Discussion Paper No. 08-117

ZEW Corporate Taxation Microsimulation Model (ZEW TaxCoMM)

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Zentrum für Europäische Wirtschaftsforschung GmbH
Centre for European Economic Research

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Non-Technical Summary

Political discussion in Germany and other European countries revealed the outstanding relevance accorded to revenue and distribution effects of tax reforms in the field of corporate taxation. Both issues are taken as crucial determinants for the feasibility and sustainability of tax systems thus eclipsing systematic aspects of taxation at least partially. So far, the coverage of existing quantitative approaches on the impact of corporate taxation does not reflect this demand. Widely recognised approaches focus on the computation of effective tax burdens thus providing important insights into the incentives of taxation. Unfortunately, these models do not allow robust conclusions on revenue impacts and distributional consequences of tax reforms. In view of the scarce evidence on these issues at least at corporate level, the intention of this paper is to put forward an instrument explicitly allowing for policy analysis of corporate tax reforms. The proposed corporate microsimulation model has been developed at the Centre of European Economic Research (ZEW) in collaboration with the University of Mannheim.

The idea of this paper is to employ the methodology of microsimulation for policy analyses since this methodology captures structural differences of micro units and is thus appropriate to draw conclusions on the individual financial impacts of tax reforms. The key feature of the proposed corporate microsimulation model consists in processing financial statements taken from the DAFNE data base of the Bureau van Dijk and deriving the tax base for corporate income tax and trade tax endogenously. In this context the consideration of firm specific balance-sheet data and profit and loss account data provides a linkage to the real economic sphere which is crucial to account for the real development of corporations over time, to capture changes in the legal framework adequately and later on to integrate behavioural responses to tax reforms. To simulate tax regulations according to a reference tax system or a reform proposal, the data-set is supplemented by survey data on tax accounting practices. It is shown that the distinct set-up of the proposed model can account for tax regulations in great detail. Among other elements of the corporate tax base, regulations governing depreciation, provisions, creditors and financial results for tax purposes are considered explicitly. This proceeding ensures that the endogenous tax assessment of the micro entities largely fits reality and can be seen as an indispensable precondition for profound policy analyses.

In the end, the approach put forward in this paper allows revealing short-term distributional implications and revenue effects of corporate tax reforms. These applications, however, will

be presented in subsequent publications as the focus of this paper is on a rather technical description.

Zusammenfassung

Die steuerpolitischen Reformdiskussionen in Deutschland und anderen europäischen Staaten verdeutlichen die hohe Bedeutung, die den Verteilungs- und Aufkommenswirkungen von Steuerreformen im Bereich der Unternehmensbesteuerung zugemessen wird. Diese Bedeutung ist insbesondere im Hinblick auf die Durchsetzbarkeit und Nachhaltigkeit von Reformvorschlägen zu sehen und lässt steuersystematische Aspekte zumindest teilweise in den Hintergrund treten. Bestehende quantitative Ansätze zur Erfassung der Steuerwirkungen spiegeln bislang jedoch den beschriebenen Bedarf nicht wider. So sind die existierenden unternehmensbezogenen Modelle in erster Linie darauf ausgerichtet, effektive Steuerbelastungsmaße zu berechnen, um daraus Rückschlüsse auf die Anreizwirkungen der Besteuerung zu ziehen. Demgegenüber erlauben es diese Ansätze nicht, Verteilungs- und Aufkommenseffekte von Steuerreformen aufzuzeigen. Angesichts des eingeschränkten Anwendungsspektrums bestehender Ansätze ist es Ziel dieser Arbeit, ein Modell vorzustellen, das explizit für die Analyse von Aufkommens- und Verteilungswirkungen der Unternehmensbesteuerung geeignet ist. Das Modell wurde am Zentrum für Europäische Wirtschaftsforschung (ZEW) in Kooperation mit der Universität Mannheim entwickelt.

Der entwickelte Ansatz fußt auf der Methodik der Mikrosimulation und erlaubt durch die explizite Berücksichtigung von unternehmensindividuellen Strukturmerkmalen eine sehr differenzierte Erfassung der finanziellen Folgen von Unternehmensteuerreformen. Im Kern zeichnet sich der vorzustellende Ansatz dadurch aus, dass auf Basis von Handelsbilanzdaten, die der DAFNE Datenbank des Büros van Dijk entnommen werden, die Bemessungsgrundlagen der Gewerbe- und der Körperschaftsteuer modellendogen abgeleitet werden. Die Berücksichtigung von Handelsbilanzdaten stellt dabei die entscheidende Verbindung zur realwirtschaftlichen Sphäre her, die es ermöglicht, die reale Entwicklung der Unternehmen im Zeitablauf zu berücksichtigen, Änderungen der rechtlichen Rahmenbedingungen adäquat abzubilden und in eine späteren Modellerweiterung Verhaltensreaktionen integrieren zu können. Um die ertragsteuerlichen Regelungen konsistent simulieren zu können, werden bei der Verarbeitung der Datengrundlage Ergebnisse von Befragungen von Steuerpraktikern einbezogen, die insbesondere über die Ausübung steuerlicher Wahlrechte Aufschluss liefern. Die gewählte Modellkonstruktion erlaubt eine detaillierte Abbildung des steuerlichen Rahmenwerks. So werden

u.a. steuerliche Regelungen im Bereich der Abschreibungen, der Rückstellungsbildung, der Forderungsbewertung und der steuerrechtlichen Behandlung von Komponenten des Finanzergebnisses modellendogen abgebildet. Durch diese detaillierte Vorgehensweise wird eine möglichst realistische Veranlagung der Mikroeinheiten im Modell sichergestellt und die Grundvoraussetzung für profunde Politikanalysen geschaffen.

Der entwickelte Ansatz erlaubt die Untersuchung kurzfristiger Verteilungs- und Aufkommenswirkungen von Unternehmensteuerreformen. Entsprechende Anwendungsfälle werden in eigenständigen Publikationen vorgestellt und sind nicht Gegenstand dieser Arbeit, die auf eine technische Beschreibung des Modells abzielt.

ZEW Corporate Taxation Microsimulation Model (ZEW TaxCoMM)

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Abstract:

Current political discussions in Germany and other European countries illustrate the importance accorded to revenue and distribution effects of tax reforms. Whereas widely recognized concepts of effective tax measures can provide important insights into the incentives of taxation they do not allow robust revenue estimations or distribution analyses. Hence there is need to supplement existing quantitative tax models by approaches apt for these issues of policy analysis. Against this background, this paper puts forward a corporate microsimulation model allowing an ex-ante evaluation of tax reforms with regard to distributional consequences and revenue effects. Central feature of the model is the processing of financial statements included in the DAFNE data base of the Bureau van Dijk. The firm-level data is supplemented by survey data on tax accounting practices. The focus of the paper is on the documentation of the model set-up. Its application will be addressed in future publications.

Keywords: Microsimulation Model, Corporate Taxation, Policy Analysis, Firm-Level Data

JEL Classification: C15, D30, H25, H32, K34

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List of Abbreviations

CC	Commercial Code
DAX	German Stock Index
MDAX	Mid-Cap-DAX
SDAX	Small-Cap-DAX
TecDAX	Technology-DAX
DIW	German Institute for Economic Research
EATR	Effective Average Tax Rate
EMTR	Effective Marginal Tax Rate
ISTAT	Italian Statistical Office
IRAP	Imposta regionale sulle attività produttive
ITA	Income Tax Act
PIM	Perpetual-Inventory-Method
SSA	Solidarity Surcharge ACT
TTA	Trade Tax Act
ZEW	Centre for European Economic Research

List of Symbols

$A_{i,h}$	Historical Acquisition Costs of Investment Vintage i in Company h
$Adj_{1,h}^{tax}$	Adjustment of Profits for tax Purposes in Period 1 for Company h
$Depr_n$	Depreciation in Period n
CA_n	Carrying Amount in Period n
$CA_{n,h}^{apriori}$	A-priori Carrying Amount in Period n for Company h
$CA_{n,h}^{apost}$	A-posteriori Carrying Amounts for Period n and Company h
$E_{i,n,h}$	Amount of Vintage Specific Disposal in Period n for Company h
$Appr_{n,h}$	Appropriation to Provisions in Period n for Company h
$Rev_{n,h}$	Appropriation to Provisions in Period n for Company h
s	Actual Life
$\bar{s}$	Useful Life
$\tilde{s}$	Average Service Life
$vCA_{i,n,h}$	Vintage Specific Carrying Amount of Vintage i, in Year n for Company h
σ	Standard Deviation

1 Introduction

It is beyond dispute that revealing the incentives of taxation is of special interest to economic agents. Approaches computing valid measures of effective tax levels can provide important insight into this issue. Recent tax reforms in Germany and other European countries showed that in political discussions revenue and distribution effects of tax reforms become more important and partly eclipse systematic aspects. Yet, no robust conclusions can be drawn from the quantitative models focussing on the identification of tax incentives with regard to distributional consequences and revenue estimation. This must be deemed an important drawback for policy analysis. Concerning the evaluation of tax reforms and the review of political decisions on tax systems' distributional implications as well as the estimation of revenue effects are crucial determinants for the feasibility and sustainability of tax systems. Therefore, the existing instruments that are used for the identification of tax incentives have to be supplemented by approaches revealing the impacts of taxation on future tax revenue and the distribution of the tax burden.

Being based on strongly disaggregated data, microsimulation models capture structural differences on the level of micro units thus allowing precise conclusion on the individual financial impacts of tax reforms (Creedy, 2001). However, whereas there exist plenty of microsimulation models focussing on private households, the number of models using firm level data is limited (Bardazzi et al., 2004, 238). This finding can be partially attributed to the higher complexity of corporate microsimulation models resulting from discrepancies between commercial law and tax law, timing-effects of corporate tax rules, the diversity of behavioural responses and potential intercompany relations. But above all, the scarce availability of micro-level tax data on corporations represents a vital constraint.

The objective of this paper is to describe the corporate microsimulation model that has been developed at the Centre of European Economic Research (ZEW) in collaboration with the University of Mannheim. Central feature of the model is the processing of financial statements included in the DAFNE data base of the Bureau van Dijk. This approach is motivated by the insight that the information requirement of a flexible corporate microsimulation model goes beyond tax data since only the inclusion of firm specific balance-sheet data in combination with profit and loss account data provides a linkage to the real economic sphere. To focus on the economic sphere is essential to comprise real developments of corporations over time in the simulation process, to capture changes in the legal framework adequately and later on

to integrate behavioural responses to tax reforms. In the microsimulation model the bases for corporate income tax and trade tax are derived endogenously by imputing missing information consistently and simulating tax regulations. The approach allows the investigation of short-term distributional and revenue consequences of potential tax reforms. Yet, the focus of this paper is on a rather technical documentation of the model set-up, its application on potential reform proposals being put forward in subsequent publications.

This paper is organised as follows. Section 2 discusses the relevance and nature of corporate microsimulation models. In this context selected corporate microsimulation models are outlined and fundamental model requirements are highlighted. Section 3 then describes the set-up and the methodical implementation of the corporate microsimulation model put forward by the ZEW. Thereafter, section 4 focuses on possible applications and potential model extensions. Finally, section 5 concludes.

2 Fundamental Issues on the Relevance and Nature of Corporate Microsimulation Models

2.1 Model Based Quantitative Analyses on the Economic Impacts of Taxation

Gaining insights into the economic impacts of taxation requires the application of models since tax regimes often show a high degree of complexity. Various quantitative approaches exist to calculate effective levels of taxation implying either backward-looking concepts or forward-looking concepts. Both concepts stem from the finding that a comparison of statutory tax rates falls short of giving insights on the economic impacts of taxation. Existing backward-looking effective tax measures are usually compiled on the basis of aggregated firm-specific or economic data given in annual accounts thus permitting to assess the actual tax burden borne by companies with respect to firm size, sector or industry. One example for backward-looking effective tax measures are the implicit tax rates.[1] However for this particular measure, difficulties arise to link its development to tax policy changes. Moreover, due to the use of ex-post data, backward looking measures do not allow conclusions on the impact of taxation on investment decisions.

Valid conclusions of the impact of taxation on future investment projects can only be drawn from forward looking effective tax burdens and cost of capital, respectively (Spengel, 1995; Spengel 2003). With regard to the methodology applied for forward looking effective tax bur-

[1] For a comparison of backward-looking concepts and forward-looking concepts see Nicodème (2001).

dens, a distinction can be made between theoretical and model firm approaches. The theoretical models that are used to measure effective tax rates are derived from neoclassical investment theory and consider a hypothetical investment. In the seminal work of King and Fullerton (1984), for the first time, effective marginal tax rates on investments were broadly computed for several countries. This model has been applied in numerous studies and became standard in international tax burden comparisons.[2] The approach of Devereux and Griffith (1999) extends the concept of King/Fullerton by setting out a framework to analyse the impact of taxation on both marginal and discrete investment decisions. The location choice represents a typical example of a decision of this type (Bond, 2000, 171; Devereux, 2000, 113). In contrast to the models derived from investment theory, model firm approaches measure the effective tax burden by simulating the development of a model firm over several years and assessing the tax payments annually. A well-known example of model firm approaches is given by the European Tax Analyzer, a computer-based model that has been developed in a joint research project of the Centre for European Economic Research (ZEW) and the University of Mannheim.[3] Its expertise in the fields of international tax burden comparisons and the evaluation of tax reform proposals has been widely recognised by scientists and policy-makers.

Although differing in the applied approach, the theoretical models of King/Fullerton and Devereux/Griffith as well as the European Tax Analyzer provide condensed and sophisticated information on the effective tax burdens of investments thus revealing tax incentives. The determination of tax incentives is a very important issue in the evaluation of the economic impact of taxation. However, since the described analytical approaches are either based on hypothetical investment projects or on particular model firms, the obtained results can not be generalised by implication. This drawback can only partially be overcome by sensitivity analyses. Hence, no robust conclusions can be drawn from the existing forward looking effective tax measures with regard to political issues beyond tax incentives namely distributional issues and revenue estimation.

Therefore, the existing instruments that are used for the identification of tax incentives should be supplemented by an approach revealing the impacts of taxation on future tax revenue and

[2] For some studies based on the King and Fullerton framework see Alworth, 1988; Crooks et al., 1989; OECD, 1991; European Commission, 1992; Baker and McKenzie, 2001; Gutekunst and Schwager, 2002.
[3] For a detailed description of the model see Spengel, 1995; Jacobs and Spengel, 1996, 2000; Meyer 1996 and Stetter 2005.

the distribution of the tax burden. In order to gain robust results, this approach should be based on a broad data set thus capturing a magnitude of taxpayers. The concept of backward looking effective tax burdens seems to be not an adequate instrument since it is not possible to analyse the distributional effects and revenue implications of reforms ex ante which is a crucial issue for policy makers due to budget constraints. In contrast, the concept of microsimulation models as it is used in economic and social science generally complies with this criterion. Being based on strongly disaggregated data, microsimulation models capture structural differences on the level of micro units thus allowing precise conclusion on the individual financial impacts of tax reforms (Creedy, 2001).

The objectives of microsimulation models are threefold covering revenue estimation, revenue forecast and distributional issues. As opposed to revenue estimation, targeting revenue effects of specific reforms (tax costing), revenue forecasts are implemented to predict the tax revenue for budget purposes over a certain forecast period whereas a main focus is on the point of time of tax payments. Therefore, revenue forecast is not part of policy analysis and will not be considered any further in this paper. Microsimulation models can either be static or dynamic. Whereas static models oppose two stages, dynamic models account for the development within the microsimulation process. Both models can either include behavioural response or not. Generally, private households and companies can be considered as micro units. However, whereas there exist plenty of microsimulation models focussing on private households, the number of models using firm level data is limited (Bardazzi et al., 2004, 238). This finding can be partially attributed to the higher complexity of corporate microsimulation models resulting from discrepancies between business law and tax law, timing-effects of corporate tax rules, the diversity of behavioural responses and potential intercompany relations. In light of the described complexity, special attention should be on the requirements for corporate microsimulation models regarding data-set, model design and the level of detail considered.

2.2 Requirements of Corporate Microsimulation Models

The requirements of corporate microsimulation models are strongly interlinked with their specific purposes. To exploit the advantage of using micro-level data, the data-set applied should be of high quality, up-to date and sufficiently broad (Spahn, 1992, 107). The data base used should ideally provide disaggregated and reliable data on all taxable firms. The employed data should cover tax data, balance-sheet data, profit and loss data and specific additional data (e.g. shareholding structures). The information requirement goes beyond tax data since only the

application of firm specific balance-sheet data as well as profit and loss data provides a linkage to the real economic sphere which is essential when considering development of corporations, changes in the legal framework and behavioural responses to tax reforms. The data should be electronically available for a sufficiently long period of time. Due to data privacy regulations, the access to tax micro-data is prohibited in Germany and many other countries thus imposing considerable constraints on available information. To overcome this restriction, the micro-simulation could be mainly based on balance-sheet data. This approach requires that tax accounting is not entirely separated from financial accounting. There must be a specific set of regulations governing the transformation of profits derived under financial accounting to taxable income. With regard to the German commercial law and tax law this relation is embodied by the authoritative principle ("Maßgeblichkeitsprinzip"). But a comparable linkage exists also in other countries.[4] In case regulations are of optional nature, however, additional information is needed to shed light on how options are practiced under both regimes. Finally, the simulation will then be run on the transformed data-set.

Concerning model building, the complexity of corporate microsimulation models should be met by a clear structure and transparent documentation of the model. In this context a modular set-up has proved to be an adequate approach allowing for a high flexibility (Spahn, 1992, 53). The modules should capture all relevant regulations and account for interdependencies (Bovi, 2003). The modular set-up permits to account quickly for changes in tax provisions and to promptly include or exclude certain modules. Moreover the model can easily be extended by further modules.

Against the background that a corporate microsimulation model should be used in policy analysis (i.e. revenue estimation and identification of distribution effects), it is indispensable that potential reforms can be simulated in great detail. In this context the methodology of adjusting profits derived under commercial law for tax purposes is advantageous since it makes tax provisions defining the corporate tax base explicit. Hence, besides changes in tax rates, proposals affecting the computation of corporate income can be evaluated. To capture timing effects of tax provisions, the microsimulation model should be based on more than one period.

[4] In most EU Member States taxable income is linked to the annual income published in financial statements. For an overview concerning the determination of income in the EU see Endres et al., 2007, 25.

Validating the model is essential to ensure the quality of the derived results. Possible failures may concern the database, assumptions made or the modelling itself. Ideally the validation should take place on the micro level by comparing the model output with actual tax payments that figure in the individual tax accounts.

2.3 Application of Microsimulation Models in Policy Analysis

It has to be stated that corporate microsimulation models do not receive large coverage. But with the Italian project "Development of a System of Indicators on Competitiveness and Fiscal Impact on Enterprise Performance" (DIECOFIS), the Canadian corporate microsimulation model and the BizTax model of the German Institute for Economic Research (DIW) there exist three documented corporate microsimulation models being employed for policy analysis.

All three models have been developed to evaluate revenue effects and distributional consequences of tax reforms. However, due to the country specific constraints in the availability of data, the described approaches differ significantly in the data-set employed. The German BizTax model is operated in cooperation with the German Ministry of Finance. It is based on tax data, more precisely on a stratified sample of the trade tax statistic of 2001 complemented by information from the income statistic of that year. By contrast, the Canadian microsimulation model includes tax data and information on company structure and company accounts. The DIECOFIS model (Castelluci et al., 2003, Oropallo and Parisi, 2005) is based on an integrated dataset comprising published financial statements and survey data on Italian firms. Information on firm specific tax due is not implemented but derived endogenously thus making tax provisions defining the corporate tax base explicit. If it is not possible to simulate missing variables, the DIECOFIS model uses imputation mechanisms that rely on the information given. Except for the Canadian model, all other models use cross-sectional data that is extrapolated by use of macroeconomic data. This extrapolation is problematic since it is hardly possible to forecast the development of firms satisfactory based on cross-sectional data. The obtained results thus might be distorted. Moreover these models are static thus neglecting timing effects of tax regulations. The dynamic Canadian model, in contrast, accounts for those timing effects. With regard to the technical set-up all models make use of a modular structure. A validation of the simulated outputs is operated for the BizTax Model and the DIECOFIS model. In both cases the results are compared with actual tax liabilities. Whereas the validation is satisfactory on individual level it yields considerable distortion on aggregated level.

It can be concluded from this brief outline of the state of research that to date there is no corporate microsimulation model meeting all the requirements outlined in section 2.2 and, hence, permitting comprehensive policy analysis on both tax rates and regulations governing the determination of the tax base. In the same way there is no model that can potentially picture behavioural responses to tax policy changes. The DIECOFIS model may serve as an example to develop a microsimulation model for Germany on the basis of firm specific balance-sheet and profit and loss account data. Like implemented in the DIECOFIS model, this approach must include an adjustment of data derived under commercial law for tax purposes. However, the Italian approach should be extended to a dynamic model thus accounting for timing effects and the actual development of the firm as it is the case for the Canadian model.

3 Methodology of the ZEW Corporate Taxation Microsimulation Model (ZEW TaxCoMM)

3.1 Underlying Micro Dataset

The ZEW approach of a corporate microsimulation model is mainly based on the DAFNE database made available by the Bureau van Dijk. This database contains balance sheets, profit and loss accounts and information on shareholding structures of about 86.000 German corporations (public companies limited by shares, companies limited by shares and limited companies) for a period of 1999-2006. At the current stage of development, the simulation is limited to the period from 2003-2005 thus reducing the number of companies included to 80.000 whereof 17.800 provide data for all three years.[5] This limitation of periods considered allows demonstrating the general operability of the approach and can be expanded depending on the data situation. The employed data set covers the following economic sectors: Construction, Electricity and Water Supply, Hotels and Restaurants, Manufacturing, Mining, Public Administration and Public Services, Trade, Transport and Telecommunications. The firm specific financial data is complemented by using an additional database of the Federal Statistical Office on municipal business tax rates, published annual reports and direct survey data on tax accounting practice.[6] Moreover, two surveys have been undertaken. The first survey was addressed to executive certified tax consultants or certified public accountants and covered the practice of options in the fields of depreciation, production costs, valuation of inventories, goodwill, accrued/deferred items, provisions and methods of loss offsetting. Responses could

[5] These figures refer to the DAFNE database dated July 2007.
[6] A first survey covered about 0.5% of all corporations whereas a second survey was addressed to people working in tax counseling.

be collected on 123 experts working mainly for the four largest German auditing and tax consulting firms (Deloitte, Ernst&Young, PricewaterhouseCoopers and KPMG) but also working for smaller tax consulting firms and in some exemptions for the management board or in executive positions in the financial department or tax department of large corporations. Additionally, in another survey firms randomly drawn from the database were interviewed on the treatment of goodwill for financial accounting and tax accounting purposes and the depreciation methods applied for fixed assets. By this means 327 statements on financial and tax accounting practice could be gained. Supplementing the firm level accounts data by profound knowledge on the accounting practice is crucial in view of the objective of transforming profits derived under commercial law into the tax base for corporate and trade tax purposes. To process the data and to programme tax algorithms, the integrated statistical software Stata (version 10) is used.

3.2 Modular Structure

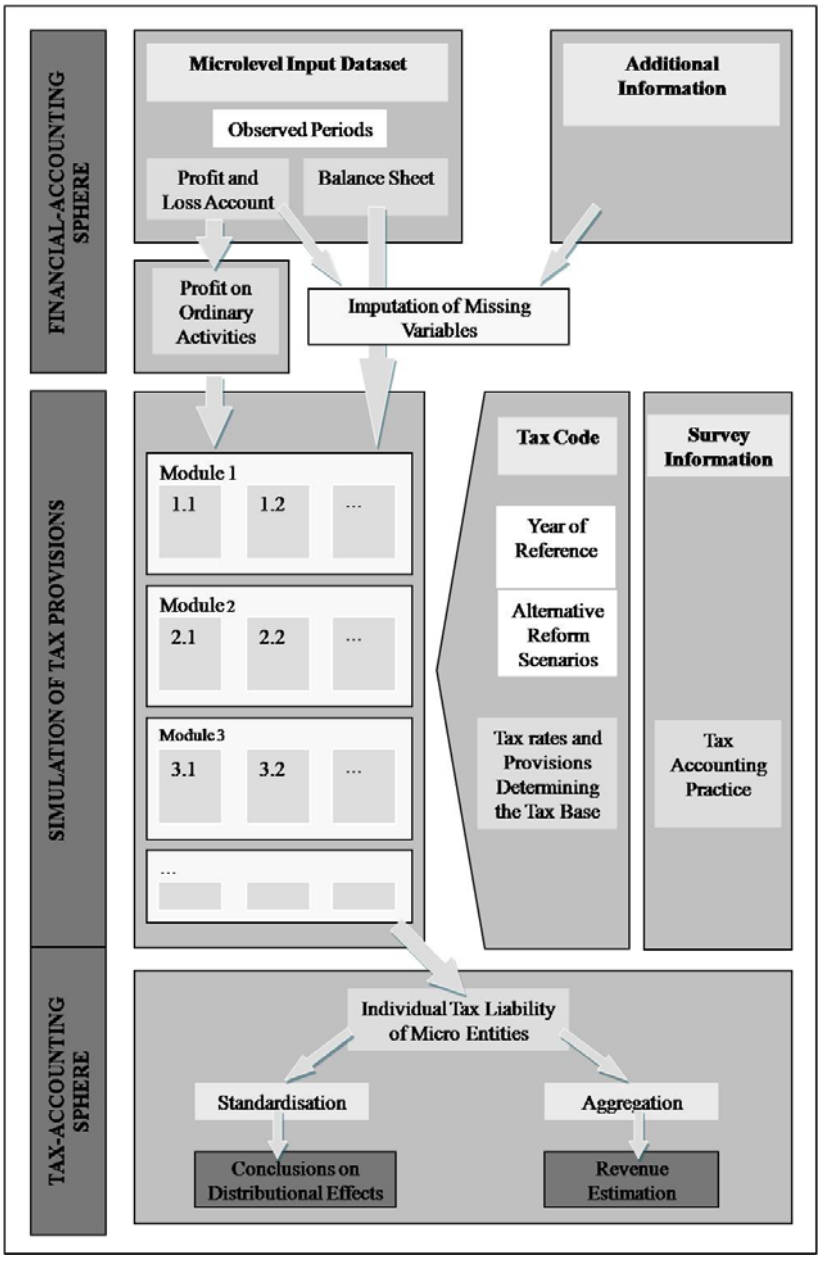
The available dataset and the specific purpose of corporate microsimulation approaches contribute to a natural structure of the proposed model encompassing a financial-accounting sphere and a tax accounting sphere. The chart displayed in figure 1 outlines this structure. The firm-level input data in terms of profit and loss accounts and balance sheet data constitutes the financial-accounting sphere. In contrast, conclusions on the economic effects of tax reforms can only be based on the comparison of pre- and post-reform tax data, thus taking place in the tax accounting sphere. Yet, it is possible to overcome the gap between financial-accounting sphere and tax accounting sphere since necessary modifications of financial accounting profits are fixed in the tax code. The approach put forward here takes the item “profit on ordinary activities” as reported in the firm specific profit and loss accounts as a starting point. The core of the proposed microsimulation model consists of deriving the corporate tax base and trade tax base endogenously by simulating a reference tax code and alternative scenarios. Based on the respective tax base the amount of tax due is calculated for each firm. Table 1 illustrates the adjustments necessary to transform “profit on ordinary activities” to taxable income for the years 2007 and 2008.

Table 1: Transformation of Profit on Ordinary Activities for Tax Purposes (2007, 2008)

	Profit on Ordinary Activities	§ 275 II No 14 / III No 13 CC	
+	Extraordinary Profit/Loss	§ 275 II No 17 / III No 16 CC	
-	Other Taxes	§ 275 II No 19 / III No 18 CC	
	Items requiring modification	**Regulation**	**Module**
+/-	Depreciation	§ 7 ITA	1
+/-	Provisions	§ 5 III-IVb ITA, § 6 I No 3a ITA, § 6a ITA	2
+/-	Creditors	§ 6 I No 3 ITA	3
+/-	Special Capitalised Expenses	§ 269 CC	4
-	Investment Grants and Subsidies	§ 12 Investment Grant Act	5
+	Interest Expenses	§ 8a CTA, § 8 No 1 TTA, § 4h ITA (2008)	6
-	Other Elements of the Financial Result	§ 8b CTA, § 8 No 5, 8 TTA, § 9 No 2, 2a, 7 TTA, Double Taxation Conventions	7
+	Non Deductible Expenses	§ 4 ITA, § 10 CTA	8
+/-	Add-backs & deductions for trade tax	§ 8,9 TTA	9
+/-	Integrated Fiscal Units	§ 14-19 CTA, 2 TTA	10
-	Fiscal Loss Carryforward	§ 10 a TTA, § 8 IV CTA (2007), § 8c CTA (2008)	11
-	Contributions from foreign permanent establishments		12
=	**Tax Base for Trade Tax**	**§ 7 TTA**	
*	**Trade Tax Rate**	**§§ 11, 16 TTA**	
+/-	Depreciation	§ 7 ITA	1
+/-	Provisions	§ 5 III-IVb ITA, § 6 I No 3a ITA, § 6a ITA	2
+/-	Creditors	§ 6 I No 3 ITA	3
+/-	Special Capitalised Expenses	§ 269 CC	4
-	Investment Grants and Subsidies	§ 12 Investment Grant Act	5
+	Interest Expenses	§ 8a CTA, § 4h ITA (2008)	6
-	Other Elements of the Financial Result	§ 8b CTA, § 8 No 5, 8 TTA, § 9 No 2, 2a, 7 TTA, Double Taxation Conventions	7
+	Non Deductible Expenses	§ 4 ITA, § 10 CTA	8
+/-	Integrated Fiscal Units	§ 14-19 CTA, 2 TTA	10
-	Trade Tax	§ 4 IV ITA (2007); Not deductible since 2008	
-	Fiscal Loss Carryforward	§ 10d ITA, § 8 IV CTA (2007), § 8c CTA (2008)	11
-	Contributions from foreign permanent establishments		12
=	**Tax Base for Corporate Income Tax**	**§§ 7,8 CTA**	
*	**Corporate Tax Rate**	**§ 23 CTA**	
*	Assesed Corporate Income Tax Surcharge	§ 4 Solidarity Surcharge Act	

The simulation of tax provisions follows a modular structure, one module being attributed to one distinct item of the financial accounting sphere requiring modification. Several modules might even be divided into sub-modules to account for the complexity of specific regulations. For instance the module simulating depreciation provisions consists of six modules each referring to assets that are subject to similar rules. The modular structure is of considerable strength in view of simulating different tax reform scenarios, since modules can be modified or switched on and off separately thus allowing for high flexibility. Yet, the modular structure should not conceal interdependencies that exist within the tax regulations and between different types of taxes. In the proposed model, those interdependencies are explicitly taken into account. A technical description of the different modules will be given in section 3.3.

Figure 1: Structure of the ZEW Microsimulation model



With regard to the level of detail considered, the main idea is to use all information available in order to simulate most precisely the individual tax assessment of all firms included in the database. To ensure this, mechanisms are developed to impute missing variables on the basis of information included in the dataset, survey data and external data sources. Although many corporate tax models assume a tax minimizing strategy of individual entities, a different approach will be used here. In view of non-tax reasons or strategies to reduce tax compliance costs or to smooth tax payments over time, firms might deviate from the tax-minimizing strategy. To capture this, survey data on tax accounting practices is exploited to shed light on the issue to what extent firms make use of options in tax law.

The bases for trade tax and corporate tax, as final output of the simulation process, are subject to trade tax and corporate income tax respectively. By applying the respective tax rates the final tax due can be computed for each individual firm. For the purpose of the proposed microsimulation identity of assed tax liability and tax payment is assumed. In order to draw robust conclusions on distributional and revenue effects, additional computations are necessary. For reasons of comparability the individual tax due has to be transformed to a reliable measure of the effective tax burden borne by the firm. This approach ensures that conclusions on distributional issues of a tax system remain unaffected by the absolute level of income of the considered companies. The determination of revenue effects requires an aggregation of the individual tax due. Section 3.4 outlines the proceeding chosen.

3.3 Description of Specific Modules

3.3.1 Depreciation

The module covering depreciation provisions is mainly based on balance sheet data or more precisely on the differentials of carrying amounts CA_n for each type of asset.[7] The general set-up of this module is illustrated in figure 2. The objective of a first step is to transform carrying amounts (stock figure) endogenously into flow figures. In this context the equation

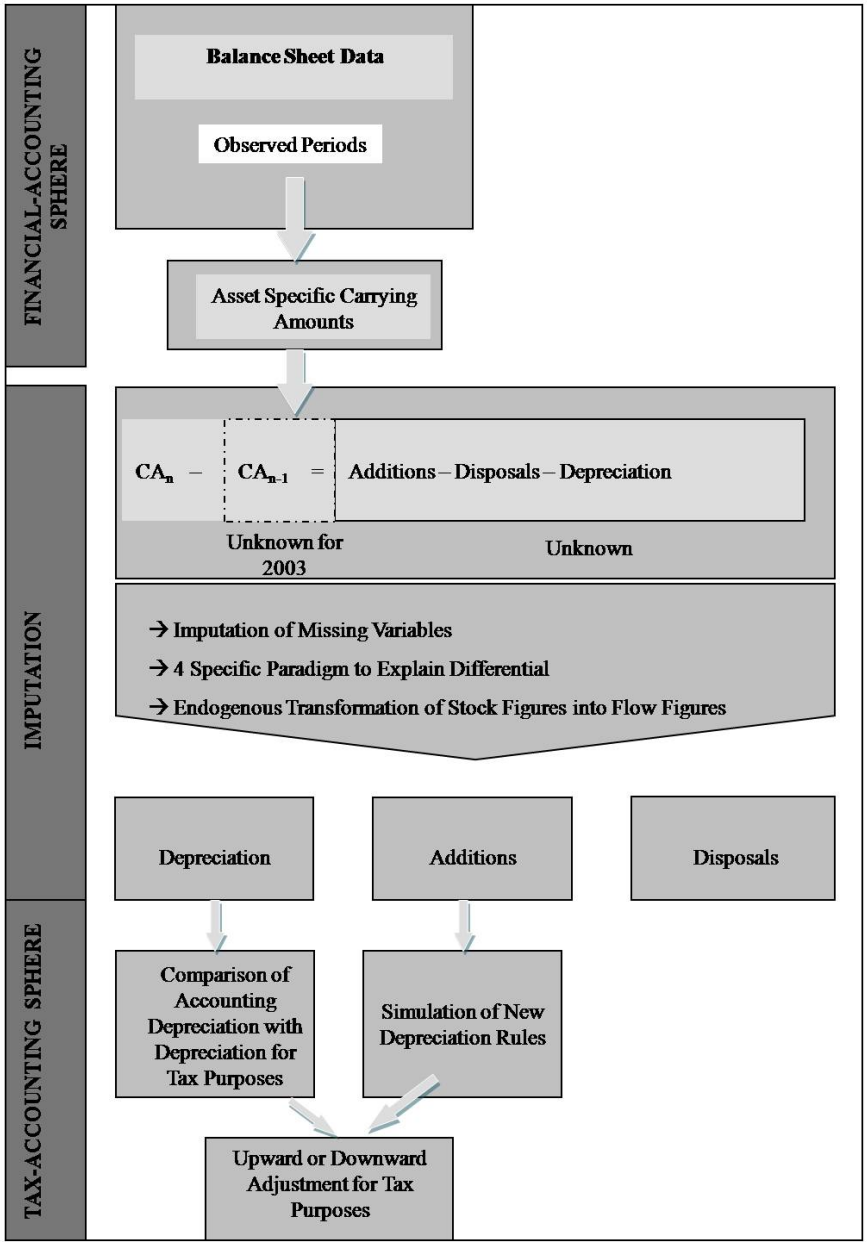
$$CA_n - CA_{n-1} = Additions - Disposals - Depreciation \qquad (1)$$

constitutes the core element of the imputation mechanism.[8] The flow figures displayed on the right-hand side of the equation are unknown for the considered years.[9] Although depreciation is included in the profit and loss account it does not make this transformation obsolete since companies are not obliged to split the depreciation position in the profit and loss account according to the underlying depreciable assets. Moreover, it is crucial to determine annual additions for each type of assets since modified depreciation rules always apply to newly acquired assets. Exploiting the financial-accounting data available in great detail ensures that the imputation mechanism used yields suitable results that are in line with the empirical development of carrying amounts. When necessary the imputation mechanism also relies on survey data on

[7] In case only groups of assets are given in the balance sheet, the respective value is broken down to single types of assets according to the average proportions observed for firms with complete information.
[8] Additions comprise acquisitions and other increases in balance sheet items except for appreciations that are excluded in the microsimulation model by assumption.
[9] Moreover for the year 2003 the carrying amount of the previous year is not included in the data.

the tax accounting practice. For the imputation of missing variables, it is necessary that regulations are applied that had been in force in the respective years of data collection, namely 2003-2005 in the model version presented here. Hence, for those years an adjustment of business profits is only required if tax accounting practice deviates from financial accounting practice. In case changes in tax law are simulated, however, new tax regulations are applicable for newly acquired assets thus making further adjustments of the business profits necessary.

Figure 2: Set-Up of the Depreciation Module



Taking the peculiarities of assets with regard to frequency of acquisition and depreciation into account, four distinct paradigms are developed to explain the differential in carrying amounts as displayed in equation (1). Table 2 provides a classification of these paradigms indicating for which type of asset it is applied.

Table 2: Classification of Models Explaining Asset Specific Differentials in Carrying Amounts

Paradigm	Additions	Depreciation		Applied in Module
		Regular	Irregular	
1	not continously	yes	no*	1.1 Goodwill 1.2 Immovable Property
2	continously	yes	yes	1.3 Intangibles 1.4 Tangible Fixed Assets
3	continously	no	yes	1.5 Current Assets
4	not continously	yes	yes	1.6 Accrued/Deferred Items

*No information available and reconstruction not possible.

As outcome of the imputation mechanism, values for regular and irregular depreciation, additions and disposals are obtained for each type of assets and each firm. A remark should be made on depreciation. Up to this point, depreciation has been derived endogenously for each asset according to financial accounting rules. Hence, the computed amount of depreciation replaces the aggregate reported in the profit and loss account which is, therefore, eliminated for the tax base. Differences between financial accounting rules and tax accounting rules with regard to depreciation have not yet been taken into account. Therefore in a next step, the values obtained for depreciation are compared with the respective values derived under tax law. In the event of deviations, an upward or downward adjustment of the tax base is implemented. A change in depreciation regulations is only applicable to new investments. Therefore, when simulating the introduction of modified depreciation provisions, the focus is on asset specific, periodical additions derived from the imputation system. This simulation might also contribute to upward or downward adjustments of the tax base.

Since the endogenous transformation of differentials in carrying amounts to relevant flow parameters constitutes an important and complex part of this module, the proceeding will now be outlined in greater detail. This will be done by following the classification in table 2.

Paradigm 1: Differentials in carrying amounts arise mainly from straight-line depreciation

Paradigm 1 explains differentials in carrying amounts mainly by straight-line depreciation. Hence, it can be applied to assets that are not acquired or sold on a regular basis and are only

subject to straight-line depreciation. Generally, goodwill and immovable property[10] fit that definition. Although impairment losses of these positions might occur, this is not considered here since there is no information available on this issue and it is not possible to derive that information in a consistent manner.

It can be seen from the data that immovable property is subject to greater fluctuations since, in contrast to goodwill, it can be traded separately. While for both types of assets the differential of carrying amounts is predominantly explained by straight-line depreciation, irregular additions and disposals might also play a role for immovable property. Therefore the imputation mechanism is split up into two sub-modules taking these particularities into account.

Module 1.1: Depreciation of Goodwill

The obligation to capitalise an acquired goodwill for tax purposes (§ 5 para. 2 ITA) is opposed to an optional capitalisation according to commercial law (§ 255 para. 4 clause 1 CC). Yet, survey data documents that firms capitalise an acquired goodwill for financial accounting purposes. Hence, as regards the capitalisation of goodwill, an analogous treatment will be assumed for commercial law and tax law purposes. The differences between subsequent carrying amounts reported for acquired goodwill are entirely attributed to straight-line depreciation. Hence, the amounts of depreciation on goodwill under financial accounting can be imputed directly. Yet, a requirement to adjust the tax base arises from differing useful lifetimes applied. Whereas for depreciation under the German tax law the useful lifetime of goodwill is fixed at 15 years (§ 7 para. 1 clause 3 ITA), the commercial code is not entirely precise on this issue (§ 255 para. 4 clause 2 and 3 CC).[11] According to survey data, acquired goodwill is in practice either depreciated over four or 15 years. It is thus necessary to identify cases in which goodwill is only depreciated over four years under financial accounting thus requiring an adjustment for tax purposes. This identification, however, is not straightforward since the database does not include information on the applied depreciation period. In the context of the proposed microsimulation model the following ratio d is used as indicator for the remaining life of an asset:

$$d_n = \frac{CA_n - CA_{n-1}}{CA_{n-1}} = \frac{Depr_n}{CA_{n-1}} \qquad (2)$$

[10] Land is not depreciable but buildings are subject to straight-line depreciation.
[11] Acquired goodwill can be depreciated over a maximum of four years or over its useful life.

Since straight-line depreciation is assumed each possible ratio can be assigned precisely to a specific remaining lifetime. In case goodwill is depreciated over 15 years, the depreciation in the first year amounts to $\frac{1}{15}$ of the carrying amount at the beginning of the year. Hence, from a computed ratio of $\frac{1}{15}$ it can be concluded that the goodwill is in its first year of use thus having a remaining lifetime of 14 years. In the same way a ratio of $\frac{1}{14}$ indicates a remaining lifetime of 13 years, a ratio of $\frac{1}{4}$ indicates a remaining lifetime of 3 years and so on. It can be concluded from this reasoning that ratios below 25% only occur in case the remaining lifetime exceeds 3 years. Whereas this outcome is not possible for a goodwill that is depreciated over four years, it is possible if the goodwill is depreciated in unison with tax law over 15 years. Consequently, whenever the computed ratio ranges below 25% an adjustment of allowances for tax purposes is not necessary.[12] Unfortunately the converse does not hold true: Ratios above 25% can occur within the last four periods of both a 15 years lifetime and a four years lifetime thus making a distinction impossible. Adjustments for tax purposes are, therefore, based on a random process that is run whenever the ratio yields a value of 25% or more. This random process takes into account that according to the survey data 25% of all firms depreciate goodwill over 4 years. Moreover it is assumed that the probability of acquisition is uniformly distributed over the period of 15 years that constitutes the useful life for tax purposes. According to the Bayes'theorem, in case a ratio of 25% or larger is observed, the probability that operating income has to be adjusted for tax purposes amounts to 55.55%[13]. The required adjustment then captures the difference between the observed depreciation and the depreciation allowed for tax purposes. Cases with one or more missing observation are worth particular consideration. Three remarks should be made on this issue:

- If no goodwill is reported in the balance sheet in the first year included in the database it is assumed that the goodwill is acquired at the end of the year of its first occurrence in the data. In case goodwill is assumed to be acquired in period n>1 an exception to the 25% rule outlined above applies since depreciation in the subsequent year must definitely be $\frac{1}{15}$ of the initial value to be in line with tax law. Therefore, in order to be consistent with the assumption of acquisition in the previous year, adjustments for tax purposes become necessary for all ratios above $\frac{1}{15}$. In contrast, an acquired goodwill that is only reported for the last year observed in the data does not require any adjust-

[12] An exception applies if the acquisition of goodwill occurs in 2004. For explanation see next paragraph.

[13] $55.55\% = \frac{0.25 \cdot 4/4}{0.75 \cdot 4/15 + 0.25 \cdot 4/4}$.

ments since it is assumed that the goodwill is acquired at the end of the year thus inducing no depreciation in that year.

- If an acquired goodwill is reported for the first year observed in the data but not in all subsequent years, the depreciation ratios in subsequent years indicate whether the goodwill is completely amortised and is therefore no longer reported in the balance sheet or whether goodwill has been left out the data base by mistake. In case of a mistake, the data base is amended by replacing missing values with carrying amounts that correspond to the observed depreciation ratio.
- If missing observations on carrying amounts preclude the calculation of the depreciation ratio, the random process described above is applied.

In case increasing carrying amounts are reported this is taken as indication for additions. The amount of additions is derived by comparing the observed carrying amount with the carrying amount of the previous period reduced by the value of straight-line depreciation applicable.

Module 1.2: Depreciation of Immovable Property

Whereas land is not depreciable, buildings that are used for business purposes are subject to straight-line depreciation. According to § 7 para. 4 clause 1 number 1 ITA the annual depreciation rate amounts to 3% of the acquisition costs if buildings are acquired or built after December 31, 2000. Other rates apply to buildings that have been built or acquired before that date. According to the applied survey data, companies do not deviate from the tax regulations concerning depreciation of buildings when calculating the respective allowance for financial accounting purposes. Hence, it is assumed that depreciation of buildings as derived endogenously under the application of commercial law is equal to the depreciation for tax purposes thus not making adjustments necessary.

In case the carrying amounts of immovable property are falling throughout the period observed in the data, the differentials in carrying amounts are entirely attributed to depreciation. It is assumed that net additions of land and buildings are zero. Whenever there is an increase in the carrying amounts between two years or a carrying amount of immovable property is reported for the first time in the data, this is taken as indication of positive net additions.[14] In this setting, differentials in carrying amounts are explained by both depreciation and additions, making it more complex to derive the value of each flow figure. However, if carrying

[14] Due to information deficit it is assumed that additions consist of 50% non depreciable land and 50% buildings.

amounts can be observed for one previous and one subsequent period, the carrying amount increasing from the previous to the current period it is possible to derive additions by resolving the following system of three equations with three unknowns.

$$CA_{n,h} = CA_{n-1,h} + Additions_{n,h} - Depr_{n,h}^{old}$$

$$Depr_{n+1}^{new} = \alpha \cdot 0.5 \cdot Additions_{n,h}$$

$$CA_{n+1,h} = CA_{n,h} - Depr_{n+1,h}^{old} - Depr_{n+1,h}^{new} \quad (3)$$

Due to straight-line depreciation $Depr_n^{old}$ equals $Depr_{n+1}^{old}$. Therefore additions in period n are given by

$$Additions_n = \frac{2 \cdot CA_n - CA_{n-1} - CA_{n+1}}{1 + \alpha \cdot 0.5} \quad (4)$$

If the development of carrying amounts indicates an increase in two subsequent periods the described approach is not feasible. Hence, in this case average depreciation ratios have to be applied. These ratios are derived by dividing the value of depreciation derived from falling carrying amounts into relation with the carrying amount of the respective previous period.

Finally, in case of constant carrying amounts most likely scenarios are values for immovable property only comprising land that is not depreciable (as there are no buildings or existing buildings are already written off). In this case depreciation is set to zero.

Paradigm 2: Differentials in carrying amounts arise from current transactions and depreciation.

Paradigm 2 explains differentials in carrying amounts by an interaction of additions, disposals, regular and irregular depreciations. Those interactions are usually found for intangible and tangible fixed assets. In the context of microsimulation, keeping in mind that the four determinants of the observed differentials are unknown, the aim should be to provide a consistent concept to determine these parameters.

The Perpetual-Inventory-Method[15] (PIM) allows deriving the value of depreciations for a specific asset solely on the basis of two stock figures. The concept is based on a vintage structure

[15] The Perpetual-Inventory-Method is originally used in the context of national accounts to produce an estimate of the stock of fixed assets in existence.

of investments and estimates on the average service life of all assets.[16] In the following a distinction will be made between the average service life $\tilde{s}$ constituting the life of an asset from economic or technical perspective, the useful life $\bar{s}$ that is applicable for depreciation purposes and the actual life s given by the period the asset is actually in use. In its original setting, the PIM is calibrated by use of long macroeconomic time series. In the context of the proposed microsimulation model time series are not available. Nevertheless the idea of the PIM can be used for the imputation mechanism when the following assumptions are made:

- Tangible and intangible fixed assets being reported in the balance sheet of a specific year can be assigned to different investment vintages, the assets of each investment vintage i being acquired at the same time in the past (in period $n - i$).
- The historical acquisition costs in real terms are identical for each investment vintage but the nominal acquisition costs increase by a rate p that might be an inflation rate or a growth rate. Moreover for periods prior to observed data, it is assumed that fixed assets are acquired continuously.[17] Another outcome of continuous additions is that the number of vintages is equal to the depreciation period $\bar{s}$. The assumption on continuous acquisitions is abandoned for the years included in the dataset.
- The actual useful life s of an asset deviates with a certain probability from the average useful life $\tilde{s}$ of the respective asset-type.[18] In order to account for the randomness of the actual useful life a discard pattern is defined (Mohr and Gilbert, 1996, 8). The discard pattern is based on the density function of a truncated normal distribution, giving the expected proportion of an investment vintage that decays in year s of useful life. The function is given by

$$f(s|\,\tilde{s},\sigma) = \begin{cases} \dfrac{e^{\frac{-(s-\tilde{s})^2}{2\sigma^2}}}{\sigma \times \int_{-2}^{2} e^{-\frac{1}{2}X^2} dX}, & 0.5\tilde{s} \le s \le 1.5\tilde{s} \\ 0, & \text{otherwise} \end{cases} \qquad (5)$$

with $X = \left(\frac{s-\tilde{s}}{\sigma}\right) \in [-2;2]$ and standard deviation $\sigma = 0.25 \cdot \tilde{s}$.

- Investments and disposals take place at the end of a period.

[16] In the following a distinction will be made between the service life constituting the lifetime of an asset from economic or technical perspective, the useful life that is applicable for depreciation purposes and the actual life given by the period the asset is actually in use.
[17] This assumption becomes necessary due to the lack of micro-level time series on investments.
[18] The deviation can be explained by accident, theft, fire or spontaneous obsolesce for example.

Based on the described assumptions the transformation of observed differentials in carrying amounts for the years 2003-2005 into the relevant flow figures is carried out in 3 steps:

Step 1: For each type of asset the first carrying amount observed in the data (i.e.: year 2003) constitutes the starting point. From this carrying amount the historical acquisition costs of all included investment vintages are derived.

Step 2: The acquisition costs of each vintage are carried forward taking depreciation and discard into account. Summing up vintage specific carrying amounts yields the a-priori carrying amount for the considered asset.

Step 3: For each type of asset and each year the derived a-priori carrying amount is opposed to the corresponding carrying amount observed in the data (named a-posteriori carrying amount). Since depreciation and discard is already incorporated in the computation of a-priori carrying amounts the difference between a-priori and a-posteriori carrying amounts is solely explained by acquisitions or disposals.

In the following the three steps will be explained in a more detailed and formula based way.

Step 1

For company h the carrying amount in the first year of observation equals the sum of vintage specific carrying amounts $vCA_{i,l,h}^{apost}$ in period one, each investment vintage being indicated by i.

$$CA_{1,h}^{apost} = \sum_{i=0}^{\bar{n}} vCA_{i,1,h}^{apost} \tag{6}$$

The vintage specific carrying amount of vintage i in period 1 is obtained by deducting accumulated depreciation and irregular depreciation from the historical acquisition cost. The following formula assumes straight-line depreciation.

$$vCA_{i,1,h} = A_{i,h} \cdot \left[1 - \underbrace{i \cdot \frac{1}{\bar{s}}}_{\text{Straight-line Depreciation}} + \overbrace{\sum_{s=0}^{i} (i-s) \cdot \frac{1}{\bar{s}-s} \cdot \left(1 - \frac{1}{\bar{s}}\right) \cdot f_{\tilde{s}}(s)}^{\text{Correction Term}} - \underbrace{\sum_{s=0}^{i} \left(1 - \frac{s}{\bar{s}}\right) \cdot f_{\tilde{s}}(s)}_{\text{Irregular Depreciation}}\right]$$

$$= A_{i,h} \cdot \varphi_{i,1,h} \tag{7}$$

The correction term accounts for the reduction of straight-line depreciation due to irregular depreciation from previous periods. With the assumption that $A_{i,h} = A_{\bar{s},h} \times (1-p)^{\bar{s}-i}$ holds, equation 6 can be rewritten as

$$CA_{1,h}^{apost} = \sum_{i=0}^{\bar{s}} \varphi_{i,1,h} \cdot A_{\bar{s},h} \cdot (1+p)^{\bar{s}-i} \tag{8}$$

Since the carrying amount $CA_{1,h}^{apost}$ can be observed in the data and $\varphi_{i,1,h}$ is fixed, too, equation 8 can be resolved for the real historical acquisition costs $A_{\bar{s},h}$.

$$A_{\bar{s},h} = CA_{1,h}^{apost} \cdot \left[\sum_{i=0}^{\bar{s}} \varphi_{i,1,h} \cdot (1+p)^{\bar{s}-i} \right]^{-1} \tag{9}$$

On this basis historical acquisition costs can be determined for each investment vintage.

Step 2

The objective of step 2 is to calculate hypothetical a-priori carrying-amounts for periods $n > 1$. The calculation of an a-priori carrying amount for period 1 is obsolete since by the set-up of step 1, it is equal to the a-posteriori carrying amount. Basically the equation to carry forward the historical acquisition costs of all investment vintages is the same as in equation 7. However, it has to be kept in mind that in each period $n > 1$ a-priori carrying amounts are compared to the observed a-posteriori carrying amounts, the difference yielding acquisitions or disposals. Since only disposals concern existing investment vintages equation 7 has to be extended by adjustments for historical disposals and their effects on the depreciable amount.

$$vCA_{i,n,h}^{apriori} = A_{i,h} \cdot \left(\varphi_{i,n,h} - \sum_{l=1}^{min[i-1;n-2]} \varepsilon_{i-l,n-l,h} + \sum_{l=1}^{min[i-1;n-2]} \frac{1}{\bar{s}-(i-l)} \cdot \varepsilon_{i-l,n-l,h} \right) \tag{10}$$

The calculation of the correction term $\varepsilon_{i-l,n-l,h}$ is explained in step 3. The first period for which a correction for disposals might be indicated is period 2 or the first period within the useful life of the investment vintage for which deviations in a-priori and a-posteriori carrying amounts can be calculated. For $n \leq 2$ no historical disposals exist since the a-priori carrying amount in period 1 is equivalent to its a-posteriori counterpart and for previous periods not

included in the database it is assumed that the capital stock is kept constant in real terms. The sum of vintage specific carrying amounts yields the a-priori carrying amount for period n.

$$CA_{n,h}^{aproiri} = \sum_{i=1}^{\bar{s}} vCA_{i,n,h}^{aproiri} \tag{11}$$

Note that the sum starts at $i = 1$ since the carrying amount of investment vintage $i = 0$ that is equivalent to acquisition costs of new investment in the respective period is derived endogenously in step 3.

Step 3

The a-priori carrying amount that has been determined in step 2 differs from its empirical counterpart given in the database. Depending on the sign of the difference between a-posteriori and a-priori carrying amount, additions or disposals are imputed to reconcile hypothetical carrying amounts with the observed carrying amounts. The absolute amount of disposals is given by

$$E_{n,h} = \left(CA_{n,h}^{apost} - CA_{n,h}^{apriori}\right) \cdot (-1). \tag{12}$$

The absolute amount of disposals has to be broken down to vintage specific disposals beginning per assumption with the oldest investment vintage that is not yet written off.

$$E_{i,n,h} = \begin{cases} CA_{i,n,h}^{apriori}, & E_{n,h} - \sum_{j=i+1}^{\bar{s}} E_{j,n,h} \geq G_{i,t,h}^{apriori} \\ E_{n,h} - \sum_{j=i+1}^{\bar{s}} E_{j,n,h}, & E_{n,h} - \sum_{j=i+1}^{\bar{s}} E_{j,n,h} < G_{i,t,h}^{apriori} \\ 0, & E_{n,h} - \sum_{j=i+1}^{\bar{s}} E_{j,n,h} = 0 \end{cases} \forall\, i = \bar{s}, \bar{s}-1, \bar{s}-2, \ldots, \bar{s}-(\bar{s}-1). \tag{13}$$

Dividing vintage specific disposals by the respective acquisition costs facilitates its consideration in the relevant equations (e.g. in equation 10).

$$\varepsilon_{i,n,h} = \frac{E_{i,n,h}}{A_{i,h}} \tag{14}$$

If the observed a-posteriori carrying amount exceeds the derived a-priori carrying amount, the difference is explained by additions that occured in the respective period.

$$CA_{n,h}^{apost} - CA_{n,h}^{apriori} > 0 \Rightarrow \left(1 - f_{\tilde{n}}(0)\right) \cdot CA_{0,n,h} \tag{15}$$

Generally, $f_0(0) = 0$ and therefore the determined differential is equal to the acquisition costs of the new investment vintage $i = 0$. In case that tax reform proposals are simulated, potential changes in depreciation regulations on fixed assets apply to the determined new investments. Further adjustments of operating income become necessary if depreciation rules applicable in the reference period differ from depreciation rules underlying the imputation mechanism referring to the years 2003-2005. Having derived additions and disposals endogenously it is now possible to calculate the amount of regular and irregular depreciation and to compare it with the respective values resulting from the application of tax law.

Paradigm 2 and the related approach are applied to intangible (module 3) and tangible (module 4) fixed assets. Module 3 and 4 differ solely in the assumption on asset specific average useful lives and the depreciation method implemented. With regard to average useful life of tangible fixed assets, depreciation charts published by the German Ministry of Finance serve as the major source of information. However, these charts do not include intangible assets and evidence from literature is ambiguous. Taking the 160 prime standard companies into account that were included in DAX30, MDAX, SDAX or TecDAX on March 31, 2008, the average useful life assumed for depreciation purposes varies from 3 to 50 years. Detailed results on useful life of intangible and tangible assets depending on economic sectors are displayed in table 3. According to the branch of each considered firm and the corresponding useful life of intangible and tangible fixed assets the parameter $\bar{s}$ is used to adjust the imputation model. It is assumed here that the useful life $\bar{s}$ is equal to the service life $\tilde{s}$ since from the year 2000 onwards the published depreciations charts also rely on the technical lifetime of an asset.

Table 3: Average useful life assumed for depreciation under financial accounting and tax accounting

Economic Sectors	Average useful life of	
	Intangible fixed assets	Tangible fixed assets
Mining and Manufacturing	7.10	7.72
Electricity and Water Supply	15.09	14.25
Construction	7.63	8.28
Trade, Hotels and Restaurants	6.17	9.14
Transport and Telecommunications	7.77	11.46
Public Administration and Public Services	5.03	8.22

Besides the differences in useful life, the accounting practice concerning depreciation methods applied varies between intangible and tangible fixed assets. Whereas intangible assets are mainly depreciated on a straight-line bases under both financial and tax accounting regimes, the proportion of companies applying the declining-balance method to tangible fixed assets

amounts to 40% according to survey data. Since according to the authoritative principle the recognition of declining-balance depreciation for tax purposes requires a corresponding treatment for financial accounting, it is assumed that both are equivalent. However, the declining method is only applicable until 2007. The general approach when assuming declining-balance depreciation with switch-over to straight-line is the same as outlined above and will, therefore, not be repeated here. Yet the values of the vintage specific a-posteriori carrying amounts $vCA_{i,l,h}^{apost}$ and the vintage specific a-priori carrying amounts $vCA_{i,n,h}^{apriori}$ differ. Therefore equation (16) replaces equation (7) and equation (17) replaces equation (10). Based on these equations, the mathematical operations to derive additions and disposals are the same as above. The switch between declining-balance depreciation and straight-line depreciation takes place after $\bar{s} - \frac{1}{\theta} + 1$ periods.

$$
\begin{aligned}
vCA_{i,1,h}^{apost} = & \left[(1-\theta)^{min\left[\bar{s}-\frac{1}{\theta}+1;i\right]} \cdot \left[1 - \sum_{s=0}^{min\left[\bar{s}-\frac{1}{\theta}+1;i\right]} f_{\bar{s}}(s) \right] - \left(i - min\left[\bar{s} - \frac{1}{\theta} + 1; i \right] \right) \cdot \frac{1}{\bar{s} - \left(\bar{s} - \frac{1}{\theta} + 1 \right)} \right. \\
& \cdot (1-\theta)^{min\left[\bar{s}-\frac{1}{\theta}+1;i\right]} \cdot \left[1 - \sum_{s=0}^{min\left[\bar{s}-\frac{1}{\theta}+1;i\right]} f_{\bar{s}}(s) \right] \\
& + \sum_{s=\bar{s}-\frac{1}{\theta}+2}^{max\left[\bar{s}-\frac{1}{\theta}+1;i\right]} (i-s) \cdot \frac{1}{\bar{s}-s} \cdot \left(1 - \frac{s - \left(\bar{s} - \frac{1}{\theta} + 1 \right)}{\bar{s} - \left(\bar{s} - \frac{1}{\theta} + 1 \right)} \right) \cdot (1-\theta)^{\bar{s}-\frac{1}{\theta}+1} \cdot f_{\bar{s}}(s) \\
& \left. - \sum_{s=\bar{s}-\frac{1}{\theta}+2}^{max\left[\bar{s}-\frac{1}{\theta}+1;i\right]} \left(1 - \frac{s - \left(\bar{s} - \frac{1}{\theta} + 1 \right)}{\bar{s} - \left(\bar{s} - \frac{1}{\theta} + 1 \right)} \right) \cdot (1-\theta)^{\bar{s}-\frac{1}{\theta}+1} \cdot f_{\bar{s}}(s) \right] \cdot A_{i,h}
\end{aligned}
\tag{16}
$$

$$
\begin{aligned}
vCA_{i,n,h}^{apriori} = & \left[(1-\theta)^{min\left[\bar{s}-\frac{1}{\theta}+1;i\right]} \cdot \left[1 - \sum_{s=0}^{min\left[\bar{s}-\frac{1}{\theta}+1;i\right]} f_{\bar{s}}(s) \right] - \left(i - min\left[\bar{s} - \frac{1}{\theta} + 1; i \right] \right) \cdot \frac{1}{\bar{s} - \left(\bar{s} - \frac{1}{\theta} + 1 \right)} \right. \\
& \cdot (1-\theta)^{min\left[\bar{s}-\frac{1}{\theta}+1;i\right]} \cdot \left[1 - \sum_{s=0}^{min\left[\bar{s}-\frac{1}{\theta}+1;i\right]} f_{\bar{s}}(s) \right] \\
& + \sum_{s=\bar{s}-\frac{1}{\theta}+2}^{max\left[\bar{s}-\frac{1}{\theta}+1;i\right]} (i-s) \cdot \frac{1}{\bar{s}-s} \cdot \left(1 - \frac{s - \left(\bar{s} - \frac{1}{\theta} + 1 \right)}{\bar{s} - \left(\bar{s} - \frac{1}{\theta} + 1 \right)} \right) \cdot (1-\theta)^{\bar{s}-\frac{1}{\theta}+1} \cdot f_{\bar{s}}(s) \\
& - \sum_{s=\bar{s}-\frac{1}{\theta}+2}^{max\left[\bar{s}-\frac{1}{\theta}+1;i\right]} \left(1 - \frac{s - \left(\bar{s} - \frac{1}{\theta} + 1 \right)}{\bar{s} - \left(\bar{s} - \frac{1}{\theta} + 1 \right)} \right) \cdot (1-\theta)^{\bar{s}-\frac{1}{\theta}+1} \cdot f_{\bar{s}}(s) \\
& - \sum_{l=\max\left[1;i-\left(\bar{n}-\frac{1}{\theta}\right)\right]}^{min[i-1,n-2]} (1-\theta)^{l} \cdot \varepsilon_{i-l,n-l,h} \\
& \left. - \sum_{l=min\left[1;i-\left(\bar{s}-\frac{1}{\theta}\right)\right]}^{\min\left[i-\left(\bar{s}-\frac{1}{\theta}+1\right);n-2\right]} \varepsilon_{i-l,n-l,h} + \sum_{l=min\left[1;i-\left(\bar{s}-\frac{1}{\theta}\right)\right]}^{\min\left[i-\left(\bar{s}-\frac{1}{\theta}+1\right);n-2\right]} \frac{1}{\bar{s}-(i-l)} \varepsilon_{i-l,n-l,h} \right] \cdot A_{i,h}
\end{aligned}
\tag{17}
$$

Paradigm 3: Differentials in carrying amounts arise from continuous additions, disposal and irregular depreciation.

The approach of paradigm 3 differs from the previous concepts since it is not based on a systematic allocation of the acquisition costs over the useful life of an asset. In contrast, differentials in carrying amounts are explained by acquisitions or disposals and impairment losses from irregular depreciation. This holds true for current assets and financial non-current assets. With regard to acquisitions, the provisions governing recognition of current assets might differ between the financial accounting and tax accounting thus making adjustments necessary. These differences concern production costs of internally generated inventories[19] and applicable methods for simplified valuation of inventories[20]. However, financial accounting practices on recognition of current assets being close to tax accounting practices, the adjustment of operating income can be omitted. Turning to irregular depreciation, it is indicated in case the recoverable amount falls below the carrying amount. Yet, it has to be stated that firm specific information on this issue is extremely scarce. As regards inventories and securities, there is neither any asset-specific information on the amount of irregular depreciation reported in the database nor are there any indications on the recoverable amount that could be used to derive the impairment loss endogenously. Therefore no simulations are implemented.

As for receivables, in contrast, information is available that allows approximating impairment losses. Survey data on payment behaviour collected from 8.000 firms provides the average percentage of receivables that became definitely irrecoverable in the considered period.[21] These ratios range from 1.85% in 2003 to 2.25% in 2004 and 2005. According to a decree of the German Ministry of Finance from 1995 (Jaudzims and Münch, 1996, 2293), lump sum valuation allowance for doubtful accounts are not accepted for tax purposes when exceeding 1% of total receivables. This limitation is not considered relevant here since the ratios given above include lump sum and individual valuation allowance for doubtful accounts. Keeping in mind that the value of receivables in the balance sheet already constitutes the recoverable amount, the ratios on irrecoverable receivables can be used to derive the value of receivables prior to the impairment. On this basis, the ratios on irrecoverable receivables that are valid in the reference period of policy simulation could be applied to simulate impairment losses on

[19] According to tax law the minimum recognisable value includes direct costs and related overhead costs whereas the commercial code only requires direct costs to be capitalised.
[20] Only the last-in-first-out and the average method are allowed for tax purposes.
[21] This data was collected by Intrum Justitia to determine the National Risk Index for the periods of 2003-2006, see http://www.intrum.de.

receivables. The derived impairment losses reduce both the base of corporate income tax and trade tax. Whereas the ITA only recognises impairment losses in case of permanent asset impairment, the German CC employs a wider concept including also temporary impairment of current assets and financial non-current assets. Hence, in the context of the proposed microsimulation model, this discrepancy might theoretically entail adjustments for tax purposes. Yet, since there is no adequate information available, the differences between temporary and permanent impairment are disregarded for the purpose of microsimulation. Especially with regard to the recognition of inventories this drawback can be deemed of minor importance since the employed survey data indicates that companies predominantly value inventories uniformly for financial accounting and tax accounting practices.

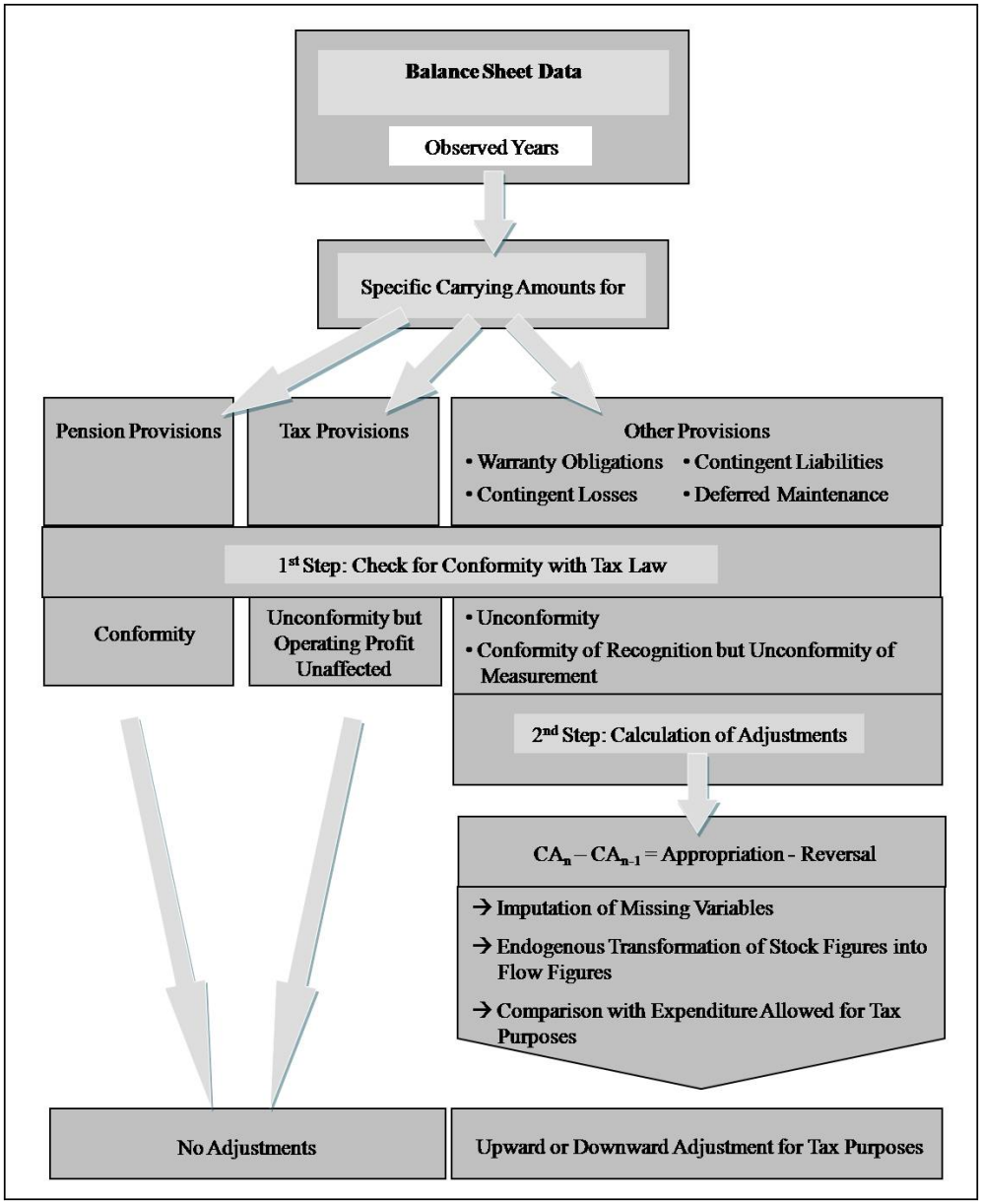
Paradigm 4: Differentials in carrying amounts arise from straight-line depreciation and irregular depreciation

Accounting for possible discrepancies in the treatment of debt discounts under commercial law or tax law proves to be problematic as it is the case for current assets. The firm specific balance sheets only report aggregates on accruals and deferrals thus not revealing the development of the carrying amount of debt discounts. However, since depreciation on debt discounts is included in the item "interest and similar expenses" in the profit and loss account (§ 275 para. 2 number 13, para. 3 Nr. 12 CC) and survey data indicates that the majority of companies do not differentiate between financial accounting and tax accounting with regard to the treatment of debt discounts the problem of missing observations could be overcome. Regular and irregular depreciation of debt discounts are, therefore, recognised in profit or loss in the period they appear and are in return not simulated endogenously. In this respect the treatment is different from the previous paradigms. Yet, no distortion arises since the treatment under tax law and under financial law corresponds.

3.3.2 Provisions

The module covering provisions is outlined in figure 3. Since the firm specific profit and loss accounts do not contain information about periodical appropriations to provisions, the following module heavily relies on balance sheet data, namely on carrying amounts for the different classes and sub-classes of provisions available.

Figure 3: Module Set-Up for Provisions



The degree to which aggregate information on provisions is broken down to different classes and sub-classes in the balance sheets generally depends on the legal obligations: Whereas large and medium-sized corporations are obliged to break provisions down to three classes (pension provisions, tax provisions and other provisions (§ 266 para 1 clause 2 CC)), small corporation are allowed report only aggregate provisions in their balance sheets. However, the database indicates that many corporations go beyond the legal obligations and specify information on provisions in greater detail than required. Hence, the general set-up of this module is based on the case that balance sheet data contains pension provisions, tax provisions and other provisions, the last class being specified into warranty obligations, contingent losses

from pending transactions, contingent liabilities and deferred maintenance.[22] In a first step the provisions given in the balance sheet are checked for conformity with tax law in respect of recognition and measurement.

Pension Provisions

The recognition of pension provisions is mandatory in financial accounting (§ 249 para. 1 clause 1 CC). In principle the recognition is optional according to § 6a ITA. However, given the obligation in financial accounting, the recognition of pension provisions is generally also binding for tax purposes (German "Maßgeblichkeitsprinzip") if the requirements of § 6a para. 1 and 2 ITA are met. That is the case if the eligible person has a legal claim and is either older than 28 years, or the claim is irrevocably according to company pension law or the ensured event already occurred. Since the balance sheets do not include information on either of these conditions they are assumed to hold true. Hence with regard to recognition of pension provisions no deviation between commercial law and tax law has to be taken into account in the microsimulation model. A potential deviation could, though, arise from an asymmetric measurement of pension provisions. Under both regimes the present value of the expenditures expected to settle the future obligation determines the measurement of pension provisions. According to survey data the present value determined with a discount rate of 6% for tax purposes is also adopted for financial accounting purposes. To sum up, with regard to pension provisions, no adjustments of the profit on ordinary activity are necessary. The same holds true for tax provisions but for different reasons.

Tax provisions

For tax purposes the recognition of provisions related to non deductible expenditures is not allowed. This concerns provisions for income taxes, other personal taxes, value-added tax and since 2008 also provisions for trade tax. Moreover, since deferred taxes are unknown in tax law, provisions for deferred taxes are not possible either. Consequently, it has to be stated that the recognition of tax provisions as given in the database is generally not conform to tax law. Nonetheless, adjustments of the operating profit are obsolete since the operating profit does not yet include expenditures incurred due to the recognition of tax provisions, the consideration of tax issues taking place at a later stage in the calculation of the annual surplus or deficit.

[22] The proceeding in case of information deficit is described at the end of this chapter.

Other Provisions

The item "other provisions" in the balance sheet is ideally split up into warranty obligations, contingent losses from pending transactions, contingent liabilities and deferred maintenance expenditure. The conformity with tax law can not be judged on the basis of the aggregate due to the heterogeneity of provisions included. Instead, an approach is chosen that differentiates between provisions that conform to tax law with regard to recognition but not with regard to measurement and provisions that do not conform to tax law in both respects.

Provisions conforming to tax law with regard to recognition but not with regard to measurement

Above all, the approach being outlined in the following covers provisions for warranty obligations. But it can also be applied to provisions for contingent liabilities in case that tax law requires measuring the obligation in present values. Under commercial law and tax law, provisions for warranty obligations and contingent liabilities[23] are recognised if they are of legal, contractual or factual binding nature. It is assumed that provisions for warranty obligations included in the database contain by assumption 50% lump-sum provisions and 50% specific provisions.

The measurement of provisions for warranty obligations differs significantly since they are not discounted for financial accounting purposes whereas tax law requires discounting future warranty obligations at a rate of 5.5% in case of specific provisions. Hence, a need for adjustment arises for 50% of the provisions for warranty obligations included in the database. The adjustment captures the deviation between the nominal obligation and the present value of the obligation at each considered date. It is, therefore, also indicated in case that tax law requires measuring provisions for contingent liabilities in present values. In order to calculate the adjustments, an assumption must be made on the duration of the obligation. Since this information is not given in the balance sheet, it is approximated by the legal warranty period according to § 438 para 1 of the German Civil Code. The legal warranty period generally amounts to 2 years. With a legal warranty period of 5 years, an exception is made for construction businesses. The approach used here will be illustrated for a warranty period w of 2 years. The methodology of investment vintages is again applied to explain the composition of the observed carrying amounts of provisions for warranty obligations and contingent liabili-

[23] With regard to the recognition of contingent liabilities, exceptions exist (infringements, anniversary expenditure). However, since the database does not reveal these exemptions, a general conformity with regard to recognition is assumed.

ties. Hence, the carrying amount observed in a specific period constitutes the sum of vintage specific carrying amounts existing at this date.

$$CA_{1,h} = \sum_{i=0}^{w} vCA_{i,1,h} = \mathrm{vCA}_{0,1,\mathrm{h}} + \mathrm{vCA}_{1,1,\mathrm{h}} + \mathrm{vCA}_{2,1,\mathrm{h}} \qquad (18)$$

$vCA_{i,1,h}$ indicates the vintage specific carrying amount of vintage i and company h in the first year that can be observed in the data. It is important to note that the carrying amount of vintage 0 $\mathrm{vCA}_{0,1,\mathrm{h}}$ is equal to the amount of appropriations to provisions $Appr_{1,h}$ in the considered period. For the periods prior to observable carrying amounts in the database, it is assumed that provisions increased continuously by factor p representing for example an increase in sales or prices depending on the provision considered. It follows from this that the carrying amount observed for the first year included in the database can be rewritten as:

$$CA_{1,h} = \underbrace{vCA_{2,1,h} \cdot (1+p)^{w} + vCA_{2,1,h}}_{\text{Appropriation in the first year of observation } Appr_{1,h}} \cdot (1+p)^{w-1} + vCA_{2,1,h} \qquad (19)$$

The carrying amount is expressed in terms of the carrying amount of the oldest vintage $vCA_{2,1,h}$. Under tax law the vintage specific carrying amounts are equal to the respective present values of the future obligation. This implies that for the computation of $CA_{1,h}^{tax}$ the vintage specific carrying amounts have to be discounted. Moreover, in each period the requirement of adding accumulated interest accrued on existing vintages has to be accounted for thus yielding the following formula:

$$CA_{1,h}^{tax} = \underbrace{\frac{vCA_{2,1,h}\cdot(1+p)^{w}}{1.055^{w}} + \left(\frac{vCA_{2,1,h}\cdot(1+p)^{w-1}}{1.055^{w-1}} - \frac{vCA_{2,1,h}\cdot(1+p)^{w-1}}{1.055^{w}}\right) + \left(vCA_{2,1,h} - \frac{vCA_{2,1,h}}{1.055^{w-1}}\right)}_{\text{Appropriation in the first year of observation } Appr_{1,h}}$$

$$+ \underbrace{\frac{vCA_{2,1,h}\cdot(1+p)^{w-1}}{1.055^{w}} + \left(\frac{vCA_{2,1,h}}{1.055^{w-1}} - \frac{vCA_{2,1,h}}{1.055^{w}}\right)}_{\text{Increase in provisions respectively one year and two years prior to observed data}} \underbrace{\qquad + \frac{vCA_{2,1,h}}{1.055^{w}}}_{\text{Increase in provisions respectively one year and two years prior to observed data}} \qquad (20)$$

The preceding formula allows identifying the appropriation to provisions for tax purposes $Appr_{1,h}^{tax}$. In a next step this increase will be opposed to the appropriation derived under commercial law $Appr_{1,h}$. The amount $Adj_{1,h}^{tax}$ to which operating profit has to be adjusted for tax purposes in the first period can be derived by subtracting both measures.

$$Adj_{1,h}^{tax} = Appr_{1,h} - Appr_{1,h}^{tax} \quad (21)$$

$$Adj_{1,h}^{tax} = vCA_{2,1,h} \cdot (1+p)^w - \left(\frac{vCA_{2,1,h} \cdot (1+p)^w}{1.055^w} + \left(\frac{vCA_{2,1,h} \cdot (1+p)^{w-1}}{1.055^{w-1}} - \frac{vCA_{2,1,h} \cdot (1+p)^{w-1}}{1.055^w}\right) + \left(vCA_{2,1,h} - \frac{vCA_{2,1,h}}{1.055^{w-1}}\right)\right)$$

For the following years $n > 1$ information is available on the current and the previous carrying amount. Hence, the assumption on continuous appropriations can be abandoned. Instead, conclusions on appropriations to provisions or reversals of provisions can be directly derived from observable data. Therefore the carrying amount of the current period is compared to the previous period.

$$CA_{n,h} - CA_{n-1,h} = Appr_{n,h} - Rev_{n,h} \quad (22)$$

The left hand side of the equation being observable and the decreases being generally equal to the vintage specific carrying amount of the oldest vintage $vCA_{2,n,h}$[24] equation (19) can be resolved for its unknown variable.

$$Appr_{n,h} = CA_{n,h} - CA_{n-1,h} + vCA_{2,n,h} \quad (23)$$

The equivalent under tax law can be derived by discounting the observed carrying amounts and by taking accumulated interests on prior vintages of provisions into account.

$$Appr_{n,h}^{tax} = \frac{CA_{n,h} - CA_{n-1,h} + vCA_{2,n,h}}{1.055^w} + \left(\frac{vCA_{2,n,h} \cdot (1+p)^w}{1.055^{w-1}} - \frac{vCA_{2,n,h} \cdot (1+p)^w}{1.055^w}\right) \quad (24)$$

$$+ \left(vCA_{2,n,h} \cdot (1+p)^{w-1} - \frac{vCA_{2,n,h} \cdot (1+p)^{w-1}}{1.055^{w-1}}\right)$$

Three different scenarios are possible: The carrying amount can increase, decrease or stay constant from one period to another. Consequently, in case of a decrease of carrying amounts that exceeds the regular reversal of the considered provisions after 2 years ($vCA_{2,1,h}$) the preceding equations can also yield negative signs. In this context the negative appropriation has to be interpreted as an additional reversal of provisions occurring before the assumed duration of the provision is over. The adjustment of operating profit for tax purposes amounts to:

$$Adj_{n,h}^{tax} = Appr_{n,h} - Appr_{n,h}^{tax}$$

[24] Generally, after the assumed two years of duration the obligation is incurred and charged against the provision thus yielding a reversal equal to the vintage specific carrying amount of the vintage departing.

$$Adj_{n,h}^{tax} = (CA_{n,h} - CA_{n-1,h}) + vCA_{2,n,h} - \left[\frac{CA_{n,h} - CA_{n-1,h} + vCA_{2,n,h}}{1.055^{w}} + \left(vCA_{2,n,h} \cdot (1+p)^{w-1} - \frac{vCA_{2,n,h} \cdot (1+p)^{w-1}}{1.055^{w-1}}\right) + \left(\frac{vCA_{2,n,h} \cdot (1+p)^{w}}{1.055^{w-1}} - \frac{vCA_{2,n,h} \cdot (1+p)^{w}}{1.055^{w}}\right)\right] \quad (25)$$

Provisions that are not conform to tax law

According to tax law the recognition of provisions is prohibited for contingent losses from pending transactions, expenditures for deferred maintenance and for general expenditures. Since the database does not allow distinguishing between provisions for maintenance deferred by less or more than three month, it is assumed that this type of provision is generally not conform to tax law.[25] In case that any of these provisions are reported in the balance sheet, adjustments for tax purposes become necessary. In this context it has to be kept in mind that provisions represent a shift of expenditure in time, the absolute amount of expenditure being equal. This timing effect has to be accounted for when calculating adjustments of the profit on ordinary activity. In case provisions do not conform to tax law, related expenditures are not deductible for tax purposes until the obligation incurs. Hence, in each period the operating profit has to be adjusted by the difference between appropriations to provisions $Appr_{n,h}$ and reversals of provisions $Rev_{n,h}$. For the first period observed in the data and an assumed duration of provisions of 2 years the adjustment amounts to:

$$Adj_{1,h}^{tax} = \underbrace{vCA_{2,1,h} \cdot (1+p)^{2}}_{\text{Appr}_{1,h}} - \underbrace{\frac{vCA_{2,1,h}}{(1+p)}}_{\text{Rev}_{1,h}} \quad (26)$$

For periods $n > 1$, the assumption of continuous appropriations is replaced by an comparison of observable carrying amounts. Since the difference between the carrying amounts of two subsequent periods is in this context per definition explained by the net amount of appropriations and reversals, the observed difference already yields the amount of adjustment required.

$$Adj_{n,h}^{tax} = CA_{n,h} - CA_{n-1,h} \quad (27)$$

The described proceeding requires detailed information on the specific type of provision especially with regard to the item “other provisions”. In case reported provisions are only broken down to the three classes pension provisions, tax provisions and other provisions this information is not available. To overcome this deficit, the proportions that could be identified

[25] It would be conform in case that maintenance is postponed by not more than three month.

for corporations reporting detailed information on the composition of "other provisions" are applied to the aggregate. In case provisions are only displayed as an aggregate, which can only be the case for small corporations[26] the aggregate has to be split up into the three categories first. It is a plausible assumption that pension provisions are uncommon for small corporations. Hence, the aggregate is split up into tax provisions and other provisions according to the proportion identified within the group of companies that yield this information.

3.3.3 Creditors

The degree to which aggregate information on creditors is broken down to specific categories in the balance sheets generally depends on the legal obligations. In this respect large and medium-sized corporations face stricter regulations. Hence, if applicable, eight different categories of creditors can be identified for large and medium-sized corporations. A list of these categories is given in table 4. The balance sheets of small corporations, in contrast, might only contain creditors as an aggregate without indications on the duration of liabilities. The problem of the resulting information deficit for small corporations will be dealt with at the end of this chapter.

Table 4: Categories of Creditors and Conformity with Tax Law

Creditors	Conformity of Measurement	Adjustment for tax purposes
Debenture loans of which convertible	Yes	No
Bank loans and overdrafts	Yes	No
Payments received on account	Yes	No
Trade creditors - of which current - of which long-term	 Yes No	 No Yes
Bills of exchange payable	Yes	No
Amounts owed to group undertakings	Information deficit	No
Amounts owed to undertakings in which the company has a participating interest	Information deficit	No
Other creditors - of which current - of which long-term	 Yes Information deficit	 No No

Since the criteria for recognition of creditors are the same under commercial law and under tax law, no requirements to adjust the profit from ordinary activities for tax purposes arise from this issue. Also with regard to conformity of measurement, table 4 indicates that except for long-term trade creditors, no adjustment is considered. This is either due to an identical valuation under both regimes or due to information deficits preventing adjustments. Measurement differentials could arise in case of transitory appreciations of creditors. Upward revaluation of creditors is only allowed for permanent appreciations under tax law but manda-

[26] For small corporations the requirements with regard to the information to be presented in the balance sheet and profit and loss account are relieved.

tory also for transitory appreciations under commercial law. However, potential differentials arising from these asymmetries are omitted since the necessary information to identify transitory appreciations is not available.

Moreover, conformity of measurement requires that the respective category of creditors complies with § 6 para. 1 number 3 ITA. According to this regulation, discounting the future obligation at a rate of 5.5% is binding for creditors, an exception being made for creditors yielding interest, creditors being based on payments received or creditors being classified as current creditors[27] (§ 6 para. 1 number 3 clause 2 ITA). Table 4 illustrates that the exception holds for the majority of creditors thus not requiring any adjustments for tax purposes except for the item "trade creditors of which long-term". Long-term trade creditors do not yield interest and therefore have to be discounted at 5.5%. Consequently, the profit on ordinary activity has to be adjusted for tax purposes taking the deviation between the nominal obligation and its present value into account. In order to compute these adjustments assumptions on the duration of long-term creditors have to be made. It is plausible to assume that durations of trade creditors are limited. For the purpose of the proposed microsimulation model it is assumed that duration amounts to two years. Hence, the approach outlined in section 3.3.2 for provisions conforming to tax law with regard to recognition but not with regard to measurement can be applied. According to this approach the adjustment for the first period observed in the data can be calculated by subtracting the increase of long-term trade creditors for tax purposes from its equivalent under commercial law. For the following periods the assumption on continuous increases in trade creditors is abandoned. Henceforth, periodical adjustments are yielded by the difference in carrying amounts of two subsequent periods. For a detailed description see equations (15)-(22).

In case "amounts owed to group undertakings", "amounts owed to undertakings in which company has a participating interest" or "other creditors of which long-term" appear in the database it is not possible to figure out whether these creditors yield interest or not. Due to this information deficit no adjustments are carried out. Since small corporations often only report creditors as an aggregate and do not specify durations it is impossible to figure out whether these creditors have to be discounted for tax purposes. Assuming that durations exceeding one year require a certain market power against the supplier, the consideration of

[27] Creditors are classified as current creditors if the duration at balance sheet date does not exceed twelve month.

long-term trade creditors is omitted for small companies. Consequently, no adjustments are required.

3.3.4 Capitalised expenses for the start-up and expansion of the business

According to § 269 clause 1 CC, corporations may capitalise expenses for the start-up and expansion of their business in case these expenses do not meet the ordinary requirements of a recognisable asset. § 282 CC requires the capitalised expenditures to be allocated systematically over not more than 4 years yielding a depreciation rate of at least 25% per annum. Since tax law does not allow capitalisation of expenses for start-up and expansion of the business, adjustments of the profit on ordinary activities are required. In this context it has to be kept in mind that adjustments are only necessary to reverse the capitalisation of expenditures in the respective period thus ensuring the expenditures incurred lower the taxable income in the same period. Adjustments of depreciation, in contrast, are redundant since from the outset depreciation on this balance sheet item has been excluded from the tax base by not simulating this regulation within the depreciation module. In order to reverse the capitalisation of expenditures for the start-up and expansion of the business, the amount and the year of capitalisation have to be known. This information is derived endogenously by comparing the development of the carrying amounts of this balance sheet item. In this context it is assumed that the minimum depreciation rate of 25% is applied thus allocating the depreciable amount constantly over the maximum period of time.[28] Hence, in absence of new capitalisations the underlying depreciation scheme results in typical relations between subsequent carrying amounts. Depending on the extent to which the originally capitalised amount is already written down the ratios $r = \frac{3}{4}, \frac{2}{3}, \frac{1}{2}$ or 0 are possible. In case the ratios calculated from the data exactly fit the hypothetical ratios the observed deviation between carrying amounts can entirely be attributed to depreciation. Consequently, no adjustment of the profit on ordinary activities is necessary for periods n>1.

For period 1 however, an adjustment amounting to the respective carrying amount in this period is necessary if the ratio in the second period yields $\frac{3}{4}$ thus indicating that the capitalisation of expenditure for the start-up and expansion of the business took place in period 1. In any case the ratio computed for the second period exceeds the typical ratios it can be concluded that a new capitalisation of expenditures for the start-up and expansion of the business took

[28] This assumption is consistent with the attempt to smoothen the income for financial statement purposes.

place in this period. The amount of new capitalisation is derived by reducing the observed carrying amount by carrying amounts of former capitalisations. The latter is equal to the carrying amount observed in the first period times the typical ratio being the next lowest to the computed ratio. To give an example, if the computed ratio lies between $\frac{3}{4}$ and $\frac{2}{3}$ the amount of new capitalisation in period two and, therefore, the adjustment for tax purposes is equal to

$$Adj_{2,h}^{tax} = CA_{2,h} - \frac{2}{3} \cdot CA_{1,h} \tag{28}$$

For subsequent periods adjustments are necessary if the observed carrying amount exceeds the a-priori carrying amount resulting from a consistent application of the depreciation scheme to existing vintages of capitalised expenditures. Continuing the example, the condition for new capitalisations in the third period yields

$$CA_{3,h} > \frac{1}{3} \cdot CA_{1,h} + \frac{3}{4} \cdot \left(CA_{2,h} - \frac{2}{3} \cdot CA_{1,h} \right) \tag{29}$$

The adjustment of profit for ordinary activity for tax purposes equals the difference between the observed carrying amount and the a-priori carrying amount. In case the observed carrying amount is equal to or falls below the a-priori value, no adjustment is induced. The complexity of the approach is reduced in case no carrying amount of capitalised expenditure is reported for the first period. In this case new capitalisation can be assumed for the first period this item is reported in the balance sheet. For subsequent periods the proceeding of comparing the observed carrying amount with its a-priori value remains unchanged.

3.3.5 Investment grants and subsidies

In contrast to the modules outlined so far, the module covering investment grants and subsidies is not based on balance sheet data but on the firm specific profit and loss account. More precisely, the focus is on “grants and subsidies” being reported as sub-item of the “other operating income”. Partially “grants and subsidies” are even broken down to “investment grants” and “undefined grants or subsidies”.

Under commercial law grants and subsidies can either be set off against acquisition or production costs or recorded as income. Generally, this treatment is in accordance with tax law. An exemption exists, however, for state investment grants being subject to specific treatment under § 12 Investment Grant Act 2007. According to this regulation the respective grants are

neither considered as taxable income nor are they set off against acquisition costs, production costs or maintenance expenses. Consequently these grants are neither subject to corporate income tax nor to trade tax. In view of this tax exemption the respective grant is usually recorded as income for financial statement purposes. Hence, profit on ordinary activities as it is taken from the financial profit and loss account has already been increased by the respective tax-free grants. The proposed microsimulation model, therefore, has to reverse this increase. The adjustment requires the identification of tax free grants. Ideally the item "grants and subsidies" is broken down to " investment grants" and "undefined grants or subsidies" thus allowing an immediate adjustment by deducting the amount of investment grants from the profit on ordinary activities. If only the aggregate "grants and subsidies" is reported the proportion of "investment grants" that has been identified in cases without information deficit is applied to the aggregate. The proceeding thus allows to impute missing information consistently and to undertake necessary adjustments for tax purposes.

3.3.6 Interest Deduction

The objective of this module is to account for regulations limiting the deduction of interest expenses for tax purposes. In Germany the limitation of interest deduction is regulated in § 8a CIT. Since the respective regulations changed recently with the introduction of the interest barrier in 2008 it is appropriate to outline the implementation of both versions of § 8a CIT within the microsimulation model. The respective regulations are of high complexity and comprise several exceptions thus resulting in extensive information requirements. To meet these requirements largely, the module is based on firm specific balance-sheets, profit and loss accounts as well as on supplemental information on shareholding relationships and fiscal units that are also included in the DAFNE database. Adjustments of the profit on ordinary activity are necessary if § 8a CIT in its respective version is applicable and none of the potential exceptions holds. To check this, a step by step approach is chosen that will be outlined separately for § 8a CIT (2007) and for the version of § 8a CIT which is in force since 2008.[29]

The thin-capitalisation rules of § 8a CIT (2007) comprise the reclassification of interest expenses as constructive dividends for corporate tax purposes if the following conditions are met:

[29] No imputation of missing variables is necessary for this model. Hence, the regulations for 2003-2005 are not relevant per se.

- A loan has been granted from a substantial shareholder (>25% of shares) or a related party and this loan is not qualified as short-term.
- Annual interest expenses exceed the exempt threshold of 250,000 Euro.
- Either a 1.5:1 debt-to-equity safe haven is violated or interest is not measured as fraction of the loan, the credit conditions not being viable with third parties.

Moreover, the respective interest expenses are not deductible for trade tax purposes.

In the context of the proposed model, the relevant loans are given by the item "amounts owed to group undertakings" in the balance sheet. The reported amount is assigned to the shareholder with the highest share and this share is checked for substantiality. In a next step interest expenses, being only reported as aggregate in the profit and loss account, are allocated to the long-term intercompany loans according to the proportion of the "amounts owed to group undertakings" to all interest-bearing loans. In case interest exceeds the exempt threshold of 250,000 Euro, it has to be checked whether the share of debt finance from the considered substantial shareholder lies within the safe haven. The relevant equity share as defined by § 8a para. 2 CIT can be derived from the balance sheet. If the amount of long-term intercompany loans lies within the save haven, interest deductibility is not restricted since it is not possible to determine whether interest is measured as a fraction of the loan and whether these conditions follow arm's length principles. If the amount of long-term intercompany loans assigned to the considered shareholder exceeds 1.5 times the respective share of equity a reclassification of interest expenses as constructive dividends is implemented in the microsimulation model. The reclassification is also considered at the level of the substantial shareholder if included in the DAFNE database. For trade tax purposes, reclassified interest expenses are not deductible.

In the course of the German business tax reform 2008, § 8a CIT has been subject to fundamental changes and a new § 4h ITA has been introduced. Most importantly, the new regulation covers all interest expenses (i.e. also on loans against third parties) and not only those incurred on loans from substantial shareholders. The deduction of interest expenses is limited to the amount of interest received in the same fiscal year plus 30% of the EBITDA[30]. Instead of reclassifying of non deductible interest as constructive interest, an interest carry forward

[30] EBITDA = earnings before interest, taxes, depreciation and amortisation.

was introduced allowing to set non deductible interest expenses off against interest received in subsequent periods. According to § 4 para. 2 ITA, the interest barrier does not apply if:

- Interest expenses exceed interest income by less than 1,000,000 Euro.
- The company is not fully consolidated in a group and interest expenses on debt financing from a substantial shareholder do not exceed interest received by more than 10%.
- The capital ratio of the company does not fall below the capital ratio of the group by more than 1% and interest expenses on debt financing do not exceed interest received by more than 10%.

To account for these regulations in the proposed microsimulation model, in a first step, interest expenses are set off against interest received the respective amounts being reported in the profit and loss account. A negative balance is compared to the exempt threshold of 1,000,000 Euro and, in case of a substantial shareholding, to the threshold of 10% of interest received. If the latter is exceeded, interest deduction is limited to 30% of EBITDA, no further exemption being possible. The relevant EBITDA is derived under modifications from the corporate tax base. Balance sheet items with the apposition "group undertakings" and the existence of a shareholder owning more than 50% of total shares are used as indicators to verify whether the respective entity is part of a consolidated group. Due to information deficits it is not possible to account for the exception being made if the capital ratio of the company is typical for the whole group. Hence in any case a company is part of a consolidated group interest deduction is limited to 30% of EBITDA for the purpose of the proposed model.

Non deductibility of interest expenses is implemented in the microsimulation model by adding the respective amount to the profit from ordinary activities. The respective interest expenses also increase the base of the trade tax.

3.3.7 Other Adjustments of Financial Results

The objective of this module is to account for tax-exempt business receipts resulting from the allocation of equity to domestic or foreign corporations or foreign partnerships. According to § 8b CIT intercompany dividends are at 95% exempt from corporate tax irrespective whether dividends are derived from domestic or foreign source. Under trade tax this exemption requires a minimum holding quota of 15% or 10% before 2008 (§8 no. 5 TTA, § 9 no. 2a, no. 7 TTA). The tax exemption of income derived from the allocation of equity to foreign partner-

ships is based on the German treaty practice in double taxation conventions to apply the exemption method for this type of income. Income derived from the allocation of loans is generally taxable.

The module to be outlined in the following is mainly based on the items "income from participating interests of which from group undertakings", "income from other long-term securities and loans of which from group undertakings", "other interest receivables and similar income of which from group undertakings" and "earnings from profit pooling agreements". When necessary, the related balance sheet items "loans to group undertakings", "loans to undertakings in which the company has a participating interest" and "securities" provide additional information. The item "income from participating interests of which from group undertakings" entirely reports income from equity. The distinction whether this income is received from a corporation or a partnership is possible since the DAFNE database contains information on the legal form of group undertakings or of undertakings with participation interest. If the respective undertakings are of heterogeneous legal forms a proportional allocation is implemented according to the share of corporations and partnerships on all group undertakings. The DAFNE database also reports country abbreviations for group undertakings and undertakings with participation interest. This allows determining the geographical source of equity income derived from partnerships.[31] If domestic and foreign partnerships coexist, a proportional allocation of income is accomplished. The verification of the minimum holding quota for trade tax purposes referring to corporations does not impose a problem either since holding quotas are included in the DAFNE database. The tax exemption is implemented in the microsimulation model by deducting the respective amounts from the profit of ordinary activity.

The item "income from other long-term securities and loans of which from group undertakings" reports both income from equity and income from loans. Since only income derived from the allocation of equity is exempt, a distinction is necessary. This distinction is based on the relative importance of the balance sheet items "loans to group undertakings" and "loans to undertakings in which the company has a participating interest" with respect to the item "securities". The share of loans entirely yields income from loans whereas it is assumed that the share of securities yields 50% income from loans and 50% income from equity. For small

[31] In case income is derived from equity allocated to a foreign partnership it is assumed that the exemption method is applicable to that income.

corporations reporting financial assets as aggregate, it is assumed that income is one half each derived from loans and equity.

The item “other interest receivables and similar income of which from group undertakings” entirely contains earnings from loans that are taxable income. Hence, no adjustment of profit from ordinary activities is required here.

The item “earnings from profit pooling agreements” entirely reports income derived from the allocation of equity. Therefore, generally the proceeding is the same as described for the item “income from participating interests of which from group undertakings”. In case of fiscal units, however, special regulations apply. The income accrued in the controlled companies is attributed to the controlling company where it is subject to tax. Since this operation is accomplished in the tax accounting sphere, a partial double taxation would arise if the item “earnings from profit pooling agreements” as reported in the profit and loss account would be only exempt at 95% from corporate tax. That is why for fiscal units “earnings from profit pooling agreements” have to be eliminated entirely from the tax base.

3.3.8 Non-deductible business expenses

There exist a number of business expenses that reduce profits for financial accounting purposes but not for corporate tax and trade tax purposes. The regulations governing the non-deductibility of business expenses are included in §§ 4 para. 5-8, 4h ITA and §§ 9, 10 CIT. However, due to information deficits, the regulations cannot be accounted for entirely. This concerns mainly the regulations in § 4 para. 5 no. 1-4, 7-8a, 10 and § 4 para. 5.8 ITA restricting the deductibility of expenses for business gifts, entertainment expenses and fines, to name only some examples. The regulations of § 9 and § 10 CIT can be taken into account with regard to the non-deductibility of taxes. Due to the systematic of the proposed microsimulation model, an adjustment for non-deductible taxes is obsolete. The calculation of the tax base is based on the profit on ordinary income from which taxes have not yet been deducted in financial accounting. Regulations restricting the deductibility of interest expenses have already been accounted for in a separate module. To sum up, no additional adjustments arise from this module.

3.3.9 Add-backs and deductions for trade tax purposes

When deriving the trade tax base, several modifications of the income from trade or business have to be accounted for. These add-backs and deductions are regulated in § 8 and § 9 TTA. According to § 8 no. 1 TTA (2007), 50% of interest on long-term debts have to be added to the tax base. In order to consider this add-back within the microsimulation model, interest expenses on debts with a duration of more than one year have to be identified in a first step. The firm specific profit and loss accounts report interest expenses as an aggregate. The amount of long-term interest is derived by applying the proportion of long-term debts to all interest-bearing debts to the aggregate of interest expenses. Half of the resulting amount is added to the tax base.

In the course of the German business tax reform in 2008, § 8 no. 1 TTA has been modified. Mainly the add-back of 50% of interest on long-term debts is replaced by an add-back of 25% of all interest, the definition of interest being extended to include also implicit interest in leasing, rental and royalty payments.[32] The add-back of interest on debts is straightforward within the microsimulation model by applying 25% to the reported item "interest payable and other similar charges". However the consideration of implicit interest elements in leasing, rental and royalty payments is more complex. Since neither rental nor leasing expenses are reported in the profit and loss account these expenses are approximated for the purpose of this model. The approximation is based on a statistic published by the German Federal Statistical Office in 2005 which displays the share of specific costs in terms of the gross production value for companies. Since both, the share of rental and leasing payments and the share of interest payments are reported, a relation between these expenses can be derived and applied to the firm specific interest expenses reported in the database. Depending on the respective sector of the company the ratio of rental and leasing expenses with regard to interest expenses ranges from 1.88 for the mining and manufacturing sector to 4.5 for the construction sector. The described proceeding allows the imputation of rental and leasing expenses in a transparent manner. The regulation of § 8 no. 1 TTA fixes the share of implicit interests included in rental and leasing expenses at 20% for movable tangible assets and at 65% for immovable tangible assets. At this stage again, the microsimulation model resorts to external information to distinguish between expenses incurred on the renting or leasing of movable or immovable tangible assets. According to analyses of the Federal Association of German Leasing Companies the

[32] Prior to the reform the add back of implicit interest in rental and leasing expenses was limited to cases in which the recipient was not subject to trade tax.

share of expenses on immovable assets amounts to 14.5% on a 10 year average. Consequently, 14.5% of the imputed rental and leasing expenditures contain a share of implicit interest of 65% which is added at a rate of 25% to the trade tax base. Respectively 85.5% of rental and leasing expenses contain a share of implicit interest of 20% which is also added at a rate of 25% to the trade tax base. Further add-backs are omitted since it is not possible to overcome the respective information deficits in a consistent manner. A tax exempt amount of 100,000 Euro for the considered add-backs is respected.

According to § 9 no. 1 TTA, 1.2% of the assessed value of real property has to be added to the trade tax base. The assessed value considered is equal to the assessed value for real estate tax increased by 40%. Since the direct calculation of the assessed value according to the directive for valuation of real estate and the application of the capitalised earnings value method or asset value method are not feasible due to information deficits an approximation is necessary. Hence, for the purpose of the proposed microsimulation model, identity of the carrying amount and the assessed value of real property is assumed. Consequently, the add-back under trade tax amounts to 1.2% of the reported values of real property.

Add-backs and deductions related to business receipts from domestic or foreign corporations and foreign partnerships (§ 8 no. 5, 8 and § 9 no. 2, 2a, 3, 7, 8 TTA) are already considered in module 7 and therefore can be omitted here. Module 7 is outlined in section 3.3.7.[33]

3.3.10 Integrated Fiscal Units

In tax terms, an integrated fiscal unit is formed by a controlled company[34] undertaking to pay over its revenues to the controlling company which holds the majority of voting rights (financial integration). The recognition of an integrated fiscal unit provides an opportunity to balance profit and losses amongst the integrated companies. Hence, to avoid distortions, the existence of integrated fiscal units also has to be accounted for within the microsimulation model. The employed approach consists of three steps: firstly, controlled companies and controlling companies belonging to the same integrated fiscal unit have to be identified. In a second step it has to be assured that tax assessment considers specific regulations for integrated fiscal

[33] The regulations governing the add-back of donations, foreign taxes (§ 8 Nr. 9, 10, 12 TTA) as well as implicit interest in annuities and encumbrances and profit shares of dormant partners not subject to trade tax (§ 8 Nr. 2, 3 TTA (2007)) are not implemented in the microsimulation model due to information deficits.
[34] The company itself is legally independent.

units. Finally, the assessed taxable income of all controlled companies being part of the fiscal unit is aggregated at the level of the controlling company where it is taxed.

The identification of integrated fiscal units starts with the identification of controlled companies. Assuming that a profit pooling agreement exists, a company included in the database is considered as a controlled company if it pays over profits or losses. Since financial integration is a constitutive requirement for an integrated fiscal unit, the information on shareholding relationships reported in the DAFNE database is utilised to identify the potential controlling company holding more than 50% of shares in the considered company. To approve the existence of an integrated fiscal unit it is checked whether the potential controlling company reports transfer of profits and losses. It is also possible that no controlling company can be identified since it might not be included in the database. In this case the integrated fiscal unit can either be neglected as a whole or the fiscal consequences can be approximated by fictitiously considering one of the controlled companies as controlling company. The latter solution is pursued here. Therefore, the income of all controlled companies having the same controlling company not included in the database will be taxed as an aggregate at the level of the first controlled company identified.

With regard to the tax assessment of the integrated fiscal unit, the taxable income of each party is computed separately also considering potential tax exemptions due § 8b para. 1-4 CIT and double taxation agreements on that level. Since only corporations are included it makes no difference for the result whether these exemptions are implemented at the level of the controlled or the controlling company. For technical reasons, however, the exemptions can be more easily considered at the level of the controlled company. For trade tax purposes addbacks and deductions of expenses according to § 8 no. 1 TTA are ceased if resulting from intra fiscal-unit transactions (§ 2 para. 2 clause 2 TTA). In the context of the microsimulation model, difficulties arise to identify relevant transactions. Solely the item “interest payable and other similar charges of which to group undertakings” can be deemed to be caused by intra-fiscal unit transactions. However, it is also possible that these expenses are related to transactions with affiliated companies not being part of the fiscal unit. Due to missing information on this issue it is assumed that in case of a controlled company the amounts reported under the abovementioned item are caused by intra fiscal-unit transactions. Consequently, the expenses are not added to the trade tax base. In light of information deficits comparable adjustments have to be omitted for other intra fiscal-unit transactions.

In a third step, the taxable income that has been calculated separately at the level of the controlled company is aggregated at the level of the controlling company where it is subject to tax. To avoid double taxation, the amounts reported as "profit or loss pooling" within the financial statements have to be deducted (profits) or added (losses). For trade tax purposes the aggregated income has to be allocated to the municipalities concerned since the applicable trade tax multiplier differs regionally. The allocation is based on the proportion of wages incurred in each municipality.

In case minority shareholders own a share in the controlled company, they receive compensation payment reported as "minority interest" in the income statement of the controlled company, which must not reduce the income of the controlled company (§ 4 para. 5 no. 9 ITA, § 7 para. 1,2 CIT, § 8 para. 1 CIT). According to § 16 CIT, 4/3 (2007) or 20/17 (2008) of the compensation payment are subject to corporate tax at the level of the controlled company (§ 16 CIT). To avoid double taxation of the same income the amount of compensation payments is deducted from the income of the controlling company.

3.3.11 Losses

The possibilities of loss offsetting for tax purposes are governed by § 10d ITA, § 7 para. 1 and § 8 para. 1 CIT and § 10a TTA. Within the microsimulation model current losses are derived endogenously in course of the computation of taxable income. For corporate tax purposes, current losses up to 511,500 Euro are carried back, since survey data indicate that this option is widely used. However, no loss carry back is possible for the first year observed in the data due to information deficits on positive income available for loss offset in the previous period. Remaining losses are carried forward, taking the relevant limitations into account.

In case a loss carried forward was borne in periods prior to the observed data, it might reduce the current tax base or increase current losses. The database does not include information on these losses, neglecting them would however result in considerable distortions. The imputation of loss carried forward from periods prior to observed data, is not straightforward since loss carried forward for tax purposes is not equal to the loss carried forward for financial accounting purposes which is reported as "cumulative losses brought forward" in the balance sheet. Hence, a test is developed to impute the amount of loss carried forward where indicated. The existence of loss carried forward in tax terms is assumed in case the following

events coexist: The item "cumulative losses brought forward" or "accumulated deficit" reports a positive value, taxes on profit as reported in the profit and loss account are zero or negative. If the taxable income derived endogenously yields a positive value, it is assumed that the amount of loss carried forward is at least that high to be set off against that positive value. Hence, the same test has to be applied in the subsequent year. In this context it has to be accounted for that since 2004 a regulation on minimum taxation is into force.[35] Therefore, in case the derived taxable income is above 1 million Euro a loss carried forward might exist even if positive amounts of income taxes are reported in the profit and loss account. Only if taxes reported exceed the amount resulting from taxing 40% of the income exceeding 1 million Euro it is assumed that no loss carry forward exists.

Apart from minimum taxation and limited loss carry back, the deduction of losses is limited in case that the corporation is not financially identical with the corporation that incurred the loss. Up to 2007, this identity was denied in case that more than 50% of all shares were transferred and the majority of business property was replaced. Within the microsimulation model there is also the possibility to account for this rule. A transfer of 50% of all shares could be determined if there is information on the development of shareholding structures. The replacement of business income could be assumed in case that total assets doubled or that the company changes the branch operating in. Since 2008, only partial loss deduction is possible if more than 25% but less than 50% of shares have been transferred. A loss deduction is entirely impossible if more than 50% of shares have been transferred.

3.3.12 Foreign Permanent establishments

In profit and loss accounts contributions resulting from foreign permanent establishments are not listed separately. But, as a consequence of the German double tax treaty policy, such foreign source income is regularly tax-exempt in Germany. Therefore, in the microsimulation model profits attributed to foreign permanent establishments have to be identified and eliminated to avoid distortions of the corporate income tax base and the trade tax base.

To identify the tax-exempt components data provided by the German Federal Statistical Office is processed. The available data refers to the corporate income tax statistics (Körperschaftsteuerstatistik) and contains proportions of tax-exempt foreign source income in relation to the taxable income for corporations subject to corporate income tax with their worldwide

[35] The amount of loss carried forward exceeding 1 million is only deductible at 60%.

income. Only few corporations with an assessment of taxes on worldwide income show parts of income that are tax-exempt according to a double tax treaty (in FY 2001: 0.55%). For those corporations the worldwide income is to reduce by 20.22% (cases with a positive total amount of income) or alternatively to reduce by 59.77% (cases with a negative total amount of income) to determine the taxable income. In the microsimulation model these ratios are used to adjust the corporate income tax base and the trade tax base for corporations showing international diffusion. In doing so it is assumed that corporations reporting numerous material participations abroad also conduct permanent establishments abroad.[36] Therefore, for those international corporations the identified parts of foreign source income are tax-exempt for corporate income tax and trade tax purposes. In this process it is accounted for participations in foreign partnerships that can lead to tax-exempt income according to double tax treaties as well (section 3.3.7) and hence have to reduce the additional part of income tax-exempted due to the conduction of permanent establishments.

3.3.13 Calculation of periodical tax payments at corporate level (trade tax, corporate income tax, solidarity surcharge)

A first run of the simulation processes is addressed to calculate the trade tax at corporate level. Therefore, the described modules of the microsimulation model are applied to determine the periodical trade tax bases. In case of a negative tax base the calculated amount is inputted to the loss module (see section 3.3.11). In case of a positive tax base the calculated amount is used to determine the trade tax base value (Gewerbesteuermessbetrag) by multiplying the trade tax base with the basic federal tax rate (Steuermesszahl) and rounding the product down to the nearest hundred (§ 11 para. 1, 2 TTA). According to § 28 para. 1 TTA, the trade tax base value has to be apportioned if a company conducts permanent establishments in more than one municipality or a permanent establishment ranges over more than one municipality or a permanent establishment was displaced from one to another municipality. In the microsimulation model there are data restrictions so that it has to be assumed that permanent establishments are only conducted at the registered seat of a corporation. Consequently, only in case of integrated fiscal units apportionments of the trade tax base values are necessary (see section 3.3.10). After having calculated (and apportioned) the trade tax base value the tax as-

[36] In detail according to the corporate income tax statistics 0.55% of the corporations showing most material participations are affected by the adjustment mechanism.

sessment is executed. This is done by multiplying the trade tax base value with the assessment rate fixed by the responsible municipality (§ 16 TTA).[37]

A second run of the simulation processes is addressed to calculate the corporate income tax for each corporation. After the application of the described modules the taxable income is available. In case of a negative tax base the calculated amount is again inputted to the loss module (see section 3.3.11). In case of a positive tax base it is multiplied with the corporate income tax rate (§ 23 para. 1 TTA) to determine the corporate income tax. The result of these calculations is on the other hand needed to ascertain the solidarity surcharge by multiplying the assessed corporate income tax with the solidarity surcharge rate (§ 3, 4 SSA).

At this stage it is possible to validate the model. By the nature of the simulation model, a validation is only feasible for years included in the data, e.g. 2005. The model validation is conducted by comparing the calculated tax due with information about assessed taxes directly collected from DAFNE corporations. To cover a larger number of corporations alternatively a model validation can be executed by comparing the calculated tax due to the item "tax on income". Nonetheless this kind of validation can only be understood as a check for plausibility. Due to tax prepayments, tax refunds and deferred taxes the reported value "taxes on profit" and the computed value will not be exactly the same. For companies with stable profits the results should be very close.

[37] Within the system of the microsimulation model the tax assessed always equals the tax due.

3.4 Calculation of Effective Tax Burdens and Determination of Aggregate Tax Revenues

Since actual tax due of different companies are not comparable thus not allowing any conclusions on distributional effects of a tax system, a normalised measure has to be defined: The tax liability has to be put into relation with one of the investor's objective variables. The idea of the objective variable is that optimising its value is equivalent to maximising the investor's consumption utility. Therefore, putting tax liabilities into relation with objective variables reveals the financial disadvantages arising from taxation. The difference between the pre-tax objective value and the post-tax objective value is referred to as tax-wedge. According to the general definition of effective tax rates, the tax-wedge is divided by the pre-tax objective variable.

$$s_{eff} = \frac{Objective\ Variable - Objective\ Variable_{after\ tax}}{Objective\ Variable} = \frac{Tax\text{-}Wedge}{Objective\ Variable} \quad (30)$$

There exist some natural candidates for objective variables (e.g. net present value, future value or costs of capital), items from balance sheets and profit and loss accounts (under both commercial law and tax law) not belonging to that group. In the context of the proposed microsimulation model, the objective variable is defined as the future value of periodical pre-tax cash flows CF_n. The periodical cash flow is calculated according to the DVFA/SG[38] definition but reduced by cash-flows arising from tax exempt foreign income:[39]

Table 5: Calculation of the Annual Cash Flow

	Profit on Ordinary Activities
+	Extraordinary Income
-	Extraordinary Charges
-	Other Taxes
+	Depreciation of Fixed Assets
-	Reversal of Long Term Provisions
+	Appropriations to Long Term Provisions
-	Reversal of Special Account with Reserve Characteristics
+	Appropriation to Special Account with Reserve Characteristics
-	Cashflow from Tax Exempt Foreign Income
=	**Cashflow (CF, pre-tax)**
-	Trade Tax, Corporate Income Tax and Solidarity Surcharge
=	**Cashfolw (CF, post-tax)**

[38] DVFA/SG = Society of Investment Professionals in Germany/Schmalenbach Association.

[39] Cash-flows arising from tax exempt foreign income have to be eliminated to avoid a mismatch between the numerator and the denominator in the effective tax rate measure as only cash-flow reductions of national tax payments are considered in the numerator, see Jacobs and Spengel, 2000, 336.

The difference between the future value of pre-tax cash flows FV^{CF} and post-tax cash flows FV_t^{CF} constitutes the tax-wedge. The individual effective tax rate can be calculated as follows:

$$s_{eff} = \frac{FV^{CF} - FV_{\tau}^{CF}}{FV^{CF}} = \frac{\sum_{n=1}^{N} CF_n \cdot (1+i_n)^n - \sum_{n=1}^{N} CF_{n,\tau} \cdot \left(1+i_{n,\tau}\right)^n}{\sum_{n=1}^{N} CF_n \times (1+i_n)^n} \quad (31)$$

Using a multi-period setting allows capturing timing effects of tax provisions. However, it raises the question which interest rate i_n to chose. Using firm specific interest rates is desirable though not feasible. Hence the interest rate is assumed to be identical for all firms. The average yield of German industrial securities in the period of 2003-2005 being 4.23% (Deutsche Bundesbank Zeitreihe WU0022, 2008), this rate is assumed as a constant interest rate.[40] Another distinction is necessary with regard to gross or net interest rates. Whereas calculating the pre-tax value of the objective variable requires the application of a gross rate, the rate applied in case of taxation is net of tax.[41] The individual effective tax rate is calculated for a reference tax system and for a potential tax reform. The standardisation of tax payments on the objective variable allows the comparison across companies and permits conclusions on the distribution of the tax burden among firms. In a sense the approach used here combines forward-looking concepts with backward-looking concepts of effective tax rates. It is backward looking because it uses real data instead of hypothetic investments but forward looking because tax reforms can be simulated ex post endogenously.

The determination of the aggregate tax revenue, in contrast, can directly be based on the absolute amount of tax payments computed for each firm. The aggregated tax revenue comprises the sum of individual tax payments on an annual basis and can be grossed up to identify revenue effects for the basic population. Hence, it is not identical with the revenue actually collected by tax authorities on the basis of quarterly estimated tax payments and tax refunds/back duty that are related to previous years. Due to these deferrals that are inherent to the system of tax collection, pure revenue effects of reforms can rather be determined on aggregated tax payments than on collected tax payments.

[40] No distinction is made between lending rate and borrowing rate.
[41] The following tax rates apply:
in 2007: $\tau_{2007} = \tau_{2007}^{CT} \cdot (1-\tau^{soli}) - \tau_{2007}^{CT} \cdot (1-\tau^{soli}) \cdot \tau_{2007}^{TT} + \tau_{2007}^{TT}$
in 2008: $\tau_{2007} = \tau_{2008}^{CT} \cdot (1-\tau^{soli}) + \tau_{2008}^{TT}$

4 Applications and Potential Extensions of the ZEW TaxCoMM

Being based on firm-level data and capturing tax regulations in great detail, the proposed microsimulation model bears considerable strength for tax policy analyses. In this context, possible applications are manifold. In a first step, an interesting application consists in taking the year 2007 as reference year and then opposing the tax reform of 2008 to the alternative reform proposal put forward by the German Council of Economic Experts, the Max Planck Institute for Intellectual Property, Competition and Tax Law and the Centre for European Economic Research. It will thus be possible to determine in great detail the "winners" and "losers" of the respective reforms in terms of regions, sectors, profitability or size and to compare revenue implications. In view of future tax reform proposals, their ex ante evaluation by means of the proposed model could provide important input to policy makers thus contributing to the fine-tuning of the reform. Besides comprehensive tax reform proposals, the modular structure of the model allows assessing single regulations by adding or modifying the respective module.

The proposed microsimulation model as outlined in this paper can be extended in three regards. In its first version, the proposed microsimulation model is based on three years in order to demonstrate the general operability of the approach. But it is intended to increase the number of years considered whereas the availability of refined high quality time series data has to be regarded as a limit for further developments. Moreover, another extension considered refers to the geographical coverage. Including foreign countries is deemed valuable in several respects: firstly it will enable tracing group relations thus making the consideration of intra-group cross-border transactions for tax purposes possible. Beyond this, the geographical extension will allow another interesting policy application namely in the context of tax harmonisation attempts of the European Commission.

An additional important strand of further enhancement of the approach consists in the implementation of investment reactions. Up to the current stage of development, the proposed microsimulation model allows conclusions on short-term effects of tax policy. In order to consider also implications going beyond first round effects of tax reforms, behavioural responses of micro entities will be implemented. In this context tax reform induced changes in the tax burden will be traced back to the real economic sphere. The application of a suitable investment function will enable direct consideration of response patterns. Consequently, the described extension will picture the adjustment of investment plans due to a modified fiscal framework thus capturing medium and long term effects of tax reforms.

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