Evaluating the economic effects of income security reforms in Switzerland: an integrated microsimulation - computable general equilibrium approach*

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Abstract

This paper analyzes the economic consequences of various reforms of the Swiss tax-benefit system using a framework which integrates an econometrically estimated microsimulation model of labor supply, a tax-benefit module, and a computable general equilibrium (CGE) model. By contrast to conventional microsimulation exercises, this integrated framework accounts for feedback effects arising in particular from the endogenization of wage rates and from the consistent treatment of the government's budget constraint. Compared to conventional CGE models, this framework provides a much more detailed representation of household income distribution and labor supply behavior. The reform scenarios considered in this paper include different versions of basic income, participation income and low-wage subsidy schemes.

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1 Introduction

In Switzerland, the costs of social transfers have grown at a faster pace than GDP in recent years. These financing problems have prompted calls for better "targeting" of social transfers towards persons in need. Other propositions to reform the income security system have emphasized the need to improve work incentives, especially for low-skill workers. In the public discussion, it has not always been clear whether these two positions are mutually compatible.

Those who favor tighter targeting of social transfers argue that the tax burden on individuals who are financing the transfers should be reduced. As a result, there would be less work disincentives for tax payers. This view is, however, incomplete since it ignores the impact on work incentives for beneficiaries of the transfers. Indeed, means-tested benefits, a common way of targeting public resources, imply high marginal tax rates for beneficiaries. If these marginal tax rates are close to 100 percent, as in the case of the minimum income guarantee, the benefit system creates a "poverty trap". At the risk of oversimplifying, the current functioning of social assistance in Switzerland resembles this description.

The problem of the poverty trap could be alleviated by implementing a universal benefit scheme. This could take the form of an unconditional basic income paid to each individual, possibly combined with a flat tax (Atkinson, 1995a). Here the main questions are how such a scheme can be financed and whether it might not discourage work effort too much, with the risk of leading to social exclusion. These worries can be partly addressed by making the payment of the basic income conditional on a participation condition: this is the idea of the "participation income" proposed by Atkinson (1995b).

The aim of this paper is to evaluate the impact of these reform proposals on the Swiss economy, in particular on poverty, income distribution and economic efficiency.[1] We use a simulation model specifically designed for that purpose. In order to address the issues discussed above, this model has to meet the following requirements. First, it must account for the fact that labor supply adjusts to changes in the tax-benefit schedule. Second, the government's budget should be balanced in the simulations, which implies that new benefits must be financed through modifications of the tax schedules. Third, far-reaching reforms, such as the introduction of a basic income, are likely to have important consequences for the entire economy.

[1] For the sake of comparison, we analyze also the effects of a rather different proposal, put forward by Drèze and Malinvaud (1994): the exemption of low wages from employers' social insurance contributions.

It is therefore crucial to take general-equilibrium effects into account.

How should the simulation model be designed in order to fulfill these requirements? Tax-benefit models (based on household survey data) are used by Callan and Sutherland (1997) to evaluate the introduction of basic income schemes in the UK and Ireland. As they do not incorporate behavioral response, our first condition is not satisfied. By contrast, endogenous labor supply lies at the heart of the structural econometric models employed by Duncan and Giles (1998), Blundell et al. (2000), and Blundell (2001), who carry out microsimulations to evaluate the effects of the British Working Families Tax Credit (WFTC).[2]

However, these microsimulations are not neutral with respect to their budgetary implications and are carried out in a partial-equilibrium framework, assuming that wages are constant. As Solow (1998) points out, the partial-equilibrium perspective neglects the fact that a policy of pushing welfare recipients into the labor market entails a fall in wages for low-skill workers. The burden of such a policy is therefore likely to fall on the (previously employed) working poor.

In order to remedy these omissions, this paper uses a framework which integrates an econometrically estimated microsimulation model of labor supply, a tax-benefit module and a computable general equilibrium (CGE) model. Compared to conventional microsimulation exercises, this integrated framework allows to consider the feedback effects that arise from the endogenization of wage rates and non labor income. Moreover, a consistent treatment of the government's budget constraint is provided, which is crucial for the evaluation of different financing options of alternative benefit schemes. In particular, the introduction of a flat income tax schedule and the increase in VAT rates are considered.

Most microsimulation studies of tax-benefit reforms focus mainly on labor supply responses. In order to give a more complete picture of simulation results, we do not limit our analysis to efficiency effects. Therefore, we report not only aggregate indicators of the Swiss economy and the labor market, but complement them with different measures of poverty and inequality.[3] Finally, ordinal comparisons of social

[2]See also Gerfin and Leu (2003) for an application to Switzerland.

[3]The use of a single poverty index might indeed be misleading, as recent evaluations of the US earned income tax credit (EITC) demonstrate. Although the EITC has led to a substantial increase in labor market participation of low educated single parents, this does not imply that the intensity of poverty is on the decline. Indeed, Blank (2002) paints a mixed picture of the evolution of poverty among families with children between 1993 and 1999 in the US. She shows that, although the share of families in poverty (headcount ratio) fell over this period, the poverty gap (measuring how far average family income of the poor is below the poverty line) increased, mainly because of the reduction in means-tested benefits which accompanied the introduction of the EITC.

welfare are carried out using Generalized Lorenz curves of the pre- and post-reform situations.

Our approach is related to other contributions that integrate microsimulation and CGE models. One strand of this literature disaggregates the household sector in the CGE model using household survey data, assuming that factor endowments (and hence labor supply) are fixed for each household (Cockburn, 2001; Hertel et al., 2004). Bourguignon et al. (2003) go further by combining a CGE model and an econometrically estimated microsimulation model for Indonesia in a recursive way. The microsimulation model describes how a household's income is generated by explaining each household member's choice between inactivity, the decision to take up wage work, and self-employment; it is estimated in a semi-reduced form. Our model differs from the Bourguignon et al. framework mainly in two respects. First, the discrete-choice labor supply model is estimated in structural form, following the approach of Blundell et al. (2000) and Duncan and Giles (1998). Second, the microsimulation model of labor supply is fully integrated into the CGE model, allowing for a consistent determination of labor market equilibrium and taking progressive income taxation into account.[4]

The remainder of the paper is organized as follows. The next section presents the integrated modeling framework. Section 3 describes the scenarios for income security reforms and presents simulation results. Section 4 concludes.

2 Modeling framework

The integrated modeling framework used in this study is illustrated in Figure 1. The *tax-benefit module* contains detailed tax and benefit schedules that are used, on the one hand, to generate budget constraints for each household in the econometric estimations and, on the other hand, as a baseline for the alternative policy scenarios that will be simulated. The *microsimulation model* contains almost five thousand households (headed by salaried workers) and is based on an econometrically estimated discrete-choice model of labor supply. In conjunction with the tax-benefit module, it allows to simulate the impact of reform policies on each household's labor supply and the resulting income changes, for given wage rates and tax rates. In order to endogenize the latter, the microsimulation model is embedded into the *computable general equilibrium model* (CGE). This amounts to replacing in the CGE

[4] In a rather different context, Cogneau (2001) elaborates a fully integrated approach in order to build a microsimulation model in general equilibrium for the labor market of a city, Antananarivo. See also Cogneau and Robilliard (2000).

the variables related to salaried households (labor supply, consumption, net tax payments) by the related aggregate indicators calculated by the microsimulation model. The new equilibrium can then be obtained by iterating between the two models on wage and tax rates. Consider each of the three models in turn.

2.1 Tax-benefit module

The tax-benefit module takes as input gross wages and non labor income, and calculates household disposable income under the alternative policy scenarios. It accounts for the federal structure of the Swiss tax system, where personal income taxes are levied not only at the federal level, but also by cantons and municipalities. Federal income tax is progressive with a maximum marginal tax rate of 13 percent. At the cantonal level, tax schedules vary widely in shape and level. The tax benefit module contains separate tax schedules for each canton which include the average municipal-level tax rate.[5] The module also distinguishes between married and unmarried couples, since their tax treatment differs, and controls for the number of children in the calculation of tax deductions.

Besides income taxes, social security contributions and compulsory health insurance premiums (differentiated by canton) are calculated. On the benefit side, we account for contributions to health insurance premiums. For a more detailed description of the tax-benefit module, see the Appendix in Abul Naga et al. (2003).

2.2 Microsimulation: discrete-choice model of labor supply

Labor supply is modeled as a discrete choice between non participation and different employment states (part-time, full-time,...). The econometric model of labor supply is specified separately for two-adult and single-adult households, using the Swiss expenditure and income survey of 1998 as data base. Note that our sample includes only households headed by salaried workers.

Consider the case of two-adult households.[6] According to the unitary model of labor supply, the couple is assumed to decide from a collective point of view. Choices are characterized by a quadratic utility function, defined over the couple's

[5] There is also some variation at the municipal level, but as there are thousands of municipalities in Switzerland this information could not be obtained.

[6] Given the observed distribution of hours, we assume that the husband can choose between three states (non participation, full time less than 42 hours, full time more than 42 hours) and the wife between four states (non participation, part time less than 14 hours, part time between 15 and 28 hours, full time more than 29 hours of work). For a more detailed description of the estimation procedure, see Abul Naga et al. (2003).

disposable income y, calculated with the help of the tax-benefit module,[7] and the work hours of both household members, h_m and h_f:

$$\begin{aligned} u(y_n, h_m, h_f; z) &= \alpha_{yy} y_n^2 + \alpha_{ff} h_f^2 + \alpha_{mm} h_m^2 + \alpha_{yf} y_n h_f + \alpha_{ym} y_n h_m + \alpha_{fm} h_f h_m \\ &\quad + \beta_y y_n + \beta_m h_m + \beta_f h_f \end{aligned} \quad (1)$$

where $y_n = y - c_f - c_m$ is disposable income net of fixed costs of working. Note that β_y and fixed costs of the female member, c_f, are assumed to depend on demographic variables.

Preferences over employment states are assumed to vary stochastically among individuals according to a type I extreme value distribution. The model can then be estimated as a conditional logit model. The behavior of single-adult households is modeled in an analogous way. Estimation results for both household types can be found in the appendix.

One of the main methodological difficulties that arises in the context of microsimulation is the treatment of unobserved heterogeneity in the econometric model. The difficulty stems from the fact that the econometric labor-supply model describes "average" behavior, whereas the microsimulation model has to account explicitly not only for observable heterogeneity (as captured by e.g. demographic variables) but also for unobserved heterogeneity. If work hours are treated as a continuous variable, this issue can be dealt with by interpreting residuals as fixed individual effects. In our discrete-hours framework of labor supply, this straightforward procedure must be modified.

Consider the conditional logit model introduced above and denote by $j = 1, \ldots, J$ the different employment states that a two-adult household can choose (in our case $J = 12$ since the husband can choose between three states and the wife between four). Collective utility of household i is given by:

$$u_{ij}^* = u(y_{ij}, h_{ij}^m, h_{ij}^f; z_i) + \varepsilon_{ij} \quad (2)$$

where u is defined as in (1), z_i is a vector of parameters capturing household i's demographic composition and ε_{ij} represent unobserved characteristics that are i.i.d. according to a type I extreme value distribution. Schematically, disposable family

[7]For non participating individuals, the potential wage rate is estimated using a Mincerian wage equation (see equation (4) below).

income is defined as:

$$y_{ij} = [1 - \tau_{ij}(Y_{ij})]Y_{ij}, \qquad Y_{ij} = (1 - \tau_S)(w_i^m h_{ij}^m + w_i^f h_{ij}^f) + \mu_i + b_i \tag{3}$$

where τ_{ij} is the average tax-benefit function applying to individual i in state j, τ_S is the rate at which social security contributions are levied, μ_i is capital income, b_i is transfer income, and w_i^m and w_i^f are the husband's and wife's hourly earnings.

A Mincerian earnings function is estimated using data for all salaried workers, and correcting for selection bias due to the lacking observations for individuals that are not working. The specification of this earnings function is crucial for the interface between the microsimulation and CGE models. Earnings of an individual of gender g and belonging to household i are denoted by w_i^g and given by

$$\ln w_i^g = \sum_k \rho_k d_{ik}^g s_k + \theta_1 x_i^g + \theta_2 (x_i^g)^2 + \xi_i^g, \qquad g = m, f \tag{4}$$

where d_{ik}^g is a dummy variable representing the level of schooling (it is equal to 1 if member g of household i has achieved schooling level k, and 0 otherwise), s_k are years of schooling completed at level k, and x_i^g is labor market experience. By contrast to the standard Mincer model, equation (4) allows for varying returns to schooling. The motivation for this choice will become clear in the linkage with the general equilibrium model. For individuals outside the labor force, potential hourly earnings are estimated using equation (4).

The household chooses the employment status yielding maximum utility. A qualitative variable S_{ij} reflecting this choice can be defined as follows:

$$S_{ij} = \begin{cases} 1 & \text{if } u_{ij}^* = \max(u_{i1}^*, \ldots, u_{iJ}^*) \\ 0 & \text{otherwise} \end{cases} \tag{5}$$

For each household i, the model provides also the probability of being in employment state j:

$$\text{Prob}(S_{ij} = 1) = \frac{e^{u(y_{ij}, h_{ij}^m, h_{ij}^f; z_i)}}{\sum_k e^{u(y_{ik}, h_{ik}^m, h_{ik}^f; z_i)}} \tag{6}$$

It is current practice among researchers who want to measure the predictive performance of their model to attribute each household to the employment status which is the most probable according to (6), given its demographic characteristics, and to compare the predicted outcome of the model with the observed employment status of households in the sample. It would be tempting to use such a predicted outcome as a basis for microsimulation. This is, however, problematic since a significant proportion of households would be mis-classified. In order to avoid this undesirable outcome, we will adopt a calibration procedure that follows Bourguignon et al. (2003). This procedure reproduces the observed distribution of employment by drawing residuals $\hat{\varepsilon}_{ij}$ conditionally on the observed employment status. In practical terms, this can be done by drawing, for each household, independently J residuals $\hat{\varepsilon}_j$ according to a type I extreme value distribution. The J residuals are drawn until they satisfy the conditions:

$$\hat{u}(y_{i\ell}, h^m_{i\ell}, h^f_{i\ell}; z_i) + \hat{\varepsilon}_{i\ell} > \hat{u}(y_{ij}, h^m_{ij}, h^f_{ij}; z_i) + \hat{\varepsilon}_{ij} \qquad \text{for all } j \neq \ell$$

where $\hat{u}(y, h_m, h_f; z) = \hat{\alpha}_{yy} y^2 + \hat{\alpha}^f_{hh} h^2_f + \ldots$ is predicted utility and ℓ is the observed employment state of household i. As these residuals are kept constant in all simulations of alternative policy scenarios, they can be interpreted as individual fixed effects.

Partial-equilibrium micro-simulation relies on the assumption that wages (w^m_i and w^f_i) and non-labor income (μ_i) are exogenous. An exogenous change in social security benefits or taxes modifies functions τ_{ij} and changes the disposable income that can be obtained in the different employment states. Each household i then reconsiders his labor supply decision and chooses the optimal employment state j^* (with optimal hours combination $h^m_{ij^*}, h^f_{ij^*}$) according to:

$$j^*(i) = \arg\max_j \{\hat{u}(y_{ij}, h^m_{ij}, h^f_{ij}; z_i) + \hat{\varepsilon}_{ij},\ j = 1, \ldots, J\}. \tag{7}$$

where y_{ij} is defined in equation (3). The post-reform (net) income distribution is then given by $y_{ij^*(i)}$. When comparing pre- and post-reform income distributions, household incomes are made comparable by using an equivalence scale.

As argued above, this procedure does not ensure a balanced government budget if it is carried out in partial equilibrium. Even if the policy reform is conceived in a neutral manner, based on the pre-reform income distribution, the induced labor-supply adjustments imply that the budget will not be balanced in the post-reform situation. This issue can only be resolved properly in a general equilibrium framework.

2.3 Computable general equilibrium model

In order to account for general equilibrium effects, the microsimulation model needs two types of feedback: equilibrium factor prices and tax rates that are consistent with a balanced government budget. One might be tempted to specify labor demand functions, on the one hand, and a government budget, on the other hand. Such an approach would however neglect their interdependence. The CGE framework provides the two types of feedback in a mutually consistent way.

The static CGE model for Switzerland has been constructed with these issues in mind. In particular, the household sector and the government budget are broken down so as to be compatible with the microsimulation model. As the value added tax (VAT) is an important source of financing for income security reforms, its features are modeled in some detail. Finally, to allow for heterogeneity in labor demand, four skill categories are considered in the CGE.

Before describing these features in more detail, it is useful to summarize the other characteristics of the CGE model.[8] It is a single-country model with 25 production sectors, exhibiting constant returns to scale and operating under perfect competition. Foreign trade is modeled by adopting the small country assumption, which excludes terms of trade effects of policy reforms, and by postulating that imported and domestic goods are differentiated by origin (Switzerland, EU, RW), which reflects the "Armington" assumption. By symmetry, goods produced in Switzerland are differentiated according to destination, using a constant elasticity of transformation (CET) function. Foreign savings are exogenous and the real exchange rate adjusts in order to clear the balance of payments. The macroeconomic equilibrium is ensured by a neoclassical closure rule: investment is determined by available savings.

In order to allow the integration of the microsimulation model into the CGE framework, the household sector is broken down into two types of households: salaried households, representing the 4974 households included in the microsimulation model, and other households, whose household heads are farmers, retired, unemployed or in independent employment. The latter category is modeled at the aggregate level, with exogenous labor supply and average direct tax rates applying to aggregate household income of this category. By contrast, the labor supply behavior of salaried households and the corresponding direct tax burden are modeled so as to be consistent with aggregate indicators calculated by the microsimulation

[8] The static CGE model used here is derived from the steady-state three-country model presented in Grether and Müller (2001). In order to facilitate the interaction with the microsimulation model, several features have been simplified. In particular, there is no imperfect competition among firms and no scale economies in production.

model. Consumption demand for both household types is derived at the aggregate level from a Cobb-Douglas utility function.[9]

Government Budget. Consider first the government's budget constraint, consolidated with the accounts of social security institutions. In order to ensure comparability across scenarios, the volume of current government expenditure, $\bar{C}_G$, and government savings, $\bar{S}_G$, are assumed exogenous. The government's budget constraint is given by:

$$TAXCGE + TAXMICRO + t_{flat}TAXBASE = P_G\bar{C}_G + \bar{S}_G \tag{8}$$

where P_G denotes the real price index associated with $\bar{C}_G$, $\bar{S}_G$ is government savings, *TAXCGE* represents net revenues from VAT, tariffs, output taxes (net of subsidies) as well as from direct taxes levied on households that are not headed by salaried workers. Note that *TAXCGE* is determined endogenously in the CGE model, using the calibrated tax and tariff rates. Direct taxes paid by salaried households are calculated by the microsimulation model. Together with social security contributions, this results in the following tax revenue which is transmitted from the microsimulation to the CGE model:[10]

$$TAXMICRO = \sum_{i,j} S_{ij}\tau_{ij}(Y_{ij})Y_{ij} + \tau_S \sum_{i,j} S_{ij}(w_i^m h_{ij}^m + w_i^f h_{ij}^f) \tag{9}$$

In some scenarios a flat tax is introduced, replacing in some cases the federal tax schedule and in other cases the entire income tax schedule. Its rate is denoted by t_{flat} in equation (8) and it is levied on the part of income that exceeds a minimum income level. This minimum income level should enable households to meet their basic needs and is given by e_iY_{min}, where Y_{min} denotes minimum income for a single adult and e_i is the equivalence scale applied to household i. The flat tax rate applies therefore to the following tax base:

$$TAXBASE = \sum_{i,j} S_{ij}\max(0, Y_{ij} - e_iY_{min}), \tag{10}$$

which is calculated in the microsimulation model and transmitted to the CGE model.

How is the government budget balanced in the integrated model? Two alternative closure rules are used in the scenarios: in some scenarios (denoted by the

[9]This highly simplifying assumption is motivated by our focus on the labor market.

[10]For simplicity, the tax payments made by single-adult households are omitted in the presention.

acronym FT), the flat tax rate t_{flat} adjust so as to satisfy the government's budget constraint (8). In other scenarios (denoted by the acronym FT), the general level of VAT rates becomes endogenous, whereas the flat tax rate is exogenous. Either of these closures necessitates to iterate between the microsimulation and the CGE model (see below).

Value Added Tax. Consider now the issue of VAT in some more detail. In most CGE models, the VAT is represented as a tax on final consumption. In a "pure" VAT system without exemptions, the VAT and a final consumption tax are indeed equivalent even if tax rates are differentiated, as is the case in Switzerland. Unfortunately, this equivalence breaks down if several sectors are excluded from the VAT base. In Switzerland, many services (banking, insurance, health, teaching, rental housing etc.) as well as farm products are particular excluded from VAT. Exclusion from the VAT base is not equivalent with a zero VAT rate, since firms belonging to these sectors do not get reimbursed for the VAT paid on their intermediate inputs and investment. As a result, the usual equivalence with a tax on final consumption disappears. Indeed, let S be the set of all sectors, $S_{in}(S_{ex})$ the subset of sectors included in (excluded from) the VAT base ($S_{ex} = S \setminus S_{in}$), and U_{kl} (I_{kl}) the intermediate consumption of (the investment in) good k by sector l. Then, using the equality between resources and uses, it is easily shown that VAT revenue collected on good l is given by:

$$V_l = \begin{cases} t_l(C_l + \sum_{k \in I} U_{lk} + \sum_{k \in I} I_{lk}) - \sum_{k \in I_T} t_k(U_{kl} + I_{kl}) & \text{si } l \in I_T \\ 0 & \text{si } l \in I_N \end{cases} \tag{11}$$

where C_l is final consumption of good l and t_l is the VAT rate. Summing over all sectors, total collected VAT revenue becomes:

$$VAT = \sum_{l \in I} V_l = \sum_{l \in I_T} t_l \left(C_l + \sum_{k \in I_N} (U_{lk} + I_{lk}) \right), \tag{12}$$

which means that in Switzerland, VAT is both a tax on the final consumption of tax-included sectors and a tax on the intermediate consumption and the investments in the tax-excluded sectors. It is in this sense that VAT is modeled and VAT rates are calibrated using direct information from fiscal authorities.

Labor market equilibrium. The partial-equilibrium microsimulation approach neglects the impact of policy reform on the level and the structure of wage rates since it is (implicitly) assumed that labor demand is infinitely elastic. This is not a particularly realistic assumption if the envisaged social security reforms lead to important changes in labor market incentives. Here the linkage between the econometric microsimulation model and the computable general equilibrium (CGE) model becomes crucial.

The main issue in the linkage of the two models is the disaggregation of the labor market. How can the highly heterogeneous labor supply (provided by the econometrically estimated microsimulation model) be made consistent with the rather aggregate treatment of labor demand in the CGE model? The heterogeneity of human capital can be reduced by assuming that there are two distinct dimensions which are represented, on the one hand, by the level of schooling and, on the other hand, by job-specific human capital accumulated through on-the-job training. Akin to Heckman et al. (1998), we assume that from the firms' point of view, workers are perfect substitutes within a given schooling type (even if they have different levels of on-the-job training), but that they are imperfect substitutes between different schooling types. Note that human capital is exogenous in our static simulation framework, by contrast to Heckman et al. (1998) who analyze the accumulation of human capital using a dynamic general equilibrium model.

These assumptions allow to preserve a certain degree of labor heterogeneity in general equilibrium since the CGE model distinguishes four labor skill categories corresponding to different schooling types. Thus, in general equilibrium the return to each schooling type is endogenized together with the return to capital, enabling us to go beyond the conventional partial-equilibrium analysis of the impact of policy scenarios on income inequality and poverty.

Consider first the determination of labor supply. In Mincer's model, earnings of individual i with schooling level k (corresponding to s_k years of schooling) are given by:

$$w_i^g = e^{\rho_k s_k}[1 - k(x_i^g)] H_x(x_i^g) H_\xi(\xi_i^g) \tag{13}$$

where k is the fraction of time invested in on-the-job training (this fraction is assumed to be linearly declining over the work life), H_x is job-specific human capital and H_ξ captures unobserved ability.[11] The two human capital components are empirically related to the estimated wage equation (4) as follows:

$$[1 - k(x_i^g)] H_x(x_i^g) \approx \exp(\theta_1 x_i^g + \theta_2 (x_i^g)^2), \qquad H_\xi(\xi_i^g) = \exp(\xi_i^g) \tag{14}$$

[11] For a recent account of the Mincer model and a discussion of its theoretical foundations, see Heckman et al. (2001).

As workers are assumed to be perfect substitutes within a given schooling type, labor supply can be aggregated (for a given schooling level) by expressing individual labor supply in efficiency units. For example, if member g of household i has schooling level k, her labor supply can be expressed in efficiency units as follows:

$$l_i^g = [1 - k(x_i^g)] H_x(x_i^g) H_\xi(\xi_i^g) \sum_j S_{ij} h_{ij}^g \tag{15}$$

The corresponding "wage rate" (which does not depend on individual characteristics) can be defined as $\omega_k = e^{\rho_k s_k}$. Measured in efficiency units, total supply of k-type human capital by gender g is:

$$L_k^g = \sum_{i \in I_k^g} l_i^g, \qquad g = m, f \tag{16}$$

where $I_k^g = \{i | d_{ik}^g = 1\}$ is the set of households including members g with schooling level k.

Turn now to labor demand, which is derived from the sectoral production functions in the CGE model. Assumptions for technology are depicted in Figure 2, representing the different levels of the nested non-separable constant-elasticity-of-substitution (CES) production function (Perroni and Rutherford, 1995). Value added and intermediate inputs are combined using a Leontief aggregation function. The four labor skill categories correspond to the four schooling levels in the wage equation (4). To account for the empirically well-established complementarity between capital and high-skilled labor and the substitutability between capital and low-skilled labor (see Hamermesh, 1993), the different skill levels enter the value-added function twice. First, a "Labor composite 1" (LC1), which is biased towards higher skills, is combined with capital. Second, the resulting aggregate(capital-LC1) factor is further combined with a "Labor composite 2" (LC2), biased towards lower skills.[12]

The assumption of profit maximization by firms leads to the derived demand for labor. Total demand for labor of schooling level k, expressed in efficiency units, can be written as

$$L_k^D = \sum_l \phi_{kl}(\omega_1, \ldots, \omega_K; \ldots), \tag{17}$$

[12] The higher skill category (university) only enters LC1 while the lowest skill category (compulsory school) only enters LC2. The intermediate skill categories are allocated between the two labor composites as follows: 2/3 in LC1 and 1/3 in LC2 for superior education; 1/3 in LC1 and 2/3 in LC2 for apprenticeship (see Table 3 in the appendix for the elasticities of substitution).

where ϕ_{kl} is the derived labor demand of sector l. In the absence of labor market imperfections, the labor market equilibrium for each schooling level k is given by $L_k^D = L_k^m + L_k^f$, which allows to determine endogenously wage rates ω_k and thus the returns to schooling ρ_k.

Note that the determination of equilibrium wage rates requires, as in the case of the government budget, to iterate between the microsimulation and the CGE model. When a reform scenario is simulated, the algorithm goes as follows. To start with, the microsimulation model calculates labor supply by skill $(L_k^m + L_k^f)$ and the aggregate fiscal indicators *TAXMICRO* and *TAXBASE*. Then the CGE model determines a "temporary" equilibrium which is consistent with the predetermined level of these variables. The factor prices obtained by the CGE model allow to recalculate returns to schooling ρ_k and to correct non-labor income μ_i for the change in the return to capital. These variables are then fed back to the tax-benefit model, and the procedure starts all over again with the microsimulation model determining new labor supply and fiscal indicators. This iterative procedure is brought to a halt when the changes in wage rates from one iteration to the next are within some small tolerance level.

3 Simulating income security reforms in general equilibrium

Most microsimulation studies of income security reforms analyze the impact of alternative benefit schedules without accounting for the way the reforms are financed. By contrast to such a partial-equilibrium perspective, our scenarios are based on the assumption of a balanced government budget: the way new benefits are financed must be clearly spelled out.

On the benefit side, three reform proposals are considered: basic income, participation income and low-wage subsidies. One of the principal objectives of these proposals is to reduce poverty without creating a "poverty trap".

They have in common that benefits do not depend on household composition.[13] The fact that benefits are paid on an individual basis is indeed one of the main features that distinguishes the basic income proposal from the negative income tax, initially put forward by Friedman in 1962. Defining benefits on an individual level has the advantage of being neutral with respect to marriage and dispenses with the administrative control of people's living arrangements. On the other hand, from the

[13] For the effects of benefits that depend on household structure, see Abul Naga et al. (2003) where simulations are carried out in a partial equilibrium framework.

perspective of poverty targeting, household-based benefits are likely to be a more efficient means of reducing poverty.

Now turn to the issue of benefit financing. Reforming the current progressive income tax schedules in view of implementing a basic income faces the following problem. If a too high marginal tax rate is to be avoided for high incomes, low-income tax rates would have to rise, leaving little scope for the graduation of the tax rate. Therefore, a flat tax (FT) seems to be a natural companion of the basic income proposal and it has the notable advantage of simplifying tax collection.

However, implementing such a flat tax in Switzerland would not be a simple undertaking because of the federal structure of the Swiss income tax system. From the point of view of political feasibility, it would seem more realistic to consider reforms only at the federal level, leaving income tax schedules unchanged at the cantonal level. It is clear that such an approach would allow to finance only moderate levels of benefits since the federal income tax schedule accounts currently for less than 15 percent of total income tax revenues (paid by salaried households).

If higher level of benefits are envisaged, reforming only the federal income tax schedule would lead to very high marginal tax rates in the high-income range, because of the addition of a progressive schedule at the cantonal level with a high federal income tax. Thus in scenarios with high benefit levels, *all* income tax schedules are replaced by a flat tax. In order not to compromise the objective of poverty reduction, the flat tax applies to the share of household income exceeding a minimum income level.[14]

As an alternative to the exclusive financing by income tax, we allow for an increase in VAT rates so as to limit the increase of income tax rates. In this context, it should be remembered that consumption decisions are modeled at the aggregate level. The distributional effects of VAT increases are therefore not taken into account in the simulations since an increase in VAT rates affects the cost-of-living indices of all households in the same way.

3.1 Scenarios

Consider now the different scenarios in more detail. To begin with, the base scenario corresponds to the current situation in Switzerland, with two exceptions. First, the standard VAT rate is increased to 10 percent from the current 7.6 percent; this seems to represent a more realistic fiscal stance with respect to future obligations in

[14]In the model, the flat tax applies only to salaried households. For other household groups (which are modeled at the aggregate level), the average income tax rate is kept constant.

old age insurance and in view of a fiscal rapprochement towards the EU. Second, the base scenario neglects the existence of social assistance schemes that are currently operated by the cantons and municipalities. There is some evidence that take-up rates are very low.[15] Unfortunately, the available data does not allow to model benefit take-up in a consistent way.

The proposal of an unconditional **basic income (BI)** is advocated forcefully from a philosophical perspective by van Parijs (1998) and discussed from a variety of (economic) angles by Atkinson (1995a). Two versions of BI are simulated: they differ by the level of benefits and the implied fiscal reforms.

First, an individual basic income of 12,000 SFr per year paid to every adult. This amount covers about half of an individual's basic needs (if he is living alone) according to the guidelines of the CSIAS.[16] As to other social security schemes (in particular, health insurance subsidies), we assume that they will continue to operate in a complementary manner, ensuring in combination with the BI an unchanged level of benefits. The introduction of this basic income scheme can be financed either by replacing all income taxes with a flat tax (BI-FT), or by the combination of a flat income tax with an increase in the VAT rate (BI-VAT).

A second version of an unconditional benefit scheme is the partial basic income (PBI) which provides each adult with an annual benefit of 6,000 SFr. This transfer can be financed by replacing the federal income tax with a flat tax (PBI-FT). This flat tax is levied over and above the cantonal (and municipal) income taxes which have a progressive structure with maximum tax rates ranging among cantons from 13 percent to 32 percent.

An important alternative is the **participation income (PI)**, which subjects the payment of the basic income to a participation condition. In Atkinson's (1995b) proposition, the participation condition is broadly interpreted, including e.g. voluntary work. Here it is assumed that the individual participation income of 12,000 SFr per year is paid under the condition that the individual works at least 30 hours a week (this rather strict conditionality is similar to the one used in the Canadian Self-Sufficiency Project).

Low-wage subsidies are implemented by reducing social security contributions for low-wage earners. Wages below 3,000 SFr /month (full-time equivalent) are subsidized at a 15% rate. There is a phase-out range for wages between 3000 and 4000 SFr / month.

[15] Leu et al. (1997) suggest that the non-take up rate varies considerably according to the type of benefit considered, and is somewhere in the range of 45% to 86%.

[16] *Conférence suisse des institutions d'action sociale* (Swiss Conference on Social Support).

3.2 Simulation results

In the conventional microsimulation approach, tax-benefit reforms lead to changes in labor supply at constant wage rates. This approach neglects the feedback effects that arise from the variation in equilibrium wage rates and from the need to adjust tax rates in order to balance the budget of the government. These two effects are most obvious in the case of a basic income, whose implementation leads to a significant contraction of aggregate labor supply. On the one hand, this creates a disequilibrium in the labor market, pushing real wage rates upwards (on average by 2.4 percent) so as to restore equilibrium in the different labor market segments, mitigating somehow the reduction in aggregate labor supply (which amounts finally to 3.5 percent).

On the other hand, the fall in labor supply leads to a decline in economic activity which tends to erode the tax base. As a consequence of the balanced budget requirement, tax rates have to rise even further than was thought necessary to finance the basic income. In the case where the basic income is financed exclusively by a flat tax replacing all federal and cantonal income tax schedules (BI-FT), the flat tax rate has to be set to 49 percent (see also Table 1). This represents a major change in the income tax schedule. Comparing tax schedules before and after the reform, a single adult living in the "average" canton gains from the reform if his pre-tax annual income is below 60,000 SFr. Above this threshold, incomes are taxed much more heavily than before, since the average tax rate rises with the reform by 7 to 10 percentage points for incomes beyond 100,000 SFr. As these numbers are based on averages, the tax rise will be far more dramatic in cantons where the income tax is currently at low levels.

A partial basic income (PBI-FT) implies a flat tax of 20.4 percent over and above cantonal income taxes. Compared to BI-FT, the tax rise in the intermediate income range is limited to some degree. However, the average tax rate still rises by more than 6 percentage points for incomes above 120,000 SFr. Financing part of the basic income by a proportional rise in VAT rates does not change the problem fundamentally. In the BI-VAT scenario, an increase in the "normal" VAT rate by almost 18 percentage points is necessary to limit the (flat) income tax rate to 40 percent. Even in the PBI-VAT scenario, a flat tax of 11 percent at the federal level (equal to the current *maximum* federal income tax rate of 11 percent) can only be obtained if the VAT rate increases by 14 percentage points.

As basic income schemes turn out to be rather costly to fund, one might conjecture that a participation condition could alleviate this problem. Indeed, the tax rates that are necessary to finance a (partial) participation income are significantly lower than in the case of the corresponding basic income (see Table 1). Figure 3 depicts the change in tax burden for a single adult implied by scenarios PI-FT and PPI-FT, compared to the base case. If the participation condition is satisfied, individuals with annual incomes below 80,000 SFr are net gainers; beyond that limit the tax burden increases by at most 3 percent of income. By contrast, if the participation condition is not fulfilled, the tax burden is significantly increased even for relatively low incomes. Here the flat-tax assumption might seem overly penalizing.

By comparison the low-wage subsidy scheme is cheap to fund. It can be financed either by a flat tax (over and above existing taxes) at the rate of less than 2 percent, or a by an increase in the general VAT rate by 2.3 percentage points.

Aggregate results. Aggregate economic activity, as measured by GDP, increases with the introduction of a participation income (by 0.2 to 0.5%), falls sharply in the case of a basic income (by 1.2 to 2.2%) and remains unchanged if low-wage subsidies are implemented, as shown in Table 2. These changes in GDP reflect the direct and indirect consequences of the labor supply "shock" induced by tax-benefit reforms and are closely related to the variations in aggregate consumption.

A closer look at consumption by household groups reveals an important difference between reforms that are financed exclusively by a flat tax and those that involve an increase in VAT rates. In the latter case salaried households gain more (or lose less) than in the former. This is due to the fact that an increase in VAT rates shifts part of the additional tax burden to other household groups (retired, self-employed, etc.) whose real consumption decreases.

Another consequence of higher VAT rates is that the real exchange rate (based on consumer prices) appreciates and real consumer wages are reduced accordingly. If the value added tax were a pure consumption tax, the real depreciation would not have any real consequences. As argued above, this is not the case in Switzerland where the current VAT system with exemptions amounts to taxing investments in the tax-excluded sectors. As a consequence, the price of investment goods used in the tax-exempted sectors rises if VAT rates ar increased. This has two implications. First, as the total value of investment is determined by available savings, the rise in the price of investment goods explains why *real* investment tends to decrease in all scenarios where benefits are partially financed by VAT. Second, the cost of capital depends on the price of investment goods. Relative to the average wage rate, the cost of capital is therefore higher in "VAT" scenarios than in "FT" scenarios.

Labor market. Consider first the introduction of a basic income. The decline in aggregate labor supply (e.g., by 3.5 percent in scenario BI-FT) conceals interesting structural effects. First, the change in labor supply is mainly due to the fact that female partners in two-adult households reduce their work hours or retreat from the labor market altogether; male partners and single adults also reduce their supply of work hours, but to a much smaller degree (see third panel of Table 3). In view of the higher elasticity of female labor supply, this is hardly a surprising result. Proponents of basic income might interpret this as meaning that women spend more time doing non-market work.

Second, one would expect individuals with little human capital to react more strongly than others to the introduction of a BI. This is indeed the case, although the effect is not easy to identify since it is more pronounced along the job-specific dimension of human capital than along the schooling dimension. It is true that the reduction in labor supply is below average in the two labor segments with higher levels of schooling (see first panel of Table 3), but these differences are relatively small. The fact that individuals with little on-the-job training (or small individual productivity) tend to reduce their hours of work more than others becomes apparent from the fact that the decline in labor supply measured in work hours is much greater than the reduction in labor supply measured in efficiency units, especially for individuals with basic schooling (see second and first panels of Table 3).[17]

There is an alternative (and complementary) explanation for the fact that labor supply measured in efficiency units declines less than total work hours. The econometric estimation of wage equations reveals that women receive lower pay than equally skilled men in Switzerland. This result is often interpreted as reflecting some form of discrimination against women in the Swiss labor market. By contrast, the calibration of the simulation model relies on the assumption that individual wage differences are due to individual productivity differences.[18] As a result, women have lower individual productivity on average than men in the simulation model. The strong decline in women's labor supply is therefore likely to result in a greater fall

[17] Individual labor supply in efficiency units is defined in equation (15). Technically speaking, the difference between the variation of labor supply measured in efficiency units (first panel of Table 3) and the variation of labor supply measured in work hours (second panel) reflects the covariance between the relative change in hours of work and an individual efficiency index (which includes job-specific human capital as well as individual productivity differences). In the case of basic income, this covariance is positive for all schooling levels.

[18] Relaxing this simplifying assumption would imply major changes in the model as the general equilibrium framework requires that the source of discrimination be modeled explicitly. For example, a dual labor market with rationing of "good" jobs might account for wage discrimination against women.

in work hours than in efficiency units of labor supply.

A third structural feature is linked to labor demand. Through its impact on economic activity, the introduction of a BI (combined with a FT) induces a fall in the user cost of capital relative to the average wage rate. Because of the complementarity between capital and skilled labor, this change in relative factor prices tends to increase demand for highly skilled workers, putting upward pressure on their wages.

Now turn to participation income. There are two effects that work in opposite direction. On the one hand, the participation condition motivates some individuals who were previously inactive or working part-time, to increase their work hours to at least 30 hours per week. On the other hand, workers who were working full-time before the reform, might be led to reduce their hours. The latter effect seems to be more pronounced for workers with basic skills and for men living in couples, whereas the former can be observed for all higher skill levels and especially for women living in two-adult households.

Poverty, inequality and social welfare. All reform scenarios lead to a reduction in poverty among salaried households. In Table 4, three poverty indices of the Foster-Greer-Thorbecke (FGT) class are calculated using the semi-official poverty line established by the CSIAS.[19] Unsurprisingly, the BI schemes achieve the strongest reduction in poverty, according to all indices of the FGT class. The PI reforms perform slightly less well: this is due to the fact that those who do not satisfy the participation condition are penalized.

When comparing the partial BI and partial PI schemes, a similar ranking appears. However, it is striking that the "poverty severity" index (a measure which is sensitive to inequality among the poor) decreases more in the PPI-FT than in the PBI-FT scenario. Note that this result does not seem to be very robust (it is overturned in the scenarios with VAT increase), as there are only few very poor salaried households in the survey.

There is another dimension of poverty analysis along which results might turn out not to be robust: the choice of the poverty line. In order to illustrate this issue, Figure 4 depicts the headcount index for the three less radical reform scenarios and poverty lines varying between 20,000 and 30,000 SFr per year. Obviously, the three

[19]The CSIAS defines a minimum subsistence level which consists in the three following components: a basic allowance depending on the demographic structure of the household; rental payments for housing (the actual rent paid by the household, up to a maximum); health insurance premiums (which vary between cantons). The poverty line we use is calculated following these guidelines, using average rents by household size (taken from Gerfin and Leu, 2003) and average health insurance premiums. Note that these guidelines also establish implicitly an equivalence scale.

reform scenarios achieve a similar reduction in "deep" poverty (equivalent incomes below 20,000 SFr). At the semi-official CSIAS poverty line (23,700 SFr per adult equivalent), differences between the scenarios start to emerge and it becomes clear that the partial basic income achieves more poverty reduction than the other two schemes because of its greater redistributional effect.

The most important result that can be drawn from the comparison of cumulative distribution functions (of which Figure 4 shows some part) refers to ordinal comparisons of poverty: each of the reform scenarios first-order dominates the base scenario for poverty lines ranging up to 40,000 SFr. From a formal viewpoint, this is a strong result since it implies that any poverty index of the FGT family (and even almost any other poverty index) will exhibit less poverty for any poverty line below that level.

Now turn to the issue of inequality. Unsurprisingly, basic income schemes diminish income inequality by the greatest amount. According to all indices reported in Table 4, the partial basic income (PBI) produces lower income inequality than the (full) participation income (PI). There is, however, an equity-efficiency trade-off involved for basic income: mean disposable income of salaried households falls in all BI/PBI schemes, by up to 4.2 percent. In that sense, the other scenarios are more promising since they allow simultaneously to reduce inequality and to increase mean disposable income.

A convenient way of analyzing the equity-efficiency trade-off is to use a social welfare function. Such an evaluation should, however, be robust with respect to assumptions underlying the choice of a specific social welfare function. In particular, one cannot expect unanimity on assumptions that rely on ethical judgments, such as the degree of inequality aversion. In this context, it is useful to carry out ordinal comparisons of social welfare, since they are valid for a *class* of social welfare functions without being sensitive to the choice of a specific functional form.

It can easily be checked that none of our scenarios first-order dominates the base case from the point of view of social welfare. First-order dominance is indeed a very strong criterion since it relies on the Pareto principle. As all our scenarios involve income redistribution, this criterion does not allow to rank any of them.

It is therefore useful to turn to second-order dominance which restricts the class of social welfare functions to those satisfying the Transfer principle. For practical purposes, second-order social welfare dominance is equivalent to Generalized Lorenz dominance. Figure 5 illustrates comparisons between Generalized Lorenz curves (based on distributions of disposable income): the three less ambitious reform scenarios are compared to the base case.[20] Obviously, the base case is dominated by the PPI-FT and LWS-FT scenarios dominate the base case, and the PPI-FT dominates the LWS-FT scenario. Stated in less technical terms, this result means that according to any social welfare function embodying some degree of inequality aversion, the introduction of a partial participation income will be preferred to the base case.

It should be emphasized that these social welfare results concern only salaried households. Fortunately, other indicators point in the same direction if the (partial) participation income is financed by a flat tax. Both consumption of "other" households and investment increase slightly, indicating that this reform would not come at the expense of future consumption.

4 Conclusion

This paper evaluates the consequences of various reform proposals (basic income, participation income, low-wage subsidies) for the Swiss tax-benefit system, using a framework which integrates an econometrically estimated microsimulation model of labor supply, a tax-benefit module and a computable general equilibrium model. Compared to conventional microsimulation exercises, this integrated framework allows to consider the feedback effects that arise from endogenous wage rates and a consistent treatment of the government's budget constraint. Simulation results suggest that the implementation of a participation income would enhance both economic efficiency and equity.

The implementation of a basic income scheme generates significant general-equilibrium effects in the model. However, general-equilibrium linkages could be improved in two directions. First, consumption heterogeneity is not taken into account in the present version of the simulation framework, since consumption demand is modeled at the aggregate level. As a result, redistribution policies do not have any impact on the structure of consumption. Accounting for non linear Engel curves and for preference heterogeneity would add undoubtedly an important dimension to the model.

Second, the way labor supply and labor demand interact in the model could be refined. When simulating the implementation of a basic income, we found that labor supply reactions are more differentiated along the job-specific dimension of human capital than along the schooling dimension. This result suggests that richer

[20]Figure 5 was drawn with the help of the DAD 4.2 software. See Duclos, J.-Y., A. Araar and C. Fortin (2001), *DAD: a software for Distributive Analysis*, MIMAP programme, IDRC, Government of Canada, and CIRPÉE, Université Laval.

effects would be obtained if we relaxed the assumption that different workers with identical schooling levels are perfect substitutes in production. It might indeed be more realistic to assume that workers with identical schooling levels but different levels of work experience are imperfect substitutes (Card and Lemieux, 2001; Borjas, 2003).

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Table 1: Description of scenarios

Scenario	Benefit	Conditionality	Financing	Acronym	Tax rates (%) Flat tax	VAT
Participation income	12'000 Sfr./year	work at least	Flat tax replacing all income taxes	PI-FT	41.9	10.0
	(individual)	30 hours a week	idem + increase in VAT	PI-VAT	35.0	20.3
Partial participation	6'000 Sfr./year	work at least	Flat tax replacing federal income tax	PPI-FT	14.6	10.0
income	(individual)	30 hours a week	idem + increase in VAT	PPI-VAT	11.0	14.5
Basic income	12'000 Sfr./year	none	Flat tax replacing all income taxes	BI-FT	49.3	10.0
	(adult ≥ 20 years old)		idem + increase in VAT	BI-VAT	40.0	27.7
Partial basic income	6'000 Sfr./year	none	Flat tax replacing federal income tax	PBI-FT	20.4	10.0
	(adult ≥ 20 years old)		idem + increase in VAT	PBI-VAT	11.0	24.0
Low-wage subsidies	Wages below 3'000 Sfr./month are subsidized		Flat tax	LWS-FT	1.9	10.0
	at rate 15%. Phasing-out betw. 3000 and 4000 Sfr.		Increase in VAT	LWS-VAT	0.0	12.3

Notes: Flat tax applies to household income above an income threshold equal to 25'600 Sfr. x (equivalence scale).
Tax rates are obtained from model simulations.

Table 2: Simulation results - aggregate indicators (percentage changes with respect to the base case)

	Participation income		Partial particip. income		Basic income		Partial basic income		Low-wage subsidies	
	PI-FT	PI-VAT	PPI-FT	PPI-VAT	BI-FT	BI-VAT	PBI-FT	PBI-VAT	LWS-FT	LWS-VAT
GDP	0.2	0.5	0.2	0.4	-2.2	-2.2	-1.4	-1.2	0.0	0.0
Consumption	0.2	0.8	0.3	0.6	-2.6	-2.2	-1.6	-1.0	0.0	0.1
salaried HHs	0.3	2.7	0.4	1.6	-3.9	-1.0	-2.4	0.4	0.0	0.5
other HHs	0.1	-2.1	0.1	-0.9	-0.7	-4.4	-0.4	-3.4	0.0	-0.5
Investment	0.4	-1.1	0.4	-0.2	-3.6	-6.6	-2.3	-4.4	-0.1	-0.5
Exports	0.3	0.9	0.3	0.6	-2.5	-1.9	-1.6	-0.9	0.0	0.0
Imports	0.3	0.1	0.3	0.3	-2.8	-3.5	-1.8	-2.2	0.0	-0.1
Labor supply	0.3	0.7	0.4	0.6	-3.5	-3.3	-2.2	-1.8	0.0	0.0
Cost of capital	0.4	-3.9	0.4	-1.4	-3.5	-10.8	-2.2	-7.9	-0.1	-1.1
Average wage	-0.4	-7.1	-0.3	-3.5	2.4	-8.4	1.5	-7.3	0.1	-1.5
Real exchange rate	0.0	-6.8	0.0	-3.1	0.4	-10.6	0.3	-8.7	0.0	-1.6

Table 3: Simulation results - labor market indicators for salaried households (percentage changes with respect to the base case)

	Participation income		Partial particip. income		Basic income		Partial basic income		Low-wage subsidies	
	PI-FT	PI-VAT	PPI-FT	PPI-VAT	BI-FT	BI-VAT	PBI-FT	PBI-VAT	LWS-FT	LWS-VAT
Labor supply by skill category (measured in efficiency units)										
University	0.6	0.9	0.2	0.8	-2.1	-1.9	-1.1	-1.2	-0.3	-0.1
Superior education	0.6	1.2	0.7	1.1	-2.7	-2.5	-2.0	-1.5	0.1	0.1
Apprenticeship	0.3	0.9	0.4	0.7	-4.7	-4.4	-2.8	-2.2	0.0	0.0
Compulsory school	-0.6	-0.4	0.0	0.2	-3.0	-3.1	-1.9	-1.8	0.0	0.0
Labor supply by skill category (measured in total hours of work)										
University	0.5	0.8	0.3	0.8	-3.4	-3.1	-1.8	-1.7	-0.3	-0.1
Superior education	0.2	0.8	0.4	0.8	-3.5	-3.3	-2.5	-1.8	-0.2	-0.1
Apprenticeship	0.1	0.7	0.5	0.8	-6.1	-5.8	-3.5	-2.8	0.1	0.1
Compulsory school	-0.8	-0.5	0.1	0.6	-6.1	-6.1	-3.8	-3.4	0.3	0.3
Labor supply by household type and sex (measured in total hours of work)										
Couples	0.0	0.8	0.5	1.0	-6.1	-5.8	-3.7	-2.9	0.0	0.1
female HH member	0.5	2.9	1.9	3.3	-15.2	-14.4	-9.7	-7.8	0.1	0.2
male HH member	-0.3	-0.1	-0.1	0.0	-2.1	-1.9	-1.0	-0.7	0.0	0.0
Singles	0.5	0.1	0.2	0.2	-2.8	-2.9	-1.5	-1.4	-0.1	-0.1
Real wage rates by skill category										
University	-1.1	-6.4	-0.3	-3.4	2.6	-6.2	1.2	-5.2	0.6	-1.0
Superior education	-0.7	-7.5	-0.8	-3.9	2.1	-8.6	1.8	-7.2	-0.1	-1.6
Apprenticeship	-0.1	-7.2	-0.2	-3.4	2.8	-8.7	1.6	-7.8	0.0	-1.6
Compulsory school	0.6	-6.3	0.2	-2.9	0.4	-10.7	0.3	-8.7	0.0	-1.6

Table 4: Simulation results - poverty and inequality indicators for salaried households

	Base	Participation income		Partial particip. income		Basic income		Partial basic income		Low-wage subsidies	
		PI-FT	PI-VAT	PPI-FT	PPI-VAT	BI-FT	BI-VAT	PBI-FT	PBI-VAT	LWS-FT	LWS-VAT
Poverty (FGT-Index)											
Headcount	0.0228	0.0080	0.0088	0.0139	0.0139	0.0073	0.0071	0.0090	0.0093	0.0163	0.0171
(α=0)		*-65.0%*	*-61.3%*	*-38.8%*	*-38.9%*	*-68.1%*	*-68.8%*	*-60.5%*	*-59.3%*	*-28.6%*	*-24.9%*
Poverty gap	0.0036	0.0013	0.0015	0.0019	0.0020	0.0012	0.0013	0.0016	0.0016	0.0023	0.0024
(α=1)		*-63.8%*	*-57.2%*	*-48.1%*	*-45.1%*	*-66.3%*	*-64.3%*	*-56.1%*	*-54.9%*	*-36.6%*	*-33.1%*
Poverty severity	0.00119	0.00043	0.00050	0.00052	0.00056	0.00028	0.00031	0.00056	0.00053	0.00062	0.00065
(α=2)		*-63.4%*	*-58.2%*	*-56.0%*	*-53.2%*	*-76.6%*	*-74.1%*	*-53.1%*	*-55.7%*	*-48.1%*	*-45.5%*
Inequality											
Gini	0.2089	0.1878	0.1949	0.1955	0.1991	0.1688	0.1764	0.1797	0.1901	0.1985	0.2008
		-10.1%	*-6.7%*	*-6.4%*	*-4.7%*	*-19.2%*	*-15.6%*	*-14.0%*	*-9.0%*	*-5.0%*	*-3.9%*
Atkinson (ε = 0.5)	0.0361	0.0294	0.0317	0.0317	0.0329	0.0243	0.0265	0.0271	0.0303	0.0328	0.0335
		-18.6%	*-12.4%*	*-12.3%*	*-9.0%*	*-32.8%*	*-26.7%*	*-24.9%*	*-16.3%*	*-9.3%*	*-7.2%*
Atkinson (ε = 2)	0.1402	0.1058	0.1137	0.1153	0.1195	0.0860	0.0932	0.0985	0.1088	0.1203	0.1230
		-24.5%	*-18.9%*	*-17.8%*	*-14.8%*	*-38.6%*	*-33.5%*	*-29.7%*	*-22.4%*	*-14.2%*	*-12.3%*
Mean income											
Mean disposable	52437	52625	53752	52678	53247	50255	51627	51049	52372	52528	52767
income		*0.4%*	*2.5%*	*0.5%*	*1.5%*	*-4.2%*	*-1.5%*	*-2.6%*	*-0.1%*	*0.2%*	*0.6%*

Notes: Numbers in italics represent relative changes of the indicator with respect to the base case.
The FGT poverty index is due to Foster et al. (1984).
Disposable income is measured per equivalent household member.
Poverty line is 23,700 SFr per equivalent adult (calculated according to CSIAS guidelines)

Figure 1: Simplified diagram of model linkages

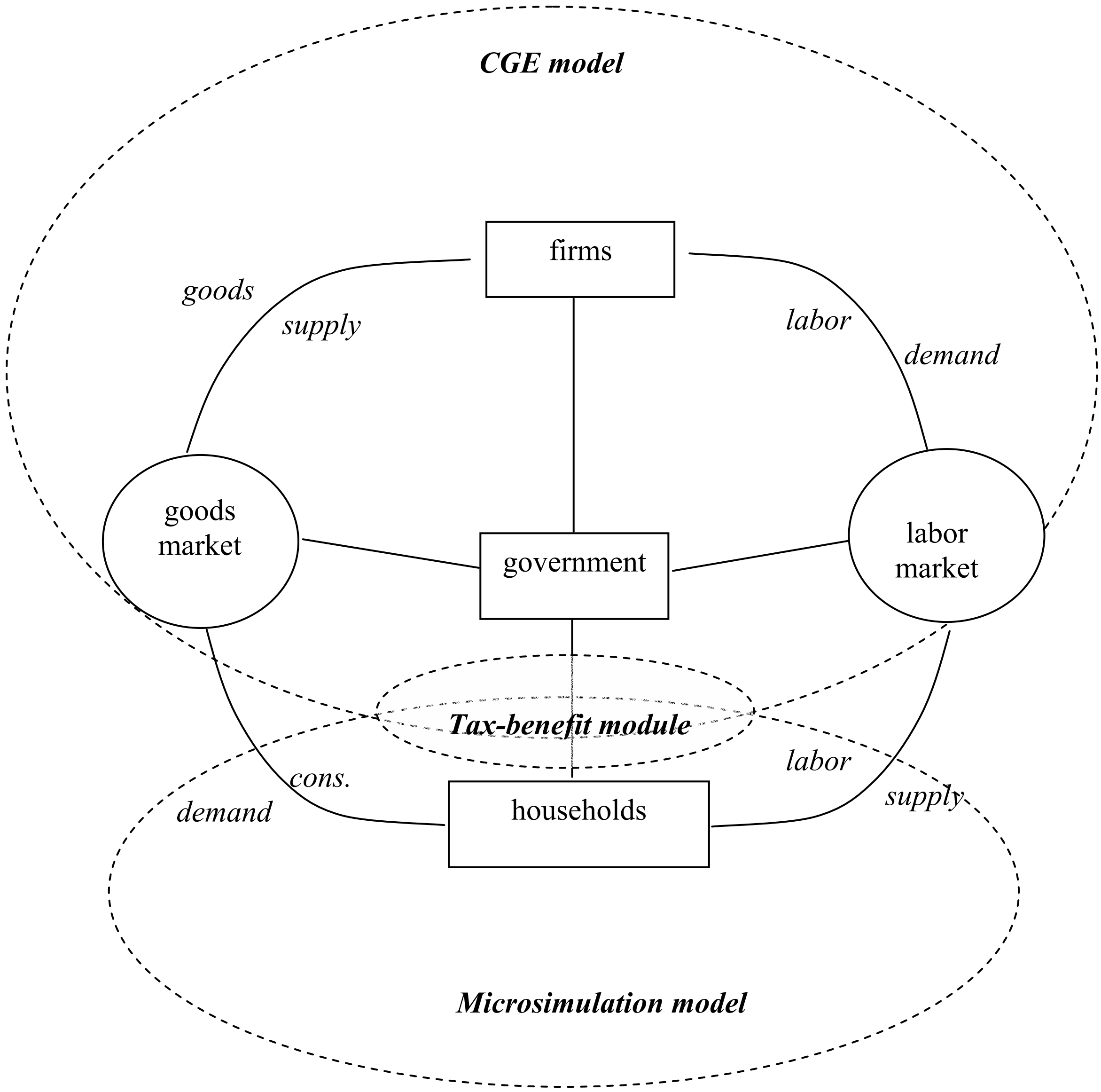


Figure 2: Production technology in the CGE model

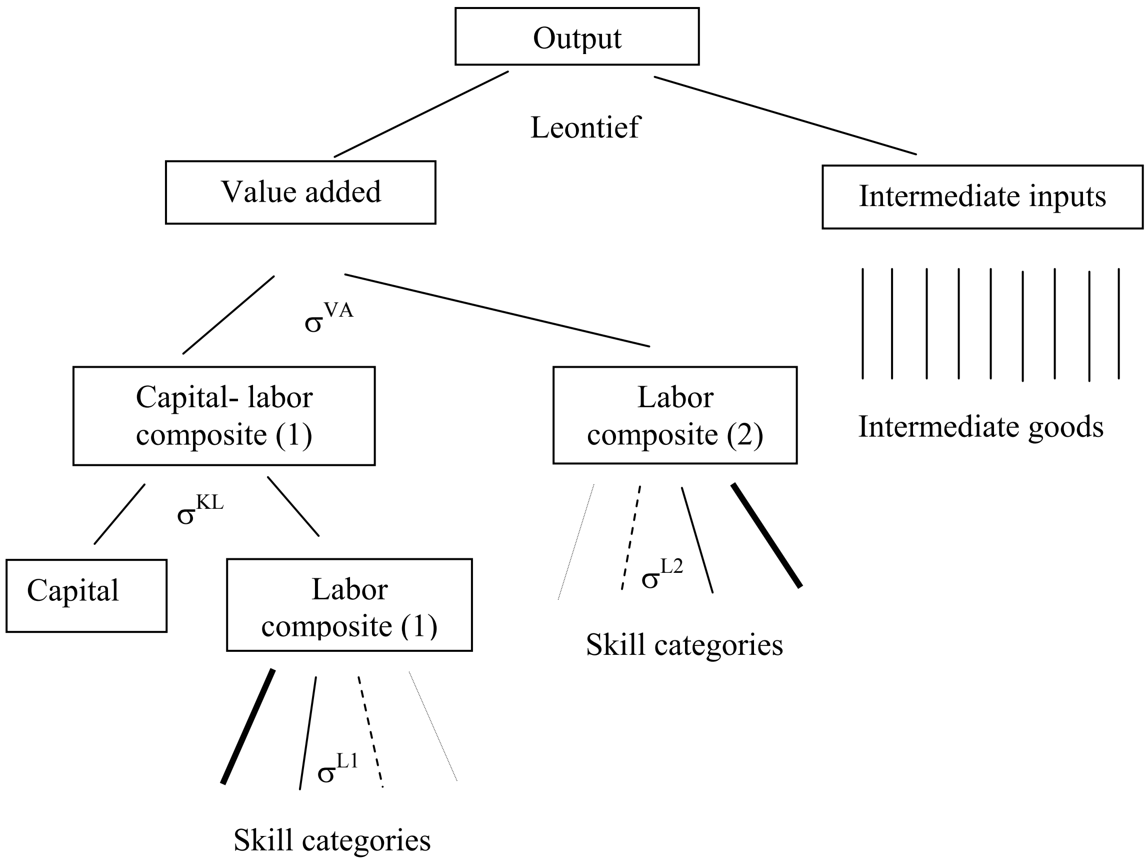


Figure 3: Impact of (partial) participation income on net tax burden
(single adult household, scenarios PI-FT and PPI-FT)

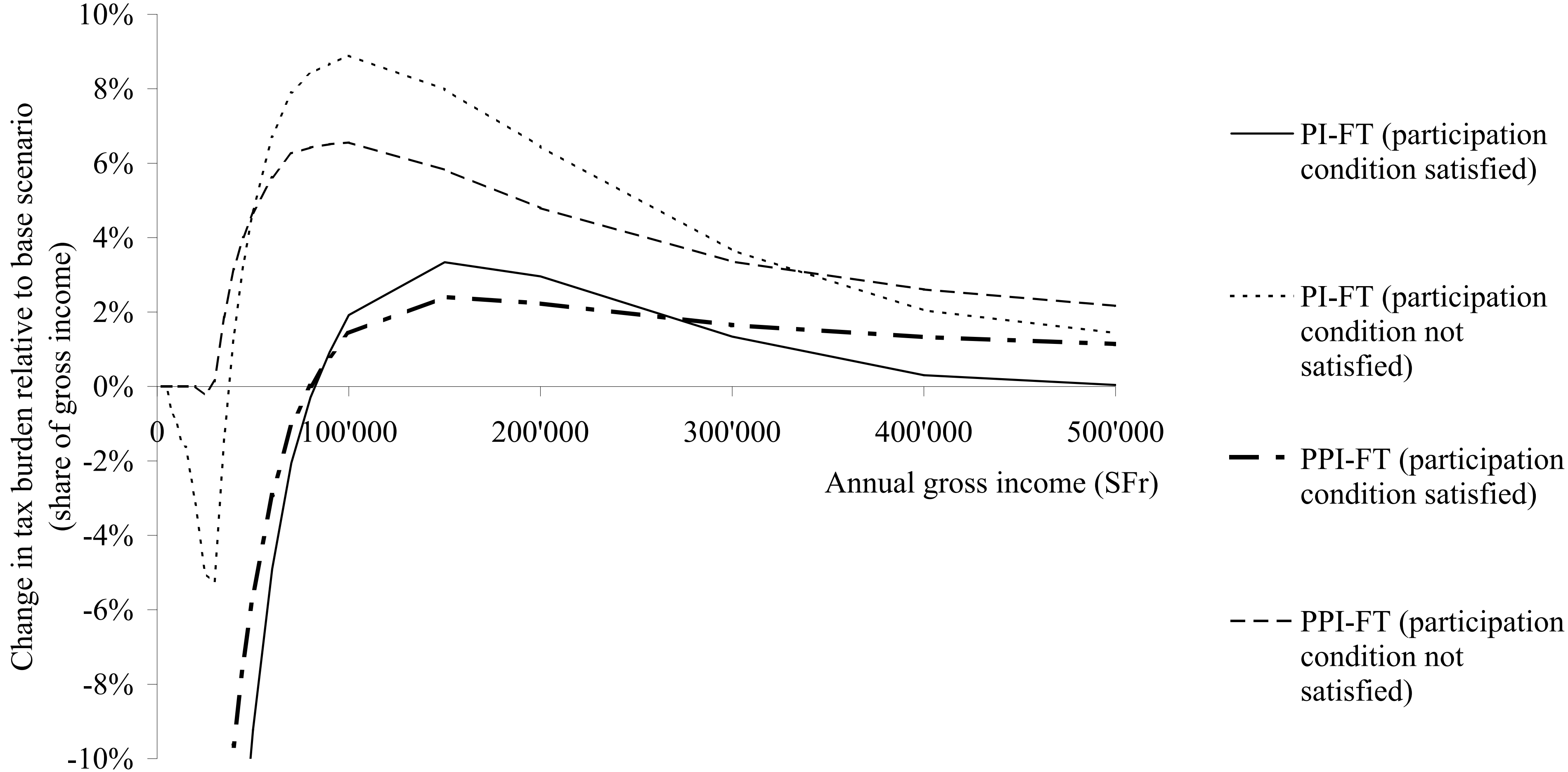


Figure 4: Poverty among salaried households
(selected scenarios with flat tax)

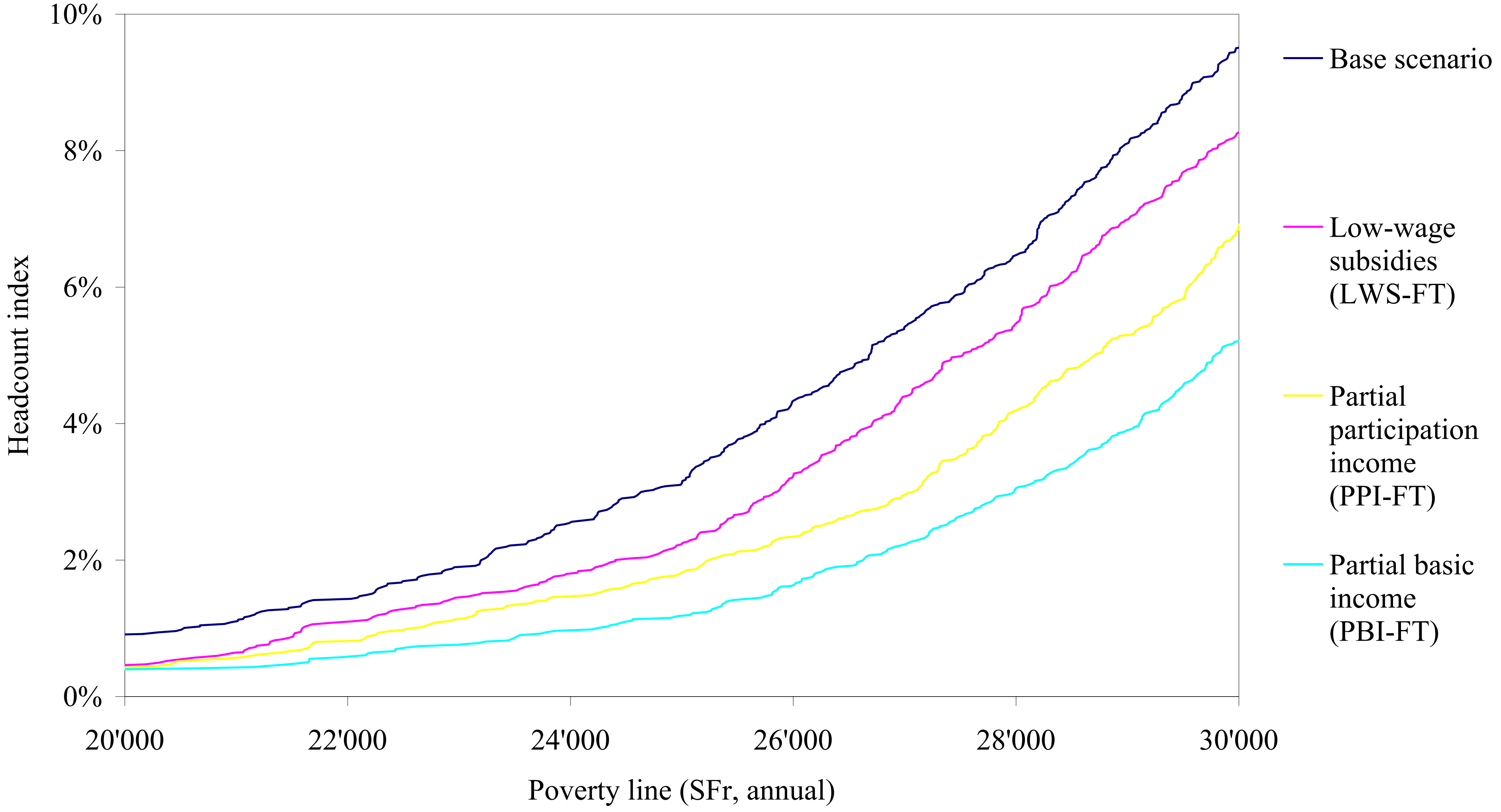
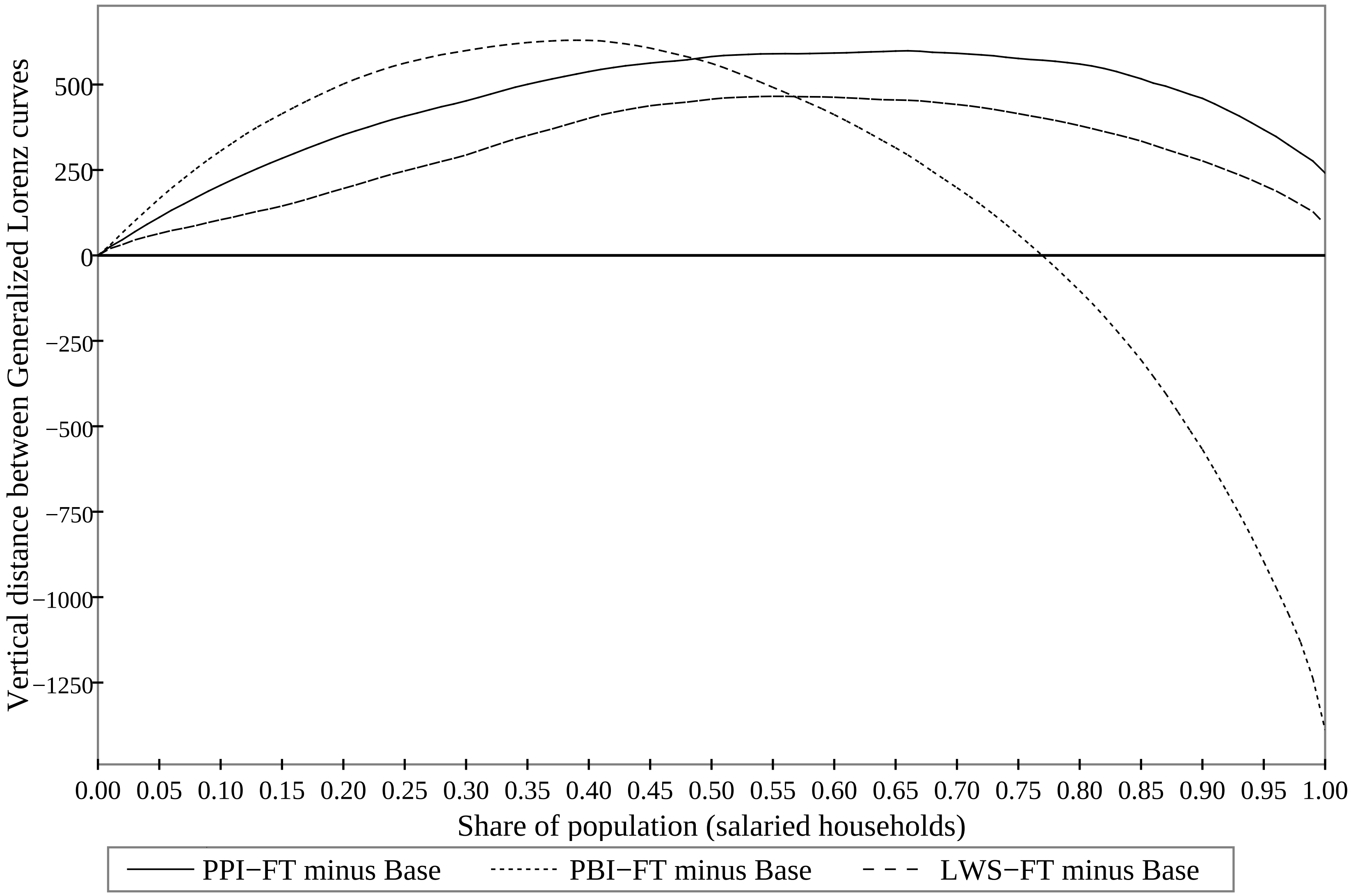


Figure 5: Social welfare comparisons

(selected flat−tax scenarios versus base case)



Appendix

Table A1: Discrete-choice labor supply model: Estimates for couples with fixed costs of working

Variable	Coefficient	Std. Error	z-stat
y^2	-0.007	0.001	-7.789
h_f^2	0.669	0.061	10.898
h_m^2	0.116	0.108	1.067
$y\ h_f$	-0.063	0.007	-9.256
$y\ h_m$	-0.060	0.011	-5.381
$h_m\ h_f$	-0.277	0.069	-3.981
y	2.192	0.206	10.637
$y\times$ age	-0.042	0.010	-4.157
$y\times$ (age^2/1000)	0.218	0.119	1.833
$y\times$ 1(less than 11 years schooling)	-0.235	0.049	-4.827
$y\times$ # children under 10 years	-0.185	0.019	-9.735
$y\times$ 1(child 0-2 years)	-0.201	0.049	-4.075
$y\times$ 1(child 3-5 years)	-0.096	0.057	-1.684
h_f	-1.217	0.199	-6.112
h_m	1.963	0.369	5.313
Fixed costs (female work)			
$\times$ # children under 10	1.011	0.184	5.512
$\times$ 1(child 0-2 years)	1.624	0.353	4.600
$\times$ 1(child 3-5 years)	1.096	0.407	2.693
$\times$ 1(married)	0.360	0.170	2.115
Fixed costs (male work)	4.127	0.390	10.587
Log-likelihood		-5851.89	
Size of sample		3246	

Note: y is disposable income of the household (calculated with the tax-benefit module), h_f and h_m denote work hours of the female and the male member of the household.

Table A2: Discrete-choice labor supply model: Estimates for singles with fixed costs of working

Variable	Coefficient	Std. Error	z-stat
y^2	restricted to 0		
h^2	0.587	0.111	5.292
$y\ h$	-0.352	0.031	-11.403
y	-0.525	0.536	-0.979
$y\times$ age	0.119	0.027	4.380
$y\times$ (age^2/1000)	-1.537	0.325	-4.737
$y\times$ 1(university education)	-0.140	0.094	-1.499
$y\times$ 1(less than 11 years schooling)	-0.579	0.086	-6.729
$y\times$ # children under 10 years	-0.784	0.101	-7.752
$y\times$ 1(child 0-2 years)	-0.527	0.258	-2.040
$y\times$ 1(child 3-5 years)	0.419	0.276	1.516
$y\times$ 1(female)	-0.557	0.080	-6.925
$y\times$ 1(Swiss citizen)	-0.109	0.104	-1.051
$y\times$ 1(living in agglomeration)	-0.247	0.087	-2.845
h	1.231	0.280	4.403
Fixed costs of work	1.199	0.359	3.342
$\times$ 1(living in agglomeration)	1.252	0.476	2.630
Log-likelihood		-1227.44	
Size of sample		1728	

Notes: y is disposable income of the household (calculated with the tax-benefit module), h denotes work hours.

Table A3: Selected parameters of the CGE model[a]

Elasticities of substitution	
in the production function:	
· between value-added and intermediate inputs	0.0
· between capital and labor (1), (σ^{VA})	1.2
· between capital-labor (1) and labor (2), (σ^{KL})	0.4
· between labor qualification categories (1), (σ^{L1})	0.4
· between labor qualification categories (2), (σ^{L2})	1.2
between domestic products and imports (Armington):	
· agriculture and food	2.5
· industry and services	3.0
Elasticity of transformation	
· between domestic and exported goods	2.0

[a] See Figure 2 for a description of the substitution elastiticities in production function.