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Discussion Paper No. 06-10

**Documentation FiFoSiM:  
Integrated tax benefit microsimulation**

Andreas Peichl and Thilo Schaefer

2006

Finanzwissenschaftliches Forschungsinstitut an der Universität zu Köln

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# Documentation FiFoSiM - Integrated tax benefit microsimulation and CGE model for Germany

by

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## Abstract

This paper describes FiFoSiM, the integrated tax benefit microsimulation and CGE model of the Center of Public Economics at the University of Cologne.

FiFoSiM consists of three main parts. The first part is a static tax benefit microsimulation module. The second part adds a behavioural component to the model: an econometrically estimated labour supply model. The third module is a CGE model which allows the user of FiFoSiM to assess the global economic effects of policy measures.

Two specific features distinguish FiFoSiM from other tax benefit models: First, the simultaneous use of two databases for the tax benefit module and second, the linkage of the tax benefit model to a CGE model.

**JEL Codes:** D58, H2, J22

**Keywords:** FiFoSiM, microsimulation, CGE

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# 1 Introduction

The aim of this paper is to describe FiFoSiM<sup>1</sup>, the integrated tax benefit microsimulation and CGE model of the Center for Public Economics (CPE) at the University of Cologne (Finanzwissenschaftliches Forschungsinstitut an der Universität zu Köln (FiFo)<sup>2</sup>). FiFoSiM consists of three main parts. The first part is a static tax benefit microsimulation module. The second part adds a behavioural component to the model: an econometrically estimated labour supply model. The third module is a CGE model which allows the user of FiFoSiM to assess the global economic effects of policy measures. Two specific features distinguish FiFoSiM from other tax benefit microsimulation models: First, the simultaneous use of two databases for the tax benefit module and second, the linkage of the tax benefit model with a CGE model.<sup>3</sup>

The basic module of FiFoSiM is a static microsimulation model for the German tax and benefit system using income tax and household survey micro data. The approach of FiFoSiM is innovative insofar as it creates a dual database using two micro data sets for Germany: FAST98 and GSOEP.<sup>4</sup> FAST98 is a micro datafile from the German federal income tax statistics containing the relevant income tax data of nearly 3 million households in Germany. Our second data source, the German Socio-Economic Panel (GSOEP), is a representative panel study of private households in Germany. The simultaneous use of both databases allows for

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<sup>1</sup>This paper is based on the English documentation of FiFoSiM (see Peichl and Schaefer (2006)), which is a short version of the detailed German description (see Fuest et al. (2005b)). See also [www.cpe-cologne.de](http://www.cpe-cologne.de) for further information.

<sup>2</sup>The Research Institute for Public Finance at the University of Cologne (FiFo = Finanzwissenschaftliches Forschungsinstitut an der Universität zu Köln) is a non-profit research body pursuing independent economic research and policy consultancy. FiFo's day-to-day work chiefly comprises autonomously financed, long-term research programmes. These programmes supply the theoretical framework for a range of medium- and short-term, market-financed research projects and consultancy mandates.

Over the last fifty years, FiFo's main research topics have naturally changed in line with the developments in public sector economics and changing political objectives. Nevertheless, some aspects of public finance are always on the agenda, and over the past twenty years the following issues have crystallised into the Institute's long-term research topics: Fiscal theory and policy, theory and instruments of national and international environmental policy, direct and indirect taxation, intergovernmental fiscal relations on regional, national and international level, theory and evaluation of public spending programmes and state aids, regional planning and sustainable regional development, innovation theory and technology policy, municipal finances and privatisation.

FiFo regularly performs short- and medium-term studies in these core areas of expertise. Additional subjects are tackled if they offer a deeper insight or a new perspective on one or more of our 'traditional' research topics.

Though legally not part of the University of Cologne, FiFo is attached to it in a relation of institutionalised co-operation and mutual assistance. For instance, professors of public sector economics at the University are simultaneously directors of FiFo. Further information about FiFo can be found at the institute's website: [www.fifo-koeln.de](http://www.fifo-koeln.de).

<sup>3</sup>One should note that both techniques have not been invented for FiFoSiM, but the application to the context of tax benefit reform proposal modelling is insofar original as it has not been done for a peer-reviewed microsimulation model before.

<sup>4</sup>In the last years several tax benefit microsimulation models for Germany have been developed (see for example Peichl (2005) or Wagenhals (2004)). Most of these models use either GSOEP or FAST data. FiFoSiM is so far the first model to combine these two databases.



the imputation of missing values or variables in the other dataset using techniques of statistical matching.

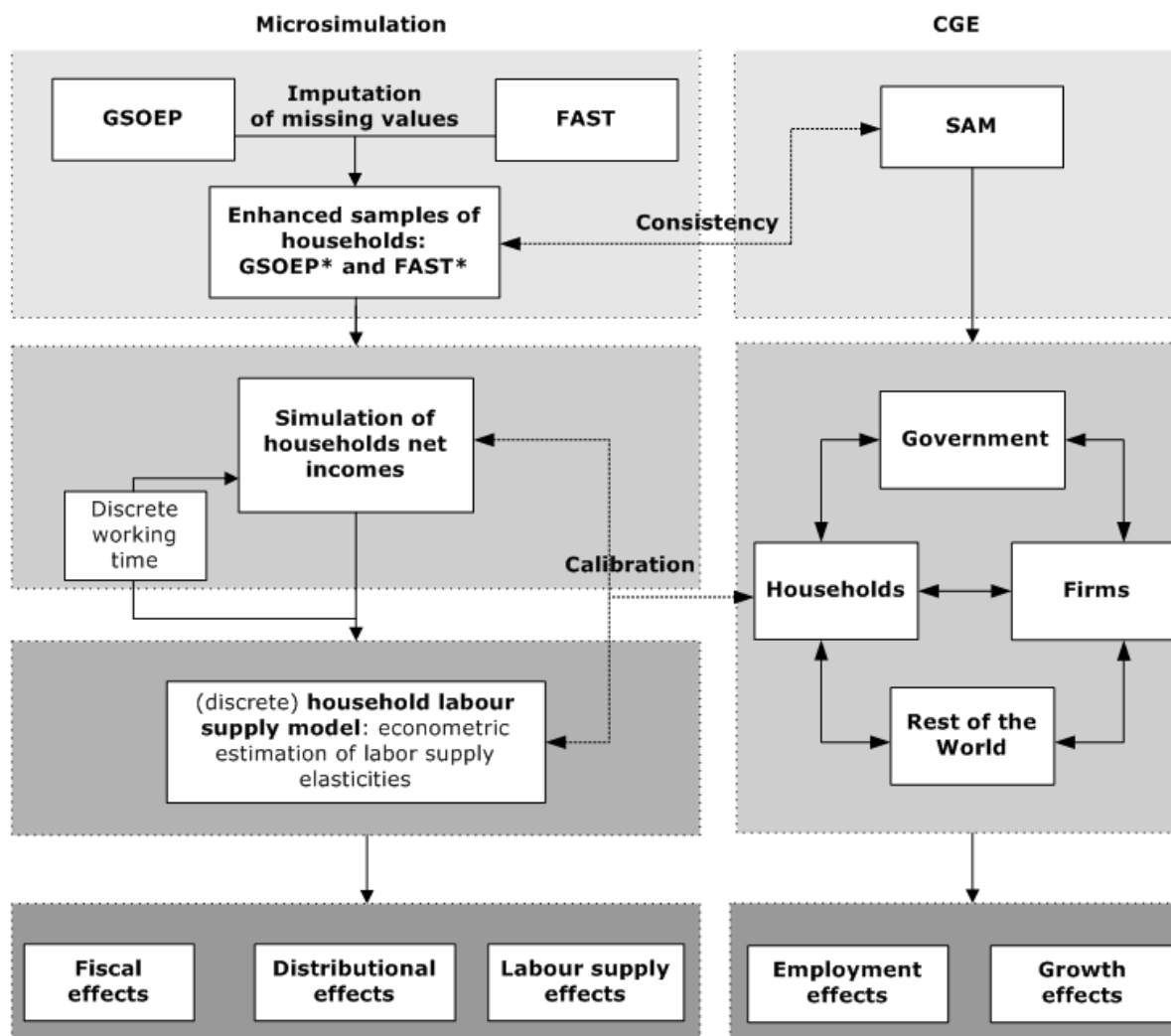


Figure 1: Basic setup FiFoSiM

Figure 1 shows the Basic setup of FiFoSiM. The layout of the tax benefit module follows several steps: First, the database is updated using the static ageing technique<sup>5</sup> which allows controlling for changes in global structural variables and a differentiated adjustment for different income components of the households. Second, we simulate the current tax system in 2006 using the modified data. The result of this simulation is the benchmark for different reform scenarios which are also modelled using the modified database.

<sup>5</sup>Cf. Gupta and Kapur (2000) for an overview of the techniques to modify the data for the use in microsimulation models.

The modelling of the tax and transfer system uses the technique of microsimulation.<sup>6</sup> FiFoSiM computes individual tax payments for each case in the sample considering gross incomes and deductions in detail. The individual results are multiplied by the individual sample weights to extrapolate the fiscal effects of the reform with respect to the whole population. After simulating the tax payments and the received benefits we can compute the disposable income for each household. Based on these household net incomes we estimate the distributional and the labour supply effects of the analysed tax reforms. For the econometric estimation of labour supply elasticities, we apply a discrete choice household labour supply model. Furthermore, FiFoSiM contains a CGE module for the estimation of growth and employment effects, which is linked to the tax benefit module. This interaction allows for a better calibration of the model parameters and a more accurate estimation of the various effects of reform proposals.

The setup of this paper is as follows. Chapter 2 describes (the creation of) the dual database of FiFoSiM, while chapter 3 describes the tax benefit module. Chapter 4 contains a description of the labour supply model, while chapter 5 describes the CGE module. In chapter 6 several applications of FiFoSiM are presented and an outlook to some developments planned for the further improvement of FiFoSiM is given.

## 2 Database

A specific feature of FiFoSiM is the simultaneous use of two micro databases allowing for the imputation of missing values or variables in the other dataset.<sup>7</sup> Due to the time lags between the census and the availability, the data has to be updated to represent the German economy in the period of analysis. The data sources, the matching and the ageing are described in detail in the following.

### 2.1 Income tax scientific-use-file 1998 (FAST98)

The federal income tax statistics is published every three years but with a time lag of five to six years. This statistic contains all information from the personal income tax form (e.g. source and amounts of incomes, deductions, age, children) for every household subject to income taxation in Germany. For 1998, almost 30 million households are included in the micro database. FAST98 is the income tax scientific-use-file 1998 (FAST98) containing a 10%-sample of the German federal income tax statistics including the relevant tax data of nearly 3 million households.<sup>8</sup>

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<sup>6</sup>Cf. Gupta and Kapur (2000) or Harding (1996) for an introduction to the field of microsimulation.

<sup>7</sup>Furthermore, a third database is used for the CGE module which is described in section 5.

<sup>8</sup>Cf. Merz et al. (2005) for a description of FAST98.

The FAST micro data is especially suitable for a detailed analysis of the German tax system. All structural characteristics of the taxpayers are well represented and can be used for a differentiating analysis of tax reforms.

## 2.2 German Socio-Economic Panel (GSOEP)

The German Socio-Economic Panel (GSOEP) is a representative panel study of private households in Germany since 1984.<sup>9</sup> In 2003 GSOEP consists of more than 12,000 households with more than 30,000 individuals. The data include information on earnings, employment, occupational and family biographies, health, personal satisfaction, household composition and living situation. The panel structure of GSOEP allows for longitudinal and cross section analysis of economic and social changes. Bork (2000) certifies GSOEP a rather good mapping of labour income whereas capital and business income are not represented just as well.

GSOEP contains information about the working time and the social environment of the households which is used for the labour supply estimations. Furthermore, the bottom end of the income distribution is better represented in GSOEP than in FAST.

## 2.3 Creating the dual database

One special feature of FiFoSiM is the creation and usage of a dual database. To be more precise, FiFoSiM actually consists of two tax benefit microsimulation models. The first one is based on administrative tax data (FAST), the second on household survey data (GSOEP). The main reason for using the dual database instead of having only one merged database is the huge difference in the number of observations (3 million vs. 30,000). Furthermore, both databases have several shortcomings, as described in the previous sections, but nevertheless, they are the two most appropriate datasets available for the analysis of the German tax benefit system. Therefore, information from one database is used for the imputation of missing values or variables in the second dataset and vice versa. A complete matching of the two databases is also possible but not yet necessary as we only need some of the variables from the second file, which are missing for our analysis in the first file.<sup>10</sup> Hence, the dual database of FiFoSiM actually consists of two enhanced datasets, which allow for a better analysis of tax benefit reforms than the two raw datasets. Another aspect is the handling of missing values in existing variables in each dataset. There exist several principal ways for matching datasets or the

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<sup>9</sup>See SOEP Group (2001) or Haisken De-New and Frick (2003) for a more detailed introduction to GSOEP.

<sup>10</sup>There are mainly legal privacy issues in Germany militating against a complete match. Nevertheless, the matching of the anonymised databases does not allow for a deanonymisation of the individuals in the datasets.

imputation of missing values.<sup>11</sup> Those used in FiFoSiM are described in the following together with information about the respective implementation.

### 2.3.1 Imputation of missing values

For the imputation of missing values in one variable several concepts exist.<sup>12</sup> In general, the imputation of missing values stands for replacing missing data with “plausible values”<sup>13</sup>. Let  $K$  be a variable from a dataset  $A$  with  $i$  non-missing values  $N = (n_1, n_2, \dots, n_i)$  and  $j$  missing values  $M = (m_1, m_2, \dots, m_j)$ :  $K = (N, M) = (n_1, n_2, \dots, n_i, m_1, m_2, \dots, m_j)$ , and  $O = (O_1, O_2, \dots)$  a vector of (other) variables without missing values, and  $H$  be the same variable as  $K$  and  $P$  the same as  $O$  but from a different dataset  $B$ .

**Mean substitution** In this approach, the missing values  $M$  in variable  $K$  are either substituted by the mean of the non missing values  $N$ :

$$\widehat{K} = (N, \overline{N}) = (n_1, n_2, \dots, n_i, \overline{n}, \overline{n}, \dots, \overline{n}),$$

or they are substituted by the mean of the same variable  $H$  from a different dataset  $B$ :

$$\widehat{K} = (N, \overline{H}) = (n_1, n_2, \dots, n_i, \overline{h}, \overline{h}, \dots, \overline{h}),$$

If the missing values can be attributed to some specific subgroups, then the missing values for each subgroup are replaced by the mean of each subgroup either from the non missing values or a different dataset.

This procedure reduces the variance of this variable and should therefore be the last option and only considered if other approaches are not applicable. The latter could be the case if there is, for example, no correlation between the variable containing missing values and any other variable. This approach is used in FiFoSiM if a reform proposal includes the taxation of a so far untaxed activity of which no micro data information is available.

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<sup>11</sup>This section is based on Rässler (2002), who gives an introduction to statistical matching procedures and imputation techniques, as well as an overview of the vast literature and software packages that exist. Furthermore, see for example D’Orazio et al. (2006) for an alternative introduction to these well-known techniques which have been developed during the 1970s (see for example Okner (1972) or Radner et al. (1980)) and applied in other fields of research before (see Cohen (1991) for a survey). As far as we know, the approach of creating a dual database has not previously been adopted by a peer-reviewed microsimulation model.

<sup>12</sup>Cf. Rubin (1987) or Little and Rubin (1987) as additional references for the imputation of missing values. The best but of course most expensive way to impute missing values would be to collect further information on the missing data. But even this solution cannot compensate for shortcomings in historic datasets.

<sup>13</sup>Schafer (1997), p. 1. The alternative to this imputation approach would be to delete (or at least omit) the cases containing missing values. This procedure would lead to biased estimations if the people with missing values share the same characteristics.

**Regression** In the regression approach, a function for the estimation of the missing values is constructed. A (linear) regression<sup>14</sup> of the non missing values of  $K$ ,  $N$ , on the other (non missing) variables  $O$  is done:

$$N = O\beta.$$

Or, as in the case of mean substitution, the similar variable  $H$  from a different dataset  $B$  is regressed on the other variables  $P$  from  $B$  :

$$H = P\beta.$$

These regression coefficients  $\beta$  are then used to predict the missing values. Often a stochastic random value  $\hat{u}$  is added to the prediction of the missing values  $M$  to allow for more variation:

$$\begin{aligned}\widehat{M} &= O\widehat{\beta} + \hat{u}, \\ &\text{or} \\ \widehat{M} &= P\widehat{\beta} + \hat{u}.\end{aligned}$$

These estimates  $\widehat{M}$  are then used to replace the missing values  $M$  :

$$K = (N, \widehat{M})$$

In FiFoSiM this approach is mainly used for variables originally coming from the FAST-Database. Most of these missing values are due to anonymisation and their values can be restricted to some intervals due to different information.

**Multiple imputation** In the multiple imputation approach, multiple values for each missing value are simulated. That is, the missing data is filled in  $m$  times using the regression approach each time with different draws from the distribution of the stochastic error term to generate  $m$  complete data sets. These multiple datasets are generated to better reflect the variation in the estimates and the uncertainty in the imputation procedure itself:

$$\widetilde{M}^i = (\widetilde{m}_1^i, \widetilde{m}_2^i, \dots, \widetilde{m}_j^i)$$

Then the average of these estimates for each observation is calculated as the estimator for

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<sup>14</sup>For categorical variables often logistic regressions are undertaken. A good textbook introduction to the different regression techniques can be found in Greene (2003).

the missing values<sup>15</sup>:

$$\widehat{M} = \frac{1}{i} \sum_i \widetilde{M}^i$$

and is used to replace the missing value in the original dataset:

$$K = (N, \widehat{M}) = (n_1, n_2, \dots, n_i, \widehat{m}_1^i, \widehat{m}_2^i, \dots, \widehat{m}_j^i)$$

This approach is used in FiFoSiM for most of the GSOEP variables containing missing values. The relatively small number of cases in the GSOEP allows the use of several simulation runs for the imputation in a few minutes, whereas for the FAST data this method takes noticeably longer.

### 2.3.2 Statistical matching

The idea of combining two existing datasets to create a joint dataset was developed during the 1970s.<sup>16</sup> The general principle is to merge two (or more) separate databases through the matching of the individual cases. This matching is done on common variables that exist in both databases (for example gender, age and income).

Figure 2 illustrates this basic idea of statistical matching. To put it more analytical<sup>17</sup>: We have three sets of variables  $X, Y, Z$  and two samples  $A = (X, Y)$  and  $B = (X, Z)$ .  $X$  are the common variables in both samples (for example gender, age and income),  $Y$  and  $Z$  are sample specific (for example hourly wages and working hours from GSOEP, special tax deductions from FAST). We can now create a new, joint sample  $C = (X, Y, Z)$  by merging a recipient sample (lets say  $A$ ) with observations from a donor sample ( $B$ ) with exact (or close) values of  $X$ .<sup>18</sup> In doing so, one assumes the Conditional Independence Assumption (CIA)<sup>19</sup> holds: Conditionally on  $X$ ,  $Y$  and  $Z$  are independent.<sup>20</sup>

Of course, one would like to find perfect matches all of the time.<sup>21</sup> But without corresponding

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<sup>15</sup>Hence it is possible to compute the variance, and confidence interval or P value of the missing value.

<sup>16</sup>Cf. Okner (1972), Radner et al. (1980) or Cohen (1991).

<sup>17</sup>This is based on Sutherland et al. (2002).

<sup>18</sup>Which sample should be chosen as the recipient and which as the donor depends on the particular matching question.

<sup>19</sup>See Sims (1972a), Sims (1972b) and Sims (1974). The CIA means that the  $X$  variables contain all information about the relationship between  $Y$  and  $Z$ . If we know  $X$ ,  $Y$  ( $Z$ ) contains no additional information about  $Z$  ( $Y$ ).

<sup>20</sup>This can “in practice [...] rarely be checked“ (Sutherland et al. (2002)). If the CIA does not hold, one can still use methods of statistical matching if the relationship between  $Y$  and  $Z$  can be estimated from other sources and incorporated into the matching process (see Paass (1986)).

<sup>21</sup>This would be possible, if one had variables (name, address, date of birth, social security number) which uniquely identify an individual. Due to privacy reasons researchers are not allowed to gain access to raw micro data that include these information without anonymisation.

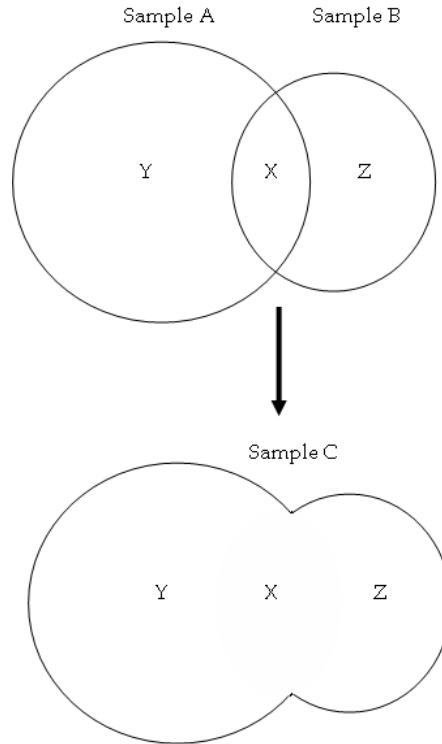


Figure 2: Basic idea of statistical matching

identification numbers and large numbers of variables, a perfect match may not always be possible.<sup>22</sup> In our case, an exact matching is not possible, therefore we have to use methods of statistical matching to match close (instead of exact) observations that share a set of common characteristics. The idea underlying this matching approach is that if two people have a lot of things in common (like for example age, sex, income, marital status, number of children), then they are likely to have other characteristics (like for example expenses) in common. The statistical matching of two databases can either be done by regression or by methods of data fusion.

**Regression** In the regression approach, the specific variable from the donor dataset  $Z$  is regressed on the vector of common variables  $X$ :

$$Z = X\beta.$$

---

<sup>22</sup>If many common variables are continuous, a perfect match seems to be impossible (see Rässler (2002), p.18).

Often a stochastic random value  $\hat{v}$  is added to the prediction to allow for more variation:

$$\hat{Z} = X\hat{\beta} + \hat{v},$$

The estimated coefficients  $\beta$  from the donor dataset are then used to predict the values of  $Z$  in the joint dataset:

$$C(X, Y, \hat{Z}(\beta)).$$

A strong correlation between  $X$  and  $Z$  is important for a successful merging. This approach is rather easy to perform, but it has the drawback that information in terms of variation is lost in the second dataset.

**Data fusion** The data fusion approach can be distinguished into two similar approaches: nearest neighbour and propensity score matching. The general idea of both approaches is related, they only differ in the first step.

The first step in the *nearest neighbour* approach is to weight and norm the common variables, whereas in the *propensity score* approach<sup>23</sup>, the propensity score is estimated. To do so, a dummy variable  $I$  is introduced into the pooled dataset  $D$ , containing the common variables  $X$  from both samples  $A, B$ , indicating 1 if the observation is from the recipient dataset and 0 if it is from the donor dataset:

$$I = \begin{cases} 1 & \text{if observation is from the recipient file} \\ 0 & \text{if observation is from the donor file} \end{cases}$$

Then a logit or probit estimation of the probability of the observation being from the recipient sample (that is of the dummy indicator variable being 1) conditional on the common variables  $X$  is done:

$$P(I = 1|X) = f(X\beta).$$

The function  $f(X\beta)$  is called the propensity score and indicates the probability of the observation belonging to the treatment group (the recipient sample).

The second step is similar for both approaches. The distance between the observations from both datasets is computed using a distance function<sup>24</sup>. In the nearest neighbour case, the

---

<sup>23</sup>Cf. Rosenbaum and Rubin (1983). In general, the propensity score is defined as the conditional probability of treatment given (the common) background variables. Therefore, the propensity score is used as a predictor of the probability of being in the treatment group versus being in the control group. In our case, an observation is in the treatment (control) group if it comes from the recipient (donor) sample.

<sup>24</sup>See Cohen (1991). In general, three different distance functions can be used to determine similarity between the two samples: the absolute, Euclidean or Mahalanobis distance. Let  $x_i^A$  denote the common variables of unit



distance is based on the weighted common variables, in the propensity score case, the distance is based on the estimates for the propensity scores, which can be interpreted as some sort of implicit weighting function.

In the third step, the joint database  $C = (X, Y, Z)$  is created by merging the observations from the two datasets  $A$  and  $B$  with the minimal distance between them. Three ways of merging are possible: Either one observation from the donor dataset is merged to one observation from the recipient dataset (one-to-one merging), or one observation from the donor dataset is merged to multiple observations from the recipient dataset (one-to-n merging) or multiple observations from the donor dataset are merged to multiple observation from the recipient dataset (n-to-m merging).

In FiFoSiM several of these approaches are used due to the difference in the number of observations (3 million vs. 30,000). In general, information from the smaller GSOEP dataset is matched to the FAST data using the regression approach. FAST information is merged to GSOEP data using propensity score matching. Missing values in both datasets are imputed using different approaches depending on the specific circumstances in each case.

## 2.4 Updating the data samples

The database is updated to the year of analysis (i.e. 2007) using the static ageing technique<sup>25</sup> which allows controlling for changes in global structural variables as well as a differentiated adjustment for different income components of the households. Especially the income tax data sample needs to be updated as it describes the situation of 1998. The GSOEP data only needs to be adjusted from 2002. Furthermore, the use of different ageing factors for each database and the reweighing of the weighting factors ensure the consistency of the two databases.

The first step is to reproduce the fundamental structural changes of the population. This is done according to the following criteria: age (in 5 year categories), assessment for income tax (separate or joint) and region (East/West Germany). The method applied here follows Quinke (2001): The cases from the FAST sample are compared to aggregated statistical data for the whole population regarding the above named criteria to calculate the degree of coverage. Assuming that this degree remains stable over the years, the actual aggregate population statistics and prognosis for the year 2006 times the coverage degree allows for an approximate

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$i$  in sample  $A$  and  $x_j^B$  those of unit  $j$  in sample  $B$ .

The absolute distance is defined as  $d_{ij}^{abs} = (x_i^A - x_j^B)$ .

The Euclidean distance is given by  $d_{ij}^E = \sqrt{(x_i^A - x_j^B)' (x_i^A - x_j^B)}$ .

The Mahalanobis distance (see Mahalanobis (1936)) is based on the correlation matrix  $S_X^{-1}$  between the two sets of variables:  $d_{ij}^M = \sqrt{(x_i^A - x_j^B)' S_X^{-1} (x_i^A - x_j^B)}$ .

<sup>25</sup>Cf. Gupta and Kapur (2000) for an overview of the techniques to modify the data for the use in microsimulation models.

adjustment of the database to account for the basic structural changes. Technically, the sample weights need to be adjusted. The weighting coefficients indicate how many actual cases of the real population are represented by each case in the sample. Using the software package Adjust by Merz et al. (2001) the sample weights are adjusted according to 52 possible combinations of the attributes (13 age categories times 2 assessment types times 2 regions). Now, the extrapolation of the sample using the adjusted weights represents the actual population structure better.

In the second step, the taxpayer’s incomes are updated with respect to the varying development of different income types. Also different income growth rates between West and East as well as for positive and negative incomes are taken into account. This allows for a differentiated estimation of the income development. Based on empirical research of the DIW (see Bach and Schulz (2003)) different coefficients for positive and negative incomes are applied on each case’s income. For the simulation model this means that each income value is multiplied with the specific coefficient and thus extrapolated to the current income level. Of course, the coefficients only represent the average development, but regarding the whole population this method provides a satisfying approximation to the income structure of today.

## 2.5 Strength and limitations of the dual database

The use of the dual database and the two tax benefit microsimulation models based on the two enhanced datasets (FAST\* and GSOEP\*) allows us on the one hand to check consistency between the two models and on the other hand to choose the model which is most appropriate for each particular problem we want to analyse. However, these methods cannot guarantee the resulting datasets to retain all advantages of both databases. Beside the huge difference in size using methods of statistical matching leads to the loss of case-specific information. Nevertheless, both datasets are each enhanced through external information while maintaining their specific advantages. If the datasets were merged to one single database, lots of details and the huge number of cases in FAST would be lost. Table 1 presents some aggregated results for the revenue of the status quo personal income tax system for the years 2005-7 and for some selected variables that are merged into the other dataset.

|          | Ref.   | FAST   | FAST*  | GSOEP  | GSOEP* |
|----------|--------|--------|--------|--------|--------|
| PIT 2005 | 181.00 | 178.75 | 181.16 | 185.85 | 180.69 |
| PIT 2006 | 192.85 | 190.02 | 192.64 | 197.27 | 192.23 |
| PIT 2007 | 200.67 | 198.71 | 201.46 | 206.51 | 200.30 |

Table 1: Strength and limitations of the dual database

Notes: The reference value (Ref.) for the personal income tax is based on the estimation of the federal government for each year. \* indicates the enhanced dataset.

The GSOEP values would overestimate the personal income tax in each year mainly because of missing information about deductions. On the contrary, the FAST simulations underestimate the tax revenue especially because of missing information about pension payments which are more heavily taxed since 1998. These shortcomings can be overcome using the enhanced datasets FAST\* and GSOEP\* which are part of the dual database of FiFoSiM.

The creation of this dual or enhanced database with information from administrative tax data and a household survey gives the users of FiFoSiM a powerful tool for the analysis of various questions regarding the German tax benefit system.

### 3 Tax benefit module

In this section, the modelling of the German tax benefit system is described. As the German tax benefit system is very complex, we focus on the major parts of the model in this description.<sup>26</sup>

#### 3.1 Modelling the German income tax law

Individuals are subject to personal income tax. Residents are taxed on their global income; non-residents are taxed on income earned in Germany only.

##### 3.1.1 Income sources

The basic steps for the calculation of the personal income tax under German tax law are according to the scheme of table 2 as follows.<sup>27</sup> The first step is to determine a taxpayer's income from different sources and to allocate it to the seven forms of income. The German tax law distinguishes between seven different categories of income: income from agriculture and forestry, business income, self employment income, salaries and wages from employment, investment income, rental income and other income (including, for example, annuities and certain capital gains). For each type of income, the tax law allows for certain income related deductions. In principle, all expenses that are necessary to obtain, maintain or preserve the income from a source are deductible from the receipts of that source. The second step is to sum up these incomes to obtain the adjusted gross income. Third, deductions like contributions to pension plans or charitable donations are taken into account, which gives taxable income

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<sup>26</sup>A more detailed description can be found in the German version of this documentation (see Fuest et al. (2005b)).

<sup>27</sup>The reference period in FiFoSiM can be either “weeks”, “months” or “years”. The default period for the status quo is “years”.

as a result. Finally, the income tax is calculated by applying the tax rate schedule to taxable income.

|   |  |
|---|--|
|   | Sum of net incomes from 7 categories<br>(receipts from each source minus expenses) |
| = | adjusted gross income  |
| - | deductions<br>(social security and insurance contributions, personal expenses)     |
| = | taxable income $x$   |
| · | tax formula  |
| = | tax payment $T$  |

Table 2: Calculation of the personal income tax

### 3.1.2 Taxable income

The subtraction of special expenses (*Sonderausgaben*), expenses for extraordinary burdens (*außergewöhnliche Belastungen*), loss deduction and child allowance from adjusted gross income gives taxable income.

The special expenses consist of:

- alimony payments (maximum of 13,805 € per year)
- church tax
- tax consultant fees
- expenses for professional training (up to 4,000 € per year)
- school fees of children (up to 30%)
- charitable donations (up to 5% of the adjusted gross income)
- donations to political parties (up to 1,650 €)
- expenses for financial provision, i.e. insurance premiums (pension schemes up to 20,000 € per person, health/nursing care/unemployment insurance)

The insurance contributions are normally equally split between employer and employee. Each premium is calculated as contribution rate times the income that is subject to contributions up to the according contribution ceiling. Current (2007) contribution rates are 19.9% for old age insurance (5,200 € ceiling in West Germany / 4,400 € in East Germany), (an

assumed average of) 14.2% for health insurance (3,525 € ceiling), 4.5% for unemployment insurance (ceilings: 5,200 €/4,400 €) and 1.7% for nursing care insurance (same ceiling as health insurance) plus various special supplements.

The expenses for extraordinary burden consist of:

- expenses for the education of dependants, expenses for the cure of illness, expenses for home help with elderly or disabled people, commuting expenses caused by disability in certain cases
- allowances for disabled persons, surviving dependants and persons in need of care
- child care costs
- tax allowances for self used proprietary, premises and historical buildings

Furthermore, negative income of up to 511,500 € income from the preceding assessment period [loss deduction carried back] is deductible from the tax base.

Each tax unit with children receives either a child allowance (2904 € per parent deduction from taxable income) or a child benefit (154 € per month for the 1st to 3rd child, 179 € as from the 4th child) depending on which is more favourable. In practice, each entitled tax unit received the child benefit. If the child allowance is more favourable, it is deducted from the taxable income while in this case the sum of received child benefits is added to the tax due. The model includes this regulation as it compares allowance and benefit for each case.

Taxable income is computed by subtracting these deductions from the adjusted gross income.

### 3.1.3 Tax due

The tax liability  $T$  is calculated on the basis of a mathematical formula which, as of the year 2007, is structured as follows:

$$T = \begin{cases} 0 & \text{if } x \leq 7,664 \\ (883.74 \cdot \frac{x-7664}{10000} + 1500) \cdot \frac{x-7664}{10000} & \text{if } 7,664 < x \leq 12,739 \\ (228.74 \cdot \frac{x-12739}{10000} + 2397) \cdot \frac{x-12739}{10000} + 989 & \text{if } 12,739 < x \leq 52,151 \\ 0.42 \cdot x - 7914 & \text{if } 52,151 < x \leq 250,000 \\ 0.45 \cdot x - 15414 & \text{if } x > 250,000 \end{cases}$$

where  $x$  is the taxable income. For married taxpayers filing jointly, the tax is twice the amount of applying the formula to half of the married couple's joint taxable income.

## 3.2 Modelling the benefit system

To simulate the labour supply effects, the calculation of net incomes has to take the transfer system into account as well. Federal transfers such as unemployment benefit, housing benefit, and social benefits are modelled in FiFoSiM.

### 3.2.1 Unemployment benefit I

Persons who were employed subject to social insurance contributions at least 12 months before getting unemployed are entitled to receive the so-called unemployment benefit I (according to the German SGB III). The amount to be paid depends on the average gross income of a certain period. This is reduced by 21% for social contributions and the individual income tax. The unemployment benefit I amounts to 60% of the resulting net income (or 67% for unemployed with children).

The benefit period depends on age and seniority (as shown in the following table 3).

| old regulation until 31.01.2006 |     |                | new regulation from 01.02.2006 |     |                |
|---------------------------------|-----|----------------|--------------------------------|-----|----------------|
| employment                      | age | benefit period | employment                     | age | benefit period |
| 12                              |     | 6              | 12                             |     | 6              |
| 16                              |     | 8              | 16                             |     | 8              |
| 20                              |     | 10             | 20                             |     | 10             |
| 24                              |     | 12             | 24                             |     | 12             |
| 30                              | 45  | 14             | 30                             | 55  | 15             |
| 36                              | 45  | 18             | 36                             | 55  | 18             |
| 44                              | 47  | 22             |                                |     |                |
| 52                              | 52  | 26             |                                |     |                |
| 64                              | 57  | 32             |                                |     |                |

Table 3: Duration of unemployment benefit entitlement

The GSOEP panel data contains information about previous unemployment benefit payments, employment periods, etc. When modelling a person's working time categories it has to be examined whether the person might get unemployment benefits in certain working time categories. This is assumed for persons who received unemployment benefits or who were employed subject to social insurance contributions at least 12 month within the last 36 month. The amount of benefit paid is calculated as described above. The remaining net income is deducted from the unemployment benefit.

### 3.2.2 Unemployment benefit II

The unemployment benefit II replaced the former system of unemployment support and social benefits in the course of the so-called Hartz reform. All employable persons between 15 and

65 years and the persons living with them in the same household are entitled to receive unemployment benefit II, as soon as they are no longer entitled to receive unemployment benefit I.

In contrast to the latter, unemployment benefit II depends on the neediness of the recipient and is therefore means-tested. Needy is a person who, by his own household's income, is not able to satisfy his own elementary needs and those of the persons living in his household. The unemployment benefit II corresponds to the former social benefits system plus housing and heating costs if necessary.

This basic amount for each person is means-tested against the household's net income.

### **3.2.3 Social benefits**

Persons who are not able to take care of their subsistence are entitled to receive social benefits. Since unemployment benefit II (see above) was introduced, only non employable persons can receive social benefits. Further on, social benefits are paid in extraordinary circumstances such as impairment of health.

Analogously to unemployment benefit II the basic amount for each person and their respective household net income are taken into account to determine the amount of social benefits actually paid.

### **3.2.4 Housing benefits**

Housing benefits are paid on request to tenants as well as to owners. The number of persons living in the household, the number of family members, the income and the rent depending on the local rent level determine if a person is entitled to receive housing benefits.

First, summing up the individual incomes considering the basic allowances gives the chargeable household income. Then, due to missing information about local rent levels, the weighted averages of rents up to the maximum support allowed are taken into account to determine the housing benefits.

## **4 Labour supply module**

### **4.1 Discrete vs. continuous labour supply modelling**

To analyse the behavioural responses induced by different tax reform scenarios we simulate the labour supply responses. Following Van Soest (1995) we apply a structural discrete choice household labour supply model.<sup>28</sup> Recent surveys of the empirical labour market literature and

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<sup>28</sup>A detailed description of the FiFoSiM labour supply module is provided in the technical appendix and by Fuest et al. (2005b).

different kinds of labour supply models are for example provided by Heckman (1993), Blundell and MaCurdy (1999) or Creedy et al. (2002). A major finding of this literature is that labour supply responds rather along the extensive than the intensive margin (see also Immervoll et al. (2007)). Working-hours elasticities are close to zero for men (see Blundell and MaCurdy (1999)) and women (see Mroz (1987), Triest (1990)). In contrast, extensive labour supply responses seem to be much stronger than intensive (Heckman (1993)), especially particular subgroups (at the bottom of the income distribution) have rather high participation elasticities (see Eissa and Liebman (1996), Meyer and Rosenbaum (2001) and Immervoll et al. (2007)).

In the standard continuous model (see Hausman (1985)), labour supply responds along the intensive margin: an infinitesimal change of the marginal tax rate changes the working hours only a little, whereas participation responses cannot be analysed within this framework satisfactorily (Blundell and MaCurdy (1999)). Discrete choice labour supply models allow to analyse both the extensive (participation) and the intensive (hours worked) labour supply decision within the same modelling framework (Blundell and MaCurdy (1999), Van Soest and Das (2001) and Van Soest et al. (2002)). The intensive decision depends on the effective marginal tax rate, whereas the extensive participation decision depends on the tax wedge between gross (pre-tax) labour costs and the after-tax net income of workers (see Kleven and Kreiner (2003)).

The continuous model “appears not to capture the data, in the sense that the number of part-time jobs is strongly overpredicted” (Van Soest (1995)). There seems to be a lack of part-time jobs because of fixed costs of hiring workers or increasing returns to scale of the worker’s production. Furthermore, because of fixed costs of working (Cogan (1981)) individuals are not willing to work below a minimum number of hours. In addition, there are working time regulations that limit the number of possible working hours to a discrete set. Therefore, a discrete choice between distinct categories of working time seems to be more realistic than a continuum of infinitesimal choices. Using a discrete choice labour supply model has also the advantage to model nonlinear budget constraints as a result of, for example, nonlinear taxes, joint filing and unemployment benefits (see MaCurdy et al. (1990), Van Soest (1995) or Blundell and MaCurdy (1999)). Furthermore, a richer stochastic specification in terms of unobserved wage rates of nonworkers and random preferences can be incorporated into a discrete choice model.

## 4.2 FiFoSiM labour supply module

Following Van Soest (1995) we assume that the household’s head and his partner jointly maximise a household utility function in the arguments leisure of both partners and net income. Household  $i$  ( $i = 1, \dots, N$ ) can choose between a finite number ( $j = 1, \dots, J$ ) of combinations



$(y_{ij}, lm_{ij}, lf_{ij})$ , where  $y_{ij}$  is the net income,  $lm_{ij}$  the leisure of the husband and  $lf_{ij}$  the leisure of the wife of household  $i$  in combination  $j$ . Based on our data we choose three working time categories for men (unemployed, employed, overtime) and five for women (unemployed, employed, overtime and two part time categories).

We model the following translog<sup>29</sup> household utility function

$$V_{ij}(x_{ij}) = x'_{ij}Ax_{ij} + \beta'x_{ij} \quad (1)$$

where  $x = \left( \ln y_{ij}, \ln lm_{ij}, \ln lf_{ij} \right)'$  is the vector of the natural logs of the arguments of the utility function. The elements of  $x$  enter the utility function in linear (coefficients  $\beta = (\beta_1, \beta_2, \beta_3)'$ ) and in quadratic and gross terms (coefficients  $A_{(3 \times 3)} = (a_{ij})$ ). Using control variables  $z_p$  ( $p = 1, \dots, P$ )<sup>30</sup> we control for observed heterogeneity in household preferences by defining the parameters  $\beta_m, \alpha_{mn}$  as

$$\beta_m = \sum_{p=1}^P \beta_{mp} z_p \quad (2)$$

$$\alpha_{mn} = \sum_{p=1}^P \alpha_{mnp} z_p \quad (3)$$

where  $m, n = 1, 2, 3$ .

Following McFadden (1973) and his concept of random utility maximisation<sup>31</sup> we add a stochastic error term  $\varepsilon_{ij}$  for unobserved factors to the household utility function:

$$\begin{aligned} U_{ij}(x_{ij}) &= V_{ij}(x_{ij}) + \varepsilon_{ij} \\ &= x'_{ij}Ax_{ij} + \beta'x_{ij} + \varepsilon_{ij} \end{aligned} \quad (4)$$

Assuming joint maximisation of the households utility function implies that household  $i$  chooses category  $k$  if the utility index of category  $k$  exceeds the utility index of any other category  $l \in \{1, \dots, J\} \setminus \{k\}$ , if  $U_{ik} > U_{il}$ . This discrete choice modelling of the labour supply decision uses the probability of  $i$  to choose  $k$  relative to any other alternative  $l$ :

$$P(U_{ik} > U_{il}) = P[(x'_{ik}Ax_{ik} + \beta'x_{ik}) - (x'_{il}Ax_{il} + \beta'x_{il}) > \varepsilon_{il} - \varepsilon_{ik}] \quad (5)$$

Assuming that  $\varepsilon_{ij}$  are independently and identically distributed across all categories  $j$  to a Gumbel (extreme value) distribution, the difference of the utility index between any two

<sup>29</sup>Cf. Christensen et al. (1971).

<sup>30</sup>We use control variables for age, children, region and nationality, which are interacted with the leisure terms in the utility function because variables without variation across alternatives drop out of the estimation in the conditional logit model (see Train (2003)).

<sup>31</sup>Cf. McFadden (1981), McFadden (1985) and Greene (2003).

categories follows a logistic distribution. This distributional assumption implies that the probability of choosing alternative  $k \in \{1, \dots, J\}$  for household  $i$  can be described by a conditional logit model<sup>32</sup>:

$$\begin{aligned} P(U_{ik} > U_{il}) &= \frac{\exp(V_{ik})}{\sum_{l=1}^J \exp(V_{il})} \\ &= \frac{\exp(x'_{ik}Ax_{ik} + \beta'x_{ik})}{\sum_{l=1}^J \exp(x'_{il}Ax_{il} + \beta'x_{il})} \end{aligned} \quad (6)$$

For the maximum likelihood estimation of the coefficients we assume that the hourly wage is constant across the working hour categories and does not depend on the actual working time.<sup>33</sup> For unemployed people we estimate their (possible) hourly wages by using the Heckman correction for sample selection<sup>34</sup>. The household's net incomes for each working time category are computed in the tax benefit module of FiFoSiM.

The labour supply module of FiFoSiM is based on GSOEP data, which is enriched by information taken from the FAST data as described in section 2.3. The sample of tax units is then categorised into 6 groups according to their assumed labour supply behaviour. We distinguish fully flexible couple households (both spouses are flexible), two types of partially flexible couple households (only the male or the female spouse has a flexible labour supply), flexible female and flexible male single households, and inflexible households. We assume that a person is not flexible in his/her labour supply, meaning he or she has an inelastic labour supply, if a person is either

- younger than 16 or older than 65 years of age,
- in education or military service
- receiving old-age or disability pensions
- self employed or civil servant.

Every other employed or unemployed person is assumed to have an elastic labour supply. We distinguish between flexible and inflexible persons, because the labour supply decision of those assumed to be inflexible (e.g. pensioners, students) is supposed to be based on a

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<sup>32</sup>McFadden (1973). Cf. Greene (2003) or Train (2003) for textbook presentations.

<sup>33</sup>This assumption is common in the literature on structural discrete choice household labour supply models (see Van Soest and Das (2001)).

<sup>34</sup>Cf. Heckman (1976) and Heckman (1979). A detailed description of these estimations can be found in Fuest et al. (2005b).

different consumption leisure decision (or at least with a different weighting of the relevant determinants<sup>35</sup>) than that of those working full time.

### 4.3 Welfare effects

The computation of welfare measures is another important aspect for the evaluation of efficiency effects of tax reforms. Several methods and measures have been developed in the long literature of Welfare Economics.<sup>36</sup> The empirical application of these methods mostly focuses on the ex-post evaluation of consumer demand using time-series data from before and after a tax reform. Creedy and Kalb (2006) propose a method for the ex-ante analysis of the effects of tax reforms on the labour-leisure decision. As far as we know, this method has not been applied in a microsimulation model to real micro data yet.<sup>37</sup> Following this method, we compute the changes in the equivalent variation as a money metric welfare measure based on the microeconomically estimated utility function of the labour supply model described in the appendix. The equivalent variation  $EV_i$  for each individual  $i$  can be expressed as:

$$EV_i = E_i(p^0, U_i^0) - E_i(p^0, U_i^1) = E_i(p^1, U_i^1) - E_i(p^0, U_i^1)$$

where  $E_i$  is the expenditure function,  $p$  the price (wage) vector and  $U_i$  the utility level before (superscript 0) and after (1) the reform. The change in the welfare (in terms of the (negative) excess burden) of the individual  $\Delta W_i$  can be expressed as

$$\Delta W_i = - (EV_i - \Delta T_i)$$

where  $\Delta T$  is the change in tax revenue. Assuming a Utilitarian aggregation function, the overall changes in welfare can be expressed as

$$\Delta W = \sum_i \Delta W_i.$$

## 5 CGE module

The tax benefit and labour supply modules of FiFoSiM only account for the household side of the economy. The computable general equilibrium (CGE) module allows us to simulate the overall economic effects of policy changes including the production side.<sup>38</sup> Therefore effects

<sup>35</sup>Therefore, it is not possible to assume the same econometric relationship for these persons.

<sup>36</sup>See Slesnick (1998) for a comprehensive survey.

<sup>37</sup>Creedy and Kalb (2006), chapter 8, present an example with hypothetical data.

<sup>38</sup>This section is based on Bergs and Peichl (2006). See for example Shoven and Whalley (1984), Shoven and Whalley (1992) or Kehoe and Kehoe (1994) for an introduction to CGE modelling.

on labour demand, employment and economic growth as well as wage and price levels can be assessed. The static CGE module of FiFoSiM models a small open economy with 12 sectors and one representative household.<sup>39</sup> The CGE module is programmed in GAMS/MPSGE<sup>40</sup>.

## 5.1 The model

### 5.1.1 Households

The representative household maximises a nested CES utility function according to figure 3.

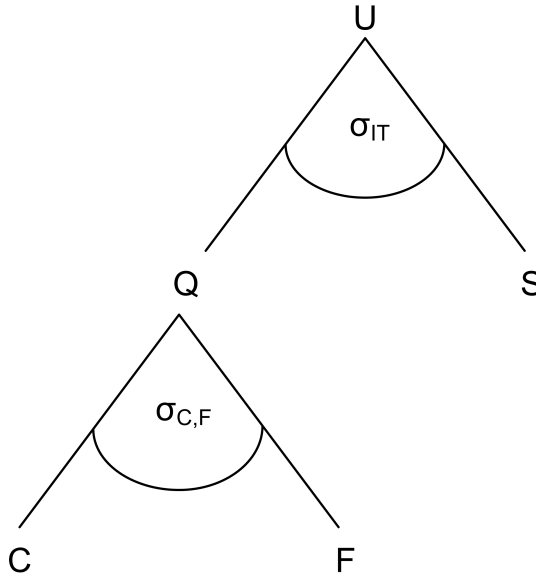


Figure 3: Household level FiFoSiM

At the top nest the household chooses between aggregated consumption (including leisure) today  $Q$  or in the future  $S$ . The result of this optimisation is the savings supply. On the second level, the present consumption leisure (or labour leisure) decision takes place. The household maximises a CES utility function  $U(C, F)$  choosing between consumption  $C$  and leisure  $F$ :

$$U(C, F) = \left[ (1 - \beta)^{\frac{1}{\sigma_{C,F}}} C^{\rho_{C,F}} + \beta^{\frac{1}{\sigma_{C,F}}} F^{\rho_{C,F}} \right]^{\frac{1}{\rho_{C,F}}} \quad (7)$$

where  $\beta$  is the value share, and  $\sigma_{C,F} = \frac{\rho_{C,F}-1}{\rho_{C,F}}$  the elasticity of substitution between consumption

<sup>39</sup>The expressiveness of this simple CGE module as a stand-alone model is rather limited. In combination with the state-of-the-art microsimulation module it becomes a powerful tool, though. Nevertheless, the improvement of the CGE module is work in progress (see section 6).

<sup>40</sup>See Brooke et al. (1998) and Rutherford (1999).

and leisure. The budget constraint is:

$$p^C C = w (1 - t^l) (E - F) + r (1 - t^k) K + \bar{T}_{LS}, \quad (8)$$

where  $p^C$  is the commodity price,  $w$  the gross wage,  $t^l$  the tax rate on labour income,  $E$  the time endowment,  $r$  the interest rate,  $t^k$  tax rate on capital income and  $K$  the capital endowment. Consumption  $p^C C$  is financed by labour income  $w (1 - t^l) (E - F)$ , capital income  $r (1 - t^k) K$  and the lump sum transfer  $\bar{T}_{LS}$ , that ensures revenue neutrality. Optimising (7) subject to (8) yields the demand functions for goods and leisure. From the latter we calculate the labour supply of the household.<sup>41</sup>

### 5.1.2 Firms

A representative firm produces a homogenous output in each production sector according to a nested CES production function. Figure 4 provides an overview of the nesting structure.

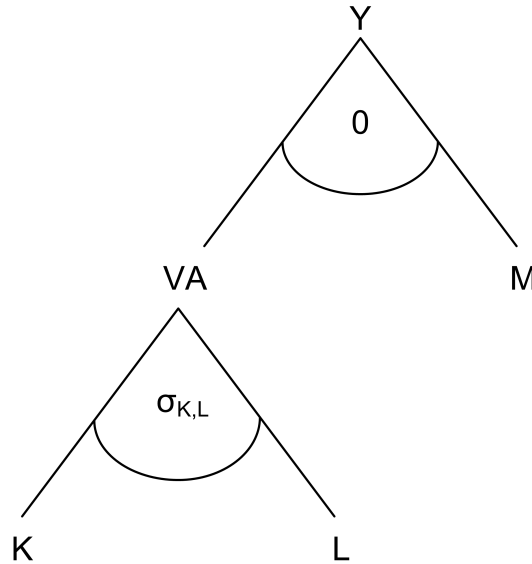


Figure 4: Production structure of FiFoSiM

At the top level nest, aggregate value added ( $VA$ ) is combined in fixed proportions (Leontief production function) with a material composite ( $M$ ).  $M$  consists of intermediate inputs with fixed coefficients, whereas  $VA$  consists of labour ( $L$ ) and capital ( $K$ ).<sup>42</sup> The optimisation problem at the top level in each sector  $i$  can be written as:

<sup>41</sup>So far, the CGE module models only one type of labour. This rather strong assumption limits the expressiveness of the household side even more and is subject to future improvements (see section 6).

<sup>42</sup>The CGE module allows for sector-specific wages and capital costs (although the latter is rarely used) depending on the context of the simulated reform.

$$Y_i = \min \left[ \frac{1}{a_{0i}} f_i(L_i, K_i); \frac{M_{1i}}{a_{1i}}; \dots; \frac{M_{12i}}{a_{12i}} \right] \quad (9)$$

In the bottom nest, the following CES function is used:

$$f_i(L_i, K_i) = [\alpha_i L_i^{\rho_i} + (1 - \alpha_i) K_i^{\rho_i}]^{\frac{1}{\rho_i}} \quad (10)$$

where  $\sigma_i = \frac{1}{1-\rho_i}$  is the constant elasticity of substitution between labour and capital.

The flexible structure of the model allows for different levels of aggregation ranging from 12 to 7 to 3 to 1 sectors.

### 5.1.3 Labour market

To account for imperfections of the German labour market, a minimum wage  $w_i^{\min}$  is introduced as a lower bound for the flexible wages in each sector<sup>43</sup>. The labour supply is therefore rationed:

$$L_i^S (1 - \mu) \geq L_i^D. \quad (11)$$

The minimum wage is calibrated so that the benchmark represents the current unemployment level of Germany.

### 5.1.4 Government

The government provides public goods ( $G$ ), which are financed by input taxes on labour and capital  $t^l$  and  $t^k$ . A lump sum transfer to the households completes the budget equation:

$$G + \bar{T}_{LS} = t^l w L + t^k r K. \quad (12)$$

### 5.1.5 Foreign trade

Domestically produced goods are transformed through a CET-function into specific goods for the domestic and the export market, respectively. By the small-open-economy assumption, export and import prices in foreign currency are not affected by the behaviour of the domestic economy. Analogously to the export side, we adopt the Armington assumption<sup>44</sup> of product heterogeneity for the import side. A CES function characterises the choice between imported and domestically produced varieties of the same good. The Armington good enters intermediate and final demand.

<sup>43</sup>It is possible to model different minimum wages for each activity.

<sup>44</sup>Vgl. Armington (1969).

## 5.2 Data and calibration

The model is based on a social accounting matrix (SAM)<sup>45</sup> for Germany which is created using the 2000 Input-Output-Table<sup>46</sup> and the static ageing technique to transform the data to 2007.

The elasticities for the utility and production functions are calibrated based on empirical estimations. The sectoral Armington elasticities are based on Welsch (2001), the elasticity of substitution between labour and capital is assumed to be 0.39 according to Chirinko et al. (2004). The elasticity of intertemporal substitution is assumed to be 0.8 (Schmidt and Straubhaar (1996)) as well as the elasticity of substitution between consumption and leisure (Auerbach and Kotlikoff (1987)).

## 5.3 Linking the microsimulation and the CGE module

### 5.3.1 Review of the literature

During the last years, the trend of linking micro and macro models emerged<sup>47</sup>. The combination of these two model types allows the utilisation of the advantages of both types of models.

There are two general possibilities for linking the models. On the one hand, one can completely integrate both models<sup>48</sup> or on the other hand, one could combine two separated models via interfaces<sup>49</sup>. The first approach requires the complete micro model to be included in the CGE model which demands high standards for the database and the construction of the integrated model. This often results in various simplifying assumptions.

The second approach can be differentiated into „top-down“, „bottom-up“ or „top-down bottom-up“ approach<sup>50</sup>. The top-down approach computes the macroeconomic variables (price level, growth rates) in a CGE model as input for the micro model. The bottom-up approach works the other way around and information from the micro model (elasticities, tax rates) is used in the macro model. Both approaches suffer from the drawback that not all feedback is used.

The top-down bottom-up approach combines both methods to a recursive approach. In an iterative process one model is solved, information is sent to the other model, which is solved and gives feedback to the first model. This iterative process continues until the two models converge. Böhringer and Rutherford (2006) describe an algorithm for the sequential calibration

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<sup>45</sup>See Pyatt and Round (1985) for an introduction into the process of creating a SAM.

<sup>46</sup>Vgl. Statistisches Bundesamt (2005).

<sup>47</sup>Cf. Davies (2004) for an overview. Most of these models deal with trade liberalization in developing countries. As far as we know, FiFoSiM is the first linked model with a special focus on the modelling and analysis of tax benefit reform proposals.

<sup>48</sup>Cf. ie. Cogneau and Robilliard (2000) or Cororaton et al. (2005).

<sup>49</sup>Cf. Bourguignon et al. (2003).

<sup>50</sup>Cf. Savard (2003) or Böhringer and Rutherford (2006).

of a CGE model to use the top-down bottom-up approach with micro models with large numbers of households.

### 5.3.2 Approach in FiFoSiM

FiFoSiM so far uses either the top-down or the bottom-up approach to combine the microsimulation and the CGE module. In the bottom-up linkage the representative household (income, labour supply, tax payments) in the CGE module is calibrated based on the simulation results of the microsimulation modules. For the top-down linkage changes of the wage or price level are computed in the CGE model and used in the microsimulation modules for the calculation of net incomes and the labour supply estimation.<sup>51</sup>

## 6 Applications and further development

### 6.1 Applications of FiFoSiM

The development of FiFoSiM started in September 2004. The first running version of the whole system was ready for use one year later. Since then, the model has been steadily improved and used for writing new publications.

During the development of FiFoSiM, some introductory papers have been written. Peichl (2005) gives an overview on the evaluation of tax reforms using simulation models. Bergs and Peichl (2006) survey the basic principles and possible applications of CGE models. Ochmann and Peichl (2006) give an introduction to the measurement of distributional effects of fiscal reforms.

Furthermore, FiFoSiM can be used in many ways for the analysis of (reforms of) the tax benefit system. Fuest et al. (2005a) and Fuest et al. (2007a) analyse the fiscal, employment and growth effects of the reform proposal by Mitschke (2004).<sup>52</sup> In Bergs, Fuest, Heilmann, Peichl and Schaefer (2006) this analysis is expanded to the negative income tax part (*Bürgergeld*) of this proposal.

Fuest et al. (2006) and Fuest et al. (2007c) analyse the efficiency and equity effects of tax simplification. Tax simplification is modelled as the abolition of a set of deductions from the tax base included in the German income tax system. Furthermore, Peichl et al. (2006) analyse the effects of these simplification measures on poverty and richness in Germany.

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<sup>51</sup>The top-down bottom-up approach is so far only executed manually and not automatically. This is also subject to future improvements (see section 6).

<sup>52</sup>The results of this analysis are described in the following subsection as an example of an application of FiFoSiM.



Fuest et al. (2007b) analyse the distributional effects of different flat tax reform scenarios for Germany. Bergs, Fuest, Peichl and Schaefer (2006a) and Bergs, Fuest, Peichl and Schaefer (2006b) analyse different reform proposals for the taxation of families in Germany.

## 6.2 Example: Tax reform proposal by Mitschke

One example of an application of FiFoSiM is our analysis of a reform of the German corporate and personal income taxes according to the proposal by Joachim Mitschke (2004)<sup>53</sup>. Our focus lies on the effects on tax revenue, employment and economic growth which are computed using FiFoSiM. The Mitschke-proposal distinguishes between an introductory phase and a final phase. For both phases the long-term revenue, employment and growth effects are calculated. In the first step, the fiscal effects are analysed in the tax benefit module (see section 3) without taking into account the behavioural reactions of the economic agents. In the second step, we allow for behavioural reactions by estimating the labour supply responses (see section 4). In the third step, the micro data information is used to calibrate the representative household in the CGE module for the computation of the overall employment and growth effects.

To compare the reform proposal with the current tax regime the alternative tax system has to be modelled using the enhanced datasets. For most of the detailed regulations appropriate variables are available in at least one of our datasets. Nevertheless, some features of the reform require several assumptions and estimations, namely the change to deferred taxation proposed by Mitschke. This concerns, for example, the estimation of the effects of a full taxation of pensions as suggested by Mitschke. Only the SOEP database includes appropriate data because the FAST dataset only covers a fraction of pensioners who were taxed in 1998. Therefore, data on pension payments are imputed from GSOEP to FAST\*. Hence, this effect can be isolated and estimated in the FAST simulation (8.4/9.5 billion € in the introduction/final phase). Apparently, the results for PIT revenue in the current tax system and for the reform proposal differ depending on the database as shown in table 4.

|              | FAST*  | SOEP*  |
|--------------|--------|--------|
| PIT 2006     | 181.16 | 180.69 |
| introduction | 179.15 | 179.08 |
| final phase  | 168.12 | 166.89 |

Table 4: Fiscal effects without behavioural reactions in billion €

We estimate the labour supply effects by comparing the estimated labour supply in the current system and in the reform alternatives using the model described in chapter 4. We find considerable differences in the labour supply reactions between couples and singles as well as

<sup>53</sup>See Fuest et al. (2005a) and Fuest et al. (2007a) for the detailed analysis.

between men and women. While married men increase their labour supply the strongest, single women even slightly decrease their labour supply.

For the employment and growth effects we link the tax benefit module to the CGE model with a minimum wage to calibrate the current unemployment level (11.5%). We use the microsimulation results to calibrate the representative household in terms of income, labour supply and tax payments. The main results are summarised in table 5.

|               | introduction | final phase   |
|---------------|--------------|---------------|
| PIT revenue   | -2 billion € | -13 billion € |
| labour supply | +103,000     | +251,000      |
| employment    | +370,000     | +540,000      |
| econ. growth  | +1.1%        | +1.7%         |

Table 5: Final results (FAST\*) for the reform proposal by Mitschke

The shift from the current German tax regime to the taxes proposed by Mitschke would result in revenue losses amounting to € 2 billion in the introductory phase and € 13 billion in the final phase. On the other hand, employment would grow by 370.000 full-time jobs, and GDP would increase by 1.1% in the introductory phase. For the final phase, we calculate a total of 540.000 new full-time jobs and a 1.7% increase of GDP. The overall employment effects are larger than the labour supply reactions because of reduced costs of labour and capital resulting in increasing labour and investment demand.

### 6.3 Further Development and conclusion

FiFoSiM is a state of the art tax benefit simulation model for Germany. FiFoSiM consists of three main parts: a static tax benefit micro simulation model, an econometrically estimated labour supply model and a CGE model. Two specific features distinguish FiFoSiM from other tax benefit models: First, the simultaneous use of two databases for the tax benefit module and second, the linkage of the tax benefit model with a CGE model. FiFoSiM can be used to analyse various policy reforms of the complex German tax and transfer system.

Nevertheless, several ideas for the further improvement of FiFoSiM exist. One major aspect of improvement is the modelling of indirect taxes. For this reason, expenditure data is needed and a third data source has to be included into the FiFoSiM database. The micro macro linkage between the microsimulation and the CGE module shall be improved using the top down bottom up approach. Furthermore, the CGE module is to be improved as well, for example by allowing for more different household types or a more sophisticated modelling of the labour market. Moreover, dynamic modules are planned. A small Ramsey type dynamic version of the CGE module exists, but has not been used for any publication yet. This module

shall be improved and used in the future. The development is not settled yet. We expect new issues of the FAST and GSOEP data, which have to be implemented in the model, soon.

To sum up, the creation of the dual database and the linkage of the tax benefit model with a CGE model give the users of FiFoSiM a powerful tool for the analysis of various questions regarding the German tax benefit system. Both methods should be of interest for the enhancement of other microsimulation models as well.

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