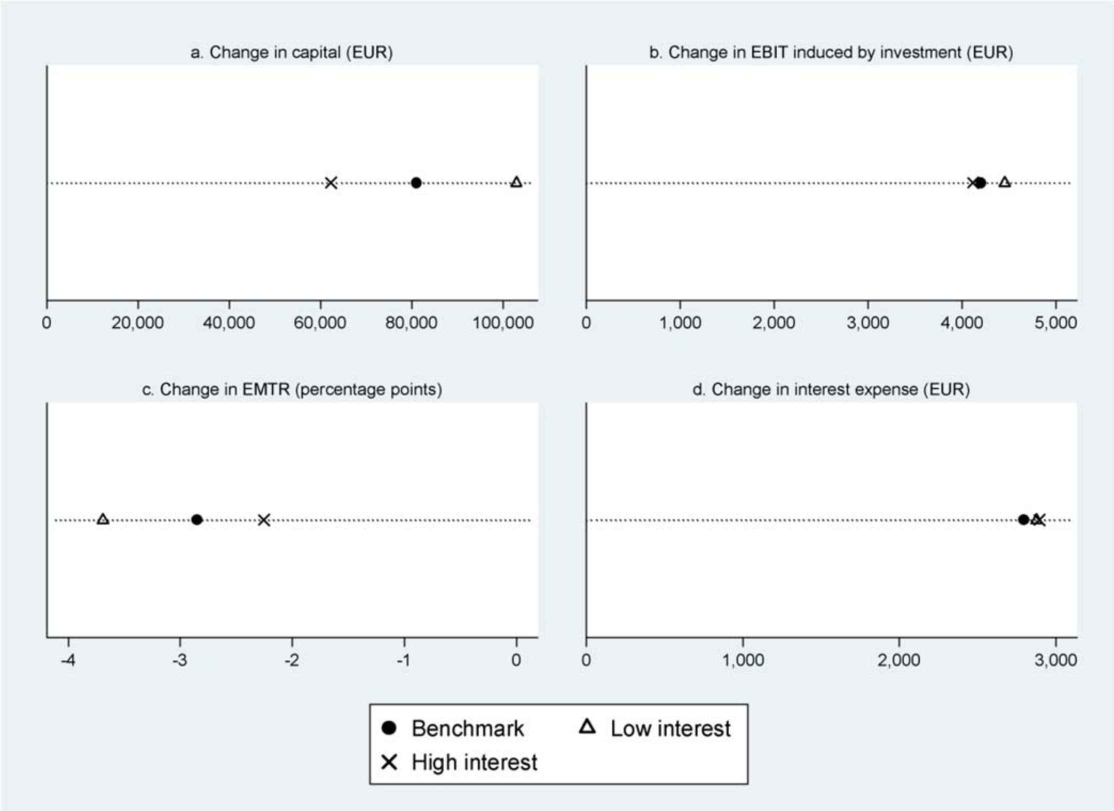
We now check the robustness of our simulation results to variations in some of the behavioral and economic parameters of ZEW TaxCoMM.

Variation of the Nominal Interest Rate

First, we modify the nominal interest rate. In our main simulation analysis the nominal interest rate is set to 4.3% (see Table D.3), corresponding to the average of the monthly reported yield on domestic industry bonds during the period from 2005 to 2007, as published by the German Federal Bank. Instead of the three-year average, we will now refer to the 10^{th} and, in a second variation, to the 90^{th} percentile of the reported monthly rates during 2005 to 2007. These rates are, respectively, 3.6% and 5.5%.

Figure 9.7 illustrates the effects of the variation of interest rates. The capital market interest rate evidently affects the cost of capital under both the 2011 benchmark tax law and the considered CCTB reform scenario. As is clear from Figure 9.7c, the simulated shock in the effective marginal tax rate is, on average, more pronounced if we implement a lower interest rate of 3.6%. By contrast, the high interest rate of 5.5% is associated with a weaker reform impact on the marginal disincentive to invest.[155]

Figure 9.7: Behavioral Response under Alternative Interest Rates



Note: This figure illustrates the impact of a variation in interest rates. The nominal interest rate is 4.3% in our main simulation. In the sensitivity analyses we consider interest rates of 3.6% and 5.5%. The figure splits up into parts a-d: Part a. illustrates the mean change in capital. The mean change in EBIT is displayed in part b. Part c highlights the mean EMTR shock and part d the mean change in interest expense.

This is intuitively plausible because the EMTR measures the share of the marginal pre-tax rate of return effectively taxed away by the government. The lower the interest rate, the higher the relative importance of the tax-induced wedge between pre-tax and after-tax rates of return. Changes in the tax code thus have a strong impact.

Correspondingly, the induced changes in capital stocks are highest for the lower interest rates. On average, the simulated capital response exceeds the response simulated for our standard assumption of a 4.3% interest rare by EUR 22,000. The response in case of the high interest rate of 5.5% instead undercuts it by EUR 19,000. Still, the implications for simulated changes in reported EBIT arising from a variation of interest rates are almost negligible. This is due to the marginal costs of finance which are, of course, strongly affected by the capital market interest rate. ZEW TaxCoMM assumes

[155] With the low interest rate, the average change in EMTR amounts to -3.7 percentage-points. The high interest rate implies an average change of -2.8 percentage-points.

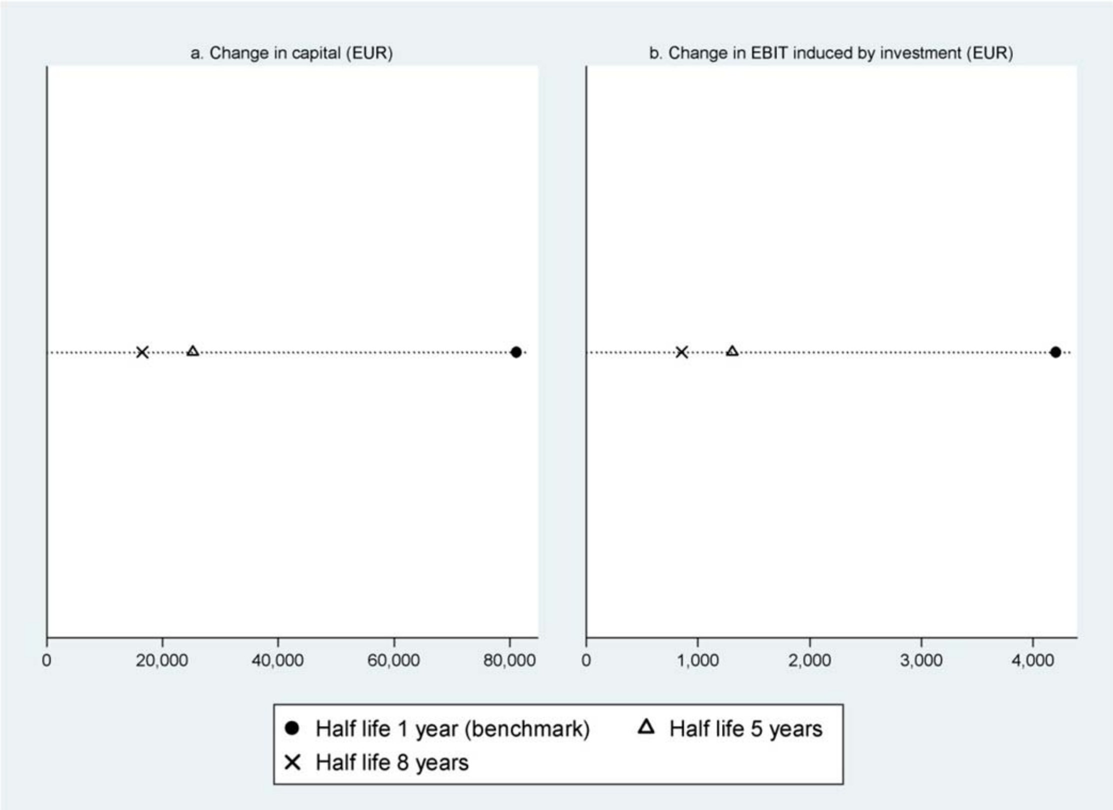
that induced capital investment just earns its marginal costs of finance. As a consequence, the two opposing effects of low/high interest rates leading to strong/weak responses in capital input, but with low/high rates of return cancel out. Moreover, the same reason explains the small effect of a variation in interest rates on simulated interest expenses (Figure 9.7d). ZEW TaxCoMM is run with low/high interest rates, the capital response is strong/weak but the cost of debt financing and, thus, induced interest expense is low/high. Accordingly, the implied tax base elasticity and associated total tax revenue effects remains all but unaffected by the variation of ZEW TaxCoMM's interest rate assumptions.

Variation of the Speed of Adjustment (Half-Life) of the Capital Response

In our main simulation analysis, we model capital adjustment to be sluggish due to the presence of disruption costs. However, according to findings reported in the empirical literature (see, among others, Buettner and Wamser, 2009a), the speed of adjustment is assumed to be relatively high, with a half-life of only one year. Thus, ZEW TaxCoMM simulates 50% of the reform-induced gap between current and target capital stock to be closed already after one year. Implications of a variation of the modeled half-life of capital accumulation are shown in Figure 9.8. Assuming a half-life of five or eight years[156] implies a considerable descrease in the simulated reform-induced change in capital input. As ZEW TaxCoMM simulates reform consequences for the first three years after the CCTB is introduced, capital adjustment is less than 50% completed at the end of the simulation. The mean change in capital input across all firms within the first three years after reform implementation amounts to EUR 16,500 if the half-life is set to eight years, compared to EUR 25,000 for a half-life of five years and, our main result, EUR 81,000 if half-life is one year (Figure 9.8a). Accordingly, the simulated implications for EBIT which arise from the partial investment response are less pronounced if adjustment is slow (Figure 9.8b). In the end, the partial EBIT increase from marginal investment is less able to offset the important tax base contraction resulting from induced profit shifting activity.

[156] A half-life of capital accumulation of eight years is assumed in the IFOmod model (Radulescu and Stimmelmayr, 2005).

Figure 9.8: Behavioral Response for Varying Half-life Assumptions with regard to Capital Accumulation



Note: This figure illustrates the impact of a variation in the half-life of capital accumulation. We consider a half-life of one year in our main simulation analysis. The sensitivity analyses assume a half-life of five years and eight years. The figure splits up into parts a and b. Part a shows the change in capital and part b the triggered EBIT response.

The effects of varying adjustment speeds on implied tax base elasticities are indeed measureable. If we consider the short-term responses of debt policy, marginal investment and profit shifting activity, the implied tax base elasticity declines from -0.10 (see Table 9.12) to, respectively, -0.14 for a half-life of five years or -0.15 for a half-life of eight years. The compensating effect of the marginal investment response is less pronounced. Accordingly, the relative impact on aggregate tax revenue from these margins goes from -1.2% to -1.6%.

We conclude from the sensitivity analyses that our simulation results reflect variations in assumed nominal interested rates or adjustment speed. While the variation of the nominal interest rate, however, has nearly no measureable effect on the simulation results, the assumed speed of capital accumulation is somewhat more influential. We do not see this as a caveat but consider it a strength of our model. The simulation approach is sufficiently sophisticated to capture the effect of these non-trivial economic assumptions. As a consequence, like for every output generated by economic models, the role of assumptions should not be forgotten. Nonetheless, the overall results and implications drawn from the model remain largely unaffected.

9.7 Conclusion

By publishing a draft Council Directive for a Common Consolidated Corporate Tax Base (CCCTB), the European Commission renewed its ambitions to harmonize company taxation in the European Union.

In this paper, we presented a corporate microsimulation model to perform a coherent micro-based analysis of tax reform impacts on aggregate tax revenue and the distribution of the tax burden across heterogeneous firms. The model allows us to separately study the impact of the tax code changes on the tax revenue and, in addition, to consider the induced behavioral responses.

With respect to simulated business behavior, continuous decisions are modeled at the level of the firm. In particular, we include tax distortions of corporate financial decisions, marginal investment, and profit shifting behavior into the analysis. The discrete choices of location and legal form and their response to tax reform are accounted for at the aggregate level.

Based on the economic environment of the period from 2005 through 2007, we find that a switch from 2011 German tax law to the proposed harmonized tax base definition, in the short term, reduces aggregate tax revenue of the corporate income tax incl. solidarity surcharge, and the trade tax by 8.6%. This is the isolated effect of the change in the legal definition of the corporate income tax base. In particular, the EU proposal with its 25% pool depreciation for short and medium lived assets, the decrease of the discount rate for pension provisions, the unrestricted loss carry-forward and the more generous deductibility of interest expenses rather attenuate current German regulations. Clearly, our simulation analysis is focused on the short term and covers the first three years after the hypothesized reform implementation. As a consequence, the results reflect the frontload of tax depreciation allowances under the CCTB regime. This effect would, at least partly, be reversed in later years.

In a variation of the supposed policy scenario, we assume that the German federal government follows a balanced budget rule. For this purpose, we calculate the increase of the corporate income tax rate required to compensate the 8.6% revenue loss. We find that the CIT rate must increase from 15% to 18.1%.

We investigate in detail how the consequences of both considered reform variations, i.e. the non-compensated and the revenue-neutral scenario, are distributed across firms. We find that the reform impacts on firms' tax burden is indeed highly heterogeneous. The increase in the corporate income tax rate under the revenue-neutral scenario is clearly detrimental for profitable firms. Capital-intensive firms benefit greatly from accelerated depreciation under the CCTB and thus, even under the revenue-neutral CCTB scenario, are hardly found among the reform losers. Moreover, we look at size-activity clusters of firms. The analysis shows that capital-intensive industries such as manufacturing, construction and energy experience the strongest decrease in tax burden. Small firms benefit less and, therefore, experience an increase in the tax burden under the revenue-neutral reform scenario.

The second stage of the analysis investigates the behavioral responses of firms. We focus on the scenario of a compensated CCTB introduction. As a result of the simulation, however, we learn that the behavioral responses of firms would prevent the reform from being effectively revenue-neutral. By contrast, the compensating increase in the CIT rate induces substantial adjustments at several behavioral margins. Considering the short term responses of corporate debt policies, marginal investment and profit shifting activity, aggregate tax revenue is simulated to decline by 1.2% relative to the benchmark levels under the current German tax regime. Taking a deeper look into the future, the tax revenue would decrease by 1.9%. If we, in addition, simulate the responses in the location decisions of multinational firms and also account for the reform's impact on the decision to incorporate, the behavior-induced loss of tax revenue collected from the corporate share of business could rise to -7%.

The microsimulation of behavioral responses again reveals considerable variation in relative and absolute reform consequences between firms. In particular, the marginal investment response depends on the asset and financial structure of firms. Furthermore, the role of multinationals is shown to be considerable. In terms of numbers, these firms represent only a minor share of the overall business population. However, they generate a significant share of the corporate tax base. Furthermore, they dispose of additional response margins due to their international affiliation and can employ diverse channels to shift profits abroad.

In each step of the analysis, the benefit of microsimulation becomes apparent. While certain isolated reform effects are not surprising, we explicitly consider their interaction, account for firm heterogeneity in numerous dimensions, and quantify the implied revenue consequences. Broadly considering firm heterogeneity prevents us from arbitrarily looking at fragments of the real distribution of firm types and characteristics. At the same time, the inferred implications from the behavioral response of firms to the new tax regime are in line with previous evidence on the aggregate tax base elasticity. The simulated behavioral adjustments of firms imply a behavioral tax base elasticity of -0.1 in the very short term and, depending on the considered response margins, of -0.2 to -0.6 in the long-term.

Part V

Summary and Outlook

Chapter 10

Summary and Outlook

The aim of this dissertation was to introduce corporate behavioral responses into a corporate tax microsimulation model (ZEW TaxCoMM). The contribution of this dissertation is to have significantly extended the scope of analysis of the microsimulation model. The enhanced simulation approach is now able to evaluate tax reform effects beyond mere first round implications. Its application can provide valuable insight and a better understanding of the aggregate and firm-level consequences of business tax reform.

In the dissertation, the behavioral algorithms of the simulation model are developed, parameterized and finally applied. It is structured accordingly.

After **Part I** introduced the key issues dealt with in this dissertation, **Part II** put the focus on the incorporation of the behavioral algorithms into the model. Chapter 2 explained the overall concept of the approach. The main idea is to compare a benchmark scenario with one or more counter-factual reform scenarios. Each scenario is defined with respect to the tax law in effect. The model can consider modifications made to the major taxes levied on corporations in Germany: the corporate income tax incl. solidarity surcharge and the local trade tax.

Chapter 3 developed the behavioral algorithms. Inspired by previous evidence, five margins of decision are considered. The model simulates behavioral responses of corporate debt policy, marginal investment decisions, and profit shifting activity. The long-term effects of the tax impact on the discrete choices of location and legal form are implemented at the aggregate level. Thus, the number of relevant behavioral margins is considerably higher than, for example, in standard household microsimulation models. At the same time, these tax margins have never been considered simultaneously in one single model framework without taking recourse to some plausible, yet ad-hoc elements. With regard to the integration of behavioral responses into the simulation model, the challenge was thus to consistently reflect the complete set of the most important behavioral tax margins. Moreover, given that the simulation traces reform consequences over three simulation periods after the simulated reform shock, the short-term dynamics of the behavioral adjustments must be accounted for. Despite these complexities, the model was designed in consistency with established microeconomic principles of firm behavior. In particular, the representation of financing and marginal investment decisions is in line with what is known from the standard microeconomic optimization problem of the firm. To model the short-term dynamics of the adjustments in corporate capital structure and capital accumulation, a partial adjustment model is adopted. In empirical investigations of capital demand and capital structures, these have proven to well describe the dynamic patterns of firm behavior.

Part III of this dissertation presented three quantitative meta-analyses. A wealth of literature investigates the effects of taxes on business behavior. As a consequence, there are hundreds of elasticity estimates in the large number of disparate studies. Meta-analysis can synthesize this evidence and, in particular, offer reasons why it can appear strongly varied. The econometric framework of meta-analysis was explained in Chapter 4. Subsequently, Chapters 5 to 7 sampled and quantitatively evaluated 2,167 primary estimates of the tax effects on business behavior.

Chapter 5 presented a meta-analysis on the relationship between foreign direct investment and company taxation. The study provided new insights into the implications of publication selection, data type and aggregation, treatment of unobserved effects, the type of tax data employed as well as the moderating influence of control variables, in particular public spending, on the estimated tax rate effects on FDI. The median tax semi-elasticity of FDI based on 704 primary estimates is -2.49. The precision weighted average of semi-elasticities is -2.55. Meta-regressions show that integrating bilateral tax regulations into the effective tax rates used for primary analysis lead to more effective measurement of adverse tax incentives on foreign investment. Regarding the control variables, it is most interesting that primary estimates are not significantly affected by the inclusion of public spending. According to most estimates in the literature, the spending side does not moderate the tax rate effects.

Chapter 6 put forward a meta-study investigating the tax effect on corporate capital structure. For this purpose, 1,143 point estimates of the marginal tax effect on the debt ratio were sampled out of 46 studies. Synthesizing the evidence by means of meta-regression analyses, the tax impact on debt was indeed found to be substantial. The results of the meta-analysis suggest that very small or even negative tax estimates found in a couple of studies do not reflect the true debt response to taxes. By contrast, accounting for all potential misspecification biases, we predict a marginal tax effect on the debt ratio of 0.30. The meta-regression results show that the point estimates of tax effects are, in particular, affected by the tax rate proxy used for identification. There is robust evidence that, as compared to statutory tax rates, simulated marginal tax rates are associated with significantly higher estimates for the tax coefficient. Average tax rates may instead introduce a significant downward bias in primary estimates which is due to endogeneity. In general, a careful consideration of the firm-specific tax status raises the magnitude of identified tax effects on corporate debt policy.

Chapter 7 quantitatively reviewed the distinct strands of empirical research dealing with multinational profit shifting strategies. The meta-analysis covers 40 studies on corporate profit shifting behavior. Based on the meta-regressions, the semi-elasticity of profit with regard to shifting incentives amounts to -1.71. The predicted semi-elasticity of EBIT is -1.28. If tax-induced real economic location effects are left unmodeled, the tax-responsiveness of pure paper profit shifting is even overestimated by 20%. Furthermore, we find some tentative evidence that the volumes of shifted tax bases are to a large extent, i.e. approximately 80%, driven by firms' inter-company transactions. From the point of view of national governments and tax administrations, this finding can have important implications. Flexible adjustments of intra-group financial structures, according to these findings, seem to be less of a concern than intra-firm trade. Surprisingly, the debate on multinational profit shifting and anti-avoidance measures taken by national governments have very much centered on the financial strategies. Given our findings, there remains doubt as to whether this policy matches with the true proportion, in terms of the shifted tax bases, of the two shifting channels.

Part IV of the dissertation brought together the behavioral algorithms developed in Part I and the information on the values of the behavioral response intensities obtained from the meta-analyses in Part II of the thesis. The functioning of the model was tested and illustrated by applying it to one of the most prevalent topics in corporate tax policy: tax harmonization in the European Union.

Chapter 8 explained how the behavioral algorithms of ZEW TaxCoMM are parameterized. Importantly, the parameterization accounts for differences in response intensities between multinational firms and domestic companies.

According to the meta-analysis in Chapter 6, the debt policy of multinationals is more responsive to tax incentives than the financial decisions of purely domestic firms. This is because subsidiaries of multinational firms can borrow internally from affiliated companies. This opens up possibilities to reallocate debt within the multinational and to exploit international tax rate differentials in a way that the overall company tax burden is reduced. As a result, the effect of taxes on capital structure is increased.

Furthermore, tax planning opportunities also play a role in the parameterization of the investment response. If firms have the discretion to shift profits to lower taxing jurisdictions, local host country tax rates become less important for investment decisions. Many profit shifting strategies are built around the intra-group transfer of firm-specific assets (e.g. patents). These assets provide for higher discretion in setting transfer prices because they are not traded on an external market. A natural proxy for the presence of firm-specific assets is the multinational's extent of R&D activity. For the purpose of the simulation, multinational firms' marginal investment response to taxes is therefore adjusted according to their industry-specific R&D intensity.

Finally, Chapter 9 applies the enhanced and fully parameterized simulation model to one of the most prevalent topics in corporate tax policy: tax harmonization in the European Union. By publishing a draft Council Directive for a Common Consolidated Corporate Tax Base (CCCTB), the European Commission renewed its ambitions to harmonize company taxation in the European Union. Based on the economic environment of the period from 2005 through 2007, we find that a switch from 2011 German tax law to the proposed harmonized tax base definition, in the short term and without considering the behavioral response of firms, reduces aggregate tax revenue of the corporate income tax incl. solidarity surcharge, and the trade tax by 8.6%. This effect is mainly due to a massive frontload of tax depreciation allowances. We calculate the increase of the corporate income tax rate required to compensate this revenue loss. We find that the rate must increase from its current level of 15% to 18.1%. Plausibly assuming that the German government follows a balanced budget rule and adjusts the corporate income tax rate, we investigate the behavioral responses of firms to this supposedly revenue-neutral reform. The simulation results show that the behavioral responses of firms would prevent the reform from being effectively revenue-neutral. In contrast, considering the short term responses of corporate debt policies, marginal investment and profit shifting activity, aggregate tax revenue is simulated to decline by 1.2% relative to the benchmark levels under the current German tax regime. Taking a deeper look into the future, the tax revenue would decrease by 1.9%. If we, in addition, simulate the responses in the location decisions of multinational firms and also account for the reform's impact on the decision to incorporate, the behavior-induced loss of tax revenue collected from the corporate share of business could rise to 7%. The simulated behavioral adjustments of firms imply a behavioral tax base elasticity of -0.1 in the very short term and, depending on the considered response margins, of -0.2 to -0.6 in the long-term. This is fully in line with the previous empirical evidence on the aggregate tax base elasticity.

Underlying the aggregate revenue effects, the microsimulation reveals considerable variation in relative and absolute reform consequences between firms. The increase in the corporate income tax rate under the revenue-neutral scenario is clearly detrimental for profitable firms. For capital-intensive firms in e.g. the manufacturing, construction or energy sector, this negative effect is - in the considered short term - compensated by accelerated depreciation patterns under the harmonized tax base. Furthermore, the role of multinationals is shown to be considerable. In terms of numbers, these firms represent only a minor share of the overall business population. However, they generate a significant share of the corporate tax base. Furthermore, they dispose of additional response margins due to their international affiliation and can employ diverse channels to shift profits abroad.

Looking at the disaggregate results, the benefit of microsimulation becomes apparent. While certain isolated reform effects are not surprising, we explicitly consider their interaction, account for firm heterogeneity in numerous dimensions, and quantify the implied revenue consequences. Broadly considering firm heterogeneity prevents us from arbitrarily looking at fragments of the real distribution of firm types and characteristics.

Future research should continue in these lines. The presented microsimulation approach is currently limited to the German context. In principle, its tax assessment algorithms and, of course, the incorporated behavioral responses of firms can be applied to other countries. The extension of the geographical coverage of the model must thus be a next step.

Appendix

For each of the meta-studies presented in Chapters 5, 6 and 7, the relevant primary studies were thoroughly evaluated. Primary estimates were sampled and transformed into a uniformly defined effect size index. The very large majority of primary studies report tax coefficients which, depending on the exact econometric specification, either represent a marginal effect of the relevant tax incentive on the considered tax-dependent variable, a semi-elasticity (also called tax-rate elasticity) or a tax elasticity.

The most frequent interpretations of primary coefficients are given below. We define *DV* to be the tax-dependent variable and τ as the relevant tax rate measuring the considered tax incentive on *DV*.

$$e_M = \frac{\partial DV}{\partial \tau}$$, marginal effect

$$e_{SEMI} = \frac{\partial \ln DV}{\partial \tau} \approx \frac{\partial DV}{\partial \tau} \cdot \frac{1}{DV}$$, semi-elasticity or tax-rate elasticity

$$e_{ELAST} = \frac{\partial \ln DV}{\partial \ln \tau} \approx \frac{\partial DV}{\partial \tau} \cdot \frac{\tau}{DV}$$, tax elasticity

$$e_A = -\frac{\partial \ln DV}{\partial \tau}(1-\tau) \approx -\frac{\partial DV}{\partial \tau} \cdot \frac{(1-\tau)}{DV}$$, elasticity with respect to the after-tax rate of return

$$e_C = \frac{\partial \ln DV}{\partial \ln c} \approx \frac{\partial DV}{\partial \tau} \cdot \frac{(1-\tau)}{DV}$$, elasticity with respect to the user cost of capital

These types of tax coefficients are related to each other in the following way:

$$e_{SEMI} = e_M \cdot \frac{1}{DV} = e_{ELAST} \cdot \frac{1}{\tau} = e_A \cdot \frac{-1}{(1-\tau)} = e_C \cdot \frac{1}{(1-\tau)}$$

Thus, once we know the required sample means of either DV and/or τ, we can transform primary tax coefficients into one common effect size index. The tables in Appendices A, B, and C list respectively for the meta-samples of the meta-studies in Chapters 5, 6 and 7 important characteristics of the sampled primary studies and, in addition, state whether a transformation in the respective meta-study's common effect size index was required and, if so, possible based on information from the primary studies themselves.

A. Appendix to Chapter 5

Table A.1: Summary Protocoll for the Meta-Study on FDI and Company Taxation

Study	Type of FDI[1]	Data Source	Country Coverage[2]		Type of data		Sample Year		Tax rate[3]	Estimation		Transformation into semi-elasticity	
			Home Country	Host Country	data structure	level of aggregation	first	last		Specification	Method[4]	required	possible
Altshuler et al. 2001	PPE	US Tax Returns (IMF)	US	58 countries	cross-section	aggregate	1984 1992	1984 1992	ATR	log-log	OLS/IV	yes	yes
Bartik 1985	P(loc)	Schmenner (1982)	row	US	panel	micro	1972	1978	STR	non-linear	Cond. Logit	yes	yes
Bellak and Leibrecht 2007	FDI	OECD	7 countries	8 EU	panel	aggregate	1995	2003	FLTR	log-level	GLS	no	-
Bellak et al. 2009	FDI	OECD	7 countries	8 EU	panel	aggregate	1995	2004	FLTR	log-level	GLS	no	-
Bénassy-Quéré et al. 2005	FDI	OECD	11 OECD	11 OECD	panel	aggregate	1984	2000	STR, ATR, FLTR	log-level	OLS/IV	no	-
Bénassy-Quéré et al. 2007	PPE	BEA	US	18 EU	panel	aggregate	1994	2003	STR	log-log	OLS	yes	yes
Bobonis and Shatz 2007	PPE	BEA	8 countries	US	panel	aggregate	1977	1999	STR	log-lin	OLS/IV	no	-
Boskin and Gale 1987	FDI	BEA	row	US	time series	aggregate	1956	1984	ATR	log-log level	OLS	yes	yes

Study	Type of FDI[1]	Data Source	Country Coverage[2]		Type of data		Sample Year		Tax rate[3]	Estimation		Transformation into semi-elasticity	
			Home Country	Host Country	data struc-ture	level of aggregation	first	last		Specification	Method[4]	required	possible
Broekman and Vliet 2001	FDI	-	row	15 EU	panel	aggregate	1989	1998	ATR	level	OLS	yes	yes
Buettner 2002	FDI	EUROSTAT	15 EU	15 EU	panel	aggregate	1991	1998	STR, FLTR	log-log	OLS, IV, GLS	yes	yes
Buettner and Wamser 2009a	PPE	MIDI	GER	22 countries	panel	micro	1996	2004	STR, FLTR	log-level	OLS, IV	no	-
Cassou 1997	FDI	BEA	EU	US	time series panel	aggregate	1970	1989	ATR	log-log	OLS	yes	yes
Demekas et al. 2007	FDI	OECD UNCTAD	24 countries	16 EU	panel	aggregate	2000 1995	2002 2003	STR	log-level	OLS, IV	no	-
Desai et al. 2004a	PPE	BEA	US	row	panel	micro	1982	1994	ATR	log-level	OLS	no	-
Devereux and Freeman 1995	FDI	EUROSTAT	7 OECD	7 OECD	panel	aggregate	1984	1989	FLTR	level	OLS, IV	yes	yes
Devereux and Griffith 1998	P(loc)	Compustat	US	3 EU	panel	micro	1980	1994	FLTR	non-linear	Conditional Logit	yes	yes
Devereux and Lockwood 2006	PPE	BEA	US	19 OECD	panel	aggregate	1983	1998	STR, FLTR	log-level	IV	no	-
Egger et al. 2009b	FDI	UNCTAD	22 OECD	26 OECD	panel	aggregate	1991	2002	FLTR	log-level	OLS, IV	no	-

Study	Type of FDI[1]	Data Source	Country Coverage[2]		Type of data		Sample Year		Tax rate[3]	Estimation		Transformation into semi-elasticity	
			Home Country	Host Country	data structure	level of aggregation	first	last		Specification	Method[4]	required	possible
Egger et al. 2009c	FDI	UNCTAD	52 countries	45 countries	panel	aggregate	1991	2004	STR	log-level	OLS	no	-
Goodspeed et al. 2007	FDI	UNCTAD	53 countries	53 countries	panel	aggregate	1984	2002	ATR	log-level	OLS	no	-
Gorter and Parikh 2003	FDI	EUROSTAT	8 EU	8 EU	panel	aggregate	1995	1996	ATR	level	OLS, SUR	yes	yes
Grubert and Mutti 1991	PPE	BEA	US	33 countries	cross-section	aggregate	1982	1982	ATR	log-level	OLS	no	-
										log-log		yes	yes
Grubert and Mutti 2000	PPE	BEA	US	60 countries	cross-section	aggregate	1992	1992	ATR	log-log	OLS	yes	yes
Hajkova et al. 2006	FDI	OECD	28 OECD	28 OECD	panel	aggregate	1996	1999	FLTR	log-level	OLS	no	-
Hartman 1984	FDI	BEA	row	US	time series	aggregate	1965	1979	ATR	log-log	OLS	yes	yes
Hines 1996	PPE	BEA	7 OECD	US	cross-section	aggregate	1987	1987	ATR	level	Tobit	yes	yes
Hines and Rice 1994	PPE	BEA	US	73 countries	cross-section	aggregate	1982	1982	ATR	log-level	OLS, IV	no	-
Jun 1994	FDI	BEA	10 OECD	US	panel	aggregate	1980	1989	ATR	level	OLS	yes	yes
Murthy 1989	FDI	BEA	row	US	time series	aggregate	1953	1984	ATR	log-log	OLS	yes	yes

Study	Type of FDI[1]	Data Source	Country Coverage[2]		Type of data		Sample Year		Tax rate[3]	Estimation		Transformation into semi-elasticity	
			Home Country	Host Country	data structure	level of aggregation	first	last		Specification	Method[4]	required	possible
Mutti and Grubert 2004	P(loc)	BEA	US	60 countries	cross-section	micro	1996	1996	ATR	non-linear	Probit	yes	yes
Newlon 1987	FDI	BEA	row	US	time series	aggregate	1956	1984	ATR	log-log	OLS	yes	yes
Overesch and Wamser 2009	NOL	MIDI	GER	30 EU	panel	aggregate	1989	2005	STR, FLTR	count data model	ML	no	-
Overesch and Wamser 2010a	NOL	MIDI	GER	10 EU	panel	aggregate	1996	2005	STR, FLTR	count data model	ML	no	-
	PPE					micro				log-level	IV		
Pain and Young 1996	FDI	-	2 EU	OECD	panel	aggregate	1977	1992	STR	log-level	OLS	no	-
Papke 1991	NOL	USEEM	row	US	panel	aggregate	1975	1982	FLTR	count data model	ML	no	-
Razin et al. 2005	FDI	OECD	17 OECD	24 OECD	panel	aggregate	1981	1998	STR	log-log	OLS[5]	no	-
Wei, 1997	FDI	OECD	14 OECD	26 OECD	panel	aggregate	1990	1991	ATR	log-level	OLS, IV	no	-
Slemrod 1990	FDI	BEA	row	US	time series	aggregate	1956	1987	FLTR	level	OLS	yes	yes
										log-log			
Stoewhase 2005a	FDI	EUROSTAT	3 EU	10 EU	panel	aggregate	1995	1999	ATR, FLTR	level	WLS	yes	yes

Study	Type of FDI[1]	Data Source	Country Coverage[2]		Type of data		Sample Year		Tax rate[3]	Estimation		Transformation into semi-elasticity	
			Home Country	Host Country	data structure	level of aggregation	first	last		Specification	Method[4]	required	possible
Stoewhase 2005b	NOL	RWI	64 countries	GER	panel	aggregate	1991	1998	STR, ATR	count data model (in logs)	ML	yes	yes
Swenson 1994	PPE	BEA	row	US	panel	aggregate	1979	1991	STR, FLTR	log-log	GLS	yes	yes
Swenson 2001a	P(loc)	BEA	46 countries	US	panel	micro	1984	1994	STR	non-linear	Conditional Logit	yes	yes
Wijeweera et al. 2007	FDI	OECD	9 OECD	US	panel	aggregate	1982	2000	STR, FLTR	log-log	OLS, GLS	yes	yes
Wolff 2007	FDI	EUROSTAT	24 EU	24 EU	panel	aggregate	1994	2003	STR	log-level	OLS[5]	no	-
Young 1988	FDI	BEA	row	US	time series	aggregate	1956	1984	ATR	log-log	OLS	yes	yes

Notes:

1 Types of FDI: FDI: Foreign direct investment, NOL: Number of locations, P(loc): Probability to locate, PPE: Property, plant and equipment.

2 EU: European countries, OECD: Member countries of the OECD, row: rest of the world, US: United States.

3 Estimation Method: GLS: Generalized least squares (i.e. random effects panel estimation), IV: Instrumental variable estimation (i.e. difference or system GMM), ML: Maximum likelihood, OLS: Ordinary least squares, WLS: Weighted least squares.

4 Tax rate: ATR: Average tax rate (backward-looking), FLTR: Forward-looking tax rate (e.g. Devereux/Griffith methodology), STR: Statutory tax rate

5 A two-stage selection model is used. We only consider the results from the second stage analysis.

B. Appendix to Chapter 6

Table B.1: Summary Protocol for the Meta-Study on Capital Structure Choice and Company Taxation

Study	Type of debt[1]	Data Source	Exploited Variation	Country Coverage[2]		Type of data[4]	Sample Year		Tax rate[5]	Estimation		Transformation into marginal effect	
				Parent Country[3]	Country		first	last		Specification	Method[6]	required	possible
Desai et al. 2004b	Debt – All types	BEA	international	US	row	panel	1982	1994	ATR	level	OLS	no	-
Aggarwal and Kyaw 2008	Debt – All types	BEA	international	US	62 coun-tries	panel	1989	1999	ATR	level	OLS	no	-
Altshuler and Grubert 2003	Debt – All types	SOI	international	US	row	cross-section	1996	1996	STR	level	OLS	no	-
Antoniou et al. 2008	Total debt	Datastream	international	-	5 OECD	panel	1989	2000	ATR	level	IV	no	-
Barion et al. 2010	Total debt	Amadeus	international	-	10 EU	panel	2002	2007	STR	level	OLS	no	-
Bartholdy and Mateus 2008	Total debt	Amadeus	international	-	16 EU	panel	1994	2004	STR / ATR	level	IV	no	-
Bauer 2004	Total debt	Prague STXX	national	-	Czech Republic	cross-section	2000 / 2001	2000 / 2001	ATR	level	OLS	no	-

Study	Type of debt[1]	Data Source	Exploited Variation	Country Coverage[2]		Type of data[4]	Sample Year		Tax rate[5]	Estimation		Transformation into marginal effect	
				Parent Country[3]	Country		first	last		Specification	Method[6]	required	possible
Booth et al. 2001	Total debt	IFC	international	-	Emerging Markets	panel	1980	1990	ATR	level	OLS	no	-
Buettner et al. 2009	Debt – All types	MIDI	international	GER	26 OECD	panel	1996	2003	STR	level	OLS	no	-
Buettner et al. 2008	Internal debt	MIDI	international	GER	36 OECD	panel	1996	2004	STR	level	OLS	no	-
Buettner and Wamser 2009b	Internal debt	MIDI	international	GER	79 coun-tries	panel	1996	2005	STR	level	OLS	no	-
Byoun 2008	Total debt	Compustat	national	-	US	panel	1971	2003	STR	level	OLS	no	-
Charalambakis et al. 2008	Total debt	Compustat	national	-	US	panel	1950	2002	ATR	level	OLS	no	-
Chen and Strange 2005	Total debt	-	national	-	China	cross-section	2003	2003	STR	level	OLS	no	-
Cheng and Green 2008	Total debt	Worldscope	international	-	11 EU	panel	1993	2005	ATR	level	IV	no	-

Study	Type of debt[1]	Data Source	Exploited Variation	Country Coverage[2]		Type of data[4]	Sample Year		Tax rate[5]	Estimation		Transformation into marginal effect	
				Parent Country[3]	Country		first	last		Specification	Method[6]	required	possible
De Jong et al., 2008	Total debt	Global Vantage	international	-	42 countries	panel	1997	2001	ATR	level	OLS	no	-
Dischinger et al. 2010	Total debt	Amadeus	international	-	30 EU	panel	1998	2006	STR	level	OLS	no	-
Dwenger and Steiner 2009	Total debt	DESTATIS	national	-	GER	panel	1998	2001	ATR	log-log	OLS/IV	yes	yes
Faulkender and Petersen 2006	Total debt	Compustat	national	-	US	panel	1986	2000	SIM	level	OLS	no	-
Gordon and Lee 2001	Total debt	SOI	national	-	US	panel	1954	1995	STR	level	OLS/IV	no	-
Gordon and Lee 2007	Total debt	SOI	national	-	US	panel	1954	2000	STR	level	OLS	no	-
Graham 1999	Total debt	Compustat	national	-	US	cross-section	1999	1999	SIM	level	OLS	no	-
Graham et al. 1998	Total debt	Compustat	national	-	US	panel	1981	1992	SIM	level	Tobit	yes	yes
Graham et al. 2004	Total debt	Compustat	national	-	US	cross-section	2000	2000	SIM	level	Tobit	yes	yes

Study	Type of debt[1]	Data Source	Exploited Variation	Country Coverage[2]		Type of data[4]	Sample Year		Tax rate[5]	Estimation		Transformation into marginal effect	
				Parent Country[3]	Country		first	last		Specification	Method[6]	required	possible
Green and Murinde 2008	Total debt	Prowess	national	-	India	panel	1989	1999	ATR	level	IV	no	-
Hebous and Weichenrieder 2010	Debt – All types	MIDI	international	GER	row	panel	1996	2006	STR	level	OLS	no	-
Homaifar et al. 1994	Total debt	Compustat	national	-	US	panel	1978	1988	ATR	level	OLS	no	-
Huang and Ritter 2009	Total debt	Compustat	national	-	US	panel	1970	2001	STR	level	OLS/IV	no	-
Huizinga et al. 2008	Total debt	Amadeus	international	-	32 EU	panel	1994	2003	STR	level	OLS	no	-
Jog and Tang 2001	Total debt	Revenue Canada	international	Canada/ US	Canada	panel	1984	1994	STR	level	OLS	no	-
Kesternich and Schnitzer 2010	Total debt	MIDI	international	GER	row	panel	1996	2006	STR	level	OLS	no	-
Klapper and Tzioumis 2008	Total debt	Amadeus	national	-	Croatia	panel	1998	2003	STR	level	OLS	no	-
Lasfer 1995	Total debt	Exstat	national	-	UK	panel	1972	1983	ATR	level	OLS	no	-

Study	Type of debt[1]	Data Source	Exploited Variation	Country Coverage[2]		Type of data[4]	Sample Year		Tax rate[5]	Estimation		Transformation into marginal effect	
				Parent Country[3]	Country		first	last		Specification	Method[6]	required	possible
Liu and Tian 2009	Total debt	CSMAR	national	-	China	panel	2006	2008	ATR	level	OLS	no	-
López-Gracia and Sorgorb-Mira, 2008	Total debt	SABI	national	-	Spain	panel	1995	2004	ATR	log-level	IV	yes	yes
Michaelas et al. 1999	Total debt	Lotus	national	-	UK	panel	1988	1995	ATR	level	OLS	no	-
Moore and Ruane 2005	Total debt	Amadeus	international	-	16 EU	panel	2000	2003	ATR	level	OLS	no	-
Mills and Newberry 2004	Total debt	SOI	international	16 coun-tries	US	panel	1987	1996	STR / ATR	level	OLS	no	-
Mintz and Weichenrieder 2010	Debt – all types	MIDI	international	GER	68 coun-tries	panel	1996	2002	STR	level	OLS	no	-
Oeztekin 2009	Total debt	Global Van-tage	national	-	37 coun-tries	panel	1991	2006	ATR	level	IV	no	-
Overesch and Voeller 2010	Total dent	Amadeus	international	n/a	23 EU	panel	2000	2005	STR	level	IV	no	-
Overesch and Wamser 2010b	Internal debt	MIDI	international	row	GER	panel	1996	2004	STR	level	OLS	no	-
Pfaffermayr et al. 2008	Total debt	Amadeus	international	-	35 EU	cross-section	1999	2004	STR	level	OLS	no	-

Study	Type of debt[1]	Data Source	Exploited Variation	Country Coverage[2]		Type of data[4]	Sample Year		Tax rate[5]	Estimation		Transformation into marginal effect	
				Parent Country[3]	Country		first	last		Specification	Method[6]	required	possible
Ruf 2010	Total debt	MIDI	international	GER	row	panel	1996	2007	STR	level	OLS	no	-
Ramb and Weichenrieder 2005	Debt – all types	MIDI	international	69 coun-tries	GER	panel	1996	2002	STR	level	OLS	no	-
Shivdasani et al. 2010	Total debt	Compustat	national	-	US	panel	1991	2003	SIM	level	OLS/IV	no	-

1 "Debt – all types" applies to studies directly or indirectly investigating both internal and total debt (incl. external debt). There are other dimensions of debt type, e.g. maturity and valuation in market and book values. For brevity, these are not considered in this summary table.
2 EU: European countries, OECD: Member countries of the OECD, row: rest of the world, US: United States.
3 Only applies if multinational firms are considered. Even then parent countries are not always considered/know.
4 Data is always micro data.
5 ATR: Average tax rate, SIM: Simulated marginal tax rate, STR: Statutory tax rate.
6 Estimation Method: IV: Instrumental variable estimation (i.e. difference or system GMM), OLS: Ordinary least squares.

C. Appendix to Chapter 7

Table C.1: Summary Protocol for the Meta-Study on the Tax-esponsiveness of Profit Shifting Activity

Study	Type of dependent variable (shifting indicator)	Data Source	Country Coverage[1]		Type of data		Sample Year		Estimation		Transformation into semi-elasticity	
			Parent Country	Affiliate Country	data structure	level of aggregation	first	last	Specification	Method[2]	required	possible
Aggarwal and Kyaw 2008	Debt	BEA	US	62 countries	panel	aggregate	1989	1999	level	OLS	yes	yes
Altshuler and Grubert 2003	Debt	SOI	US	row	cross-section	micro	1996	1996	level	OLS	yes	yes
Azemar 2010	Profit	US IRS	US	row	panel	aggregate	1992	2000	log-level	OLS	no	-
Barion et al. 2010	Debt	Amadeus	-	10 EU	panel	micro	2002	2007	level	OLS	yes	yes
Bartelsmannv and Beemtsma 2003	EBIT[3]	STAN	row	16 OECD	panel	aggregate	1979	1997	log-level	ML	no	-
Bernard and Weiner 1990	Price	EIA	US	row	panel	micro	1973	1984	level	WLS	yes	no
Bernard et al. 2006	Price	LFTTD	US	139 countries	panel	micro	1993	2000	log-level	OLS	no	-
Beuselinck et al. 2009	Profit	Amadeus	-	20 EU	panel	micro	1998	2004	level	OLS	yes	no
	EBIT								log-level		no	-

Study	Type of dependent variable (shifting indicator)	Data Source	Country Coverage[1]		Type of data		Sample Year		Estimation		Transformation into semi-elasticity	
			Parent Country	Affiliate Country	data structure	level of aggregation	first	last	Specification	Method[2]	required	possible
Blouin et al. 2011	Profit	BEA	US	row	panel	micro	1982	2005	log-level	OLS	no	-
Buettner and Wamser 2009b	Debt	MIDI	GER	79 countries	panel	micro	1996	2005	level	OLS	yes	yes
Buettner et al. 2008	Debt	MIDI	GER	26 OECD	panel	micro	1996	2004	level	OLS	yes	yes
Buettner et al. 2009	Debt	MIDI	GER	36 OECD	panel	micro	1996	2003	level	OLS	yes	yes
Clausing 2001	Intra-group Trade	BEA	US	58 countries	panel	aggregate	1982	1994	level	OLS	yes	yes
Clausing 2003	Price	IPP	US	54 countries	panel	micro	1997	1999	log-log	OLS	yes	yes
			54 countries	US								
Clausing 2006	Intra-group Trade	BEA	US	51 countries	panel	aggregate	1992	2000	level	OLS	yes	yes
									log-level		no	-
Clausing 2009	Profit	BEA	US	row	panel	aggregate	1982	2004	level	OLS	yes	yes
Collins et al. 1998	Profit	Compustat	US	-	panel	micro	1984	1992	level	OLS	yes	yes

Study	Type of dependent variable (shifting indicator)	Data Source	Country Coverage[1]		Type of data		Sample Year		Estimation		Transformation into semi-elasticity	
			Parent Country	Affiliate Country	data structure	level of aggregation	first	last	Specification	Method[2]	required	possible
Conover and Nichols 2000	Profit	Compustat	US	row	panel	micro	1982	1990	level	OLS	yes	no
Desai et al. 2004b	Debt	BEA	US	row	panel	micro	1982	1994	level	OLS	yes	yes
Dharmapala and Riedel 2011	Profit	Amadeus	25 EU	25 EU	panel	micro	1995	2005	log-level	OLS	no	-
Dischinger and Riedel 2011	Profit	Amadeus	25 EU	25 EU	panel	micro	1995	2005	log-level	OLS	no	-
Dischinger et al. 2010	Debt	Amadeus	-	30 EU	panel	micro	1998	2006	level	OLS	yes	yes
Dischinger 2007	Profit	Amadeus	-	24 EU	panel	micro	1995	2005	log-level	OLS	no	-
Grubert and Mutti 1991	Profit		US	29 countries	cross-section	aggregate	1982	1982	level	OLS	yes	no
Grubert 1998	Profit	US IRS	US	row	cross-section	micro	1990	1990	level	OLS	yes	no
	Interest/Royalties									Tobit	yes	no
Grubert 2003	Profit	US IRS	US	60 countries	cross-section	aggregate	1996	1996	level	OLS	yes	yes
Hebous and Weichenrieder 2009	Debt	MIDI	GER	OECD	panel	micro	1996	2006	level	OLS	yes	yes

Study	Type of dependent variable (shifting indicator)	Data Source	Country Coverage[1]		Type of data		Sample Year		Estimation		Transformation into semi-elasticity	
			Parent Country	Affiliate Country	data structure	level of aggregation	first	last	Specification	Method[2]	required	possible
Hines and Rice 1994	EBIT	BEA	US	108 countries	cross-section	aggregate	1982	1982	log-level	OLS/IV	no	-
Hoonsawat 2007	EBIT[4]	-	52 countries	52 countries	panel	aggregate	1978	2002	log-level	OLS	no	-
Huizinga and Laeven 2008	EBIT	Amadeus	25 EU	25 EU	cross-section	micro	1999	1999	log-level	OLS	no	-
Huizinga et al. 2008	Debt	Amadeus	-	32 EU	panel	micro	1994	2003	level	OLS	yes	yes
Maffini and Mokas 2011	EBIT[5]	ORBIS	10 EU	10 EU	panel	micro	1998	2004	log-level	OLS	no	-
Markle 2010	Profit	Orbis	World	World	cross-section	micro	2006	2006	log-level	OLS	no	-
McDonald 2008	EBIT	US IRS	US	60 countries	cross-section	micro	1996	1996	level	OLS	yes	yes
							2000	2000				
							2002	2002				
Mills and Newberry 2004	Profit	SOI	16 countries	US	panel	micro	1987	1996	level	OLS	yes	yes
Mintz and Weichenrieder 2010	Debt	MIDI	GER	68 countries	panel	micro	1996	2002	level	OLS	yes	yes

Study	Type of dependent variable (shifting indicator)	Data Source	Country Coverage[1]		Type of data		Sample Year		Estimation		Transformation into semi-elasticity	
			Parent Country	Affiliate Country	data structure	level of aggregation	first	last	Specification	Method[2]	required	possible
Overesch and Schreiber 2010	Trade	MIDI	GER	row	panel	micro	1996	2005	log-level	OLS	no	-
Overesch and Wamser 2010b	Debt	MIDI	row	GER	panel	micro	1996	2004	level	OLS	yes	yes
Overesch 2006	Trade	MIDI	GER	31 countries	panel	micro	1996	2003	log-level	IV	no	-
Ramb and Weichenrieder 2005	Debt	MIDI	69 countries	GER	panel	micro	1996	2002	level	OLS	yes	yes
Rousslang 1997	Profit	US IRS	US	91 countries	cross-section	aggregate	1988	1988	level	OLS	yes	yes
Schwarz 2009	Profit	BEA	US	row	cross-section	aggregate	1999	2001	level-log	OLS	yes	yes
Swenson 2001b	Price	TSUSA	5 OECD	US	panel	micro	1981	1988	level	GLS	yes	yes
Weichenrieder 2009	Profit	MIDI	row / GER	GER / row	panel	micro	1996	2003	level	OLS	yes	yes

1 EU: European countries, OECD: Member countries of the OECD, row: rest of the world, US: United States.
2 Estimation Method: GLS: Generalized least squares, IV: Instrumental variable estimation (i.e. difference or system GMM), ML: Maximum likelihood, OLS: Ordinary least squares, WLS: Weighted least squares.
3 Value-labor-ratio.
4 Value added.
5 Total factor productivity.

D. Appendix to Chapter 9

Table D.1: Key Financial Ratios and Reform-Induced Change in Taxes Due According to Firm Size and Economic Activity

Firm Size	Economic Activity	Profitability		Debt Ratio		Capital Intensity		Change in Taxes Due under CCTB		Change in Taxes Due under CCTB + CIT adj	
		Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Small	Mining, Manufacturing	2.8	2.6	60.8	68.1	22.7	15.9	-6.0	-2.2	0.9	2.0
	Energy, Water Supply	4.6	3.6	48.0	48.2	39.8	36.4	-2.2	-1.2	6.6	7.2
	Construction	3.2	2.6	67.1	73.7	16.9	11.9	-5.0	-1.9	2.4	4.3
	Trade, Hotels, Restaurants	5.9	2.1	63.8	73.0	16.7	10.1	-3.0	-0.5	3.5	3.9
	Transportation, Telecommunication	5.2	3.1	55.0	59.5	22.1	10.4	-3.6	-0.7	3.2	3.5
	Business Services, R&D, Technical Services	4.4	3.9	30.5	10.8	24.1	13.0	-2.3	0.0	5.0	7.9
	Health	-0.4	0.5	41.5	36.4	28.5	18.2	-4.0	0.0	0.9	0.0
	Other	-0.5	2.0	41.5	38.2	27.4	19.8	-3.2	-0.3	3.6	4.5
	Overall	4.3	3.0	46.3	48.7	20.6	12.5	-3.3	-0.2	3.8	5.8
Medium-sized	Mining, Manufacturing	6.2	3.3	57.3	61.4	26.1	21.9	-8.9	-4.4	-2.8	0.0
	Energy, Water Supply	4.5	3.0	55.7	61.9	44.8	54.1	-4.6	-1.6	1.6	1.7
	Construction	2.3	1.8	65.7	68.7	18.8	11.1	-10.4	-4.3	-4.4	0.0
	Trade, Hotels, Restaurants	2.9	1.9	70.9	77.0	17.1	10.8	-6.8	-3.2	-1.3	0.0
	Transportation, Telecommunication	2.6	1.7	56.5	63.5	32.8	25.2	-7.7	-1.8	-2.0	0.1
	Business Services, R&D, Technical Services	4.5	2.3	51.3	54.4	27.7	11.7	-5.5	-0.7	0.5	2.7
	Health	1.5	0.6	43.3	35.6	64.3	71.0	-8.2	-3.5	-0.2	0.0
	Other	2.2	1.5	38.0	34.5	37.3	28.5	-6.7	-1.3	-0.7	0.0
	Overall	3.8	1.9	59.3	65.2	26.6	16.7	-7.3	-2.6	-1.3	0.0
Large	Mining, Manufacturing	5.7	3.9	47.9	48.0	22.6	17.7	-7.6	-2.8	-2.1	0.0
	Energy, Water Supply	4.5	3.6	43.1	42.0	59.1	70.2	-12.6	-4.8	-6.3	0.0
	Construction	2.0	0.9	67.4	73.6	26.9	13.7	-5.4	-3.1	-1.8	0.0
	Trade, Hotels, Restaurants	4.4	2.6	60.0	69.4	12.9	6.5	-6.9	-1.9	-1.7	0.0

Firm Size	Economic Activity	Profitability		Debt Ratio		Capital Intensity		Change in Taxes Due under CCTB		Change in Taxes Due under CCTB + CIT adj	
		Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Large	Transportation, Telecommunication	2.3	1.3	42.0	38.5	24.5	9.4	-5.0	0.0	-0.3	0.0
	Business Services, R&D, Technical Services	3.0	1.2	47.2	52.2	42.6	29.9	-7.6	-0.3	-3.3	0.5
	Health	0.6	0.5	32.5	28.6	66.6	71.2	-11.8	-6.6	-4.2	0.0
	Other	1.5	0.2	29.9	24.0	55.2	70.7	-5.4	0.0	-0.1	0.0
	Overall	3.4	1.3	47.4	48.1	37.3	26.0	-8.0	-1.4	-2.9	0.0
Overall		4.2	2.6	48.5	52.7	23.2	13.7	-4.2	-0.35	2.6	4.0

Source: Data is from the extrapolated DAFNE sample underlying the ZEW TaxCoMM simulation analysis. Data is for 2005 – 2007.

Table D.2: Sample Coverage and Firm Characteristics for Domestic Firms and Multinationals

	Sample Coverage		Firm Characteristics							
			Share of		Capital (T EUR)		EBIT (T EUR)		Debt Ratio (%)	
Firm Type	Total	%	Loss-making	Holding	Mean	Median	Mean	Median	Mean	Median
Domestic	841,072	97.84	34%	3.2%	1,527	16	255	9	48.4	52.7
MNE 1	10,544	1.23	34%	1.4%	10,376	332	4,750	203	53.4	55.7
MNE 2	7,501	0.87	41%	20%	7,876	12	6,896	3	31.3	19.2
MNE 3	512	0.06	25%	0.2%	21,724	718	24,869	854	40.0	43.9
All MNE	18,557	2.16	36%	9.5%	9,648	140	6,236	137	43.7	43.7

Source: Data is from the extrapolated DAFNE sample underlying the ZEW TaxCoMM simulation analysis. Data is for 2005 – 2007.

Table D.3: Further Economic Parameters Set in ZEW TaxCoMM

Nominal interest rate	4.3%
Real interest rate	2.5%
Inflation Rate	1.8%
Economic Depreciation Rates	
Buildings	3.1%
Tangible fixed assets (short-lived)	17.5%
Tangible fixed assets (long-lived)	6.3%

Bibliography

Abreu, M., H. de Groot and R. Florax. (2005). A Meta-Analysis of b-Convergence: The Legendary 2%. *Journal of Economic Surveys* 19: 389-420.

Aggarwal, R. and N. A. Kyaw. (2008). Internal Capital Networks as a Source of MNC Competitive Advantage: Evidence from Foreign Subsidiary Capital Structure Decisions. *Research in International Business and Finance* 22: 409-439.

Altshuler, R. and H. Grubert. (2003). Repatriation Taxes, Repatriation Strategies and Multinational Financial Policy. *Journal of Public Economics* 87: 73-107.

Altshuler, R., H. Grubert and T. S. Newlon. (2001). Has U.S. Investment Abroad Become More Sensitive to Tax Rates? In *International Taxation and Multinational Activity,* ed. J. R. Hines, 182-232. Chicago, IL: University of Chicago Press.

Alworth, J. and G. Arachi. (2001). The Effect of Taxes on Corporate Financing Decisions: Evidence from a Panel of Italian Firms. *International Tax and Public Finance* 8: 353-376.

Amromin, G. and N. Liang. (2003). Hedging Employee Stock Options, Corporate Taxes and Debt. *National Tax Journal* 56: 513-533.

Antoniou, A., Y. Guney and K. Paudyal. (2008). The Determinants of Capital Structure: Capital Market-Oriented versus Bank-Oriented Institutions. *Journal of Financial and Quantitative Analysis* 43: 59-92.

Ayers, B. C., C. B. Cloyd and J. R. Robinson. (2001). The Influence of Income Taxes on the Use of Inside and Outside Debt by Small Businesses. *National Tax Journal* 54: 27-55.

Azémar, C. (2010). International Corporate Taxation and U.S. Multinationals' Behaviour: An Integrated Approach. *Canadian Journal of Economics* 43(1): 232-253.

Bach, S., H. Buslei, N. Dwenger and F. Fossen. (2007). Aufkommens- und Verteilungseffekte der Unternehmensteuerreform 2008. *Vierteljahrshefte zur Wirtschaftsforschung* 76: 74-85.

Bach, S., H. Buslei, N. Dwenger and F. Fossen. (2008). Dokumentation des Mikrosimulationsmodells BizTax zur Unternehmensbesteuerung in Deutschland. DIW Data Documentation 29, Berlin.

Baker, M. and J. Wurgler. (2002). Market Timing and Capital Structure. *Journal of Finance* 57: 1-32.

Baldwin, R. E. and P. Krugman. (2004). Agglomeration, Integration and Tax Harmonization. *European Economic Review* 48: 1-23.

Barclay, M. J. and C. W. Smith Jr. (1995). The Priority Structure of Corporate Liabilities. *Journal of Finance* 50: 899-917.

Barion, F., R. Miniaci, P. M. Panteghini and M. L. Parisi. (2010). Profit Shifting via Debt Financing in Europe. Working Paper, Università di Brescia.

Barrios, S., H. Huizinga, L. Laeven and G. Nicodème. (2009). International Taxation and Multinational Firm Location Decisions. *European Commission Taxation Paper*. Bruxelles.

Bartelsman, E. J. and R. M. W. J. Beetsma. (2003). Why Pay More? Corporate Tax Avoidance through Transfer Pricing in OECD Countries. *Journal of Public Economics* 87: 2225-2252.

Bartholdy, J. and C. Mateus. (2008). Taxes and Corporate Debt Policy: Evidence for Unlisted Firms of Sixteen European Countries. Working Paper, University of Arhus.

Bartik, T.J. (1985). Business Location Decisions in the United States: Estimation of the Effects of Unionization, Taxes, and Other Characteristics of States. *Journal of Business & Economic Statistics* 3: 14-22.

Bauer, P. (2004). Determinants of Capital Structure - Empirical Evidence from the Czech Republic. *Czech Journal of Economics and Finance* 54: 2-21.

Baum, C.F. (2006). *An Introduction to Modern Econometrics Using Stata*. College Station, TX: Stata Press.

Becker, J., C. Fuest and T. Hemmelgarn. (2006). How Does FDI React to Corporate Taxation? A Comment on Studies Using Aggregate Data. Working Paper, University of Cologne.

Bellak, C. and M. Leibrecht. (2007). Some Further Evidence on the Role of Effective Corporate Income Taxes as Determinants of Foreign Direct Investment in Central and East European Countries. In *Proceedings of the National Tax Association Conference 2006*, ed. National Tax Association , 311-343. Boston, MA.

Bellak, C., M. Leibrecht and J. P. Damijan. (2009). Infrastructure Endowment and Corporate Income Taxes as Determinants of Foreign Direct Investment in Central and Eastern European Countries. *The World Economy* 32: 267-290.

Bénassy-Quéré, A., L. Fontagne and A. Lahrèche-Révil. (2001). Tax Competition and Foreign Direct Investment. Mimeo, CEPII, Paris.

Bénassy-Quéré, A., L. Fontagné and A. Lahrèche-Révil. (2005). How Does FDI React to Corporate Taxation?. *International Tax and Public Finance* 12: 583-603.

Bénassy-Quéré, A., N. Gobalraja and A. Trannoy. (2007). Tax and Public Input Competition. *Economic Policy* 19: 385-430.

Bernard, J. T. and R. J. Weiner. (1990). Multinational Corporations, Transfer Prices, and Taxes: Evidence from the US Petroleum Industry. In *Taxation in the Global*

Economy, eds. A. Razin and J. Slemrod, 123-154. Chicago, IL: University of Chicago Press.

Bernard, A. B., J. B. Jensen and P.K. Schott. (2006). Transfer Pricing by US-Based Multinational Firms. NBER Working Paper 12493, Cambridge (MA).

Bettendorf, L. and A. van der Horst. (2006). Documentation of CORTAX. CPB Memorandum 161, The Hague.

Bettendorf, L., M. P. Devereux, A. van der Horst, S. Loretz and R. A. de Mooij. (2010). Corporate Tax Harmonization in the EU. *Economic Policy* 25: 537-590.

Beuselinck, C., M. Deloof and A. Vanstraelen. (2009). Multinational Income Shifting, Tax Enforcement and Firm Value. Working Paper, University of Tilburg.

Bijmolt, T. H. A. and R. G. M. Pieters. (2001). Meta-Analysis in Marketing When Studies Contain Multiple Measurements. *Marketing Letters* 12: 157-169.

Billington, N. (1999). The Location of Foreign Direct Investment: An Empirical Analysis. *Applied Economics* 31: 65-76.

Bloningen, B. A. (2005). A Review on the Empirical Literature on FDI Determinants. *NBER Working Paper* No. 11299.

Blouin, J., J.E. Core and W. Guay. (2010). Have the Tax Benefits of Debt Been Overestimated?. *Journal of Financial Economics* 98: 195-213.

Blouin, J., L. Robinson and J. Seidman. (2011). Coordination of Transfer Prices on Intra-Firm Trade. Tuck School of Business Working Paper No. 2010-74, Dartmouth.

Bobonis, G. J. and H. J. Shatz. (2007). Agglomeration, Adjustment, and State Policies in the Location of Foreign Direct Investment in the United States. *Review of Economics and Statistics* 89: 30-43.

Bom, P. R. D. and J. E. Ligthart. (2008). How Productive is Public Capital? A Meta-Analysis. CESifo Working Paper No. 2206, Munich.

Bond, S. and J. Van Reenen. (2007). Microeconometric Models of Investment and Employment. *Handbook of Econometrics*, vol. 6 (2), eds. J. J. Heckman and E. E. Leamer, 4417-4498. Amsterdam: North Holland.

Booth, L., V. Aivazian, A. Demirguc-Kunt and V. Maksimovic. (2001). Capital Structures in Developing Countries. *Journal of Finance* 56: 87-130.

Boskin, M. J. and G. Gale. (1987). New Results on the Effects of Tax Policy on the International Location of Investment. In *The Effects of Taxation on Capital Accumulation*, ed. M. Feldstein, 201-219. Chicago, IL: University of Chicago Press.

Bosworth, B. and S. Collins. (1999). Capital Flows to Developing Economies: Implications for Saving and Investment. *Brookings Papers on Economic Activity* 1999: 143-169.

Brealey, R.A., S.C. Myers and A.J. Marcus. (2008). Fundamentals of Corporate Finance. New York, NY: McGraw-Hill/Irwin.

Brill, A. and K. A. Hassett. (2007). Revenue-Maximizing Corporate Income Taxes: The Laffer Curve in OECD Countries. Working Paper No. 137, American Enterprise Institute for Public Policy, Washington D.C.

Broekman, P. and W. N. Vliet. (2001). Winstbelasting en Kapitaalstromen in de EU. *Openbare Uitgaven* 33: 46-53.

Brons, M. R. E. (2006). *Meta-Analytical Studies in Transport Economics: Methodology and Applications*. PhD diss., Vrije Universiteit Amsterdam.

Brons, M., P. Nijkamp, E. Pels and P. Rietveld. (2008). A Meta-Analysis of the Price Elasticity of Gasoline Demand, A SUR Approach. *Energy Economics* 30: 2105-2122.

Buettner, T. (2002). The Impact of Taxes and Public Spending on the Location of FDI: Evidence from FDI-Flows within Europe. ZEW Discussion Paper No. 02-17, Mannheim.

Buettner, T. and M. Ruf. (2007). Tax Incentives and the Location of FDI: Evidence from a Panel of German Multinationals. *International Tax and Public Finance* 14: 151-164.

Buettner, T. and G. Wamser. (2009a). The Impact of Nonprofit Taxes on Foreign Direct Investment: Evidence from German Multinationals. *International Tax and Public Finance* 16: 298-320.

Buettner, T. and G. Wamser. (2009b). Internal Debt and Multinationals' Profit Shifting - Empirical Evidence from Firm-Level Panel Data. OUCBT Working Paper 09/18, Oxford.

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.

Buettner, T., M. Overesch, U. Schreiber and G. Wamser. (2009). Taxation and Capital Structure Choice – Evidence from a Panel of German Multinationals. *Economics Letters* 105: 309-311.

Bundestag Printed Paper (Bundestag Drucksache) 16/4841 March 27, 2007.

Bundestag Printed Paper (Bundestag Drucksache) 17/5748 May 5, 2011.

Bushman, R., A. Smith and F. Zhang. (2008). Investment-cash flow sensitivities are really investment-investment sensitivities. Working Paper, University of North Carolina.

Byoun, S. (2008). How and When Do Firms Adjust Their Capital Structures toward Targets?. *Journal of Finance* 63: 3069-3096.

Caballero, R. J., E. Engel and J. Haltiwanger. (1995). Plant-level Adjustment and Aggregate Investment Dynamics. *Brookings Papers on Economic Activity* 1995: 1–54.

Card, D. and A. B. Krueger. (1995). Time-Series Minimum-Wage Studies: A Meta-Analysis. *American Economic Review* (Papers and Proceedings) 85: 238–43.

Card, D., J. Kluve and A. Weber. (2010). Active Labor Market Policy Evaluations: A Meta-Analysis. *Economic Journal* 120: F452–F477.

Castellucci, L., M. Coromaldi, V. Parisi, L. Perlini and M. Zoli. (2003). Report Describing Results and Country IT Tax Schedule Model. DIECOFIS Deliverable No. 6.2.

Cassou, S. P. (1997). The Link Between Tax Rates and Foreign Direct Investment. *Applied Economics* 29: 1295-1301.

Charalambakis, E. C., S. K. Espenlaub and I. Garrett. (2008). Leverage Dynamics, the Endogeneity of Corporate Tax Status and Financial Distress Costs, and Capital Structure. Working Paper, Manchester Business School.

Chen, J. and R. Strange. (2005). The Determinants of Capital Structure: Evidence from Chinese Listed Companies. *Economic Change and Restructuring* 38: 11-35.

Cheng, Y. and C. J. Green. (2008). Taxes and Capital Structure: A Study of European Companies. *Manchester School* Supplement 2008: 85-115.

Chirinko, R. S. (2002). Corporate Taxation, Capital Formation, and the Substitution Elasticity between Labor and Capital. *National Tax Journal* 55: 339-355.

Chirinko, R. S., S. M. Fazzari and A. P. Meyer. (1999). How Responsive is Business Capital Formation to its User Cost? An Exploration with Micro Data. *Journal of Public Economics* 74: 53-80.

Chirinko, R. S., S. M. Fazzari and A.P. Meyer. (2004). That Elusive Elasticity: A Long-Panel Approach to Estimating the Capital-Labor Substitution Elasticity. *CESifo Working Paper Series* 1240.

Clausing, K. A. (2001). The Impact of Transfer Pricing on Intrafirm Trade. In *International Taxation and Multinational Activity*, ed. J. R. Hines, 173-194. Chicago, IL: University of Chicago Press.

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 US International Trade. *National Tax Journal* 59: 269-287.

Clausing, K. A. (2007). Corporate Tax Revenues in OECD Countries. *International Tax and Public Finance* 14: 115-133.

Clausing, K. A. (2009). Multinational Firm Tax Avoidance and Tax Policy. *National Tax Journal* 62: 703-725.

Clauss, M. and S. Schubert. (2009). The ZEW Combined Microsimulation-CGE Model: Innovative Tool for Applied Policy Analysis. ZEW Discussion Paper No. 09-062, Mannheim.

Collins, J., D. Kemsley and M. Lang. (1998). Cross-Jurisdictional Income Shifting and Earnings Valuation. *Journal of Accounting Research* 36: 209-229.

Conover, T.L. and N. B. Nichols. (2000). A Further Examination of Income Shifting Through Transfer Pricing Considering Firm Size and/or Distress. *International Journal of Accounting* 35: 189-211.

Cooper, R.W. and J.C. Haltiwanger. (2006). On the Nature of Capital Adjustment Costs. *Review of Economic Studies* 73: 611–633.

Creedy, J. and N. Gemmell. (2009). Corporation Tax Revenue Growth in the UK. A Microsimulation Analysis. *Economic Modelling* 26: 614-625.

Creedy, J. and N. Gemmell. (2010). Modelling Responses to Profit Taxation over the Economic Cycle: The Case of the UK Corporation Tax. *FinanzArchiv* 66: 207-235.

Cummins, J. G., K. A. Hassett and R. G. Hubbard. (1994). A Reconsideration of Investment Behaviour using Tax Reforms as Natural Experiments. *Brookings Papers on Economic Activity* 1994: 1–59.

DeAngelo, H. and R. W. Masulis. (1980). Optimal Capital Structure under Corporate and Personal Taxation. *Journal of Financial Economics* 8: 3-29.

De Jong, A., R. Kabir and T. T. Nguyen. (2008). Capital Structure Around the World: The Roles of Firm- and Country-Specific Determinants. *Journal of Banking and Finance* 32: 1954-1969.

De Long, J. B. and K. Lang. (1992). Are All Economic Hypotheses False?. *Journal of Political Economy* 100: 1257-72.

De Mooij, R. A. (2005). Will Corporate Income Taxation Survive?. *De Economist* 153: 277-301.

De Mooij, R. A. and M. P. Devereux. (2011). An Applied Analysis of ACE and CBIT Reforms in the EU. *International Tax and Public Finance* 18: 93-120.

De Mooij, R. A. and S. Ederveen. (2003). Taxation and Foreign Direct Investment: A Synthesis of Empirical Research. *International Tax and Public Finance* 10: 673-693.

De Mooij, R. A. and S. Ederveen. (2005). Explaining the Variation in Empirical Estimates of Tax Elasticities of Foreign Direct Investment. *Tinbergen Institute Discussion Paper* No. 2005-108/3.

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 Paper No. 261, Bruxelles.

De Mooij, R. A. and S. Ederveen. (2008). Corporate Tax Elasticities: A Reader's Guide to Empirical Findings. *Oxford Review of Economic Policy* 24: 680-697.

De Mooij, R. A. and G. Nicodème. (2008). Corporate Tax Policy and Incorporation in the EU. *International Tax and Public Finance* 15: 478-498.

Demekas, D. G., B. Horváth, E. Ribakova and Y. Wu. (2007). Foreign Direct Investment in European Transition Economies - the Role of Policies. *Journal of Comparative Economics* 35: 369-386.

Desai, M. A., C. F. Foley and J. R. Hines. (2004a). Foreign Direct Investment in a World of Multiple Taxes. *Journal of Public Economics* 88: 2727-2744.

Desai, M. A., C. F. Foley and J. R. Hines. (2004b). 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. (2008). Capital Structure with Risky Foreign Investment. *Journal of Financial Economics* 88: 534-553.

Deutsche Bundesbank (1998), The Methodological Basis of the Deutsche Bundesbank's Corporate Balance Sheet Statistics, Monthly Report October 1998, Frankfurt am Main.

Deutsche Bundesbank (2011), Zeitreihe WU0022, Umlaufsrenditen inländischer Inhaberschuldverschreibungen, Industrieobligationenen, Frankurt am Main.

Devereux, M. P. (2007a). Developments in the Taxation of Corporate Profit in the OECD since 1965: Rates, Bases and Revenues. Working Paper No. 0704, Oxford University Centre for Business Taxation.

Devereux, M. P. (2007b). The Impact of Taxation on the Location of Capital, Firms and Profit: A Survey of Empirical Evidence. OUCBT Working Paper No. 0702, Oxford.

Devereux, M. P. and H. Freeman. (1995). The Impact of Tax on Foreign Direct Investment: Empirical Evidence and the Implications for Tax Integration Schemes. *International Tax and Public Finance* 2: 85-106.

Devereux, M. P. and R. Griffith. (1998). Taxes and the Location of Production: Evidence from a Panel of US Multinationals. *Journal of Public Economics* 68: 335-367.

Devereux, M. P. and R. Griffith. (1999). The Taxation of Discrete Investment Choices. Revision 2. IFS Working Paper No. W98/16.

Devereux, M. P. and R. Griffith. (2003). Evaluating Tax Policy for Location Decisions. *International Tax and Public Finance* 10: 107-126.

Devereux, M. P. and B. Lockwood. (2006). Taxes and the Size of the Foreign-Owned Capital Stock: Which Tax Rate Matters? Paper presented at the European Tax Policy Forum 2006, London.

Devereux, M. P. and S. Loretz. (2008). The Impact of EU Formula Apportionment on Corporate Tax Revenues. *Fiscal Studies* 29: 1-33.

Devereux, M. P., C. Elschner, D. Endres and C. Spengel. (2009). Effective Levels of Company Taxation within an Enlarged EU. Study prepared for the European Commission, Update 2009, Mannheim and Oxford.

Dhaliwal, D., R. Trezevant and S.-W. Wang. (1992). Taxes, Investment Related Tax Shields and Capital Structure. *Journal of the American Taxation Association* 14: 1-21.

Dharmapala, D. and N. Riedel. (2011). Earnings Shocks and Tax-Motivated Income-Shifting: Evidence from European Multinationals. OUCBT Working Paper 11/01, Oxford .

Dischinger, M. (2007). Profit Shifting by Multinationals: Indirect Evidence from European Micro Data. Discussion Paper, Ludwig-Maximilians-University Munich.

Dischinger, M. and N. Riedel. (2011). Corporate Taxes and the Location of Intangible Assets within Multinational Firms. *Journal of Public Economics* 95: 691-707.

Dischinger, M., U. Glogowski and M. Strobel. (2010). Leverage, Corporate Taxes and Debt Shifting of Multinationals: The Impact of Firm-Specific Risk. Working Paper, University of Munich.

Downs, T. W. (1993). Corporate Leverage and Non-Debt Tax Shields: Evidence on Crowding-Out. *Financial Review* 28: 549-583.

Dwenger, N. (2010). User Cost Elasticity of Capital Revisited. Working Paper, Max Planck Institute for Intellectual Property, Competition and Tax Law, Munich.

Dwenger, N. and V. Steiner. (2008). Effective Profit Taxation and the Elasticity of the Corporate Income Tax Base: Evidence from German Corporate Tax Return Data. DIW Discussion Paper No. 829, Berlin.

Dwenger, N. and V. Steiner. (2009). Financial Leverage and Corporate Taxation: Evidence from German Corporate Tax Return Data. DIW Discussion Paper No. 855, Berlin.

Egger, M., G. D. Smith, M. Scheider and C. Minder. (1997). Bias in Meta-Analysis Detected by a Simple, Graphical Test. *British Medical Journal* 316: 629-634.

Egger, P., W. Eggert and H. Winner. (2010). Saving Taxes Through Plant Ownership. *Journal of International Economics* 81: 99-108.

Egger, P., S. Loretz, M. Pfaffermayr and H. Winner. (2009a). Firm-Specific Forward-Looking Effective Tax Rates, *International Tax and Public Finance* 16, 850-870.

Egger, P., S. Loretz, M. Pfaffermayr and H. Winner. (2009b). Bilateral Effective Tax Rates and Foreign Direct Investment. *International Tax and Public Finance* 16: 822 – 849.

Egger, P., S. Loretz, M. Pfaffermayr and H. Winner. (2009c). Corporate Taxation and Multinational Activity. OUCBT Working Paper No. 0904, Oxford.

Elschner, C. (2010). Special Tax Regimes and the Choice of Organizational Form: Empirical Evidence from European Tonnage Taxes. Working Paper, University of Mannheim.

European Commission. (2001). Company Taxation in the Internal Market. COM(2001) 582 final, Office for Official Publications of the European Communities, Luxembourg.

European Commission. (2007). Common Consolidated Corporate Tax Base Working Group (CCCTB WG): Possible Elements of a Technical Outline. Working Document, Brussels.

European Commission. (2011). Proposal for a Council Directive on a Common Consolidated Corporate Tax Base (CCCTB), COM 2011 121/4, Brussels.

Fama, E. F. and K. R. French. (2002). Testing Trade-Off and Pecking Order Predictions about Dividends and Debt. *Review of Financial Studies* 15: 1-33.

Faulkender, M. and M. A. Petersen. (2006). Does the Source of Capital Affect Capital Structure?. *Review of Financial Studies* 19: 45-79.

Feld, L. P. (2000). *Steuerwettbewerb und seine Auswirkungen auf Allokation und Distribution: Ein Überblick und eine empirische Analyse für die Schweiz.* Tübingen: Mohr Siebeck.

Feld, L. P., T. Baskaran and J. Schnellenbach. (2007). Fiscal Federalism, Decentralization and Economic Growth: A Meta-Analysis. Unpublished Manuscript, University of Heidelberg.

Feld, L. P. and J. H. Heckemeyer. (2011). FDI and Taxation: A Meta-Study. *Journal of Economic Surveys* 25: 233-272.

Feld, L. P., J. H. Heckemeyer and M. Overesch. (2011). Capital Structure Choice and Company Taxation: Meta-Study. CESifo Working Paper No. 3400, Munich.

Finke, K., J. H. Heckemeyer, T. Reister and C. Spengel. (2010). Impact of Tax Rate Cut Cum Base Broadening Reforms on Heterogeneous Firms – Learning from the German Tax Reform 2008. Working Paper No. 1005, Oxford University Centre for Business Taxation.

Flannery, M. J. and K. P. Rangan. (2006). Partial Adjustment toward Target Capital Structures. *Journal of Financial Economics* 79: 469-506.

Florax, R., H. de Groot and R. de Mooij. (2002). Meta-Analysis in Policy-Oriented Research. *CPB Report* 2002/1: 21-25.

Fox, T. and D. Fullerton. (1991). The Irrelevance of Detail in a Computable General Equilibrium Model. *Economics Letters* 36: 67-70.

Frank, M. Z. and V. K. Goyal. (2007). Capital Structure Decisions: Which Factors Are Reliably Important?. *Financial Management* 38: 1-37.

Fuest, C., Hemmelgarn, T. and F. Ramb. (2007). How Would the Introduction of an EU-wide Formula Apportionment Affect the Size and the Distribution of the Corporate Tax Base?: An Analysis Based on German Multinationals. *International Tax and Public Finance* 14: 605-629.

Fuest, C., B. Huber and J. Mintz. (2005): Capital Mobility and Tax Competition. *Foundations and Trends in Microeconomics* 1: 1-62.

Fuest, C., Peichl, A. and T. Schaefer. (2005). Dokumentation FiFoSiM: Integriertes Steuer-Transfer-Mikrosimulations-und CGE-Modell. Finanzwissenschaftliche Diskussionsbeiträge Nr. 05 – 3, Universität zu Köln.

Goerg, H. and E. Strobl. (2001). Multinational Companies and Productivity Spillovers: A Meta-Analysis. *Economic Journal* 111: 723-740.

Goldstein, H. (1995) *Multilevel Statistical Models*. London: Edward Arnold.

Goodspeed, T., J. Martinez-Vazquez and L. Zhang. (2007). Are Government Policies more Important than Taxation in Attracting FDI?. ISP Working Paper 07-02, Georgia State University.

Goolsbee, A. (1998). Taxes, Organizational Form and the Deadweight Loss of the Corporate Income Tax. *Journal of Public Economics* 69: 143-152.

Goolsbee, A. (2004). The Impact of Corporate Income Tax: Evidence from State Organizational Form Data. *Journal of Public Economics* 88: 2283-2299.

Gordon, R. H. (2010). Taxation and Corporate Use of Debt: Implications for Tax Policy. *National Tax Journal* 63: 151-174.

Gordon, R. H. and Y. Lee. (2001). Do Taxes Affect Corporate Debt Policy? Evidence from U.S. Corporate Tax Return Data. *Journal of Public Economics* 82: 195-224.

Gordon, R. H. and Y. Lee. (2007). Interest Rates, Taxes and Corporate Financial Policies. *National Tax Journal* 60: 65-84.

Gorter, J. and A. Parikh. (2003). How Sensitive is FDI to Differences in Corporate Income Taxation within the EU? *De Economist* 151: 193-204.

Graham, J. R. (1996a). Debt and the Marginal Tax Rate. *Journal of Financial Economics* 41: 41-73.

Graham, J. R. (1996b). Proxies for the Corporate Marginal Tax Rate. *Journal of Financial Economics* 41: 187-221.

Graham, J. R. (1999). Do Personal Taxes Affect Corporate Financing Decisions?. *Journal of Public Economics* 73: 147-185.

Graham, J. R. (2003). Taxes and Corporate Finance: A Review. *Review of Financial Studies* 16: 1075-1129.

Graham, J. R. and H. Kim. (2009). The Effects of the Length of the Tax-Loss Carryback Period on Tax Receipts and Corporate Marginal Tax Rates. Working Paper, Duke University.

Graham, J. R. and L. F. Mills. (2008). Using Tax Return Data to Simulate Corporate Marginal Tax Rates. *Journal of Accounting and Economics* 46: 366-388.

Graham, J. R. and A. L. Tucker. (2006). Tax Shelters and Corporate Debt Policy. *Journal of Financial Economics* 81: 563-594.

Graham, J. R., M. H. Lang and D. A. Shackelford. (2004). Employee Stock Options, Corporate Taxes, and Debt Policy. *Journal of Finance* 59: 1585-1617.

Graham, J. R., M. L. Lemmon and J. S. Schallheim. (1998). Debt, Leases, Taxes, and the Endogeneity of Corporate Tax Status. *Journal of Finance* 53: 131-162.

Green, C. J. and V. Murinde. (2008). The Impact of Tax Policy on Corporate Debt in a Developing Economy: A Study of Unquoted Indian Companies. *European Journal of Finance* 14: 583-607.

Greene, W. H. (2003). *Econometric Analysis*. Upper Saddle River, NJ: Prentice Hall.

Gruber, J. and J. Rauh. (2007). How Elastic is the Corporate Income Tax Base?. In *Taxing Corporate Income in the 21st Century*, eds. A. Auerbach, J. R. Hines and J. Slemrod, 140-163. Cambridge, MA: Cambridge UP.

Grubert, H. (1998). Taxes and the Division of Foreign Operating Income Among Royalties, Interest, Dividends and Retained Earnings. *Journal of Public Economics* 68: 269–290.

Grubert, H. (2003). Intangible Income, Intercompany Transactions, Income Shifting, and the Choice of Location. *National Tax Journal* 56: 221-242.

Grubert, H. and 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. Mutti. (2000). Do Taxes Influence Where U.S. Corporations Invest?. *National Tax Journal* 53: 825-837.

Gupta, A. and V. Kapur. (2000). *Microsimulation in Government Policy and Forecasting*. Amsterdam: North-Holland.

Hajkova, D., G. Nicoletti, L. Vartia and K.-Y. Yoo. (2006). Taxation, Business Environment and FDI Location in OECD Countries. OECD Economics Department Working Paper No. 502, Paris.

Hall, R. E. and D. W. Jorgenson. (1967). Tax Policy and Investment Behaviour. *American Economic Review* 57: 391–414.

Harding, A. (1996). *Microsimulation and Public Policy.* Amsterdam: North Holland.

Harris, D. G. (1993). The Impact of US Tax Law Revision on Multinational Corporations' Capital Location and Income-Shifting Decisions. *Journal of Accounting Research* 31: 111-140.

Hartman, D. G. (1984). Tax Policy and Foreign Direct Investment in the United States. *National Tax Journal* 37: 475-488.

Hassett, K. A. and R. G. Hubbard. (2002). Tax Policy and Business Investment. In *Handbook of Public Economics*, vol. 3, eds. A. J. Auerbach and M. Feldstein, 1293-1343. Amsterdam: North Holland.

Hassett, K. A. and K. Newmark. (2008). Taxation and Business Behavior: A Review of the Recent Literature. In *Fundamental Tax Reform: Issues, Choices, and Implications,* eds. J. W. Diamond and G. R. Zodrow, 191-213. Cambridge, MA: MIT press.

Havranek, T. and Z. Irsova. (2011). Estimating Vertical Spillovers from FDI: Why Resulty Vary and What the True Effect Is. *Journal of International Economics*. Forthcoming.

Head, K. and J. Ries. (2008). FDI as an Outcome of the Market for Corporate Control: Theory and Evidence. *Journal of International Economics* 74: 2-20.

Hebous, S. and A. Weichenrieder. (2010). Debt Financing and Sharp Currency Depreciations: Wholly versus Partially-Owned Multinational Affiliates. *Review of World Economics* 146: 281-306.

Heckemeyer, J.H. and M. Overesch. (2012). Auswirkungen der Besteuerung auf Entscheidungen international tätiger Unternehmen - Ein Überblick zu den empirischen Befunden. *Die Betriebswirtschaft*, forthcoming.

Heckman, J. (1979). Sample Selection Bias as a Specification Error. *Econometrica* 47: 153-161.

Hedges, L. V. and I. Olkin. (1985). *Statistical Methods for Meta-Analysis*. Orlando, FL: Academic Press.

Helpman, E. (1984). A Simple Theory of International Trade with Multinational Corporations. *Journal of Political Economy* 92: 451-471.

Helpman, E. (1985). Multinational Corporations and Trade Structure. *Review of Economic Studies* 52: 443-458.

Hines, J. R. (1996). Altered States: Taxes and the Location of Foreign Direct Investment in America. *American Economic Review* 86: 1076-1094.

Hines, J. R. (1997). Tax Policy and the Activities of Multinational Corporations. In *Fiscal Policy: Lessons from Economic Research*, ed. A. J. Auerbach, 401-445. Cambridge, MA: MIT Press.

Hines, J. R. (1999). Lessons from Behavioral Responses to International Taxation. *National Tax Journal* 52: 305-322.

Hines, J. R. and E. M. Rice. (1994). Fiscal Paradise: Foreign Tax Havens and American Business. *Quarterly Journal of Economics* 109: 149-182.

Homaifar, G., J. Zietz and O. Benkato. (1994). An Empirical Model of Capital Structure: Some New Evidence. *Journal of Business Finance and Accounting* 21: 1-14.

Hoonsawat, R. (2007). Transfer Pricing: Does the Size and Remoteness of Countries Matter?, Working Paper, Syracuse University.

Horstmann, I. J. and J. R. Markusen. (1992). Endogenous Market Structures in International Trade (natura facit saltum). *Journal of International Economics* 32: 109-129.

Huang, R. and J. R. Ritter. (2009). Testing Theories of Capital Structure and Estimating the Speed of Adjustment. *Journal of Financial and Quantitative Analysis* 44: 237-271.

Hubbard, R. G. (1998). Capital-Market Imperfections and Investment. *Journal of Economic Literature* 36: 193-225.

Huizinga, H. and L. Laeven. (2008). International Profit Shifting within Multinationals: A Multi-Country Perspective. *Journal of Public Economics* 92: 1164-1182.

Huizinga, H. and G. Nicodème. (2006). Foreign Ownership and Corporate Income Taxation: An Empirical Evaluation. *European Economic Review* 50: 1223–1244.

Huizinga, H., L. Laeven and G. Nicodème. (2008). Capital Structure and International Debt Shifting in Europe. *Journal of Financial Economics* 88: 80-118.

Hunter, J. E. and F. L. Schmidt. (1990). *Methods of Meta-Analysis: Correcting Error and Bias in Research Findings.* Newbury Park, CA: Sage Publications.

Jacob, J. (1996). Taxes and Transfer Pricing: Income Shifting and the Volume of Intra-Firm Transfer. *Journal of Accounting Research* 34: 301-312.

Jacobebbinghaus, P. and V. Steiner (2003). Dokumentation des Steuer-Transfer-Mikrosimulationsmodells STSM, Version 1995-1999, ZEW Dokumentation Nr. 03-06, Mannheim.

Jarrell, S. B. and T. D. Stanley. (1989). Meta-Regression Analysis: A Quantitative Method of Literature Surveys. *Journal of Economic Surveys* 3: 54-67.

Jarrell, S. B. and T. D. Stanley. (1990). A Meta-Analysis of the Union-Nonunion Wage Gap. *Industrial and Labor Relations Review* 44: 54-67.

Jarrell, S. B. and T. D. Stanley. (2004). Declining Bias and Gender Wage Discrimination? A Meta-Regression Analysis. *The Journal of Human Resources* 39: 828-838.

Jarrell, S. B. and T. D. Stanley. (2005). Meta-Regression Analysis: A Quantitative Method of Literature Surveys. *Journal of Economic Surveys* 19: 299-308.

Jensen, M. C. (1986). Agency Costs of Free Cash Flow, Corporate Finance and Takeovers. *American Economic Review* 76: 323-329.

Jensen, M. and W. H. Meckling. (1976). Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure. *Journal of Financial Economics* 42: 159-185.

Jog, V. and J. Tang. (2001). Tax Reforms, Debt Shifting and Tax Revenues: Multinational Corporations in Canada. *International Tax and Public Finance* 8: 5-26.

Jorgenson, D. W. (1963). Capital Theory and Investment Behavior. *American Economic Review* 53: 247-259.

Jun, J. (1994). How Taxation Affects Foreign Direct Investment: Country Specific Evidence. World Bank Policy Research Working Paper No.1307.

Karkinski, T. and N. Riedel. (2009). Corporate Taxation and the Choice of Patent Location within Multinational Firms. OUCBT Working Paper No. 0914, Oxford.

Keen, M. and M. Marchand. (1997). Fiscal Competition and the Pattern of Public Spending. *Journal of Public Economics* 66: 33-53.

Kesternich, I. and M. Schnitzer. (2010). Who is Afraid of Political Risk? Multinational Firms and their Choice of Capital Structure. *Journal of International Economics* 82: 208-218.

Keuschnigg, C., D. Radulescu and M. Stimmelmayr. (2005). Model Documentation IFOmod, Working Paper, University of Munich.

King, M. A. and D. Fullerton. (1984). *The Taxation of Income from Capital.* Chicago, IL: University of Chicago Press.

Klapper, L. and K. Tzioumis. (2008). Taxation and Capital Structure - Evidence from a Transition Economy. Policy Research Paper No. 4753, World Bank.

Klassen, K. J. and S. K. Laplante. (2010). The Effect of Financial Reporting and Foreign Reinvestment Opportunities on Cross-Jurisdictional Income Shifting. Working Paper, University of Waterloo (CA).

Klassen, K., M. Lang and M. Wolfson. (1993). Geographic Income Shifting by Multinational Corporation in Response to Tax Rate Changes. *Journal of Accounting Research* 31: 141-173.

Kleinert, J. and F. Toubal. (2010). Gravity for FDI. *Review of International Economics* 18: 1-13.

Kraus, A. and R. H. Litzenberger. (1973). A State-Preference Model of Optimal Financial Leverage. *Journal of Finance* 28: 911-922.

Lasfer, M. (1995). Agency Costs, Taxes and Debt: The UK Evidence. *European Financial Management* 1: 265-285.

Lemmon, M. L., M. R. Roberts and J. F. Zender. (2008). Back to the Beginning: Persistence and the Cross-Section of Corporate Capital Structure. *Journal of Finance* 63: 1575-1608.

Liu, Q. and G. G. Tian. (2009). Leverage Ratio and Determinants of Capital Structure in SMEs: Evidence from China. Working Paper, University of Wollongong.

López-Gracia, J. and F. Sogorb-Mira. (2008). Testing Trade-Off and Pecking Order Theories Financing SMEs. *Small Business Economics* 31: 117-136.

Lucas, R. (1976). Econometric Policy Evaluation: A Critique. In *The Phillips Curve and Labor Markets*, eds. K. Brunner and A. Meltzer, 19-46. New York, NY: American Elsevier.

Macaskill, P., S.D. Walter and L. Irwig. (2001). A comparison of Methods to Detect Publication Bias in Meta-Analysis. *Statistics in Medicine* 20: 641-654.

MacKie-Mason, J. K. (1990). Do Taxes Affect Corporate Financing Decisions?. *Journal of Finance* 45: 1471-1493.

MacKie-Mason, J. K. and R. H. Gordon. (1997). How Much Do Taxes Discourage Incorporation?. *The Journal of Finance* 52: 477-505.

Maffini, G. and S. Mokkas. (2011). Profit Shifting and Measured Productivity of Multinational Firms. *Oxford Bulletin of Economics and Statistics* 73: 1-20.

Markle, K. S. (2010). A Comparison of the Tax-Motivated Income Shifting of Multinationals in Territorial and Worldwide Countries. Working Paper, University of North Carolina.

Markusen, J. R. (1997). Trade Versus Investment Liberalization. NBER Working Paper No. 6231.

Markusen, J. R. (2002). *Multinational Firms and the Theory of International Trade*. Cambridge, MA: MIT Press.

McDonald, M. (2008). Income Shifting from Transfer Pricing: Further Evidence from Tax Return Data. OTA Technical Working Paper 2, Department of the Treasury, Washington D.C.

Michaelas, N., F. Chittenden and P. Poutziouris. (1999). Financial Policy and Capital Structure Choice in U.K. SMEs: Empirical Evidence from Company Panel Data. *Small Business Economics* 12: 113-130.

Miller, M. H. (1977). Debt and Taxes. *Journal of Finance* 32: 261-276.

Mills, L. F. and K. J. Newberry. (2004). Do Foreign Multinational's Tax Incentives Influence their U.S Income Reporting and Debt Policy?. *National Tax Journal* 57: 89-107.

Mintz, J. M. and A. J. Weichenrieder. (2010). *The Indirect Side of Direct Investment - Multinational Company Finance and Taxation*. Cambridge, MA: MIT Press.

Modigliani, F. and M. Miller. (1963). Corporate Income Taxes and the Cost of Capital: A Correction. *American Economic Review* 53: 433-443.

Moore, P. J. and F. P. Ruane. (2005). Taxation and the Financial Structure of Foreign Direct Investment. Discussion Paper 88, Institute for International Integration Studies.

Murthy, N. R. V. (1989). The Effects of Taxes and Rates of Return on Foreign Direct Investment in the United States: Some Econometric Comments. *National Tax Journal* 42: 205-207.

Mutti, J. and H. Grubert. (2004). Empirical Asymmetries in Foreign Direct Investment and Taxation. *Journal of International Economics* 62: 337-358.

Myers, S. C. (1977). Determinants of Corporate Borrowing. *Journal of Financial Economics* 5: 147-175.

Myers, S. C. (1984). The Capital Structure Puzzle. *Journal of Finance* 15: 81-102.

Myers, S. C. and N. S. Majluf. (1984). Corporate Financing and Investment Decisions when Firms Have Information that Investors Do not Have. *Journal of Financial Economics* 13: 187-222.

Neumark, F. (1963). *Tax Harmonization in the Common Market ('Neumark-Report')*. New York.

Newberry, K. J. and D. S. Dhaliwal. (2001). Cross-Jurisdictional Income Shifting by US Multinationals: Evidence from International Bond Offerings. *Journal of Accounting Research* 39: 643-662.

Newlon, T. S. (1987). *Tax Policy and Multinational Firm's Financial Policy and Investment Decisions.* PhD diss., Princeton University.

Nickel, S. J. (1978). *The Investment Decisions of Firms*. Cambridge, MA: Cambridge University Press.

Oestreicher, A. and R. Koch. (2011). The Revenue Consequences of Using a Common Consolidated Corporate Tax Base to Determine Taxable Income in the EU Member States. *FinanzArchiv* 67: 64-102.

Oestreicher, A., Reister, T. and C. Spengel. (2009). Common Corporate Tax Base and Effective Tax Burdens in the EU Member States. *Word Tax Journal* 1 : 46-66.

Oeztekin, O. (2009). Capital Structure Decisions Around the World: Which Factors are Reliably Important?. Working Paper, University of Kansas.

Orcutt, G., S. Caldwell and R. Wertheimer II. (1976). *Policy Exploration Through Microanalytic Simulation*. Washington, D.C: The Urban Institute.

Oropallo, F. and V. Parisi. (2005). Will Italy's Tax Reform Reduce The Corporate Tax Burden? A Microsimulation Analysis. Working Paper No. 403, Italian Association of Public Finance SIEP, Pavia.

Overesch, M. (2006). Transfer Pricing of Intrafirm Sales as a Profit Shifting Channel - Evidence from German Firm Data. ZEW-Discussion Paper 06-084, Mannheim.

Overesch, M. (2009). The Effects of Multinationals' Profit Shifting Activities on Real Investments. *National Tax Journal* 62: 5-23.

Overesch, M. and U. Schreiber. (2010). Asset Specificity, International Profit Shifting, and Investment Decisions. *Zeitschrift für Betriebswirtschaft* 70 (Special Issue 2): 23-47.

Overesch, M. and D. Voeller. (2010). The Impact of Personal and Corporate Taxation on Capital Structure Choices. *FinanzArchiv* 66: 263-294.

Overesch, M. and G. Wamser. (2009). Who Cares about Corporate Taxation? Asymmetric Tax Effects on Outbound FDI. *The World Economy* 32: 1657-1684 .

Overesch, M. and G. Wamser. (2010a). The Effects of Company Taxation in EU Accession Countries on German FDI. *Economics of Transition* 18: 429-457.

Overesch, M. and G. Wamser. (2010b). Corporate Tax Planning and Thin-Capitalization Rules: Evidence from a Quasi Experiment. *Applied Economics* 42: 563-573.

Pain, N. and G. Young. (1996). Tax Competition and the Pattern of European Foreign Direct Investment. Mimeo, National Institute of Economic and Social Research.

Papke, L. E. (1991). Interstate Business Tax Differentials and New Firm Locations: Evidence from Panel Data. *Journal of Public Economics* 45: 47-68.

Parrino, R. and M. S. Weisbach. (1999). Measuring Investment Distortions Arising from Stockholder–Bondholder Conflicts. *Journal of Financial Economics* 53: 3-42.

Peichl, A. (2005). Die Evaluation von Steuerreformen durch Simulationsmodelle. Discussion Paper No. 05-01, Finanzwirtschaftliches Forschungsinstitut, University of Cologne.

Pfaffermayr, M., M. Stoeckl and H. Winner. (2008). Capital Structure, Corporate Taxation and Firm Age. OUCBT Working Paper No. 0829, Oxford.

Radulescu, D. and M. Stimmelmayr. (2005). Implementimg a Dual Income Tax in Germany. Effects on Investment and Welfare. IFO Working Paper No. 20, Munich.

Radulescu, D. and M. Stimmelmayr. (2010). The Impact of the 2008 German Corporate Tax Reform: A dynamic CGE analysis. *Economic Modelling* 27: 454 - 467.

Rajan, R. G. and L. Zingales. (1995). What Do We Know about Capital Structure? Some Evidence from International Data. *Journal of Finance* 50: 1421-1460.

Ramb, F. and A. J. Weichenrieder. (2005). Taxes and the Financial Structure of German inward FDI. *Review of World Economics* 141: 670-692.

Razin, A. (2004). The Contribution of FDI Flows to Domestic Investment in Capacity, and Vice Versa. In *Growth and Productivity in East Asia*, NBER-East Asia Seminar on Economics 13, eds. T. Ito and A. K. Rose, 149-176. Chicago, IL: University of Chicago Press.

Razin, A., Y. Rubinstein and E. Sadka. (2005). Corporate Taxation and Bilateral FDI with Threshold Barriers. NBER Working Paper No. 11196.

Reister, T. (2009). *Steuerwirkungsanalysen unter Verwendung von unternehmensbezogenen Mikrosimulationsmodellen*. Wiesbaden: Gabler.

Reister, T., C. Spengel, J. H. Heckemeyer and K. Finke. (2008). ZEW Corporate Taxation Microsimulation Model (ZEW TaxCoMM). ZEW Discussion Paper No. 08-117, Mannheim.

Rousslang, D. J. (1997). International Income Shifting by US Multinational Corporations. *Applied Economics* 29: 925-934.

Ruf, M. (2010). Trade Off or Pecking Order - What Drives the Leverage of Subsidiaries in High Tax Countries up?. Working Paper, University of Mannheim.

Scheffler, W. and C. Krebs. (2011). Richtlinienvorschlag zur CCCTB: Bestimmung der Steuerbemessungsgrundlage im Vergleich mit der Steuerbilanz nach EStG. *Deutsches Steurrecht (DStR)*: Beihefter Heft 22.

Schmenner, R.W. (1982). *Making Business Location Decisions*. Englewood Cliffs, N.J: Prentice-Hall.

Schoen, W. (2005). The Odd Couple: A Common Future for Financial and Tax Accounting?. *Tax Law Review* 58:111-148.

Schoen, W., U. Schreiber and C. Spengel, eds. (2008). *A Common Consolidated Corporate Tax Base for Europe*. Berlin and Heidelberg: Springer.

Scholes, M. S. and M. A. Wolfson. (1992). *Taxes and Business Strategy - A Planning Approach*. Englewood Cliffs, NJ: Prentice-Hall.

Schwarz, P. (2009). Tax-Avoidance Strategies of American Multinationals: An Empirical Analysis. *Managerial and Decision Economics* 30: 539–549.

Sharpe, S. A. and H. H. Nguyen. (1995). Capital Market Imperfections and the Incentive to Lease. *Journal of Financial Economics* 39: 271-294.

Shevlin, T. (1990). Estimating Corporate Marginal Tax Rates with Asymmetric Tax Treatment of Gains and Losses. *Journal of the American Taxation Association* 12: 51-67.

Shivdasani, A. and I. Stefanescu. (2010). How Do Pensions Affect Corporate Capital Structure Decisions?. *Review of Financial Studies* 23: 1287-1323.

Sinn, H.-W. (2003). *The New Systems Competition.* Oxford: Blackwell.

Slemrod, J. (1990). Tax Effects on Foreign Direct Investment in the U.S.: Evidence from a Cross-Country Comparison. In *Taxation in the Global Economy*, eds. A. Razin and J. Slemrod, 79-122. Chicago, IL: University of Chicago Press.

Smith, V. K. and J.-C. Huang. (1995). Can Markets Value Air Quality? A Meta-Analysis of Hedonic Property Value Models. *Journal of Political Economy* 103: 209-227.

Spengel, C. (1995). *Europäische Steuerbelastungsvergleiche. Deutschland – Frankreich – Großbritannien*. Düsseldorf: IDW-Verlag.

Spengel, C. (2008). Concept and Necessity of a Common Tax Base. In *A Common Consolidated Corporate Tax Base for Europe*, eds. W. Schoen, U. Schreiber, C. Spengel, 1-47. Heidelberg: Springer.

Spengel, C. and Y. Zoellkau, eds. (2012). *Common Corporate Tax Base (CC(C)TB) and Determination of Taxable Income. An International Comparison*. Berlin and Heidelberg: Springer.

Stanley, T. D. (1998). New Wine in Old Bottles: A Meta-Analysis of Ricardian Equivalence. *Southern Economic Journal* 64: 713-727.

Stanley, T. D. (2000a). An Empirical Critique of the Lucas Critique. *Journal of Socio-Economics* 29: 91-107.

Stanley, T. D. (2000b). *Challenging Time Series: Limits to Knowledge, Inertia and Caprice*. Cheltenham: Edward Elgar.

Stanley, T. D. (2001). Wheat from Chaff: Meta-Analysis as Quantitative Literature Review. *Journal of Economic Perspectives* 15: 131-150.

Stanley, T. D. (2005). Beyond Publication Bias. *Journal of Economic Surveys* 19: 309-345.

Stanley, T. D. (2008). Meta-Regression Methods for Detecting and Estimating Empirical Effects in the Presence of Publication Selection. *Oxford Bulletin of Economics and Statistics* 70: 103-127.

Stanley, T. D. and H. Doucouliagos. (2007). Identifying and Correcting Publication Selection Bias in the Efficiency Wage Literature: Heckman Meta-Regression. Working Paper – Economic Series 2007/11, School of Accounting, Economics and Finance, University of Deakin.

Stanley, T. D and H. Doucouliagos. (2010). Picture This: A Simple Graph that Reveals Much Ado about Research. *Journal of Economic Surveys* 24: 170-91.

Stanley, T. D. and S. B. Jarrell. (1989). Meta-Regression Analysis: A Quantitative Method of Literature Surveys. *Journal of Economic Surveys* 3: 54-67.

Stanley, T. D. and S. B. Jarrell. (1998). Gender Wage Discrimination Bias? A Meta-Regression Analysis. *Journal of Human Resources* 33: 947-973.

Statistisches Bundesamt (2006), Umsatzsteuerstatistik 2004, Wiesbaden.

Statistisches Bundesamt (2011a), Verbraucherpreisindizes für Deutschland, Jahresbericht (Januar 1991 - Dezember 2010), Wiesbaden.

Statistisches Bundesamt. (2011b). Körperschaftsteuerstatistik 2006, Sonderauswertung, Wiesbaden.

Steiner, V. (2008). Review of *Fundamental Capital Income Tax Reforms - Discussion and Simulation Using IFOmod*, by M. Stimmelmayr. *Journal of Economics* 94: 279-282.

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

Stoewhase, S. (2005a). *Taxes and Multinational Enterprises in the EU: Location Decisions and Income Shifting*. PhD diss., LMU München.

Stoewhase, S. (2005b). Tax-Rate-Differentials and Sector-Specific Foreign Direct Investment: Empirical Evidence from the EU. *FinanzArchiv* 61: 535-558.

Stulz, R. (1990). Managerial Discretion and Optimal Financing Choices. *Journal of Financial Economics* 26: 3-28.

Sutton, A. J., K. R. Abrama, D. R. Jones, T. A. Sheldon and F. Song. (2000). *Methods for Meta-analysis in Medical Research*. Chichester: John Wiley and Sons.

Swenson, D. L. (1994). The Impact of U.S. Tax Reform on Foreign Direct Investment on Foreign Direct Investment in the United States. *Journal of Public Economics* 54: 243-266.

Swenson, D. L. (2001a). Transaction Type and the Effect of Taxes on the Distribution of Foreign Direct Investment in the United States. In *International Taxation and Multinational Activity*, ed. J. R. Hines, 89-112. Chicago, IL: University of Chicago Press.

Swenson, D. L. (2001b). Tax Reforms and Evidence of Transfer Pricing. *National Tax Journal* 54: 7-25.

Thompson, S. G. and S. J. Sharp. (1999). Explaining Heterogeneity in Meta-Analysis: A Comparison of Methods. *Statistics in Medicine* 18: 2693-2708.

Tiebout, C. M. (1956). A Pure Theory of Local Expenditures. *Journal of Political Economy* 64: 416-424.

Titman, S. and R. E. Wessels. (1988). The Determinants of Capital Structure Choice. *Journal of Finance* 43: 1-19.

Trezevant, R. (1992). Debt Financing and Tax Status: Tests of the Substitution Effect and the Tax Exhaustion Hypothesis Using Firms' Response to the Economic Recovery Tax Act of 1981. *Journal of Finance* 47: 1557-1568.

Van Soest, A. (1995). Structural Models of Family Labor Supply: A Discrete Choice Approach. *Journal of Human Resources* 30: 63-88.

Wagenhals, G. (2004). Tax-Benefit Micro-Simulation Models for Germany: A Survey. Discussion Paper No. 235/2004, Institut für Volkswirtschaftslehre, University of Hohenheim.

Wei, S.-J. (1997). How Taxing is Corruption on International Investors?. NBER Working Paper No. 6030.

Weichenrieder, A. (2009). Profit Shifting in the EU: Evidence from Germany. *International Tax and Public Finance* 16: 281-297.

Weiner, J. (2006). *Company Tax Reform in the European Union: Guidance from the United States and Canada on Implementing Formulary Apportionment in the EU*. New York, NY: Springer.

Wijeweera, A., B. Dollery and D. Clark. (2007). Corporate Tax Rates and Foreign Direct Investment in the United States. *Applied Economics* 39: 109-117.

Wilson, J. D. (1999). Theories of Tax Competition. *National Tax Journal* 52: 269-304.

Wilson, J. D. and D.E. Wildasin. (2004). Capital Tax Competition: Bane or Boon?. *Journal of Public Economics* 88: 1065-1091.

Winner, H. (2005). Has Tax Competition Emerged in OECD Countries? Evidence from Panel Data. *International Tax and Public Finance* 12: 667-687.

Wolff, G. B. (2007). Foreign Direct Investment in the Enlarged EU: Do Taxes Matter and to What Extent?. *Open Economies Review* 18: 327-346.

Wooldridge, J. M. (2002). *Econometric Analysis of Cross Section and Panel Data*. Cambridge, MA: MIT Press.

Young, K. H. (1988). The Effects of Taxes and Rates of Return on Foreign Direct Investment in the United States. *National Tax Journal* 41: 109-121.

Cited Financial Reports (Chapter 7, p. 150):

BASF SE, Geschäftsbericht 2010, available for download (11/8/2011): http://www.bericht.basf.com/2010/de/serviceseiten/downloads/files/BASF_Bericht_2010.pdf

Bayer AG, Konzernabschluss 2010, available for download (11/8/2011): http://www.geschaeftsbericht2010.bayer.de/de/bayer-konzernabschluss-2010.pdfx

Daimler AG, Geschäftsbericht 2010, available for download (11/8/2011): http://www.daimler.com/Projects/c2c/channel/documents/1985488_Daimler_Geschaeftsbericht_2010.pdf

Lufthansa AG, Geschäftsbericht 2010, available for download (11/8/2011): http://reports.lufthansa.com/2010/gb/serviceseiten/dateisammlung/files/collection.php?cat=b

MAN SE, Geschäftsbericht 2010, available for download (11/8/2011): http://www.man.eu/MAN-Downloadgalleries/All/3Investor_Relations/Geschaeftsbericht/2010/gb_2010_online_d_Auf_einen_Blick.pdf

ThyssenKrupp AG, Geschäftsbericht 2010, available for download (11/8/2011): http://www.thyssenkrupp.com/financial-reports/09_10/download/de/ThyssenKrupp_2009_2010_GB.pdf