DISCUSSION PAPER SERIES

IZA DP No. 4865

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April 2010

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zur Zukunft der Arbeit
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Discussion Paper No. 4865
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IZA Discussion Paper No. 4865
April 2010

ABSTRACT

Documentation IZAΨMOD: The IZA Policy SImulation MODel*

This paper describes IZAΨMOD, the policy microsimulation model of the Institute for the Study of Labor (IZA). The model uses household microdata from the German Socio-Economic Panel Study and firm data from the German linked employer-employee dataset LIAB. IZAΨMOD consists of three components: First, a static module simulates the effects of a tax reform on the budget of the individual households. Secondly, behavioral labor supply responses are estimated. The third component distinguishes our model from most other microsimulation tools. A demand module takes into account possible restrictions of labor demand and identifies the partial equilibrium of the labor market after the supply reactions.

JEL Classification: D58, H20, J22, J23

Keywords: IZAΨMOD, microsimulation, tax and benefit systems, labor demand

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* The authors would like to thank everybody who has been helping developing IZAΨMOD over the past years. Especially, we want to give credit to Holger Bonin for giving birth to the model and programming the main part of it. We also thank Ulf Rinne for continuing with the programming and establishing the model's current structure. Furthermore, we want to thank Mathias Dolls, Vanessa Dräger, Jens Hogenacker, Dirk Neumann, Nico Pestel and Caroline Wehner for valuable contributions.

1 Introduction

This paper describes IZAΨMOD, short for IZA Policy SImulation MODel, the behavioral microsimulation model of the Institute for the Study of Labor (Institut zur Zukunft der Arbeit (IZA)). IZAΨMOD consists of three main components. The basis is a static microsimulation model for the German tax and benefit system. The second module is an econometrically estimated labor supply model, which takes into account behavioral reactions to tax reforms. The third component is a labor demand module, which completes the analysis of the labor market and allows a global assessment of the effects of policy measures. Figure 1 shows the basic setup of IZAΨMOD. Components one and two are based on data from the German Socio-Economic Panel Study (GSOEP), a representative panel study of private households in Germany, whereas the demand module uses the German linked employer-employee dataset LIAB.

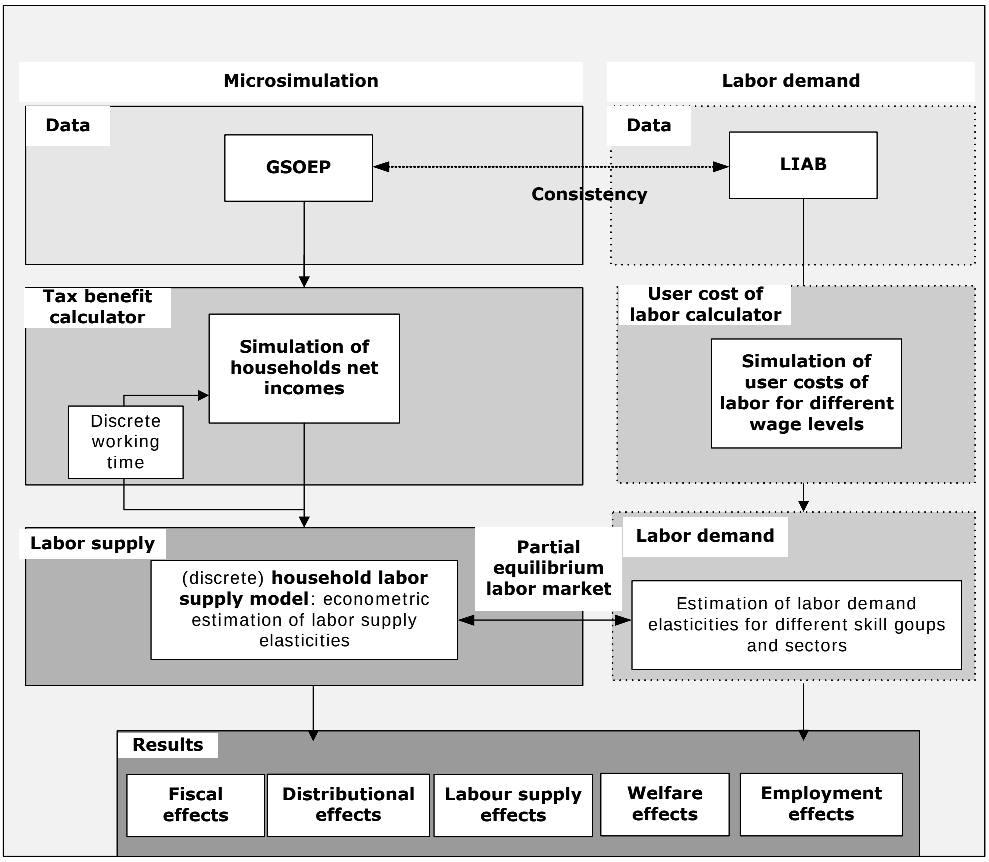

Figure 1: Basic setup

Microsimulation models (MSM) have become a standard analyzing tool of economic policies during the last 20 years. The main feature of a microsimulation approach is the partial equilibrium analysis that simulates the effects of a policy reform (i.e. tax or benefit change) on one side of the market (i.e. households, firms, individuals). The simulation basically consists of evaluating effects of a change in the economic environment of individual agents in terms of welfare or activity (Bourguignon and Spadaro (2006)). MSM are based on microdata and therefore account for heterogeneity of economic agents within the population. Hence, the advantage of MSM consists in the precise identification of winners and losers of a reform, which allows for the overall evaluation of welfare effects as well as political economy factors that may obstruct the implementation.

Within the MSM category, many models are applied to redistribution policies. Tax models, for example, are widely used to simulate the distributional consequences of a tax or benefit change among heterogeneous groups of families and to predict the likely costs to the government of a proposed or hypothetical policy reform (Creedy and Duncan (2002)).

As far as the distributional analysis is concerned, there is a variety of different approaches. Non-behavioral models, also referred to as arithmetic models, simulate changes in the real disposable income of individuals or households due to a tax or benefit reform under the assumption that behavior is exogenous to the tax and benefit system (Bourguignon and Spadaro (2006)). Hence, individuals are not allowed to change their behavior and the models only simulate first-round effects, which comprise immediate fiscal and distributional changes.

In contrast to arithmetic models, behavioral models take some kind of behavioral response of individuals or households into account. Within this approach, labor supply and consumption are among the types of behavior most frequently included in the analysis. Microeconometric labor supply models incorporate a theoretical grounding of the behavioral response and allow for the modeling of labor supply decisions along the extensive (labor market participation) as well as the intensive (hours worked) margin (Peichl (2009)). Usually, a labor supply module is either integrated into the microsimulation model or can be linked to it as an external module.

The simulation steps of IZAΨMOD can broadly be described as follows: First, the database is updated using the static ageing technique[1], which allows control-

[1] Cf. Gupta and Kapur (2000) for an overview of the techniques to modify the data for the use

ling for changes in global structural variables and a differentiated adjustment for different income components of the households. Secondly, the current tax system is simulated using the modified data. IZAΨMOD 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.The result of this simulation is the benchmark for different reform scenarios which are also modeled using the modified database. After applying the current tax and benefit system the disposable income is computed for each household. Based on these net incomes the distributional effects of the tax system at the status quo are assessed. Thirdly, a discrete choice household labor supply model is applied to estimate consumption/leisure preferences of each household using the calculated net incomes and information on working hours. Fourthly, the effects of tax and benefit reforms are analyzed. The reforms will change the net incomes of the households (first-round effect), which in a second step will induce labor supply reactions following the previously estimated consumption/leisure preferences which are assumed to be fix. In a last step, the labor demand module is employed to estimate how the labor supply reactions translate into employment effects.

The setup of the rest of this paper is as follows. Section 2 describes the data used for the different modules. Section 3 sets up the tax benefit module, in section 4 the labor supply module is presented and section 5 describes the labor demand module. Section 6 concludes by presenting selected applications of IZAΨMOD.

2 Datasets

2.1 The German Socio-Economic Panel Study

Both the tax benefit and the labor supply module of IZAΨMOD are based on the German Socio-Economic Panel Study, which is a microdata household panel study. GSOEP was launched in 1984 as a representative cross-section of the adult population living in private households in (Western) Germany and dealt with the expansion of its "survey territory" due to the fall of the Berlin wall in late 1989 by introducing the East German sample in June 1990 (Wagner et al. (2007)). The number of cases was enlarged over time by additional samples that represent the entire Ger-

in microsimulation models.

man population. Moreover, the representativeness of the sample was improved by oversampling certain groups such as high income households or foreigners. Thanks to a refresher sample in 2006 the cross-sectional number of cases is at the level of about 20,000 households.

The dataset is intended to follow original sample members as long as possible, but new households are constantly added to the sample as well. In order to obtain a less-biased view of the entire household and its members as well as to ensure high data quality, not just one respondent per household is interviewed (proxy interview), but all adult members (individuals 17 years and older) (Wagner et al. (2007)).

The main purpose of GSOEP is to measure well-being. Besides information on psychological and, more recently, also on behavioral concepts, the main focus rests on income data, which is also the major dimension of information exploited by IZAΨMOD. Among others we draw the following data from the GSOEP: gross wage, job type, government transfers, working time, composition of households, age and education of household members and housing costs. IZAΨMOD is constantly updated to the newest GSOEP wave, but it is also possible to employ older waves (back to the year 2005) to analyze potential effects of changes in the German population, e.g. in the household composition.

IZAΨMOD differentiates between several types of households: (A) single households, (B) single parents, (C) couple households where only one spouse is flexible as far as working hours are concerned and (D) couples with two flexible spouses.[2] Additionally there are households, that are inflexible as far as their labor supply decision is concerned. It is assumed that the labor supply reaction of those inflexible households is based on a different consumption/leisure decision (or at least with a different weighting of the relevant determinants[3]) than that of those working full time. We assume that a person is not flexible in his/her labor supply, meaning he or she has an inelastic labor supply, if a person is either

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

[2] This notation will be kept during the rest of the documentation.
[3] Therefore, it is not possible to assume the same econometric relationship for these persons.

Every other employed or unemployed person is assumed to have an elastic labor supply.

Another important differentiation is the assignment of individuals to three skill levels. The high-skilled hold a university, polytechnical or college degree. Medium-skilled workers have either completed a vocational training or obtained the German highest high school diploma, called "Abitur". Unskilled workers have neither finished vocational training nor obtained Abitur.

The database is updated to the year of analysis (i.e. 2010) using the static ageing technique[4] which allows controlling for changes in global structural variables as well as a differentiated adjustment for different income components of the households. The GSOEP is adjusted from 2007 onwards. 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 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 2010 times the coverage degree allows for an approximate 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) so that the extrapolation of the sample using the adjusted weights better represents the actual population structure.

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, e.g., 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

[4] Cf. Gupta and Kapur (2000) for an overview of the techniques to modify the data for the use in microsimulation models.

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 current income structure.

2.2 The Linked Employer-Employee Dataset LIAB

As the GSOEP is a household survey and does not contain any information on firms, the demand module is based on a different dataset. We employ the linked employer-employee dataset (LIAB) from the Institute of Employment Research (IAB) in Nuremberg, Germany.[5] The LIAB combines data from the employment statistics from the German Federal Employment Agency (Bundesagentur für Arbeit) with the IAB Establishment Panel, which are panel data on plant level. The employment statistics come from official records, namely the German employment register, which covers all employees paying social security taxes or receiving unemployment benefits. Since 1973 all employers have been required to report all employees covered by social security to the social security agencies (Bender and Haas (2002)). All these notifications are aggregated to a big dataset called employee history, which covers about 80 percent of the German employees. Civil servants, self-employed and family workers are not included in the statistics. Among others, the employee history provides information on daily wages, age, seniority, schooling, training, occupation, industry and region (Bender et al. (2000)). In a first step, the Institute of Employment Research combines the employee history with the benefit receipt history, that is data on the benefits received when unemployed. Thus, the periods of non-employment are filled, completing the (un)employment history of the individuals.

The second source of the LIAB is the IAB Establishment Panel, which contains annual information on establishment structures and personnel decisions in the period from 1993 onwards (Alda et al. (2005)). It is a representative stratified random sample from the population of all establishments that only covers establishments

[5] The advantage of using linked employer-employee data in the context of labor demand estimations is straightforward. When only relying on employee data, it is possible to observe qualification and wages, but generally no information on firms is available. When using datasets on firms, variables like output, labor demand and investments are observed, but in general the individual wages of the employees are missing. Sometimes the sum of wages and the number of workers can be used to calculate an average wage. This procedure, however, has a major disadvantage, since the most important variable determining the labor demand from a theoretical perspective, i.e. the wage, is derived from an aggregate. It is not observed on the micro level which automatically casts doubt on the reliability and accuracy of the results.

with at least one socially insured employee. The name establishment has to be taken literally, since the unit of observation is the individual plant, not the company. Consequently, there can be several plants per company (Kölling (2000)). The establishment panel covers 16 industries and 10 employment size classes. In 1993 the sample comprised 4265 plants, that is 0.27 percent of all plants in Western Germany. The Eastern German subsample was established in 1996. In 2005 the unified sample was made up of 16,280 establishments.

The goal of the panel is to provide detailed information of the demand side of the labor market. Therefore, questions on the staff, the changes in employment and the structure of the qualification claim a big part of the questionnaire (Kölling (2000)). Further questions are on export, investment or technological status. All these topics are treated annually. Other information is not provided every year; indicators on technological change, for example, are only available for the waves of 1995, 1998, 2000, 2001, 2004 and 2007.

The employee history is linked with the establishment panel via a plant identifier. In order to reduce the size of the datasets, several versions of the LIAB are available. In general, the models can be separated into cross-sectional models and longitudinal models. The cross-sectional model only covers people working in an establishment on June, 30th, of every year, which is the reference date of the establishment panel questionnaire. Thus, the numbers of individual notifications is kept relatively low. In contrast, the longitudinal models cover all notifications during a certain period of time, but limit the number of plants covered. There are four longitudinal models varying in the time periods and number of establishments and employees included. For the cross-sectional design there is only one model available. It covers the years from 1993 to 2006, 4000 to 16000 establishments and 1.8 to 2.5 millions employees a year (Jacobebbinghaus (2008)).

We use this cross-sectional model and select the waves from 1996 to 2007 due to several reasons. First, we need to have a sufficiently high number of Eastern German plants. Therefore we ignore the waves prior to 1996. Second, we are interested in a general estimation of German labor demand. Therefore we choose as many years as possible, covering times of economic crisis as well as of economic prosperity. As far as the employees are concerned, we are interested in full-time workers, excluding trainees, home and part-time workers.

One important characteristic of the employee history is that the wages are right-censored at the upper limit for contributions to the statutory pension fund. In 2008, this limit was 5300 euros per month for a Western German employee. Up to this limit the contributions to the pensions insurance of workers and employees are 19.9 percent. For an income of 5300 euros per month, this yields about 1055 euros of contributions, which marks the maximum monthly amount of contributions to the pension fund. Consequently, the wages above the threshold have to be imputed using a censored regression model. We use a technique designed by the IAB to correct for right-censored wages (Gartner (2005)). Covariates for the imputation are age, tenure, qualification, sex and dummies for foreign workers as well as for Eastern/Western Germany and industries. The imputation is done separately for every wave.

As for qualification we distinguish between three skill levels: unskilled, medium-skilled and high-skilled workers following the classification presented in section 2.1. Since we are interested in the labor demand depending on the skill levels, individuals with missing information on qualification are dropped. In the end the average deflationized real wages per skill group and per establishment are computed, as well as the number of employees per plant and skill level.

As far as the establishment data is concerned, we are mainly interested in output and capital. Since there is no direct measure of capital, we approximate capital by the investment in the preceding year, following an approach chosen by several other authors using LIAB (see e.g. Bellmann et al. (2002), Kölling and Schank (2002), Addison et al. (2008)). Output and capital are both deflationized using the German consumer price index. Plants with missing information on output or capital are dropped, as well as establishments with less than three workers in any skill category. Finally, time and industry dummies are computed.

The data from the employee history are linked with the establishment sample year by year. Employees working in a plant that is not part of the Establishment panel are dropped, as well as establishments whose workers could not be identified in the employment statistics. Eventually, all waves are combined to a pooled cross-sectional dataset. The set comprises 11 years (from 1996 to 2007) and 4,073 establishments, which are on average observed 3.3 times during our period of consideration. On the whole, this gives us 13,451 observations.

3 Static tax benefit module

In this section, the modeling of the German tax benefit system is described. As the system is very complex, we focus on the major parts of the model in this description.[6]

3.1 Modeling 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.[7]

3.1.1 Income sources

The basic steps for the calculation of the personal income tax under German tax law are illustrated by table 1. 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[8]: 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 as a result. Finally, the income tax is calculated by applying the tax rate schedule to taxable income.

3.1.2 Taxable income

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

[6] This section is partly based on the documentation of the microsimulation model FiFoSiM, which was also developed by Andreas Peichl, cf. Peichl and Schaefer (2009).

[7] The legal norm setting up the German tax system is called Einkommensteuergesetz (EStG). As the concrete tax rules, especially specific numerical values such as ceilings, allowances or deductible contributions constantly change, we will only present the general underlying principle of the tax system and refer to the concrete legal norm, from which the current concrete numerical values can be obtained.

[8] See EStG §§13 - 23.

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

Table 1: Calculation of the personal income tax

The special expenses consist of:

- alimony payments
- church tax
- tax consultant fees
- expenses for professional training
- school fees of children
- charitable donations
- donations to political parties
- expenses for financial provision, i.e. social insurance contribution[9]

The social insurance contributions are normally equally split between employer and employee. Social insurance payments consist of health insurance, old-age, unemployment and nursing care contributions. As for health insurance, civil servants and self-employed are insured privately. Ordinarily, employees can choose a private insurance as well if their income exceeds a certain threshold. All other employees fall under the statutory health insurance. As for old-age insurance only civil servants are excluded from the statutory insurance and are insured under a specific pension plan. As far as the unemployment insurance is concerned, civil servants,

[9] For the concrete legal regulation, see EStG §§10 - 10c.

self- and marginally employed are exempt from the statutory plan. Each social insurance premium is calculated as contribution rate times the income that is subject to contributions up to the according contribution ceiling.[10]

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[11]

Furthermore, negative income from the preceding assessment period (loss deduction carried back) is deductible from the tax base.[12]

Each tax unit with children receives either a child allowance [13] or a child benefit[14] depending on which is more favorable[15]. In practice, each entitled tax unit receives the child benefit. If the child allowance is more favorable, 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 2009[16], is structured as follows:

[10] Current contribution rates and ceilings can be found in the Sozialgesetzbuch (SGB). For health insurance see SGB-V, for old age insurance see SGB-VI, for unemployment insurance SGB-III and for nursing care insurance SGB-XI.

[11] For more details, see EStG §§33 - 33b.

[12] See EStG §10d.

[13] Cf. EStG §32.

[14] The amount of child benefits can be found in §66 of the EStG.

[15] See EStG §31.

[16] Since 2009, Germany levies a dual income tax with a flat rate of 25% on capital incomes in addition to the progressive tax schedule on the other income sources.

$$T = \begin{cases} 0 & if\ x \leq 7,834 \\ (939.68 \cdot \frac{x-7834}{10000} + 1400) \cdot \frac{x-7834}{10000} & if\ 7,834 < x \leq 13,139 \\ (228.74 \cdot \frac{x-13139}{10000} + 2397) \cdot \frac{x-13139}{10000} + 1007 & if\ 13,139 < x \leq 52,552 \\ 0.42 \cdot x - 8064 & if\ 52,552 < x \leq 250,400 \\ 0.45 \cdot x - 15576 & if\ x > 250,400 \end{cases}$$

where x is the taxable income.[17] 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 Modeling the benefit system

In addition to the tax schedule, the German benefit system, mainly consisting of unemployment benefit, housing benefit, and social benefits, is also modeled in IZAΨMOD.

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 SGB-III). The amount to be paid depends on the average gross income of a certain period.

The GSOEP panel data contains information about previous unemployment benefit payments, employment periods, etc. When modeling 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 months within the last 36 months. 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

[17] See EStG §32a.

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.[18]

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. Ever since unemployment benefit II (see above) was introduced, only non employable persons can receive social benefits. Furthermore, social benefits are paid in extraordinary circumstances such as impairment of health. Analogous 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.[19]

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 relative to the local rent level determine if a person is entitled to receive housing benefits.[20]

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.

[18] See SGB-II.
[19] See SGB-XII.
[20] See §26 SGB-I and Wohngeldgesetz WoGG.

4 Behavioral labor supply module

Tax-benefit models with labor supply responses are the prime example for behavioral microsimulation models. Many tax and transfer policies are designed to encourage labor supply participation.[21] Hence, tax-benefit models are a crucial economic tool to ex-ante evaluate a given policy reform not only in terms of changes in the net income but also in terms of behavioral responses of the economic agents. The budget constraint of the household in the model is affected by a change in the tax-benefit system. Therefore, households modify their disposable income and may decide to change their labor supply (Bourguignon and Spadaro (2006)). The consideration of behavioral responses in the model may be done through estimation of a structural econometric model or through the calibration of working hours (see e.g. Creedy and Duncan (2002)). Within the model framework, there are several possibilities to model labor supply. A major distinction can be made between the use of continuous and discrete behavioral models.

4.1 Discrete vs. continuous labor supply modeling

When analyzing the behavioral responses induced by different tax reform scenarios, one has to choose, among others, whether to apply a discrete or a continuous labor supply model. For recent surveys of the empirical literature on labor supply models see, for example, Heckman (1993), Blundell and MaCurdy (1999) or Creedy et al. (2002).

In the standard continuous model (see Hausman (1985)), labor 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 analyzed within this framework satisfactorily (Blundell and MaCurdy (1999)). In contrast, discrete choice labor supply models allow to analyze both the extensive (participation) and the intensive (hours worked) labor supply decision within the same modeling 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) labor costs and the after-tax net income of workers (see Kleven and Kreiner (2006)).

[21] See for example the Working Families' Tax Credit (WFTC) in the United Kingdom.

These stylized facts have consequences for the choice of a suitable supply model. 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 labor 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 Labor supply estimation

It is for the reasons presented in the preceding subsection that we choose a structural discrete choice household labor supply model. Following Van Soest (1995) we assume that the household's head and his partner jointly maximize a household utility function in the arguments leisure of both partners and net income. Household i $(i = 1, ..., N)$ can choose between a finite number $(j = 1, ..., J)$ 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 seven working time categories for men and women (0, 10, 15, 20, 30, 40 and 50 hours per week).

We model the following translog[22] household utility function

$$V_{ij}\left(x_{ij}\right) = x'_{ij} A x_{ij} + \beta' x_{ij} \tag{1}$$

where $x = \begin{pmatrix} \ln y_{ij}, & \ln lm_{ij}, & \ln lf_{ij} \end{pmatrix}'$ 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

[22] Cf. Christensen et al. (1971).

$A_{(3\times3)} = (a_{ij})$). Using control variables z_p $(p = 1, ..., P)$[23] we control for observed heterogeneity in household preferences by defining the parameters β_m, α_{mn} as

$$\begin{aligned} \beta_m &= \sum\nolimits_{p=1}^{P} \beta_{mp} z_p & (2) \\ \alpha_{mn} &= \sum\nolimits_{p=1}^{P} \alpha_{mnp} z_p & (3) \end{aligned}$$

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

Following McFadden (1973) and his concept of random utility maximisation[24] we add a stochastic error term ε_{ij} for unobserved factors to the household utility function:

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

Assuming joint maximization 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 $l \in \{1, ..., J\} \backslash \{k\}$, if $U_{ik} > U_{il}$. This discrete choice modeling of the labor supply decision uses the probability of i to choose k relative to any other alternative l:

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

Assuming that ε_{ij} are independently and identically distributed across all categories j following a Gumbel (extreme value) distribution, the difference of the utility index between any two categories follows a logistic distribution. This distributional assumption implies that the probability of choosing alternative $k \in \{1, ..., J\}$ for

[23] 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)).

[24] Cf. McFadden (1981), McFadden (1985) and Greene (2003).

household i can be described by a conditional logit model[25]:

$$P(U_{ik} > U_{il}) = \frac{\exp(V_{ik})}{\sum_{l=1}^{J} \exp(V_{il})} = \frac{\exp(x_{ik}' A x_{ik} + \beta' x_{ik})}{\sum_{l=1}^{J} \exp(x_{il}' A x_{il} + \beta' x_{il})} \quad (6)$$

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.[26] For unemployed people we estimate their (possible) hourly wages by using the Heckman correction for sample selection (see Appendix)[27]. The household's net incomes for each working time category are computed in the tax benefit module of IZAΨMOD.

After the consumption leisure preferences are estimated, the probabilities of changing working time categories due to a changed net income induced by a tax reform can be calculated. There are various methods to derive these probabilities (see Creedy and Duncan (2002) for an overview). IZAΨMOD uses an analytical approach proposed by Bonin and Schneider (2006a), which optimally exploits information on the range of error terms by comparing real choices with predicted choices in the status quo. Moreover, it is based on the assumption that the error terms remain unchanged after a change of disposable income. Algebraically, the probabilities of changing the working time category are derived conditional on being in a certain (optimal) category m before the reform. In a last step, the overall new working hours for the whole population are calculated.

4.3 Labor supply elasticities

Instead of analyzing the effects of a tax reform MSM can also be employed to derive labor supply elasticities, a measure frequently reported in labor economics indicating the percentage reaction of labor supply induced by a certain percentage rise of one of the variables determining income. There are several distinctions that have to be borne in mind when reporting elasticities. First, it has to be distinguished between

[25] McFadden (1973). Cf. Greene (2003) or Train (2003) for textbook presentations.

[26] This assumption is common in the literature on structural discrete choice household labor supply models (see Van Soest and Das (2001)).

[27] Cf. also Heckman (1976) and Heckman (1979).

hours and participation elasticities. The former ones report the percentage change in labor supply after a rise of an income related variable. Thus, they indicate the reaction at the intensive margin, whereas participation elasticities focus on the effect at the extensive margin. Secondly, the elasticities can be uncompensated or compensated. The latter ones only measure the substitution effect, whereas the former ones comprise substitution and income effect. Thirdly, elasticities may be conditional or unconditional. Conditional elasticities measure the labor supply reactions conditional on being part of the labor force prior to the change in income, whereas unconditional elasticities also take into account reactions at the extensive margin. Fourthly, the rise of the income variable may vary. Normally it is either increased by one or by ten percent. Finally, the income variable itself has to be chosen. Commonly, one increases the gross wage, the net wage or the net income.

Table 2 shows the uncompensated, unconditional, one percent, own wage hours and participation elasticities.

	Type A		Type B		Type C		Type D		Total
	F	M	F	M	F	M	F	M	
Hours	0.22	0.18	0.21	0.24	0.28	0.09	0.11	0.07	0.13
Participation	0.18	0.16	0.15	0.18	0.21	0.08	0.07	0.06	0.11

Table 2: Estimated one percent LS elasticities (hours)

From looking at the table three basic conclusions can be drawn. First, all hours elasticities are positive, implying that the positive (negative) substitution effect of a wage rise on labor (leisure) overcompensates the negative (positive) income effect. Second, participation elasticities are smaller than hours elasticities, which must be true, since we have estimated unconditional hours elasticities which comprise the participation decision. Nevertheless, it becomes obvious that the participation elasticities make up a big share of the hours elasticities, implying that the participation decision is the driver of the positive labor supply effect. Finally, with one exception, women have higher elasticities than men. These qualitative results also hold, when gross wages are increased by ten percent.

The results are qualitatively and quantitatively in line with other studies both for Germany (see e.g. Bonin et al. (2002), Steiner and Wrohlich (2004), Haan and Steiner (2005), Bargain and Orisini (2006), Haan and Steiner (2006), Haan and Uhlendorff (2007), Fuest et al. (2008) or Bargain et al. (2010)) and in an international context. Most studies on labor supply find that labor supply responds rather along the extensive than the intensive margin (see e.g.Heckman (1993), Immervoll et al. (2007) or Fuest et al. (2008)). In particular, certain 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)). Moreover, working-hours elasticities are close to zero for men (see Blundell and MaCurdy (1999)) and women (see Mroz (1987), Triest (1990)).

4.4 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.[28] 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 labor-leisure decision. Following this method, we compute the changes in the equivalent variation as a money metric welfare measure based on the microeconometrically estimated utility function of the labor 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 $\triangle W_i$ can be expressed as

$$\triangle W_i = -\left(EV_i - \triangle T_i\right)$$

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

$$\triangle W = \sum_i \triangle W_i.$$

[28] See Slesnick (1998) for a comprehensive survey.

5 Labor demand module

The incorporation of labor demand adjustments is an important extension to microsimulation models, since employment predictions can only be accurate when taking into account the demand side as well. In order to control for demand effects and see how labor supply reactions eventually translate into employment outcomes, we firstly estimate the labor demand for Germany (section 5.1). In a second step, we feed this information into IZAΨMOD (section 5.2).

5.1 Labor demand estimation

This section provides only a short and rudimentary description of our labor demand estimation strategy and our results. For a more thorough presentation see Peichl and Siegloch (2010b). Almost all studies that estimate labor demand depart from the *dual approach*. Assuming a constant output, cost minimization yields the same factor demands as profit maximization (Hamermesh (1993)). In general, we are faced with a cost function of some form. We apply Shephard's lemma (see Shephard (1970)) to the cost function and derive estimable factor demand functions conditional on output. From these it is trivial to derive own-wage elasticities for differently skilled labor. There are several cost functions, which can be chosen. For IZAΨMOD we pick a non-constant return to the scale Translog specification with three differently skilled, flexible labor inputs, capital as a quasi-fixed input, a time trend and industry dummies. We obtain a labor demand elasticity of -0.62, -0.33 and -0.89 for high-, medium- and low-skilled workers.[29]

5.2 Supply-demand iterations

The demand module of IZAΨMOD uses these elasticities to calculate labor demand adjustments after a change of the labor supply.[30] Building on approaches proposed by Creedy and Duncan (2005) and Haan and Steiner (2006), these adjustments can be considered as a third-round effect after the technical adjustment of the budget and the behavioral effects of the labor supply following a tax reform. The rationale

[29] For more the details on the impacts of different specifications and the estimation procedure and a comparison of our results with findings on labor demand for Germany, see Peichl and Siegloch (2010b).

[30] For a more detailed description of the demand module and its effect, see Peichl and Siegloch (2010a).

behind the demand module can be best described graphically and is based on the presentation by Haan and Steiner (2006).

Figure 2 shows the effects of some general tax reform shifting labor supply to the north-east. Without a demand module, implicitly assuming a perfectly elastic labor demand, the resulting employment would be at E^B. Taking into account the labor demand curve, however, it is trivial to see that this cannot be the solution of the labor market under perfect competition, since supply does not equal demand. Since the own-wage labor demand elasticities are theoretically and also empirically negative, a rise in employment is associated with a decrease in the wage. These elasticities can be used to arrive at the market equilibrium in point C.

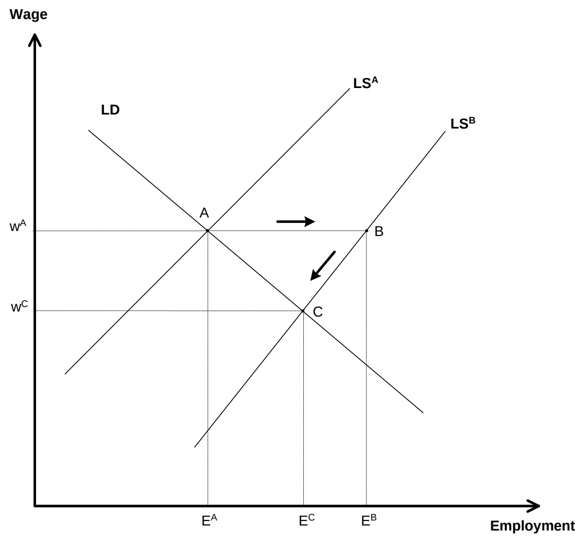

Figure 2: Demand module

The labor demand module of IZAΨMOD, thus, uses the elasticities derived from the labor demand estimations to calculate the change in wage which has to follow the change in employment of $E^B - E^A$. In a next step this wage change is used to recalculate the net income of the household, which will again have an effect on labor supply. This effect is simulated using the new net income and the established leisure/consumption preferences. Assuming a positive labor supply elasticity, the labor supply shifts to the left reducing the initial positive employment effect. Once again using the demand elasticities, this reduction of the employment will lead to an increase in the wage, leading to a right shift of the supply curve. This procedure is iterated until the employment shifts and thus the wage shifts become arbitrarily small[31] and the model converges. At this point supply equals demand and we are situated in the market equilibrium.[32]

6 Applications and further development

So far, IZAΨMOD has been applied to simulate the effects of several reform proposals for Germany. The model is flexible enough to assess a wide range of possible changes of the German tax and benefit system, such as an introduction of workfare concepts, flat tax schedules, tax credits or negative income tax systems.

Among others, concrete reform proposals which have been analyzed using IZAΨMOD are:

- the effect of a workfare, requiring every recipient of government transfers to work full-time as proposed by IZA (cf. Bonin and Schneider (2006b))
- the introduction of a Negative Income Tax in combination with a flat tax and the simplification of social insurance payments as proposed by the former prime minister of the Free State of Thuringia, Dieter Althaus (cf. Bonin and Schneider (2007))
- the introduction of wage subsidies in the spirit of the US Earned Income Tax Credit in combination with a workfare as proposed by the ifo Institute in Munich (cf. Bonin et al. (2003) and Bonin and Schneider (2006b))
- a tax reform proposed by the German liberal party in the run-up to the 2009 national elections reducing the progression of the current schedule by introducing three tax brackets (cf. Neumann et al. (2009))

IZAΨMOD is constantly revised and extended. For information on the most current version, please consult the IZAΨMOD section on IZA's homepage (www.iza.org).

[31] Here we consider a change of less than 10,000 hours a months, which equals 250 full-time equivalents or less than 0.1 percent of the average labor supply effect of our reform scenarios to be arbitrarily small. The maximum number of iterations is set at 50.

[32] It must be noted that figure 2 is merely a broad illustration of that iteration process. The figure misleadingly suggests that the way into the equilibrium in point C is achieved by walking down the new labor supply curve LS^B. In reality, the wage change which is calculated via the labor demand elasticity leads to a new simulation of the labor supply reaction. Thus the LS shifts again.

7 Appendix: Heckman correction

Statistical analyses based on non-randomly selected samples often include selection biases that may lead to erroneous conclusions from the estimated model. In our case, the parameters of the utility function are estimated using the data of employed individuals, whereas the simulation of the labor supply behavior is also conducted for non-workers. The economic model assumes that these people have an offered wage below their reservation wage and therefore do not offer work. As a consequence, one will mainly observe individuals with a relative high wage rate, which leads to biased results concerning the correlation of labor supply decisions and wage rates.

The two-step estimation method developed by Heckman (1979) helps to avoid a biased selection sample and is shortly presented here.[33]

The procedure consists of two equations: The first equation can be formulated as

$$y_i = x_i'\beta + \varepsilon_i \tag{7}$$

and is called the equation of primary interest. In this case, the variable of interest is the wage rate y_i, which is not observed if the individual is not working. Equation (7) captures the relationship between y_i and some factors of influence, denoted x_i. The error term ε_i is assumed to be normally distributed with zero expected value $E(\varepsilon_i) = 0$ and constant variance $var(\varepsilon_i) = \sigma_u^2$. The second equation, which determines the sample selection may be formulated as

$$z_i^* = w_i'\gamma + u_i \qquad \text{with } E(u_i) = 0, var(u_i) = 1. \tag{8}$$

It is assumed that ε_i and u_i have a bivariate normal distribution with zero means and a positive correlation $corr(\varepsilon_i, u_i) = \rho$ (see Puhani (2000)). In order to estimate equation (7), one has to be aware that the wage rate is only observed for individuals who are working. For $\rho \neq 0$, a standard Ordinary Least Squares (OLS) regression of equation (7) may lead to biased estimates of β. The regression function of the sub-sample may be stated as

$$E(y_i|x_i, D = 1) = x_i'\beta + E(\varepsilon_i|D = 1), \tag{9}$$

[33] This section is drawn largely from Puhani (2000) and Peichl and Schaefer (2009).

where

$$D = \begin{cases} 1 & \text{if } w_i'\gamma + u_i > 0 \\ 0 & \text{if } w_i'\gamma + u_i < 0. \end{cases} \tag{10}$$

Therefore, y_i is only observed ($D = 1$) if the sum of a weighted determining factor of labor supply $w_i\gamma$ and the error term u_i is greater than zero.

Since the regression function for the whole sample corresponds to

$$E(y_i|x_i) = x_i'\beta, \tag{11}$$

equation (9) will only equal equation (11) if $E(\varepsilon_i|D = 1) = 0$, which is normally not the case. Given that ε_i and u_i have a bivariate normal distribution with zero means and $corr(\varepsilon_i, u_i) = \rho$, it can be shown that the conditional expectation of the error term ε_i is:

$$E(\varepsilon_i|D = 1) = \rho \cdot \sigma_\varepsilon \cdot \frac{\phi(-(w_i'\gamma)/\sigma_u)}{1 - \Phi(-(w_i'\gamma)/\sigma_u)}. \tag{12}$$

$\phi(\cdot)$ and $\Phi(\cdot)$ represent the density and cumulative density functions of the standard normal distribution respectively. Inserting equation (12) into (9) yields

$$E(y_i|x_i, D = 1) = x_i'\beta + \rho \cdot \sigma_\varepsilon \cdot \frac{\phi(-(w_i'\gamma)/\sigma_u)}{1 - \Phi(-(w_i'\gamma)/\sigma_u)}. \tag{13}$$

The term

$$\lambda_i = \frac{\phi(-(w_i'\gamma)/\sigma_u)}{1 - \Phi(-(w_i'\gamma)/\sigma_u)} \tag{14}$$

is also called the *Inverse Mills Ratio.* Equation (13) can now be rewritten as

$$E(y_i|x_i, D = 1) = x_i'\beta + \rho \cdot \sigma_\varepsilon \cdot \lambda_i. \tag{15}$$

According to Heckman, the problem with using OLS on equation (7) is that estimates of β may be biased due to an omitted variable problem, where the Mills Ratio is the omitted variable. The procedure proposed by Heckman consists of

1) Run a probit model of the treatment on the vector $\mathbf{w}$ to obtain estimates of γ/σ_u.

2) Construct the Inverse Mills Ratio λ by using these estimates.

3) Estimate equation (7) by running OLS of y_i on $\mathbf{x}$, using the estimated Mills

ratio as additional regressor.

The described procedure includes the omitted variable λ_i in the OLS regression and therefore removes the bias in the estimates of β.

References

Addison, J. T., Bellmann, L., Schank, T. and Teixeira, P. (2008). The Demand for Labor: An Analysis Using Matched Employer-Employee Data from the German LIAB. Will the High Unskilled Worker Own-Wage Elasticity Please Stand Up?, *Journal of Labor Research* **29**(2): 114–137.

Alda, H., Bender, S. and Gartner, H. (2005). The Linked Employer-Employee Dataset of the AB (LIAB), *Schmollers Jahrbuch - Journal of Applied Social Science Studies* **125**(2): 327–336.

Bach, S. and Schulz, E. (2003). Fortschreibungs- und Hochrechnungsrahmen für ein Einkommensteuer- Simulationsmodell. Projektbericht 1 zur Forschungskooperation Mikrosimulation mit dem Bundesministerium der Finanzen, Materialien des DIW Berlin, Nr. 26.

Bargain, O., Caliendo, M., Haan, P. and Orsini, K. (2010). 'Making work pay' in a rationed labor market, *Journal of Population Economics* **23**(1): 323–351.

Bargain, O. and Orisini, K. (2006). In-Work Policies in Europe: Killing Two Birds with One Stone?, *Labour Economics* **13**(6): 667–697.

Bellmann, L., Caliendo, M., Hujer, R. and Radic, D. (2002). Beschäftigungswirkungen technisch-organisatorischen Wandels : Eine mikroökonometrische Analyse mit dem Linked IAB-Panel, *Mitteilungen aus der Arbeitsmarkt- und Berufsforschung* **35**(4): 506–522.

Bender, S. and Haas, A. (2002). Die IAB-Beschäftigungsstichprobe, *in* G. Kleinhenz (ed.), *IAB-Kompendium Arbeitsmakt- und Berufsforschung, Beiträge zur Arbeitsmarkt- und Berufsforschung 250*, W. Bertelsmann, Bielefeld, pp. 3–12.

Bender, S., Haas, A. and Klose, C. (2000). The IAB Employment Subsample 1975-1995, *Schmollers Jahrbuch - Journal of Applied Social Science Studies* **120**(4): 649–662.

Blundell, R. and MaCurdy, T. (1999). Labor Supply: A Review of Alternative Approaches, *in* O. Ashenfelter and D. Card (eds), *Handbook of Labor Economics, Vol. 3A*, Elsevier, Amsterdam, pp. 1559–1695.

Bonin, H., Kempe, W. and Schneider, H. (2002). Household Labor Supply Effects of Low-Wage Subsidies in Germany, IZA Discussion Paper No. 637.

Bonin, H., Kempe, W. and Schneider, H. (2003). Kombilohn oder Workfare? Zur Wirksamkeit zweier arbeitsmarktpolitischer Strategien, *Quarterly Journal of Economic Research* **72**(1): 51–67.

Bonin, H. and Schneider, H. (2006a). Analytical Prediction of Transition Probabilities in the Conditional Logit Model, *Economic Letters* **90**(1): 102–107.

Bonin, H. and Schneider, H. (2006b). Workfare: Eine wirksame Alternative zum Kombilohn, IZA Discussion Paper No. 2399.

Bonin, H. and Schneider, H. (2007). Beschäftigungswirkungen und fiskalische Effekte einer Einführung des Solidarischen Bürgergelds, online.
URL: *http://www.iza.org/files/IZA-Berechnungen$_A$lthaus − Modell.pdf*

Bourguignon, F. and Spadaro, A. (2006). Microsimulation as a tool for evaluating redistribution policies, *Journal of Economic Inequality* **4**(1): 77–106.

Christensen, L., Jorgenson, D. and Lau, L. (1971). Conjugate Duality and the Transcedental Logarithmic Function, *Econometrica* **39**: 255–256.

Cogan, J. (1981). Fixed costs and labor supply, *Econometrica* **49**: 945–963.

Creedy, J. and Duncan, A. (2002). Behavioural Microsimulation with Labour Supply Responses, *Journal of Economic Surveys* **16**(1): 1– 39.

Creedy, J. and Duncan, A. (2005). Aggregating labour supply and feedback effects in microsimulation, *Australian Journal of Labour Economics* **8**(3): 277–290.

Creedy, J., Duncan, A., Harris, M. and Scutella, R. (2002). *Microsimulation Modelling of Taxation and the Labour Market: the Melbourne Institute Tax and Transfer Simulator*, Edward Elgar Publishing, Cheltenham.

Creedy, J. and Kalb, G. (2006). *Labour supply and microsimulation: the evaluation of tax policy reforms*, Edward Elgar, Cheltenham.

Eissa, N. and Liebman, J. (1996). Labor supply response to the earned income tax credit, *Quarterly Journal of Economics* **111**(2): 605–637.

Fuest, C., Peichl, A. and Schaefer, T. (2008). Is a flat tax reform feasible in a grown-up democracy of Western Europe? A simulation study for Germany, *International Tax and Public Finance* **15**(5): 620–636.

Gartner, H. (2005). The Imputation of Wages Above the Contribution Limit with the German IAB Employment Sample, FDZ Methodenreport Nr. 2/2005.

Greene, W. (2003). *Econometric Analysis*, Prentice Hall, New Jersey.

Gupta, A. and Kapur, V. (2000). *Microsimulation in Government Policy and Forecasting*, North-Holland, Amsterdam.

Haan, P. and Steiner, V. (2005). Distributional Effects of the German Tax Reform 2000 - A Behavioral Microsimulation Analysis, *Schmollers Jahrbuch* **125**(1): 39–49.

Haan, P. and Steiner, V. (2006). Labor Market Effects of the German Tax Reform 2000, *in* C. Dreger, H. P. Galler and U. Walwei (eds), *Determinants of Employment*, Nomos, Baden-Baden, pp. 101–117.

Haan, P. and Uhlendorff, A. (2007). Intertemporal Labor Supply and Involuntary Unemployment, IZA Discussion Paper No. 2888.

Hamermesh, D. S. (1993). *Labor Demand*, Princeton University Press, Princeton.

Hausman, J. (1985). Taxes and Labor Supply, *in* A. Auerbach and M. Feldstein (eds), *Handbook of Public Economics*, North-Holland, Amsterdam, pp. 213–263.

Heckman, J. (1976). The Common Structure of Statistical Models of Truncation, Sample Selection and Limited Dependent Variables and a Simple Estimator for Such Models, *Annals of Economic and Social Measurement* **5**: 475–492.

Heckman, J. (1979). Sample Selection Bias as a Specification Error, *Econometrica* **47**(1): 153–161.

Heckman, J. (1993). What has been learned about labor supply in the past twenty years?, *American Economic Review Papers and Proceedings* **85**(2): 116–121.

Immervoll, H., Kleven, H., Kreiner, C. and Saez, E. (2007). Welfare Reform in European Countries: A Micro-Simulation Analysis, *The Economic Journal* **117**(1): 1–44.

Jacobebbinghaus, P. (2008). LIAB-Datenhandbuch Version 3.0, FDZ Datenreport Nr. 3/2008.

Kleven, H. J. and Kreiner, C. (2006). The Marginal Cost of Public Funds in OECD Countries: Hours of Work versus Labor Force Participation, *Journal of Public Economics* **90**(10-11): 1955–1973.

Kölling, A. (2000). The IAB-Establishment Panel, *Schmollers Jahrbuch - Journal of Applied Social Science Studies* **120**(2): 291–300.

Kölling, A. and Schank, T. (2002). New Evidence on the Determinants of the Employment Structure from Linked Employer-Employee Panel Data for Germany, *10th International Conference on Panel Data*, International Conferences on Panel Data, Berlin.

MaCurdy, T., Green, D. and Paarsch, H. (1990). Assessing Empirical Approaches for Analyzing Taxes and Labor Supply, *The Journal of Human Resources* **25**(3): 415–490.

McFadden, D. (1973). Conditional Logit Analysis of Qualitative Choice Behavior, *in* P. Zarembka (ed.), *Frontiers in Econometrics*, Academic Press, New York, chapter 4, pp. 105–142.

McFadden, D. (1981). Econometric Models of Probabilistic Choice, *in* C. Manski and D. McFadden (eds), *Structural Analysis of Discrete Data and Econometric Applications*, The MIT Press, Cambridge, pp. 198–272.

McFadden, D. (1985). Econometric Analysis of Qualitative Response Models, *in* Z. Griliches and M. Intrilligator (eds), *Handbook of Econometrics*, Elsevier, Amsterdam, pp. 1396–1456.

Merz, J., Stolze, H. and Imme, S. (2001). ADJUST FOR WINDOWS - A Program Package to Adjust Microdata by the Minimum Information Loss Principle, FFB-Dokumentation No. 9, Department of Economics and Social Sciences, University of Lüneburg, Lüneburg.

Meyer, B. and Rosenbaum, D. (2001). Welfare, the earned income tax credit, and the labor supply of single mothers, *Quarterly Journal of Economics* **116**(3): 1063–1114.

Mroz, T. (1987). The sensitivity of an empirical model of married women's hours of work to economic and statistical assumptions, *Econometrica* **55**: 765–799.

Neumann, D., Peichl, A., Schneider, H. and Siegloch, S. (2009). Die Steuerreformpläne der neuen Bundesregierung und das Bürgergeld: Eine Simulation von Risiken und Nebenwirkungen, IZA Standpunkt Nr. 21.

Peichl, A. (2009). The Benefits and Problems of Linking Micro and Macro Models: Evidence from a Flat Tax Analysis for Germany, *Journal of Applied Economics* **12**(2): 301–329.

Peichl, A. and Schaefer, T. (2009). FiFoSiM - An Integrated Tax Benefit Microsimulation and CGE Model for Germany, *International Journal of Microsimulation* **2**(1): 1–5.

Peichl, A. and Siegloch, S. (2010a). Incorporating Labor Demand Effects into the Microsimulation of Tax and Benefit Reforms. mimeo.

Peichl, A. and Siegloch, S. (2010b). Labor Demand for Germany: A Critical Review. mimeo.

Puhani, P. A. (2000). The Heckman Correction for Sample Selection And Its Critique, *Journal Of Economic Surveys* **14**(1): 53–68.

Quinke, H. (2001). Erneuerung der Stichprobe des ESt-Modells des Bundesministeriums der Finanzen auf Basis der Lohn- und Einkommensteuerstatistik 1995, GMD - Forschungszentrum Informationstechnik GmbH, Technical Report.

Shephard, R. W. (1970). *The Theory of Cost and Production Functions*, Princeton University Press, Princeton.

Slesnick, D. T. (1998). Empirical Approaches to the Measurement of Welfare, *Journal of Economic Literature* **36(4)**: 2108–2165.

Steiner, V. and Wrohlich, K. (2004). Household Taxation, Income Splitting and Labor Supply Incentives - A Microsimulation Study for Germany, *CESifo Economic Studies* **50**(3): 541–568.

Train, K. (2003). *Discrete Choice Models Using Simulation*, Cambridge University Press, Cambridge.

Triest, R. (1990). The effect of income taxation on labor supply in the United States, *Journal of Human Resources* **25**: 491–516.

Van Soest, A. (1995). Structural Models of Family Labor Supply: A Discrete Choice Approach, *Journal of Human Resources* **30**(1): 63–88.

Van Soest, A. and Das, M. (2001). Family Labor Supply and Proposed Tax Reforms in the Netherlands, *De Economist* **149(2)**: 191–218.

Van Soest, A., Das, M. and Gong, X. (2002). A Structural Labour Supply Model with flexible Preferences, *Journal of Econometrics* **107**: 345 – 374.

Wagner, G. G., Frick, J. R. and Schupp, J. (2007). The German Socio-Economic Panel (SOEP) - Scope, Evolution and Enhancements, *Schmoller's Jahrbuch - Journal of Applied Social Science Studies* **127**(1): 139–169.