

ZEW TaxCoMM – A Corporate Tax Microsimulation Model

Concept and Application to the 2008 German Corporate Tax Reform

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Abstract

Economists have a long standing experience in capturing the incentives of taxation on microeconomic decision behaviour. Approaches based on the neoclassical investment theory (Hall and Jorgenson (1967), King and Fullerton (1984), Devereux and Griffith (1999)) consistently reveal the distorting effects of taxation, particularly on corporate investment and financing decisions. However, their strictly microeconomic foundation prevents these models from being applicable for purposes other than the identification of tax incentives on rational, i.e. tax minimizing, representative agents. As a consequence, the coherent analysis of implications of tax reforms for tax revenue and the distribution of tax consequences across firms has remained a largely unresolved issue. Still, providing this information to decision makers is required of comprehensive economic tax policy analysis.

We present a corporate microsimulation model - ZEW TaxCoMM - which closes the identified methodological gap. In its current stage of development, ZEW TaxCoMM is designed particularly to simulate German corporate tax law and corresponding reforms. Up to now, it does not account for corporate behavioural responses and its analytical capacity is thus limited to first round effects. In its final stage of development, however, the model will integrate the variety of effects corporate taxes exert on business behaviour.

In this preliminary paper we sketch the model's structure and functioning. Its current analytical capacities will be highlighted by taking a close look at the simulated consequences of the major 2008 German corporate tax reform. Simulation results show that firms with a high profitability, low debt ratio and low capital intensity are strongly favoured by the reform. The reform's first-round negative effect on tax revenue is simulated to amount to 9.8 bn Euro. Furthermore, we will outline the intended conceptual extensions for the consideration of behavioural responses. The ongoing work is planned to be mostly completed in June 2010.

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1 Introduction: Corporate Microsimulation as an Instrument of Tax Policy Analysis

Microsimulation models, by definition, trace or simulate all analytically relevant processes and interdependencies at the lowest level of aggregation, i.e. the single economic agent. Due to their micro-level perspective, these models are able to precisely capture central agent characteristics and their response to (alternative) legal settings (Creedy (2001)). Since microsimulation models do not only focus on representative economic agents but process real data on a vast number of heterogeneous subjects, they are able to broadly and authentically anticipate the consequences of policy reforms (Orcutt et al. (1976)). With special regard to tax reform scenarios, the *ex ante* assessment of corresponding distributional and revenue implications becomes possible. Indeed, microsimulation models of *households* have already been successfully applied in the evaluation of transfer and benefit policies (see inter alia Fuest et al. (2005), Arntz et al. (2008)).¹ For various reasons, however, they have been less established for the analysis of the corporate sector (Bardazzi et al. (2004)).

On the one hand, as compared to household data, the availability of quantitative firm-level information has traditionally been more limited. Especially in Europe, databases with disaggregated financial accounting information have emerged only in recent years. The access to comprehensive original tax data is even more restricted. In Germany, official firm-level tax data is available for selected flow variables only. Hence, the duality of financial and tax accounting is one of the major challenges corporate microsimulation has to cope with. While household microsimulation models can directly refer to economic flow data, corporate microsimulation must possibly process a multitude of stock and flow variables from the financial accounting sphere and transform them according to tax accounting provisions. Otherwise, the model might only be able to capture the effect of a change in nominal tax rates, rather than a reform of tax base regulations.

Another issue closely linked to the aspect of data availability is the models' capacity to allow for general conclusions on the total population of corporate firms. Samples of firm-level financial accounting data are mostly of an arbitrary, i.e. statistically non-random type. Therefore, an appropriate weighting scheme must be constructed on the basis of more or less aggregate information covering the total population of firms. Only in this case, potential sample biases can be eliminated and tenable conclusions referring to the total population of firms become possible.

¹ A comprehensive review of these household microsimulation models is provided by O'Hare and Gupta (2000) and - with a special focus on Germany - by Wagenhals (2004).

A second source of increased complexity besides data issues is the existence of inter-temporal effects of tax provisions governing the tax base (depreciation, loss offset, etc.) which go beyond the merely one-periodic perspective in the tax assessment of households. Consequently, the time horizon covered by corporate microsimulation should also be multi-periodic in order to consistently trace firm-level developments of fundamental tax base variables over time (dynamic microsimulation).

Behavioural responses to a change in legal settings are the third complexity enhancing aspect in corporate microsimulation. Economic agents are generally expected to react to changes in the institutional set-up as soon as these have an impact on their individual target functions. In order to capture more than only first-round consequences of tax reforms a microsimulation model should therefore consider these behavioural responses. As compared to private households which are mainly expected to adjust their labour participation, corporate tax margins, however, are far more numerous.

Defining these sources of conceptual complexity as central requirements of corporate microsimulation models allows categorising existing models relative to the new approach represented by the ZEW TaxCoMM and described in more detail in *Section 2*. In total, three corporate microsimulation models with a specific focus on tax policy evaluation exist (see *Table 1*). Precisely, these are the Italian microsimulation model DIECOFIS, a model provided by the Canadian ministry of finance and BizTax, a microsimulation approach designed to analyse business tax reforms in Germany which has been put forward by the German Institute for Economic Research (DIW). The Italian DIECOFIS² project led to the development of a corporate microsimulation model under the aegis of the Italian statistical office ISTAT (Castelluci et al. (2003), Oropallo and Parisi (2005)). The DIECOFIS microsimulation model is a one-periodic model based on cross-sectional real financial accounting data. The representative dataset (29,196 corporations, reporting year 2000) underlying the DIECOFIS model has been assembled from numerous sources comprising published financial statements and survey data on Italian firms. In order to simulate the corporate tax burden of companies, the given financial accounting data are first transformed into tax data. Subsequently, the firm-specific corporate income is computed in a very detailed way and then multiplied with the statutory corporate income tax rate.

² Development of a System of Indicators on Competitiveness and Fiscal Impact on Enterprises Performance (DIECOFIS).

Table 1: Corporate Microsimulation Models in Applied Tax Policy Analysis

		ZEW TaxCoMM	DIW BizTax	DIECOFIS	Canadian Corporate Microsim.
Simulation design	Detailed ascertainment of profits	Yes	No	Yes	Yes
	Dynamic simulation (multi-period)	Yes	No	No	No
Data features	Primary tax data	No	Yes	No	Yes
	Data extrapolation possible	Yes	Yes	Yes	Yes

The corporate microsimulation approach employed by the Canadian ministry of finance³ complements a macroeconomic model called CEFM.⁴ It is based on a representative dataset covering 18,000 corporations. The micro data is directly assembled from tax returns plus additional information taken from the financial accounts. The CEFM framework does not only serve the purpose of pure policy analysis but is also conceived to fulfill a revenue forecasting function. Therefore, the database is updated or extrapolated to the current period. Moreover, the model is capable of capturing tax base regulations as well as certain inter-temporal effects of tax legislation.

In 2007, the German Institute for Economic Research (DIW) presented a microsimulation model (BizTax) designed particularly to evaluate the German business tax reform 2008 (Bach et al. (2008)). In line with the DIECOFIS model, BizTax keeps a one-periodic perspective in its analyses. Inter-temporal aspects of taxation hence might not be fully reflected in the computations. Moreover, BizTax does not precisely simulate the definition of the tax base. Instead, changing regulation with respect to the ascertainment of profits thus is taken account of via imposed proportional adjustments of benchmark profits. However, BizTax has been successfully employed for the evaluation of selected issues subject to the business tax reform 2008 (Fossen and Bach (2008)).

The design of the ZEW TaxCoMM has in part been inspired by these existing approaches. However, offering broad analytical capacities within a multi-periodic framework, the new model goes beyond prior approaches and thus closes a gap in the conceptual design of corporate microsimulation models. Precisely, ZEW TaxCoMM is the first microsimulation

³ No primary documentation is available for this model. The following précis therefore is based on Ahmet (2006).

⁴ CEFM: Canadian Economic and Fiscal Model.

model which allows for a detailed assessment of all major elements forming the tax bases for profit taxes including e.g. depreciation, thin capitalization rules and loss offset as well as tax regulations concerning different types of provisions.

Section 2 will present some details on the conception of the ZEW TaxCoMM microsimulation approach. *Section 3* will illustrate its analytical capacity by evaluating the 2008 major German corporate tax reform. *Section 4* will sketch the enhancements which will be added to the model in order to integrate behavioural corporate responses to tax reform. *Section 5* concludes.

2 The ZEW TaxCoMM: A new Corporate Microsimulation Approach

ZEW TaxCoMM establishes an explicit linkage between the corporate financial accounting sphere and the tax accounting sphere. The principal data input is taken from the DAFNE database provided by Bureau van Dijk. DAFNE contains detailed financial information of German corporations. Precisely, our microsimulation database covers the years from 2003-2005. We expect that the 2008 reform did not affect business behaviour during this period. The public debate only started at the end of the year 2006. The data excluded from DAFNE thus should not reflect any (anticipated) reform consequences. The microsimulation procedure requires the underlying data panel to be balanced. Hence, only corporations with balance sheets as well as profit and loss accounts for this entire time span are included in the sample.⁵ Eventually, the sample includes 12,569 companies, i.e. 37,707 firm-year observations.

Table 2: Number of companies in the sample classified according to economic activity and size

Economic Activity	Small Corporations	Medium-sized Corporations	Large Corporations
Mining and Manufacturing	1,210	730	997
Energy and Water Supply	44	70	377
Construction	1,159	220	90
Trade, Hotels and Restaurants	1,574	620	505
Transportation and Telecommunications	401	140	195
Other Services	2,330	766	1,141
All economic activities	6,718	2,546	3,305
Share of companies in size range	53.45%	20.26%	26.29%

Note: The table shows absolute numbers of corporations considered by ZEW TaxCoMM classified by company size and economic activity. Proportions of company size ranges are displayed in the bottom row. Company size is defined according to annual balance sheet totals. Small corporations display an annual balance sheet total of not more than € 4,015,000. Corporations are classified as medium-sized if the annual balance sheet total ranges between € 4,015,000 and € 16,060,000. The balance sheet total of large corporations exceeds € 16,060,000.

⁵ Non-tax-paying charitable companies are excluded from the dataset.

Table 2 illustrates the structure of the sample with regard to size and economic activity. The sample covers small, medium-sized and large corporations operating in six different economic sectors. In order to smooth out structural differences between the microsimulation sample and the population of all corporations in Germany, data and results from the considered sample are extrapolated. For this purpose, we principally proceed along the lines of the method applied by the Deutsche Bundesbank to extrapolate financial accounts data from a sample of German corporations to the total business population. However, while Deutsche Bank resorts to official turnover statistics, the extrapolation here is based on the corporate income tax statistic of 2004 provided by the German Federal Statistical Office (Statistisches Bundesamt (2009)).⁶ It provides only moderately aggregated information based on a virtually complete survey of tax declarations from corporations. The statistic inter alia reports the number of corporations falling into predefined income ranges and the aggregate gross taxable corporate income earned from corporations within each range. The data are grouped according to economic sectors and according to profit and loss making corporations. Due to its full coverage of corporations and its reference to gross taxable corporate income which is a key output variable in the ZEW TaxCoMM, the corporate income tax statistic is well suited to extrapolate the results from the considered sample. Precisely, we proceed as follows. First, for each economic activity, the corporations in the ZEW TaxCoMM sample are grouped into intervals of gross taxable corporate income corresponding to those defined in the corporate income tax statistic. Second, for each resulting activity-income-class, we calculate the proportion of the class-specific number of sample observations to population observations in that same class, as given by the corporate income tax statistic. Third, sample observations in each activity-income-cluster are weighted by the reciprocal of this proportion.⁷ The weights for extrapolation are determined annually. Thus, firms might switch income classes over the considered years. For each year, however, the sample data is aligned to the total business population as represented by the corporate income tax statistic of 2004. The extrapolation ensures that structural distortions of the sample due to less prominently represented small and medium-sized corporations or underrepresented sectors are offset. Hence, ZEW TaxCoMM allows for conclusions on the distribution of the tax burden among corporations as well as on revenue implications of tax reforms. *Table 3* illustrates the structure of the *extrapolated* sample.

⁶ The Federal Statistical Office has provided us with a special evaluation of the corporate income tax statistic. It contains tabulations in much higher detail than those in the standard version.

⁷ The procedure thus implicitly assumes that within each activity-income-class, the ratio between gross corporate taxable income and individual balance sheet or profit and loss account items of firms not included in the sample on average corresponds to that of corporations covered by the dataset.

Due to the panel structure of the exploited financial accounts data, ZEW TaxCoMM is able to take the intertemporal effects of tax provisions into account. In this regard it thus contrasts with other microsimulation models which resort to mainly cross-sectional tax data as principal source of information. Furthermore, ZEW TaxCoMM is capable of tracing the consequences of changes in tax provisions in high detail, since it derives flow data from financial stock data and thereby allows a detailed simulation of firm specific tax assessment.

Table 3: Number of companies in the extrapolated sample classified according to economic activity and size (3-year average)

Economic Activity	Small Corporations	Medium-sized Corporations	Large Corporations
Mining and Manufacturing	84,341	17,580	8,800
Energy and Water Supply	3,829	1,393	2,194
Construction	81,781	6,359	844
Trade, Hotels and Restaurants	150,463	20,103	6,507
Transportation and Telecommunications	24,807	2,212	1,267
Other Services	349,021	32,236	23,112
All economic activities	694,242	79,882	42,723
Share of companies in size range	84.99%	9.78%	5.23%

Note: The table shows absolute numbers of corporations considered by ZEW TaxCoMM after extrapolation on the basis of the corporate income tax statistic of 2004. Proportions of company size ranges are displayed in the bottom row. Company size is defined according to annual balance sheet totals. Small corporations display an annual balance sheet total of not more than € 4,015,000. Corporations are classified as medium-sized if the annual balance sheet total ranges between € 4,015,000 and € 16,060,000. The balance sheet total of large corporations exceeds € 16,060,000.

As a central link between both the financial accounting and the tax accounting sphere, ZEW TaxCoMM uses the *profit on ordinary activities* as defined in § 275 II No 14/ III No 13 CC (Commercial Code). In a first stage, the model, therefore, comprises a sequence of modules which determine required modifications of variables for each firm separately. These modifications account for deviations of financial accounting schemes from corresponding tax accounting regulations and practices for both corporate tax as well as trade tax purposes. While the relevant modules may vary with respect to their computational complexity and the technical approach chosen, they all are conceived along the lines of four essential notions:

- Exploit and never contradict all available information from financial statements
- Consistently trace firm-level developments over time
- Opt for the most realistic assumption with regard to firm-level choices, even if it is not in line with tax-minimizing behaviour
- Modules must easily adapt to different tax regulations and reform scenarios

In a second stage of the microsimulation procedure, the identified required modifications are applied to the profit on ordinary activities for each firm separately. *Figure 1* summarizes these potential modifications and illustrate the model's current overall conception.⁸

After computing firm-specific tax bases ZEW TaxCoMM calculates the individual tax due by applying the relevant tax rates for corporate income tax and trade tax purposes. Since total amounts of tax due are not directly comparable across companies, ZEW TaxCoMM additionally computes an effective tax burden measure particularly suitable for microsimulation purposes.

By definition, the employed effective tax rate measures the relative wedge between pre-tax and post-tax values of a given target variable. A target variable which can be easily extracted from financial accounts data is the future value of periodical pre-tax cash flows⁹ (FV^{CF}). To generate the post-tax value of this variable (FV_{τ}^{CF}), periodic pre-tax cash flows (CF_t) are reduced by profit taxes (τ) and accumulated according to the time horizon (T). Hence, the ZEW TaxCoMM effective tax burden on cash flows is defined as

$$\tau_{eff} = \left| \frac{FV^{CF} - FV_{\tau}^{CF}}{FV^{CF}} \right|$$

$$= \left| \frac{\sum_{t=1}^T CF_t \cdot (1+i)^{T-t} - \sum_{t=1}^T CF_{t,\tau} \cdot (1+i_{\tau})^{T-t}}{\sum_{t=1}^T CF_t \cdot (1+i)^{T-t}} \right|.$$

The (unique) interest rate (i) used to calculate the future value of cash flows is the average yield of German industrial securities in the period of 2003 to 2005 which amounts to 4.2%. While this (gross) interest rate is directly applied to compute future values of pre-tax cash-flows, a net interest rate (i_{τ}) is needed for the calculation of respective post-tax cash flow future values.

⁸ For a concise explanation of the principles and technicalities of the German tax and business law, see Wolff et al. (2005). For a more detailed technical description of ZEW TaxCoMM see Reister et al. (2008).

⁹ The periodic cash flow used follows the definition of the Society of Investment Professionals in Germany (Schmalenbach Association). It is reduced by cash-flows arising from tax-exempt foreign income.

Figure 1: ZEW TaxCoMM – Deriving the tax base

Checking items of profit from ordinary activities for required adjustments for tax purposes	Computation of required adjustments for tax purposes												
Turnover													
Increase or decrease in finished goods and work in progress													
Other own work capitalized													
Other operating income <i>Investments grants and subsidies</i>													
Cost of materials													
Staff costs													
Amortization and depreciation <i>Goodwill, intangible fixed assets (other), immovable fixed assets, movable fixed assets</i>													
Financial Results <i>Income from participating interests Income from other long-term securities and loans Interest payable</i>													
Required adjustments due to deviations in recognition and measurement of balance sheet items, not referring to a specific ordinary profit item													
Provisions <i>Other provisions</i>													
Creditors <i>Long-term trade creditors</i>													
Capitalised Expenses for the Start-up and Expansion of the Business													
Non-deductible expenses													
Add-backs and deductions for trade tax purposes													
Profit from ordinary activities + Extraordinary profit/loss + Other Taxes	+ AGS	+ AD	+ AF	+ AP	+ AC	+ ACE	+ AND		Integrated fiscal units	Tax loss carry forward	Foreign permanent establishments	Corporate income tax base	Corporate income Tax due
	+ AGS + AGS_TT	+ AD + AD_TT	+ AF + AF_TT	+ AP + AP_TT	+ AC + AC_TT	+ ACE + ACE_TT	+ AND + AND_TT	+ ABD_TT				Trade Tax Base	Trade tax due

Legend: AGS: Adjusting for investment grants and subsidies; AD: Adjusting for tax depreciation; AF: Adjusting for financial results (interest deductibility and further adjustments); AP: Adjusting for non-conforming regulation on provisions; AC: Adjusting for non-conforming regulation on creditors; ACE: *Adj. for capitalised expenses for the start-up and expansion of the business*; AND: *Non-deductible business expenses*; ABD: *Adj. for add-backs and deductions for trade tax purposes*; *_TT: Specific adjustments for trade tax purposes.*

Validating ZEW TaxCoMM

Validating ZEW TaxCoMM is not an easy task since tax statistics refer to cash tax revenue¹⁰ and, moreover, do not report disaggregated data on firm specific tax due. Yet, as regards the validation at firm level, ZEW TaxCoMM's capability to consistently approximate tax bases and hence, resulting corporate income and trade taxes due can be evaluated on the basis of information about taxes paid on income included in the ZEW TaxCoMM data sample taken from the DAFNE database for the corresponding years 2003 to 2005. However, this is a relatively rough approach since the financial accounting item "taxes on profit" reflects tax prepayments, tax refunds and deferred taxes within a reporting period. Thus, it might significantly deviate from the tax due for that specific period. However, for companies with relatively stable profits over time, both variables should be rather close. Therefore, validation of the ZEW TaxCoMM will rely on comparing computed taxes due with taxes paid on profits for this type of companies. In total, 129 companies belong to this group of firms with a very smooth profit dynamic (+/- 5% over all three years considered). Looking at the relative gap between the simulated tax due and financial "taxes on profit", the corresponding mean relative deviation for all 387 observations amounts to 2.0% if outlying results (below respectively higher than 1st and 99th percentiles) are eliminated. We conclude that there is no considerable systematic deviation of the ZEW TaxCoMM microsimulation results from underlying "real" taxes due.

That the gross taxable income is very realistically simulated is also confirmed in course of the extrapolation of the dataset. In this context, the intervals of gross taxable corporate income for which the Federal Statistical office refuses to report the number of firms¹¹ match with those intervals to which we allocate only a few firms on the basis of ZEW TaxCoMM. This would not be the case if ZEW TaxCoMM would systematically over- or underestimate the actual income.

¹⁰ If one compares the simulated total tax revenues with official government statistics for 2004 (BMF (2007)), the simulated revenue exceeds the reported revenue. This is, however, not surprising, as government statistics generally refer to cash tax revenues. In the reporting years covered by the simulation sample, these are still heavily influenced by tax refunds originating from the abolishment of the credit tax system in Germany in 2001. Furthermore, cash tax revenues are generally influenced by effects relating to other periods and therefore, only a limited indicator for annual taxes due.

¹¹ For some intervals covering the highest positive or negative gross taxable income, the Federal Statistical Office only reports the aggregate income but not the number of firms in this interval, since it would otherwise be possible to conclude on the identity of the respective firms.

3 Applying ZEW TaxCoMM to the 2008 German Corporate Tax Reform

Regulatory changes in detail

The consequences of the 2008 German corporate tax reform are still at the heart of an ongoing academic and political debate. The German corporate tax reform followed internationally prevalent pattern of cutting tax rates and financing these tax rate cuts by broadening the tax base. Hence, its evaluation also provides valuable insights into the general implications of tax rate cut cum base broadening reforms on heterogeneous firms.

The regulatory changes underlying the analysis are detailed in *Table A.1* in the appendix. Generally, the central aims of the corporate tax reform as declared by the German federal government were the improvement of Germany's location attractiveness from a tax perspective and the enhancement of tax neutrality with respect to the choice of legal form as well as financing decisions (Bundestag (2007)). Moreover, a major focus has been put on the sustained strengthening of the German tax base. As a consequence, revenue neutrality played a major role in the design of the reform.

Consequences of the German Corporate Tax Reform for the Distribution of the Tax Burden across Firms

As a primary output, ZEW TaxCoMM calculates the annual tax due at the level of each firm. To gain insight in the distribution of the tax burden across companies of different sizes and economic activity, the following analysis is based on the effective tax burden on cash flows (*Table 4*). The effective tax burden on cash flow, as shown in *Section 3*, represents the tax induced relative cut of the future value of periodical pre-tax cash flows.¹²

In the reference tax system 2007, the average effective tax burden on cash flow across all economic activities amounts to 26.38% for small corporations, 19.41% for medium-sized corporations and 19.21% for large corporations. Furthermore, *Table 6* reveals a considerable variation of the average effective tax burden on cash flow across company size and economic activity.

After the corporate tax reform of 2008, the effective tax burden on cash flow varies between 7.86% for medium-sized corporations in the energy sector and 23.15% for small corporations in the service sector. The average decline in the tax burden is highest for small

¹² Implausible values have been eliminated by applying the Median Absolute Deviation Method (MAD) with a tolerance interval of 20xMAD. This procedure removed 142 firms from the dataset.

corporations (5.97 percentage points) and lowest for large corporations (2.80 percentage points).

Table 4: ZEW TaxCoMM effective tax burden on cash flow (in %) for reference and reform tax system and deviation between the two systems (in percentage points)

Economic Activity	Small Corporations			Medium-Sized Corporations			Large Corporations		
	2007	2008	Δ	2007	2008	Δ	2007	2008	Δ
Mining, Manufacturing	22.23%	17.22%	-5.01	19.08%	14.70%	-4.39	18.33%	14.78%	-3.55
Energy, Water Supply	12.13%	9.96%	-2.17	9.56%	7.86%	-1.70	7.78%	6.64%	-1.15
Construction	23.80%	18.53%	-5.27	21.60%	16.51%	-5.09	15.43%	12.53%	-2.91
Trade, Hotels, Restaurants	22.85%	17.44%	-5.41	17.97%	13.95%	-4.01	20.14%	16.60%	-3.54
Transportation, Telecommunication	23.54%	18.61%	-4.93	14.91%	12.63%	-2.28	15.03%	12.19%	-2.84
Other Services, Activities	29.87%	23.15%	-6.73	20.79%	15.56%	-5.23	20.74%	18.29%	-2.45
All economic activities	26.38%	20.41%	-5.97	19.41%	14.83%	-4.59	19.21%	16.42%	-2.80

Note: This table shows the ZEW TaxCoMM effective tax burden on cash flow in % and its reform induced changes in percentage points for different company sizes and economic activities. The results are based on the extrapolated sample. The effective tax burden on cash flow represents the tax induced relative cut of the future value of periodical pre-tax cash flows. Implausible values have been eliminated by applying the Median Absolute Deviation Method (MAD) with a tolerance interval of 20xMAD. This procedure removed 142 firms from the dataset. Company size categories are defined as explained in footnote of *Table 2*. Source: ZEW TaxCoMM

The reduction of the tax burden for large corporations is comparably low since large corporations are to a greater extent subject to newly implemented interest deduction ceiling regulations and extended interest add-backs. The average share of corporations underlying the interest deduction ceiling regulation, for instance, amounts to 6.73% for large corporations as opposed to virtually 0% for small corporations and 0.11% for medium-sized corporations.

Table 5 illustrates in detail how the reduction in the effective tax burden is distributed within the sample.

Table 5: Distribution of the reduction in the effective tax burden on cash flow (in percentage points)

Percentile	1%	5%	10%	25%	50%	75%	90%	95%	99%
Reduction of effective tax burden in percentage points	-3.31	0.04	0.30	1.13	5.28	8.40	9.86	13.37	32.17

Note: This table displays the distribution of the reform induced reduction in the effective tax burden on cash flow in percentage points. The results are based on the extrapolated sample. Source: ZEW TaxCoMM

25% of the corporations in the sample experience a decrease in the effective tax burden on cash flow of less than 1.13 percentage points. However, under 2008 tax law, less than 5%

of all corporations in the microsimulation sample are subject to an increased effective tax burden on their cash flows. Moreover, the reduction ranges between 1.13 and 8.40 percentage points for 50% of the corporations. Only 10% of the corporations see their effective tax burden on cash flow to be reduced by more than 9.86 percentage points.

The extent to which the important tax rate cuts translate into a decrease in the effective tax burden is closely related to the profitability of the corporation.¹³ In contrast, structural ratios such as debt ratio and capital intensity indicate the exposure of corporations to elements of the reform which broaden the tax base (abolition of the declining balance method and extended restrictions governing the deduction of interest expenses). Therefore, companies of high profitability, low debt ratio and low capital intensity are expected to gain most from the reform. By capturing the heterogeneity of firms, ZEW TaxCoMM can very precisely illustrate this issue. *Table 6* matches the reduction in the effective tax burden on cash flows with the relevant financial ratios of the corporations in the sample. Precisely, the reduction in the tax burden is separated into quarters, the boundaries of which are defined by the quartiles given in *Table 5*. For each quarter, *Table 6* shows the corresponding median of financial ratios across those companies contained in that respective quarter.

Table 6: Matching up effective tax burdens on cash flows with financial ratios

Reduction in effective tax burden	Financial Ratio	Median of Financial Ratio	Standard Deviation of Financial Ratio
1st quarter	Profitability	-1.29%	30.78%
2nd quarter		1.66%	12.68%
3rd quarter		5.86%	23.79%
4th quarter		5.41%	29.70%
1st quarter	Debt Ratio	48.26%	28.20%
2nd quarter		41.11%	24.35%
3rd quarter		34.59%	24.63%
4th quarter		28.98%	28.85%
1st quarter	Capital Intensity	20.59%	28.34%
2nd quarter		16.93%	23.84%
3rd quarter		11.16%	18.84%
4th quarter		7.08%	18.37%

Note: This table shows for each quarter of the reduction in effective tax burden on cash flow the corresponding median of profitability, debt ratio and capital intensity across companies contained in the respective quarter. The results are based upon the extrapolated sample. The boundaries of the quarters are defined by the quartiles of the distribution given in *Table 7*. Profitability is defined as the 3-year average ratio of annual profit of ordinary activity to annual balance sheet total. The 3-year average ratio of interest-bearing liabilities to annual balance sheet total yields the debt ratio. The capital intensity is given by the 3-year average ratio of tangible fixed assets to annual balance sheet total.

Source: ZEW TaxCoMM

¹³ The financial ratios referred to in this analysis are defined as follows: The profitability of a corporation is defined as the 3-year average ratio of annual profit of ordinary activity to annual balance sheet total. The 3-year average ratio of interest-bearing liabilities to annual balance sheet total yields the debt ratio. The capital intensity is given by the 3-year average ratio of tangible fixed assets to annual balance sheet total.

ZEW TaxCoMM shows that corporations falling into the lowest quarter of the reduction in the effective tax burden are indeed of low profitability, largely debt financed and show a high capital intensity. Hence, while these corporations benefit from tax rate cuts to a comparably smaller extent, their tax burden is hit particularly hard by extended interest add-backs, the interest deduction ceiling regulations and the abolition of the declining balance depreciation. Vice versa, the decline in the effective average tax burden is most accentuated for highly profitable corporations with a low debt ratio and low capital intensity. Corporations falling into the third or fourth quarter, i.e. experiencing a reduction in the effective tax burden of more than 5.28 percentage points, are of a similarly high profitability. Yet, the 25% of corporations that benefit most from the corporate tax reform yield, in addition to the high profitability, a considerably lower debt ratio and a lower capital intensity.

Table 5 clearly indicates that a vast majority of corporations experiences a decline in the effective tax burden on cash flow. *Table 6* matches the degree of reduction in effective tax burden up with corresponding financial ratios. *Table 7* now takes a complementary look at the distribution of winners and losers across company sizes and economic activities.

Table 7: Share of “winners” and “losers” of the reform 2008

Economic Activity	Small Corporation			Medium-Sized Corporation			Large Corporation		
	"Winner"	"No change"	"Loser"	"Winner"	"No change"	"Loser"	"Winner"	"No change"	"Loser"
Mining, Manufacturing	94.19%	0.28%	5.53%	92.12%	0.00%	7.88%	90.88%	0.00%	9.12%
Energy, Water Supply	77.32%	0.00%	22.68%	80.45%	0.00%	19.55%	73.68%	0.00%	26.32%
Construction	95.40%	0.00%	4.60%	98.13%	0.00%	1.87%	96.29%	0.00%	3.71%
Trade, Hotels, Restaurants	95.77%	0.22%	4.00%	93.97%	0.00%	6.03%	93.62%	0.00%	6.38%
Transportation, Telecommunications	92.02%	0.00%	7.98%	73.69%	0.00%	26.31%	94.25%	0.00%	5.75%
Other Services, Activities	97.66%	0.06%	2.28%	96.93%	0.00%	3.07%	88.06%	0.00%	11.94%
All economic activities	96.25%	0.11%	3.64%	94.29%	0.00%	5.71%	89.13%	0.00%	10.87%

Note: This table displays the share of companies according to company size and economic activity that are “winner” or “loser” of the corporate tax reform 2008 or that are not subject to reform induced changes in the effective tax burden on cash flow (“no change”). The results are based on the extrapolated sample. Company size categories are defined as in the footnote of *Table 2*.

Source: ZEW TaxCoMM

The share of “winners” ranges from 73.68% for large corporations in the energy sector to 98.13% for medium-sized corporations in the construction sector. With regard to all economic activities, the highest share of “winners” can be stated for small corporations and the lowest share for large corporations. Despite the important tax rate cuts, there is still a distinct share of corporations that do not benefit from the tax reform but incur an increase in the effective tax

burden on cash flow. This result holds true for each size range and economic activity. The proportion of companies whose effective tax burden remains unchanged is generally negligible.

Simulated Revenue Consequences of the 2008 German Corporate Tax Reform

To shed light on the reform induced changes in the tax revenue, ZEW TaxCoMM aggregates the firm specific tax due for each year. The results are displayed in *Table 8*. For the reference tax system 2007 the 3-year average tax revenue collected from corporations of all sizes amounts to € 49.762 billion (column 5). The respective contribution of trade tax to the total tax revenue amounts to € 22.709 billion (46% of the overall revenue). The corporate income generates tax revenue of € 25.642 billion (52% of the overall revenue). Comparing the contributions of companies of different sizes to the overall revenue (columns 2 - 4) reveals that large corporations pay 75% of the overall tax revenue, although they make up only 5% of all corporations considered.

Table 8: Tax revenue in bn € for the reference tax system, the tax system of 2008 and change in %

Tax system	3-year Average			Total
	Small Corporations	Medium-sized Corporations	Large Corporations	
Reference tax system 2007				
Overall tax revenue (bn €)	6.326	6.215	37.221	49.762
thereof trade tax	2.855 (45.1%)	2.836 (45.6%)	17.018 (45.7%)	22.709 (45.6%)
Thereof corporate income tax	3.290 (52%)	3.202 (51.5%)	19.150 (51.5%)	25.642 (51.5%)
Thereof solidarity surcharge	0.181 (2.9%)	0.176 (2.8%)	1.053 (2.8%)	1.467 (2.9%)
Post-reform tax system 2008				
Overall tax-revenue (bn €)	4.929	4.832	30.185	39.945
Δ-%	-22.08%	-22.25%	-18.90%	-19.73%
thereof trade tax	2.328 (47.2%)	2.276 (47.1%)	14.416 (47.8%)	19.021 (47.6%)
Δ-%	-18.44%	-19.74%	-15.29%	-16.24%
thereof corporate income tax	2.465 (50%)	2.422 (50.1%)	14.947 (49.5%)	19.834 (50%)
Δ-%	-25.08%	-24.36%	-21.95%	-22.65%
thereof solidarity surcharge	0.136 (2.8%)	0.133 (2.8%)	0.822 (2.7%)	1.091 (2.7%)
Δ-%	-25.08%	-24.36%	-21.95%	-22.65%

Note: The table displays simulated tax revenues in billion € for the reference and reform tax system on the basis of the extrapolated sample and corresponding deviations in %. Tax revenue is calculated by aggregation of firm-level annual taxes due. Results are itemized according to the different taxes: Trade tax and corporate income tax plus solidarity surcharge. Company size categories are defined as explained in footnote of *Table 2*. Source: ZEW TaxCoMM

With regard to the respective share of corporate income tax and trade tax in overall revenue, the results illustrate that the trade tax gains fiscally in importance in course of the reform. The tax rate cuts which have been considerably higher for the corporate income tax as compared to the trade tax mainly drive this result. At the same time, the trade tax is no longer

deductible as a business expense, which adds to the increased effective weight of the trade tax burden.

In the short run, when *disregarding behavioural responses* to changes in the tax system, the corporate tax reform 2008 results in a decline in tax revenues. The deficiency as simulated by ZEW TaxCoMM amounts to a total of € 9.817 billion and splits up into a loss of € 5.808 billion from corporate income tax, a loss of € 3.688 billion from trade tax and a loss of € 0.376 billion from the solidarity surcharge. A comparison with the estimates of the Federal Ministry of Finance is given in *Table 9*.

Table 9: Revenue Effects in bn € as estimated by the government and comparison to ZEW TaxCoMM results

	Corporate Income Tax	Trade Tax	Solidarity Surcharge	Overall
ZEW Tax CoMM	-5.808	-3.688	-0.367	-9.817
Federal Ministry of Finance¹	-6.150	-3.967	-0.585	-10.701
Deviation	0.342	0.279	0.218	0.884

Note: The table displays the revenue effects of the corporate tax reform as proposed by the Federal Ministry of Finance and as derived by ZEW TaxCoMM. These figures refer to income collected from corporations.

¹The revenue effects estimated by the Federal Ministry are displayed net of those revenue gains the Ministry presumes to earn from the self-financing effect of the reform and from special restrictions on tax avoidance (e.g. relocation of functions, security lending).

Source: ZEW TaxCoMM and Federal Ministry of Finance (Bundestag (2007)).

According to the Federal Ministry of Finance, the presumed financing gap of the corporate tax reform totals € 10.701 billion.¹⁴ Thus, the revenue loss computed by ZEW TaxCoMM is about € 900 million lower. This deviation does not seem implausibly high. ZEW TaxCoMM simulates the considered tax base regulations more precisely directly at the micro level and thus simulates revenue gains from the broadening of the tax base that outweigh the effect from the tax rate cut to a larger extent than in the ministry's calculations.

4 Ongoing Work: Integrating behavioural responses to tax reform into ZEW TaxCoMM

Economic agents' behavioural reactions to changes in relevant variables generally enter microsimulation models via built-in elasticities which reflect the corresponding influence intensities. However, no general approach neither with respect to the level of detail in modeled decision margins nor with respect to the derivation of relevant elasticities has yet emerged. While some models (e.g. Salinger and Summers (1983); Shanazarian (2004)) rely on elastic-

¹⁴ These are deficiencies in revenue collected from corporations. The share of trade tax collected from corporations is approximated with 55% of total trade tax. The share of solidarity surcharge on corporate income is approximated with 11% of total solidarity surcharge revenue. The displayed loss is net of those revenue gains the Ministry presumes to earn from the self-financing effect of the reform and from special restrictions on tax avoidance (e.g. relocation of functions, security lending) (Bundestag (2007) p. 39).

ties which are directly estimated on the basis of the underlying micro data, others (e.g. Creedy and Gemmell (2007, 2008)) plug in plausible elasticities taken from the prior empirical literature. Regarding the model detail, existing approaches vary between rather rudimentary simulations of behavioural responses with a focus mainly on corporate investment (Salinger and Summers (1983)) or the overall corporate tax base (Creedy and Gemmell (2007, 2008)). Shanzarian (2004) instead recursively estimates an extremely large number of behavioural parameters, trying to fully disentangle the corporate decision making process with all its interdependencies.

The approach chosen for the behavioural enhancement of the ZEW TaxCoMM will be conceived along the lines of De Mooij and Ederveen (2008) and take account of the most important corporate tax margins which together compose the overall tax base elasticity. De Mooij and Ederveen formally split the aggregate semi-elasticity of the corporate tax base ε into five parts which refer to the choice of organisational form ε^{OF} , the response in the debt-equity ratio ε^{DE} , multinational profit shifting ε^{PS} , the investment distortion ε^{INV} , and the effect on location choices ε^{LOC} :

$$\varepsilon = \varepsilon^{OF} + w^N \varepsilon^{DE} + w^M \varepsilon^{PS} + w^N \varepsilon^{INV} + w^F \varepsilon^{LOC}$$

, where w^N, w^M , and w^F stand for respectively the share of normal return on equity in the total corporate tax base, the share of profits made by multinationals, and the share of assets owned by foreigners. De Mooij and Ederveen choose plausible values for these variables and plug in semi-elasticities taken from selected empirical literature in order to approximate ε . Note that summing up the single semi-elasticities necessitates the change in relevant tax rates to be equal across all firms and tax base components. The ZEW TaxCoMM will also resort to semi-elasticities taken from existing empirical evidence since the estimation of tax margins on a purely national dataset is highly problematic due to insufficient variation in tax rates. However, the semi-elasticities plugged into the model will be based on a full assessment of the empirical evidence by means of extensive meta-studies (Feld and Heckemeyer (2009); Feld, Heckemeyer and Overesch (2009)). Moreover, according to the nature of a microsimulation model the computation of the aggregate tax base response will be bottom-up. First, the model will resort to those types of tax rates which are respectively relevant at the different decision margins. Wherever decision margins are defined with respect to forward-looking effective tax rates, these tax rates and thus any reform induced changes will be firm-specific. Furthermore, based on the evidence gained from the prior quantitative meta-analyses of the empirical evidence, it will be possible to differentiate influence intensities, i.e. semi-elasticities, according to central firm characteristics such as industry, size, degree of

multinationalisation as well as according to certain asset characteristics (e.g. debt maturity). Thus, the tax base response to reform will eventually result from the aggregation of all detailed firm-level responses. By departing from the assumption of average or representative business agents subject to uniform tax rate changes, the microsimulation analysis is expected to allow for valid second-round conclusions about tax reform consequences on revenue and the distribution of tax burden across heterogeneous firms.

5 Conclusions

In this paper we presented a new corporate microsimulation model, ZEW TaxCoMM, which performs coherent micro-based analyses (*ex ante* and *ex post*) of reform induced revenue implications and the distribution of the tax burden across heterogeneous firms.

ZEW TaxCoMM was employed to evaluate the distributional and revenue consequences of the German corporate tax reform 2008. Among other results, the analysis showed that high profitability, low debt ratio and low capital intensity favour a strong decline in the tax burden measure. On the basis of these results, the internationally prevalent tax rate cut cum base broadening reforms might indeed be identified as being harmful for many firms in times of massive economic downturn.

Up to now, the presented microsimulation is limited to the analysis of first-round reform effects. The paper shortly sketched the enhancements which will be added to the model in the short term. By integrating empirically plausible behavioural responses at the micro level, the scope of analysis of ZEW TaxCoMM will be significantly extended to second-round reform effects.

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Appendix

Table A.1: Regulations concerning German taxes on profits before and after the 2008 corporate tax reform

Tax Year 2007	Tax Year 2008
<p><u>Taxes on profits:</u></p> <ul style="list-style-type: none"> - corporate income tax (“Körperschaftsteuer”) - solidarity surcharge (“Solidaritätszuschlag”) - trade tax (“Gewerbsteuer”) 	<p><u>Taxes on profits:</u></p> <ul style="list-style-type: none"> - corporate income tax (“Körperschaftsteuer”) - solidarity surcharge (“Solidaritätszuschlag”) - trade tax (“Gewerbsteuer”)
<p><u>Tax bases:</u></p>	<p><u>Tax bases:</u></p>
<p><u>Corporate income tax:</u></p> <ul style="list-style-type: none"> - trade tax is deductible - depreciation: generally straight-line method is applied, declining balance depreciation at a rate of 30% is possible for movable property (§ 7 ITA) - exemption (95%) of dividend income according to § 8b CTA - loss carry back (limitation: € 511,500) to the previous year and loss carry forward (€ 1,000,000 without limitation, exceeding amounts to 60%) are possible (§ 10d ITA) - losses can generally only be set off against positive income if legal and economic identity of a corporation is maintained (§ 8 IV CTA) - limitation of the deductibility of interests resulting from debt financing only for shareholders loans (§ 8a CTA) 	<p><u>Corporate income tax:</u></p> <ul style="list-style-type: none"> - trade tax is no longer deductible (§ 4 IV ITA) - depreciation: generally straight-line method is applied, declining balance depreciation is abolished (§7 ITA) - exemption (95%) of dividend income according to § 8b CTA - loss carry back (limitation: € 511,500) and loss carry forward (€ 1,000,000 without limitation, exceeding amounts to 60%) are possible (§ 10d ITA) - losses can generally only be set off against positive income if there are no substantial changes in shareholder structure (proportional loss offset if 25% to 50% of shareholder change, no loss offset if more than 50% of shareholder change, § 8c CTA) - general limitation of the deductibility of interests resulting from debt financing to 30% of tax EBITDA with an exemption limit of € 1,000,000 and the possibility of an interest carry forward (§ 8a CTA, § 4h ITA, “Zinsschranke”)
<p><u>Solidarity surcharge:</u></p> <ul style="list-style-type: none"> - levied on corporate income tax due (§ 3 Solidarity Surcharge Act) 	<p><u>Solidarity surcharge:</u></p> <ul style="list-style-type: none"> - levied on corporate income tax due (§ 3 Solidarity Surcharge Act)
<p><u>Trade tax:</u></p> <ul style="list-style-type: none"> - corporate taxable income is used as a starting point and modified by certain adjustments (§ 7 TTA) - exemption (95%) of dividend income according to § 9 TTA only for dividends resulting from an amount of holding of at least 10% (“gewerbsteuerliches Schachtelprivileg”) - only loss carry forward (€ 1,000,000 without limitation, exceeding amounts to 60%) possible (§ 10a TTA) - losses can generally only be set off against positive income if legal and economic identity of a corporation is maintained (§ 10a TTA, § 8 IV CTA) - addition of 50% of interest expenditures resulting from long-term loans (no exemption limit granted, § 8 TTA) 	<p><u>Trade tax:</u></p> <ul style="list-style-type: none"> - corporate taxable income is used as a starting point and modified by certain adjustments (§ 7 TTA) - exemption (95%) of dividend income according to § 9 TTA only for dividends resulting from an amount of holding of at least 15% (“gewerbsteuerliches Schachtelprivileg”) - only loss carry forward (€ 1,000,000 without limitation, exceeding amounts to 60%) possible (§ 10a TTA) - losses can generally only be set off against positive income if there are no substantial changes in shareholder structure (proportional loss offset if 25% to 50% of shareholder change, no loss offset if more than 50% of shareholder change, § 10a TTA, § 8c CTA) - addition of 25% of all interest expenditures as well as parts of rental, lease and licence fees deemed to be interest expenditures (exemption limit: € 100,000, § 8 TTA)

<p><u>Tax rates:</u></p> <ul style="list-style-type: none"> - corporate income tax: 25% (§ 23 CTA) - solidarity surcharge: 5,5% (§ 4 Solidarity Surcharge Act) - trade tax: varying municipal rates (minimum 200%, at average about 400%) and a multiplier of 5% (§§ 11, 16 TTA) 	<p><u>Tax rates:</u></p> <ul style="list-style-type: none"> - corporate income tax: 15% (§ 23 CTA) - solidarity surcharge: 5,5% (§ 4 Solidarity Surcharge Act) - trade tax: varying municipal rates (minimum 200%, at average about 400%) and a multiplier of 3.5% (§§ 11, 16 TTA)
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Source: Own compilation.