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Brigitte van Baalen and Tobias Müller

No 2005.03

Cahiers du département d'économétrie
Faculté des sciences économiques et sociales
Université de Genève

Février 2005

Département d'économétrie
Université de Genève, 40 Boulevard du Pont-d'Arve, CH -1211 Genève 4
http://www.unige.ch/ses/metri/

Social welfare effects of tax-benefit reform under endogenous participation and unemployment*

Brigitte van Baalen[†] and Tobias Müller[‡]

February 2005

Abstract

This paper analyzes the effects of tax-benefit reforms in a framework integrating endogenous labor supply and unemployment. There is a discrete distribution of individuals' productivities and labor supply decisions are limited to the participation decision. Unemployment is modeled in a search and matching framework with individual wage bargaining. We adopt an ordinal approach to social welfare comparisons and explore numerically various reform policies. For Switzerland, a participation income is shown to be an "uncontroversial" tax reform, improving social welfare according to any social welfare criterion displaying inequality aversion.

*Support by the Swiss National Science Foundation (Grant No 4045-59741, National Research Programme 45: "Future Problems of the Welfare State") is gratefully acknowledged.

[†]Département d'économie politique, Université de Genève, 40 boul. du Pont-d'Arve, 1211 Geneva 4, Switzerland. Email: Brigitte.vanBaalen@ecopo.unige.ch

[‡]Département d'économétrie, Université de Genève, 40 boul. du Pont-d'Arve, 1211 Geneva 4, Switzerland. Email: Tobias.Mueller@metri.unige.ch

1 Introduction

The persistence of unemployment and the appearance of new types of poverty in Europe has raised the awareness of the link between the tax system, unemployment insurance and social assistance. In this context, incentive problems — such as the possible existence of a poverty or unemployment trap — have become more prominent. As governments face increasing difficulties to finance the social transfer system, piecemeal reform might turn out to be insufficient and more comprehensive reforms will then be called for.

The economic consequences of reform proposals, such as the negative income tax or the extension of tax credits, have traditionally been analyzed in a competitive labor market setting, focusing on labor supply response (see, e.g. Moffitt, 1985 and 2003; Fortin et al., 1993; Blundell et al., 2000). In this context, as in the optimal taxation literature originated by Mirrlees (1971), redistribution implies necessarily a trade-off between equity and efficiency. A more equitable distribution of income can only be obtained at the expense of reduced aggregate output.

The exclusive reliance on labor supply response can, however, be misleading. An ill-conceived reform of the tax-benefit system might have the unwanted side effect of increasing involuntary unemployment. To avoid unwarranted conclusions, it is crucial to take labor market imperfections into account in the analysis of tax-benefit reforms. In such a framework, more redistribution does not necessarily come at the expense of economic efficiency.

This paper takes a first step towards analyzing the effects of tax-benefit reforms in a framework integrating endogenous labor supply and unemployment. Using a search-matching model of labor markets with endogenous participation and heterogeneity in skills, we address the question whether there are reforms leading to outcomes that are socially preferred to the current situation. To ensure comparability, reforms are required to be neutral with respect to the government budget.

What criterion should be used to determine whether a reform is socially desirable? As most reforms produce winners and losers, the Pareto criterion is of little use for ranking pre- and post-reform situations. In order to overcome the incompleteness of Pareto rankings, many economists resort to social welfare functions which rely on interpersonal comparisons of well-being. As the choice of a specific social welfare function reflects an observer's value judgments, its use in the evaluation of policy reforms might be criticized for its subjectivity. This weakness can however be addressed by carrying out comparisons of pre- and post-reform income distributions for an entire *class* of social welfare functions. By performing such ordinal comparisons of income distributions, unanimous judgments on the desirability of a reform can be obtained. This approach is used in our paper.

We label a policy reform as "uncontroversial" if the post-reform situation dominates the current situation in terms of social welfare. This terminology is motivated by the fact that all observers whose ethical preferences are characterized by a social welfare function of a given class would support such a reform. In our search for uncontroversial policy reforms, we concentrate on second-order social welfare dominance. That is, we are evaluating the desirability of a reform with respect to the class of social welfare functions that embody some degree of inequality aversion.

Necessary conditions for a reform to be uncontroversial are that economic efficiency is improved and that the poorest individual's utility does not deteriorate. The latter condition excludes as possible reform candidates a simple reduction in unemployment benefits. There is, however, scope for enhancing efficiency without worsening the situation of the least well-off. In models of involuntary unemployment, a more progressive tax structure might improve overall economic efficiency. For example, in a model of firm-union bargaining, Pissarides (1998) finds that a revenue-neutral reform reduces unemployment when tax progressivity is increased, while leaving wages almost at the same level. Sørensen (1999) shows in various labor market models that an increase in progressivity can reduce involuntary unemployment and improves the representative worker's welfare although productivity is reduced.[1]

These results are based on models where labor supply is exogenous and skill heterogeneity is not taken into account. They are at odds with the optimal taxation literature which focuses on skill heterogeneity and where greater equity comes at the expense of efficiency. In order to build a bridge between these approaches, our framework integrates endogenous labor supply decisions into a search-matching model of unemployment with heterogeneous skills. As in recent models of optimal taxation (Saez, 2002), we assume that there is a discrete distribution of individuals' productivities. In our model, labor supply decisions consist in deciding whether to participate or not; individuals cannot choose the number of hours they would like to work. This simplifying assumption is motivated by the fact that elasticities of hours of work conditional on participating are found to be small in most empirical studies (Blundell and MaCurdy, 1999).

[1] In a model with individual bargaining and heterogenous labor, Strand (2002) shows that with given employment, an increase in tax progressivity reduces wages but its impact on the profit of firms is ambiguous. With endogenous employment and firm entry, an increase in progressivity increases government tax revenues and diminishes after-tax income inequalities without any changes in efficiency.

Unemployment is modeled in a search and matching framework with individual wage bargaining, following Pissarides (2000). We assume that different skill levels are perfect substitutes in production. To allow a consistent evaluation of welfare effects, transitions towards the steady state are explicitly taken into account and social welfare evaluations are based on individuals' intertemporal utilities. To the extent that the impact of policy changes on social welfare has an ambiguous sign, we calibrate the model using data for Switzerland.

As to policy instruments, we consider linear tax-benefit schemes where benefits can be differentiated according to the labor market status of the individual (employed; unemployed; outside the labor force). Akin to the optimal taxation literature, we assume that the tax-benefit schedule has to be conditioned on individual income as individual productivity cannot be observed. It is therefore impossible to differentiate transfers to inactive individuals according to skill. As a consequence, the first-best optimum cannot be reached in the presence of unemployment benefits. Nevertheless, the introduction of a participation income turns out to be an uncontroversial reform. We show that this result holds even if the model is calibrated in a more realistic manner on Swiss data, taking into account non linear tax schedules and the distinction between unemployment insurance and assistance.

The proposal of a participation income was first put forward by Atkinson (1995a). According to this proposal, the payment of a basic income is made subject to a broadly interpreted participation condition. In this sense, the participation income is a variant of the basic income scheme.[2]

In order to explore further the role of the participation condition, we contrast the participation income with the basic income scheme. The latter cannot be considered to be an uncontroversial reform, as its introduction leads to a decline in participation rates, implying a significant efficiency loss. Indeed, a major problem of basic income or NIT schemes is that a significant benefit can only be given at the cost of high marginal tax rates. Akerlof (1978) shows that "tagging" can make this tradeoff more favorable by directing resources towards the most needy groups of population. In this case, the loss in economic efficiency is smaller although identification of the needy is imperfect.

Our paper differs from previous contributions in two respects. First, our model combines an endogenous participation decision with heterogeneous skills and unem-

[2]The basic income scheme is forcefully advocated from a philosophical perspective by van Parijs (1998) and discussed from a variety of economic angles by Atkinson (1995b). Note that the idea of a negative income tax, which was initially put forward by Friedman in 1962, is closely related to the basic income proposal. Although there are important practical differences (e.g. the basic income would be paid on an individual basis, regardless of the marital status), we consider the two to be equivalent in our simplified theoretical framework.

ployment. In our view, all these elements are crucial for the analysis of tax-benefit reform; other contributions have considered only a subset. For example, Lehmann (2003) analyzes the introduction of a basic income in a search-matching model with two skill categories, fixed and variable component of the unemployment insurance, a minimum wage for the low-skill labor market and risk-averse individuals. As labor supply is exogenous in his model, redistribution has no efficiency cost and the participation income and basic income schemes cannot be differentiated. Chéron (2002) analyzes the replacement of unemployment assistance by a basic income using a dynamic model with endogenous search effort. In a framework with union bargaining, risk-averse workers and exogenous labor supply, Van der Linden (2002) analyzes partial and full participation income. Van der Linden (2004) endogenizes the participation decision, but does not capture skill heterogeneity.

Second, we carry out social welfare comparisons in a systematic way. For a consistent treatment of individual utilities, dynamic adjustment paths have to be taken into account. This differs from the other contributions. For example, Van der Linden (2002, 2004) discusses the impact of a participation / basic income on individual utilities in the steady-state, neglecting the adjustment path. Moreover, as there is no skill heterogeneity in his model, he obtains the strong result that the introduction of a participation income can be Pareto improving (see also Chéron, 2002). Obviously, such a strong conclusion does not carry over to more realistic settings where individuals are heterogenous with respect to skill and labor supply is endogenous.

The remainder of the paper is organized as follows. The next section describes the model. As a policy reform can only be uncontroversial if it improves overall economic efficiency, Section 3 characterizes optimal (linear) policies from the point of view of efficiency. Turning our attention to the broader objective of social welfare in Section 4, we then explore numerically the consequences of different tax-benefit structures, for various forms of the social welfare function. A participation income is identified as an "uncontroversial" tax reform. This policy option is explored in depth in Section 5. Section 6 shows that the main result holds also if the model is calibrated in a more realistic manner, taking into account non linear taxation and the distinction between unemployment insurance and assistance.

2 The model

As we want to sort out the implications of possible reform policies, it is important to give an accurate definition of the pre-reform situation, on the one hand, and to define clearly the policy instruments that are available for reform, on the other hand. We try to capture the current situation in Switzerland (and other continental European countries) by assuming that the existing tax-benefit system is characterized by the existence of an unemployment insurance and assistance scheme, but that no help is provided by the government to individuals who are not actively seeking for work.[3] Unemployment benefits are financed by a flat-rate tax on labor earnings. By contrast to the situation in the US and the UK, no Earned Income Tax Credit (EITC) or Working Tax Credit (WTC) exists in the initial situation.

As to possible reform scenarios, we assume that the government's action is constrained by the impossibility to observe an individual's earning power or skill. Therefore, the tax-benefit schedule has to be conditioned on income and labor market status (employed; unemployed; outside the labor force). We assume furthermore that the tax schedule is linear in all reform scenarios: labor income is taxed at a constant marginal rate, τ.[4] Because of the absence of capital in the model, we adopt the conservative assumption that there is no tax on firm profits.[5] A reform scenario can be entirely defined by spelling out the benefits received in different labor market states (see Table 1); the constant tax rate on labor income is then determined by the government's intertemporal budget constraint.

Table 1: Tax-benefit schemes: who receives the benefit?

Group Benefit	Out of the labor force z_n	Unemployed workers z_u	Employed workers z_w
Unemployment insurance / assistance[a]		X	
Participation income		X	X
Negative income tax / Basic income	X	X	X
Earned income tax credit			X

[a] Current (pre-reform) situation.

Table 1 illustrates how different reform proposals can be represented in our model. As there is no distinction between individuals and households in the model, the basic income and NIT proposals are equivalent in the model. An important question is how the existing unemployment benefits are adjusted in the reform scenarios. For example, one might consider the introduction of a basic income or a NIT

[3] In our base model, we do not distinguish between unemployment insurance and unemployment assistance. This distinction is taken up below in an extension of the model (Section 6.2).

[4] Non-linear tax schedules are considered below as an extension of the model (see Section 6.2).

[5] The only source of profits in our model is the entrepreneurs' rent from occupied jobs. This rent could be taxed away without creating distortions in our model, but such an outcome would be unrealistic. Indeed, in a more complete model with capital accumulation, a tax on profits has detrimental effects on growth.

at a smaller level than current unemployment benefits, and reduce unemployment benefits by an equivalent amount. In that case, the overall transfer z_u paid to the unemployed would not change and individuals outside the labor force and employed workers would receive a smaller amount than the unemployed ($z_n = z_w < z_u$). A similar question arises with the introduction of an EITC: should unemployment benefits and social assistance be kept at current levels or should they be reduced, as it happened in the 1990s in the US? As is clear from Table 1, the introduction of a participation income is under certain conditions equivalent to the combination of an EITC with unemployment assistance being maintained at its initial level.

2.1 Employment, unemployment and participation

We assume that there is a finite number of skill levels and that productivity p_i of a worker with skill level i can be perfectly observed by firms. Each firm employs one worker and produces an identical homogeneous good whose price is the *numéraire*.[6] In this setup, labor markets for different skill levels would operate independently from each other if there was no government intervention; redistributive policies constitute the only link between these markets.

The labor market for each skill level is modeled following a standard search-matching framework (Pissarides, 2000). Let u_i denote the unemployment rate and v_i vacant jobs as a fraction of the labor force with skill level i. The process by which job vacancies and unemployed workers are matched is represented by a matching function $M(u_i, v_i)$ which is assumed increasing in both arguments, concave and homogeneous of degree 1. For simplicity, M is identical for all skill levels. The probability of matching a vacant job to an unemployed worker per unit time is given by $M(u_i, v_i)/v_i = M(u_i/v_i, 1) = M(1/\theta_i, 1) = m(\theta_i)$ where $\theta_i = v_i/u_i$ measures tightness of the labor market for skill level i.

The unemployment rates u_i evolve according to

$$\dot{u}_i = (\dot{\pi}_i/\pi_i)(1 - u_i) + q(1 - u_i) - \theta_i m(\theta_i) u_i, \tag{1}$$

where q is the exogenous probability of job destruction per unit time (identical for all i) and π_i is the participation rate.

Consider now the present discounted value of expected profits from a vacant job,

[6] This assumption is analogous to the hypothesis, which is standard in the literature of optimal taxation, that different labor types are perfectly substitutable.

V_i, and from an occupied job, J_i. The Bellman equation for V_i is:

$$rV_i = -p_i c + m(\theta_i)(J_i - V_i) + \dot{V}_i, \tag{2}$$

where c is the cost of maintaining a job vacant. The zero-profit condition implies that $V_i = \dot{V}_i = 0$ such that

$$J_i = p_i c / m(\theta_i) \tag{3}$$

holds at any moment in time. Moreover, J_i evolves according to

$$rJ_i = p_i - w_i(1+\tau) - q(J_i - V_i) + \dot{J}_i. \tag{4}$$

The present discounted value of an unemployed worker's expected future income, U_i, evolves according to

$$rU_i = z_u + \theta_i m(\theta_i)(W_i - U_i) + \dot{U}_i, \tag{5}$$

whereas for employed workers the corresponding expression is

$$rW_i = w_i + z_w + q(U_i - W_i) + \dot{W}_i. \tag{6}$$

After a vacant job has been occupied by an unemployed worker, the wage is determined by bilateral wage bargaining. Thus the wage is obtained as the solution to the generalized Nash maximand

$$\max_{w_i}(W_i - U_i)^{\beta}(J_i - V_i)^{1-\beta} \tag{7}$$

where β represents the worker's relative bargaining power. Assuming that wages are continually renegotiated implies that the necessary condition

$$\beta(J_i - V_i) = (1-\beta)(1+\tau)(W_i - U_i) \tag{8}$$

holds not only in levels and but also in rates of change. After some manipulation (see e.g. Pissarides, 2000) the following wage equation is obtained:

$$w_i = (1-\beta)(z_u - z_w) + \frac{\beta p_i}{1+\tau}(1 + \theta_i c) \tag{9}$$

Net wages are a weighted average of the worker's fallback position and the net output that the worker produces on his job (including the saving of hiring costs enjoyed by the firm). The latter term depends on the worker's skill level p_i and on his bargaining power: the higher his bargaining power, the greater his share of net output.

Individuals who stay outside the labor force receive a real return from leisure of x per unit of time, in addition to any monetary transfer paid by the government (in the case of an unconditional basic income). The present discounted value of such an individual's utility (measured in real monetary units), N, is therefore given by:

$$rN = x + z_n \tag{10}$$

Individuals of a given skill level are all equally productive on their jobs, but heterogeneous with respect to their preference for leisure. This heterogeneity is described by a distribution function $H(x)$ which is common to all skill levels. Individuals for whom $U_i > N$ choose to work. The reservation level ξ_i of the leisure parameter x (i.e. the value at which an individual of skill i is indifferent between leisure and work), is determined implicitly by the arbitrage condition $N(\xi_i) = U_i$ and is therefore equal to

$$\xi_i = \frac{(r+q)(z_u - z_n) + \theta_i m(\theta_i)(w + z_w - z_n)}{r + q + \theta_i m(\theta_i)}. \tag{11}$$

Finally, the fraction of the population who choose to work (or to look for work) is equal to $\pi_i = H(\xi_i)$.

The government's budget constraint constitutes the only link between labor market segments (corresponding to skill levels). We require that the intertemporal budget constraint be satisfied across segments, but the budget does not have to be balanced in each period. It useful to break down the government's net borrowing by labor market segments

$$\dot{b}_i = rb_i + \pi_i u_i z_u + \pi_i(1-u_i)z_w + (1-\pi_i)z_n - \pi_i(1-u_i)\tau w_i, \quad \sum_i b_i(0) = 0, \tag{12}$$

where b_i is per-capita borrowing by the government related to skill level i. The initial values of b_i, which are endogenized through the intertemporal budget constraint, indicate the degree of redistribution among skill levels. A positive (negative) value of $b_i(0)$ indicates that individuals of skill i are net tax payers (net tax beneficiaries) in present value terms.

Integrating equation (12) and imposing the no-Ponzi condition yields the following intertemporal budget constraint for the government:

$$\sum_i \int_0^\infty [\pi_i u_i z_u + \pi_i(1-u_i)z_w + (1-\pi_i)z_n - \pi_i(1-u_i)\tau w_i]\ \mathrm{e}^{-rt} dt = 0 \tag{13}$$

We assume that the levels of per-capita transfers (z_u, z_w and z_n) and the tax rate on labor income (τ) are constant over time. The government chooses the levels of these variables such as to balance the intertemporal budget constraint (13), anticipating thereby the future evolution of the economy.

The dynamics of the model can now be made explicit. Substituting equation (9) into (4) establishes, together with (3), that both J_i and θ_i are constant over time, i.e. they jump instantaneously to their equilibrium value. The same is true for the variables U_i and W_i, since differential equations (5) and (6) are unstable.[7] The only variable that does not adjust immediately to its steady-state level is the unemployment rate (because of the forward-looking behavior of the government, all fiscal variables are assumed to be constant over time).

The equilibrium of the model can thus be summarized as follows. Consider first the determination of labor market tightness and the wage rate. Combining equation (3) and (4) yields the "job creation" condition:

$$w_i = \frac{p_i}{1+\tau}\left[1 - \frac{c(r+q)}{m(\theta_i)}\right]. \tag{14}$$

For each skill level, the wage curve (9) and the job creation condition (14) determine jointly the equilibrium level of θ_i, for a given tax rate τ, as follows:

$$(1-\beta)[p_i - (1+\tau)(z_u - z_w)] = [r + q + \beta\theta_i m(\theta_i)]p_i c/m(\theta_i) \tag{15}$$

As τ is determined using the intertemporal budget constraint of the government (13), each θ_i depends in general on the levels of participation rates and on the path of the unemployment rates in all labor market segments. There is, however, one particular set of policies which breaks the interdependence between the levels of labor market tightness in the different labor market segments. Indeed, it is obvious from (15) that the tax rate has no incidence on the determination of θ_i if the condition $z_u = z_w$ is satisfied. Equation (15) allows even a stronger conclusion: any policy reform which satisfies the condition $z_u = z_w$ leaves labor market tightness unchanged for all skill levels.

Turn now to the determination of the rates of participation and unemployment. It should be emphasized that, on the one hand, the unemployment rate does not

[7] Note that, because of wage bargaining, the difference $W_i - U_i$ depends only on θ_i. Indeed, equations (3)and (8) imply:

$$W_i - U_i = \left(\frac{\beta}{1-\beta}\right)\frac{p_i c}{(1+\tau)m(\theta_i)}.$$

adjust immediately to its long-run level and, on the other hand, the *initial* unemployment rate is not fixed. Indeed, as equation (11) reveals, the participation rate π jumps immediately to its equilibrium value after a shock. As a consequence, individuals who choose to participate must queue for jobs, increasing thereby the initial unemployment rate.[8] This argument makes clear that in the model with endogenous participation, the "sticky" variable is not the unemployment rate, but the employment rate, i.e. the share of employed individuals in total population, $(1 - u_i)\pi_i$. Equation (1) can therefore be reformulated as follows:

$$\dot{u}_i = q(1 - u_i) - \theta_i m(\theta_i) u_i, \qquad u_i(0) = \left(u_i^0 + \frac{\pi_i - \pi_i^0}{\pi_i^0}\right)\frac{\pi_i^0}{\pi_i}, \tag{16}$$

where u_i^0 and π_i^0 denote the unemployment and participation rates before the shock.

2.2 Individual utilities and social welfare

The social policy reforms that we explore below have consequences both for economic efficiency and equity. These issues can be analyzed rigorously with the help of Social Welfare Functions (SWF). A reform is judged desirable if it improves social welfare according to any SWF satisfying the criterion of anonymity, the Pareto criterion and the principle of transfers (see Section 5 for details). A limit case of this class of SWFs is the utilitarian social welfare function, equal to the sum of individual utilities, which measures economic efficiency without any consideration for equity.[9]

The SWFs that we will use for the evaluation of policy reforms are built on the assumption that interpersonal comparisons of utility levels are possible. It is therefore important to define individual utility levels in a consistent way. This can be ensured by measuring utility levels in a money metric and by choosing the the *initial* utility level (at time $t = 0$) as the pertinent indicator for the assessment of policy reforms. Indeed, the initial utility level can be interpreted as the "asset value" of being in a certain state (employment, unemployment, etc.) and summarizes the present value of expected future income. This is why we use the dynamic formulation of the model in our analysis; the steady-state equations would not allow to obtain correct measures of individual utilities.

When using social welfare measures which are sensitive to distributional considerations, the structure of firm ownership matters. To keep things transparent,

[8] Alternatively, if a shock decreases the participation rate, some of the unemployed will quit the queue, thereby decreasing the unemployment rate.

[9] In the remainder of the paper, we refer to the sum of individual utilities also as "aggregate welfare" or "economic efficiency".

Table 2: Individual utility levels and population shares

	Share in population	Utility
Disabled	$(1-s_J)s_D$	D
Workers (of skill i)		
– inactive ($\xi_i < x < \infty$)	$(1-s_J)(1-s_D)s_i H'(x)$	N
– unemployed	$(1-s_J)(1-s_D)s_i \pi_i u_i(0)$	U_i
– employed	$(1-s_J)(1-s_D)s_i \pi_i [1-u_i(0)]$	W_i
Entrepreneurs[a]	s_J	J^*

[a]Total profits from occupied jobs are distributed equally among entrepreneurs: $J^* = \sum_i (1-s_D)s_i\pi_i[1-u_i(0)]J_i/s_J$.

we assume that there is a homogeneous group of entrepreneurs whose only income stems from entrepreneurial activity, i.e. profits from occupied jobs. It would not be realistic to assume that each entrepreneur owns exactly one firm (they would be the poorest population group); we assume instead that all entrepreneurs share equally the ownership of all firms.[10]

Another question that arises with inequality-averse social welfare indicators is how to evaluate the utility level of individuals outside the labor force. This issue becomes especially important when evaluating the social welfare consequences of transfers to the inactive. In order to be consistent with the model, we assume that the utility level of an inactive, but able, individual is equal to his utility from leisure, x. As we assume that there is a distribution of x inside each skill category, the "richest" individuals in population can be found among the inactive. However, in order to add some realism to account for the heterogeneity of individuals outside the labor force, we assume that an exogenous share of population is unable to take up any work. The utility of these "disabled" individuals is given exogenously and assumed to be smaller than the utility level of the active population.

2.3 Calibration of the model

When evaluating the social welfare consequences of different reform programs, it is not always possible to get clear-cut qualitative results. Nevertheless, quantitative conclusions can be drawn by calibrating the model and by simulating various reform policies in our dynamic framework.[11] The parameters of the model are chosen in

[10]The population share s_J is calibrated in such a way that the entrepreneur's initial utility level is twice the utility level of the average worker.

[11]The dynamic simulation model is written in discrete time (monthly periods) using the GAMS language (Brooke et al., 1998). Consistency with the continuous-time theoretical model is ensured by the fact that the steady state is identical.

Table 3: Calibration of the model: aggregate indicators

Parameter or variable (base values)[a]		
Unemployment rate	u	0.039
Participation rate (average)	π	0.84
Semi-elasticity of participation (average)		0.20
Labor market tightness	θ	0.23
Replacement rate	z_u/w	0.40
Job destruction rate[b]	q	0.077
Real interest rate[b]	r	0.03
Workers' bargaining power	β	0.5
Matching function (elasticity)	η	0.5
Cost of vacant job[c]	c	2.3
Matching function (scale parameter)[c]	m_0	0.31
Initial tax rate[c]	τ	0.0162

[a]Data sources: unemployment (OFS, 2001a, p.152), participation (OFS, 2001b, tableau 1a*; reference population: 15 years – retirement), vacancies (OFS, 2000, p. 34), job destruction (anual mean from Flückiger and Vassiliev, 2002),

[b]Annual basis.

[c]Calibrated using the equations of the model.

such a way that the long-run equilibrium of the model replicates the main labor market indicators of the Swiss economy in 1998 (see Tables 3 and 4).

The matching technology is specified as a constant-returns-to-scale Cobb-Douglas function: $m(\theta) = m_0\theta^{-\eta}$. As a consequence, the matching elastiticy, η, is constant. In their survey of the matching function, Petrongolo and Pissarides (2001) report that most empirical studies do not reject the assumption of constant returns to scale and that most estimates of η lie in the range $[0.5 - 0.7]$. As most authors of simulation studies, we chose as our main case the symmetric specification with $\eta = 0.5$. Together with the assumption of symmetric bargaining ($\beta = 0.5$), this ensures that the decentralized equilibrium is efficient.

The model is calibrated for four skill categories, which we take to represent different education levels. Wage differentials (reported in Table 4) between skill levels are estimated on the basis of a modified Mincerian wage equation, using dummy variables for the four skill levels instead of a unique variable measuring years of schooling. These estimations (as well as the proportions of the different skill groups in population) are obtained from the Swiss wage structure survey 1998. Note that in this survey, employers report *required* skill levels for each job; this indicator is linked more closely to productivity than the worker's actual education

Table 4: Calibration of the model: structural indicators

Skill level	Share in population[a]	Wage index[a]	Participation rate[b]	Semi-elasticity of participation[b]
University	0.055	1.000	0.921	0.117
Superior education	0.225	0.695	0.869	0.168
Apprenticeship	0.460	0.535	0.820	0.208
Basic skills	0.260	0.404	0.756	0.248

[a]Estimates from the *Enquête sur la structure des salaires 1998*.

[b]Calibrated using the equations of the model.

level. Productivity parameters p_i are then calibrated such as to reproduce the structure of wages.

Turn now to the participation decision. The shape of the distribution function $H(\cdot)$ determines both the rate and the elasticity of participation, for all skill levels. The participation elasticities estimated for Switzerland are rather low on average, and tend to decrease with the level of skill. The lognormal distribution function reproduces these features quite well. Define the semi-elasticity of participation as $E_i = (d\pi_i/d\xi_i)x_i$. Then the lognormal distribution has the following properties:

$$\pi_i = \Phi\left(\frac{\log(\xi_i) - \mu}{\sigma}\right), \qquad E_i = \phi\left(\frac{\log(\xi_i) - \mu}{\sigma}\right), \tag{17}$$

where $\Phi(\cdot)$ denotes the cumulative distribution function and $\phi(\cdot)$ the density function of the standard normal distribution. Given the average rate and elasticity of participation (see Table 3), equations (17) allow to calibrate the parameters μ and σ of the lognormal distribution. When the model is calibrated for different productivity levels, as described above, participation rates and semi-elasticities differ by skill level (see Table 4).

Finally, it is important to note that there is no distinction in our model between unemployment benefits and social assistance. The "unemployment" state should be interpreted in the Swiss context as capturing both unemployment benefits (where the replacement rate is 70–80 percent, but benefits are limited to a maximum of 520 days) and social assistance (which guarantees, upon demand, a minimum income level). Hence the calibrated value of the replacement rate (z_u/w) represents the present value of future benefits that a long-term unemployed can expect.

3 Efficiency

The social policy reforms that we consider in this paper have consequences both for economic efficiency and equity. Before considering these two aspects simultaneously in the framework of a SWF, it is useful to focus first on economic efficiency only. In this section, we derive the conditions that characterize efficient policies and ask whether the optimum can be attained using the policy instruments described in Table 1.

According to the utilitarian criterion, aggregate welfare Ψ (at time $t = 0$) is defined as the sum of individual utilities:

$$\Psi = \sum_i \Big[(1-\pi_i)\bar{N}_i + \pi_i u_i(0)U_i + \pi_i(1-u_i(0))(W_i+J_i)\Big], \tag{18}$$

where $\pi_i = H(\xi_i)$, $u(0)$ is the initial unemployment rate and $\bar{N}_i = \int_{\xi_i}^{\infty} xH'(x)dx/(1-\pi_i) + z_n$ is average utility of inactive individuals. It can be shown that (18) is equal to:[12]

$$\Psi = \sum_i \int_0^{\infty} \left\{ \int_{\xi_i}^{\infty} xH'(x)dx + \pi_i\left[(1-u_i(t))p_i - u_i(t)p_i c\theta\right] \right\} \mathrm{e}^{-rt}\mathrm{d}t. \tag{19}$$

where $u_i(t)$ evolves according to (16). Unfortunately, the fact that $u_i(0)$ are not fixed in this model implies that $u_i(t)$ are not suitable state variables for the maximization of (19). As discussed above in section 2, the state variable is not the unemployment rate, but the employment rate, $\ell_i = (1-u_i)\pi_i$. With such a change in variables the problem of efficiency maximization can be reformulated as follows:

$$\max_{\ell_i} \sum_i \int_0^{\infty} \left\{ \int_{\xi_i}^{\infty} xH'(x)dx + \ell_i(t)p_i - (\pi_i - \ell_i(t))p_i c\theta_i \right\} \mathrm{e}^{-rt}\mathrm{d}t \tag{20}$$

$$\dot{\ell}_i(t) = \theta_i m(\theta_i)\pi_i - [q + \theta_i m(\theta_i)]\ell_i(t), \quad \pi_i = H(\xi_i), \quad \ell_i(0) = \ell_i^0. \tag{21}$$

Consider first the optimal level of labor market tightness, denoted by $\hat{\theta}_i$. According to the necessary conditions of the Maximum Principle, $\hat{\theta}_i$ is the solution of[13]

$$[r + q + \theta_i m(\theta_i)]c/(1+\theta_i c) = m(\theta_i)[1-\eta(\theta_i)] \tag{22}$$

[12]The proof is straightforward but necessitates tedious developments. It can be obtained from the authors.

[13]Condition (22) is implied by the following conditions of the Maximum Principle: $\partial H_c/\partial\theta_i = 0$ and $\dot{\mu}_i - r\mu_i = -\partial H_c/\partial\ell_i$ where H_c is the current-value Hamiltonian and μ the multiplier associated with (21). Close inspection of necessary conditions reveals that $\dot{\mu}_i = 0$ since μ_i jumps to its steady state value.

where $\eta(\theta_i) = |\theta_i m'(\theta_i)/m(\theta_i)|$ is the absolute value of the elasticity of $m(\theta_i)$.

What policies can the government use to attain maximum efficiency? In the decentralized equilibrium, θ_i is determined by equation (15). Combining this equation with the optimality condition (22) and using (9) yields[14]

$$\frac{\eta(\theta_i) - \beta}{\beta} = \frac{(1-\beta)(z_u - z_w)}{w_i - (1-\beta)(z_u - z_w)}. \tag{23}$$

It is obvious from condition (23) that an efficient level of labor market tightness can only be achieved for all skill levels if (i) the government chooses $z_u = z_w$ and if (ii) the condition $\eta(\theta_i) = \beta$ is satisfied for all i. It is well known that if condition (ii) is satisfied, search externalities are internalized and the resulting equilibrium is efficient (Hosios, 1990 and Pissarides, 2000). The fact that z_u and z_w can take any value as long as they are identical demonstrates that there is scope for redistribution without detrimental effects on efficiency.

It should be emphasized that β and η are independent in this model. There is no reason why they should be equal, since the wage bargaining process is not influenced by the matching process. By contrast, several other search models lead to an equilibrium outcome where Hosios' efficiency condition is satisfied.[15] If $\beta \neq \eta$, there is no combination of policy instruments among those discussed above that could ensure an efficient determination of θ_i for all skill levels. However, if we assume that unemployment assistance can be conditioned on the unemployed's former wage rate, then efficiency can still be achieved. This issue is discussed further below in section 6.1.

Now turn to the optimal choice of labor market participation, denoted by $\hat{\pi} = H(\hat{\xi}_i)$. The optimal reservation level of the leisure parameter is given by $\hat{\xi}_i = g_i(\hat{\theta}_i)$, where g_i is derived from the following first-order condition, obtained by maximizing the Hamiltonian with respect to ξ_i:

$$\xi_i = \frac{m(\theta_i) - (r+q)c}{r + q + \theta_i m(\theta_i)} p_i \theta_i \equiv g_i(\theta_i). \tag{24}$$

What policies are compatible with optimal participation rates? Combining (24)

[14]Note that (15) can be written as:

$$\frac{r + q + \theta_i m(\theta_i)}{1 + \theta_i c} c = (1-\beta)\left(1 - \frac{(1+\tau)(z_u - z_w)}{p_i(1+\theta_i c)}\right) m(\theta_i).$$

[15]See, e.g., Greenwald and Stiglitz (1988), Moene (1997), Mortensen and Pissarides (1999).

with the job creation condition (14) yields

$$\xi_i = \frac{\theta_i m(\theta_i)}{r + q + \theta_i m(\theta_i)}\ w_i(1+\tau). \tag{25}$$

Comparison of (25) with the determination of ξ_i in the decentralized equilibrium (11) leads to the following condition:

$$\tau w_i = z_w - z_n + \frac{r+q}{\theta_i m(\theta_i)}\ (z_u - z_n). \tag{26}$$

Equation (26) leads to the conclusion that a *laissez-faire* policy without government intervention ensures maximum efficiency with respect to the participation decision. As there are no externalities involved, this does not come as a surprise. A more interesting question is whether there exist other policies that can ensure an efficient outcome. To address this question more clearly, the government's budget constraint has to be taken into account. Substituting (26) into the intertemporal budget constraint (13) yields the condition[16]

$$z_n = \frac{r\pi_i[1-u_i(0)]}{r\pi_i[1-u_i(0)] + \theta_i m(\theta_i)}\ z_u - \frac{\theta_i m(\theta_i)}{r\pi_i[1-u_i(0)] + \theta_i m(\theta_i)}\ rb_i(0). \tag{27}$$

As z_n cannot be conditioned on the individual's skill level, there exists in general no unique z_n that would be optimal simultaneously in all labor market segments if z_u (and z_w) take positive values. Nevertheless, condition (27) helps to shed some light on the underlying mechanisms.

Assume to begin with that all workers have identical skills. Then the balanced-budget rule implies $b_i(0) = 0$ and maximum efficiency can be achieved by fixing z_n at the (positive) level given by (27). It is remarkable that any change in z_w is neutral with respect to the participation decision because the required variation in the tax rate τ applies to the same employment state as the change in z_w and their incentive effects therefore cancel out. The same cannot be said of unemployment assistance: z_u is received when an individual is unemployed, but the corresponding tax is paid when the individual is working. An individual who is out of the labor force and considers looking for work will first be unemployed before being able to find a job. Hence the increase in unemployment assistance will be of more value for

[16] In deriving equation (27), we have used the following result:

$$\int_0^\infty u_i(t)\exp(-rt) = [u_i(0) + q/r]/[r + q + \theta_i m(\theta_i)].$$

him than the fall in the net wage due to the corresponding tax increase. Therefore a rise in z_u tends to increase participation even if the government budget is balanced. A positive benefit paid to individuals outside the labor force, as defined in equation (27), counterbalances this effect.

If individuals have different (unobservable) skill levels, there are two problems that prevent z_n from being optimal for all i. First, unemployment rates are likely to differ by skill level so that (27) can not define a unique z_n for all i even if $b_i(0)$ were zero. Second, tax-subsidy schemes that imply redistribution among skill levels ($b_i(0) \neq 0$) introduce a further distortion in the participation decision. Consider for instance an EITC-type policy with $z_w > 0$, financed through a constant marginal tax rate τ. Such a scheme acts as a progressive wage tax, implying positive $b_i(0)$ for high skill levels and negative $b_i(0)$ for low skill levels. It is clear from equation (27) that the optimal z_n should then be negative for the former and positive for the latter. As we rule out the possibility of differentiating z_n by skill level, we would expect that an EITC scheme induces inefficient participation rates: too low for high-skill and too high for low-skill workers.[17]

To sum up the results of this section, *laissez-faire* is the most efficient policy among all admissible linear tax-benefit schemes. As a consequence, the implementation of any redistributional policy involves a trade-off between efficiency and equity. In our setup, this tradeoff arises primarily because of the endogenous participation decision. Indeed, a progressive wage tax is not incompatible with an efficient labor market tightness as long as condition (23) is satisfied.

4 Social welfare

The objective of this section is to identify reform policies where the post-reform situation is preferred to the current situation in terms of social welfare. To avoid excessively subjective judgments, we adopt an ordinal approach to social welfare comparisons which consists in comparing pre- and post-reform situations with respect to an entire class of SWFs. We consider the class of SWFs which are increasing in individual utilities and satisfy the properties of anonymity and inequality aversion. Note that the concept of second-order social welfare dominance is based on this class of SWFs.

As a first step towards the analysis of social welfare dominance, we explore

[17] It should however not be concluded from this discussion that any EITC scheme results in inefficient participation rates. If the tax schedule is non linear, it could be designed in such a way that incentive effects (stemming from the transfers z_w and z_u paid to active individuals) are exactly compensated by disincentive effects (due to the wage tax τ and the benefit z_n for the inactive).

numerically the consequences of various reform policies on SWFs displaying different degrees of inequality aversion. Because of the convenient parameterization of inequality aversion, we choose the additive specification of the SWF proposed by Atkinson (1970). According to this specification, “equally distributed equivalent utility” Y^e is defined as

$$Y^e = \left(s_J Y_J^{1-\epsilon} + (1 - s_J) \sum_{i,j} f_{ij}^0 Y_{ij}^{1-\epsilon} \right)^{1/(1-\epsilon)}, \tag{28}$$

where i is the skill category, j the employment state (employment, unemployment, leisure), f_{ij}^0 the share of workers of skill i in state j and Y_{ij} the per-capita utility of those workers.[18] For the sake of completeness, entrepreneurs are included in the welfare criterion. We assume that they represent a fixed share, s_J, of population; their per-capita utility Y_J is proportional to $\sum_i s_i \pi_i (1 - u_i(0)) J_i$. The parameter ϵ captures the degree of inequality aversion. For $\epsilon = 0$, Y^e is equal to the utilitarian aggregate welfare criterion, Ψ. With $\epsilon \to \infty$, Y^e tends towards the Rawlsian criterion where only the welfare of the poorest individual is taken into account.

All possible reform policies can be represented in the model by different combinations of benefits z_u, z_w and z_n; the corresponding tax rate is determined by the balanced budget constraint of the government. As a first step, we explore numerically the impact of different combinations of z_u and z_w on social welfare. In the simulations of this section, we assume that Hosios' condition is satisfied so that the efficiency condition (23) for each θ_i boils down to $z_u = z_w$. As these benefits are financed using a linear tax, increasing z_w and z_u in parallel implies greater redistribution between skill categories. This kind of redistribution is good for equity but has a negative impact on efficiency since it tends to distort the participation decision.

It is useful to consider first the limit case where participation is exogenous. Figure 1 depicts indifference curves of the SWF for different values of inequality aversion. This figure illustrates clearly that there is no tradeoff between efficiency and equity in this version of the model: more redistribution is always preferred (strongly preferred for $\epsilon > 0$; indifference if $\epsilon = 0$), as long as the condition $z_u = z_w$

[18] Individual utilities are measured in a monetary metric. For example, for employed workers we have $f_{iW}^0 = s_i \pi_i (1 - u_i(0))$ and $Y_{iW} = W_i/(1 - s_J)$. We divide W_i by $(1 - s_J)$ in order to correct per capita utilities for the presence of entrepreneurs since the population of workers is normalized to unity in the equations of the model.

Because of the heterogeneity of individuals outside the labor force, their contribution to social welfare, Y_{iN}, is more tedious to compute, especially if $z_n > 0$. In the simulations below, we use a second-order approximation of Y_{iN} which is exact if $z_n = 0$ (see the Appendix for the complete derivation).

is satisfied. Thus it can be conjectured that, among all policies shown in Figure 1, $z_u = z_w = 0.6$ dominates all other policies from the point of view of all inequality-averse SWFs.

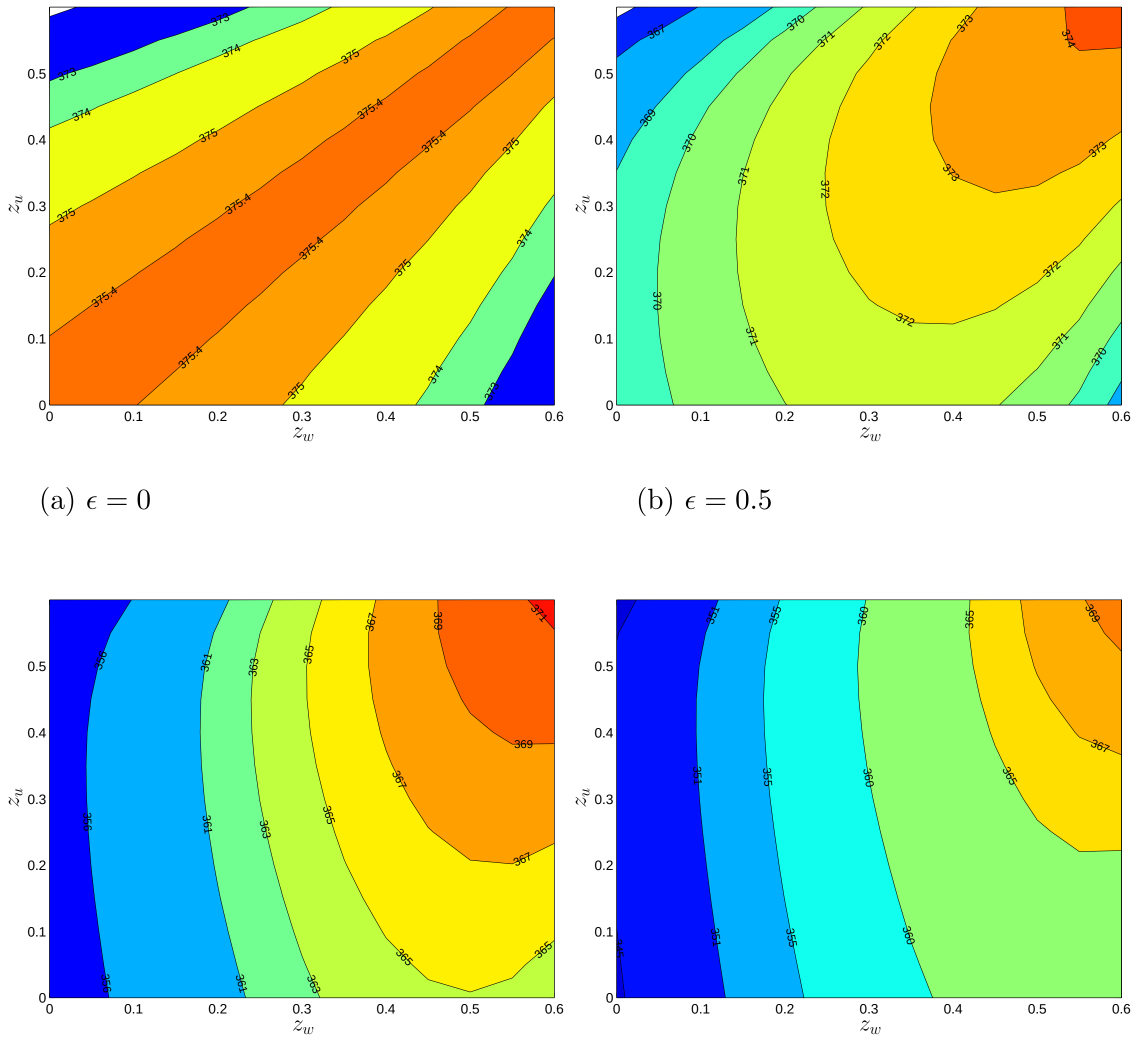
If participation is determined endogenously, it is impossible to draw such a clear conclusion because greater equity can be achieved only at the expense of efficiency. As discussed in section 3, the efficiency-maximizing policy is no government intervention. This result is illustrated in Figure 2 (a), depicting social welfare contours for $\epsilon = 0$, with a maximum at $z_u = z_w = 0$.

The efficiency cost of redistribution seems to be rather low, however, since the optimal z_u and z_w grow very rapidly with increasing inequality aversion. For $\epsilon = 0.1$ optimal social welfare is attained for approximately $z_u = z_w = 0.3$, corresponding to $\tau = 0.48$ (equivalent to a tax rate of 0.32 levied on pre-tax income). For $\epsilon = 0.5$, the optimal z_w obviously exceeds 0.4 but the condition $z_u = z_w$ should still hold approximately at the social welfare optimum. It should be emphasized that $z_u = z_w$ is an efficiency condition, without any consideration for equity. One should therefore expect that for high ϵ, the policymaker would aim at reducing also the inequality within a given skill category, in particular the inequality between the employed and the unemployed. This could be achieved by raising z_u relative to z_w. However, this turns out to be a rather blunt measure because its efficiency cost is high relative to the reduction in inequality (within a skill category, there is only little inequality between the employed and the unemployed because of the rapid turnover in the Swiss labor market).

Some first conclusions can be drawn from these results. Starting from the current situation in Switzerland (which is characterized by $z_u = 0.4$ and $z_w = 0$, the upper left corner of Figures 2 (a) to (d)), increasing z_w seems to be an "uncontroversial" reform, since it is social-welfare-improving for any degree of inequality aversion. This issue will be explored further in the next section.

Now consider the introduction of allowances to the population outside the labor force, z_n. In the political debate, such transfers are much more controversial than those paid to the unemployed. The crucial question is whether an individual is (perceived to be) outside the labor force because he chooses not to work or because he is unable to work. In order to clarify the issues at stake, we account for both cases in the model. Individuals who choose not to work enjoy (by definition) a higher utility level than the unemployed of the same skill category, and an important share among them even get higher utility than the employed.[19] Therefore, providing

[19]In the model, individuals of a given skill class are heterogeneous with respect to the utility-from-leisure parameter. On the other hand, all the employed of the same skill category enjoy the



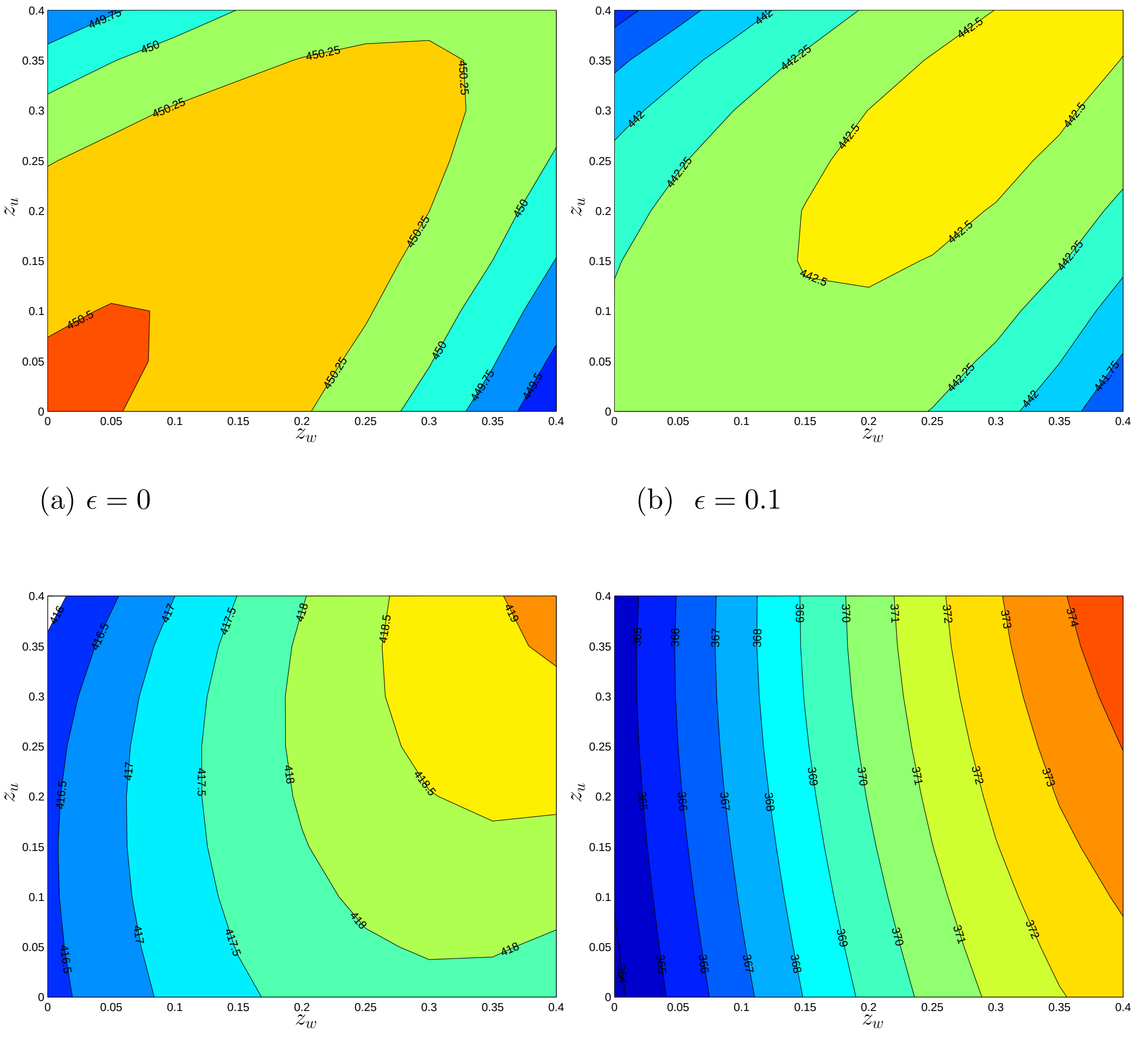
(a) $\epsilon = 0$

(b) $\epsilon = 0.5$

(c) $\epsilon = 2$

(d) $\epsilon = 3$

Figure 1: Social welfare contours as a function of z_w and z_u, for different values of inequality aversion: exogenous labor supply



(a) $\epsilon = 0$

(b) $\epsilon = 0.1$

(c) $\epsilon = 0.5$

(d) $\epsilon = 2$

Figure 2: Social welfare contours as a function of z_w and z_u, for different values of inequality aversion: endogenous labor supply

transfers to these inactive individuals by taxing the employed cannot be justified on the grounds of inequality reduction. However, if there is a positive unemployment benefit, economic efficiency might require such transfers, although the first-best level cannot be achieved because of the inobservability of skills (see condition (27) and the discussion thereafter).

In the case of individuals unfit for work ("disabled"), the assumption of interpersonal comparability of utility levels is particularly problematic. Somehow arbitrarily, we assume that in the base situation the utility level of a disabled person amounts to half the utility level of the (average) unemployed. This assumption becomes important when the desirability of redistribution is judged using high values of ϵ. Indeed, as the degree of inequality aversion increases, Atkinson's (1970) social welfare function attaches more weight to the distribution at the lower end of the scale. Therefore, a sufficiently inequality-averse government may find it desirable to carry out transfers to the inactive at the expense of economic efficiency. It is clear that the efficiency-equity trade-off is less pronounced if transfers can be targeted towards the disabled.

This advantage of targeted social assistance programs has been first pointed out by Akerlof (1978). He shows in an optimal taxation framework that if the needy are "tagged"(i.e. identified, although imperfectly), the optimal transfer to tagged individuals exceeds the optimal transfer to untagged individuals. [20] Moreover, the optimal transfers towards the tagged are greater than in the absence of tagging.

These results apply also to our framework. If the disabled could be perfectly identified, the efficiency cost of providing them with social assistance would be very low. Thus, even for very small levels of inequality aversion such as $\epsilon = 0.1$, social welfare would increase with the introduction of such a social assistance scheme. Note that the case of perfect tagging should be considered as a benchmark since it is obviously not very realistic. Compared to this benchmark, imperfect tagging would increase the efficiency cost of social assistance and reduce poverty and inequality in a less pronounced way. Because of the lack of pertinent information in Switzerland on type I and type II errors, we do not simulate this intermediate case and turn instead to the polar opposite case of a universal transfer (which could also be interpreted

same utility, which is only marginally greater than the utility of the unemployed. As a result, those who choose not to work enjoy, on average, a higher utility level than the employed workers of the same skill class.

[20] This result is robust to changes in Akerlof's (1978) original model. He had assumed that only part of the needy population would be "tagged" (type I errors). Parsons (1996) generalizes this set-up to two-sided classification error (introducing also type II errors where some of the tagged individuals are in fact not needy) and Salanié (2002) adopts a more general formulation of labor supply.

as perfectly unsuccessful targeting).

The idea of a universal transfer to individuals outside the labor force is an integral part of the NIT and basic income schemes. Because of their high cost and the heterogeneity of the inactive population, these propositions have met with much resistance. Figure 3 illustrates the controversial nature of these policies, depicting social welfare indifference curves with respect to transfers to the inactive (z_n) and transfers to the active population (satisfying the approximate optimality rule, $z_u = z_w$). If the decision-maker has no consideration for equity, Figure 3 (a) illustrates that for a given (not necessarily optimal) $z_u = z_w$, it is efficient to introduce a small transfer to the inactive in order to counterbalance the incentive to participate created by unemployment benefit (see section 3). However, the optimal transfer to the inactive is quantitatively very small (for example, for $z_u = z_w = 0.3$ the optimal z_n is equal to approximately 0.025).

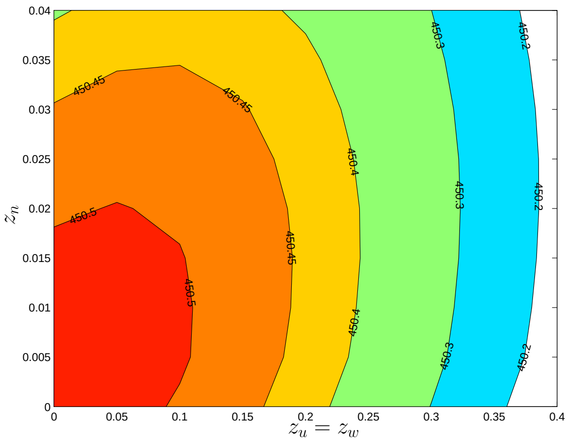
If the decision-maker is inequality averse, the analysis becomes more ambiguous, since the introduction of z_n, financed by a flat tax, is equivalent to redistributing from the middle of the utility distribution towards the extremes, i.e. the well-off "lazy" and the poor disabled.[21] In a medium range of inequality aversion (e.g., $\epsilon = 0.5$), there is no advantage to introducing a positive z_n from the point of view of social welfare. This is due to the fact that for such values of ϵ, the transfers towards the well-off weigh more heavily than those towards the poor. From the point of view of social welfare, this increase in inequality dominates the efficiency gain for small z_n. Finally, with a high degree of inequality aversion, as in Figure 3 (d), the disabled, who are the "poorest" individuals in our society, start to play a greater role in social welfare, and the introduction of a positive z_n becomes desirable even without the possibility of targeting transfers to the disabled.

We conclude from these observations that, starting from the current situation in Switzerland ($z_n = 0$), the introduction of benefits to the individuals outside the labor force is probably not an uncontroversial reform if the disabled cannot be identified in an appropriate way.

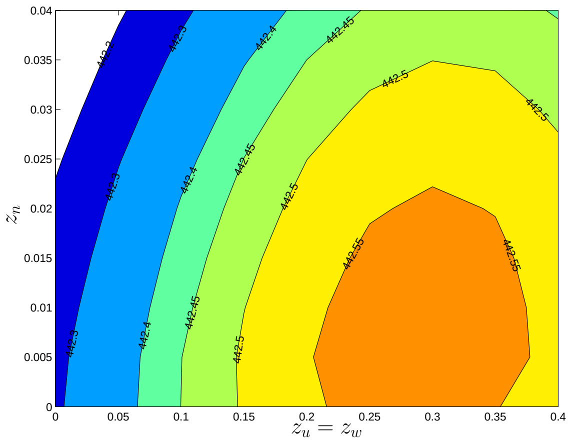
5 Uncontroversial reforms

Having identified the participation income as a promising candidate for reform, we proceed in this section to a more formal check whether such a measure would indeed

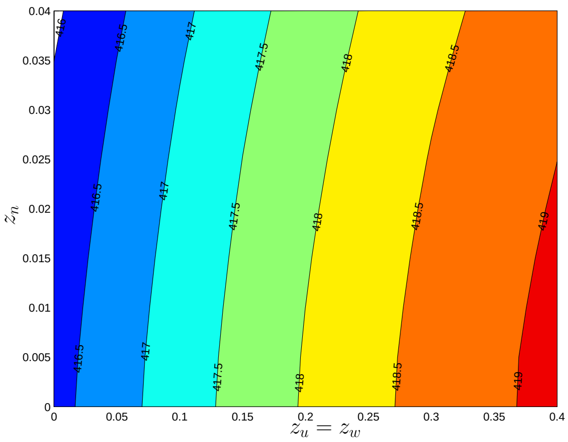
[21] In terms of inequality orderings, this implies that the pre- and post-reform Lorenz curves cross (where "reform" means the introduction of z_n, for constant $z_u = z_w$). Thus the use of different inequality measures leads to no unanimous conclusion regarding the change in inequality.



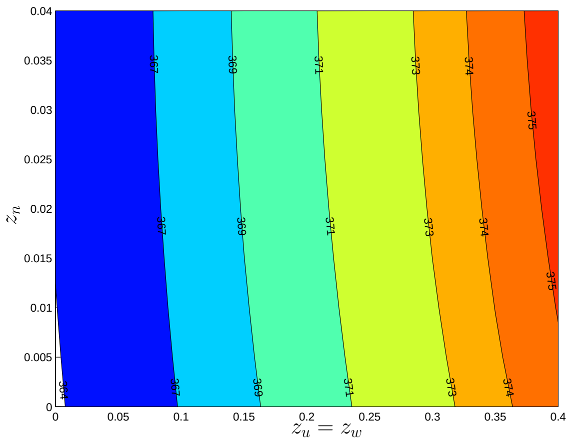
(a) $\epsilon = 0$



(b) $\epsilon = 0.1$



(c) $\epsilon = 0.5$



(d) $\epsilon = 2$

Figure 3: Social welfare contours as a function of $z_u = z_w$ and z_n, for different values of inequality aversion: endogenous labor supply

be "uncontroversial". We follow the ordinal approach to social welfare and define a reform as "uncontroversial" if it improves social welfare for an entire class of SWFs. We consider the class of SWFs satisfying (i) the criterion of anonymity (SWF is symmetrical with respect to individual utilities), (ii) the Pareto criterion (SWF is weakly increasing in individual utilities) and (iii) the principle of transfers (SWF is S-concave).[22] The transfer principle states that a mean-preserving equalizing transfer does not decrease social welfare. All SWFs of this class embody therefore a preference for equity, but the utilitarian SWF (where only the sum of individual utilities matters) is included as a limit case.

The ordinal approach ensures that conclusions are robust with respect to the specification of the SWF. The desirability of a reform would therefore be judged in an unanimous way by observers whose ethical preferences can be described by any SWF satisfying the three criteria given above. Ordinal social welfare comparisons can be carried out by applying Shorrocks' (1983) theorem 2. According to this theorem, a reform would increase social welfare according to any SWF satisfying the conditions given above if (and only if) the post-reform Generalized Lorenz (GL) curve dominates the pre-reform GL-curve.[23]

Two necessary conditions for a reform to be uncontroversial are: an increase in economic efficiency and a rise in the poorest individual's utility.[24] How should a participation income be designed according to these two conditions? Assuming that the current situation in Switzerland can be characterized by $z_u = 0.4$ and $z_w = 0$, the two necessary conditions and the simulations of the preceding section suggest that (i) the gap between z_u and z_w should be diminished (in order to enhance efficiency) and (ii) z_u should not be reduced (otherwise the reform reduces utility of the unskilled unemployed, who are the poorest individuals inside the labor force).[25]

A promising reform candidate is therefore the increase in z_w, with z_u remaining unchanged. With linear taxation and a balanced government budget, such a reform increases the progressivity of the tax system and implies more redistribution.

[22]Note that S-concavity implies symmetry.

[23]Generalized Lorenz dominance is equivalent to second-order stochastic dominance (Thistle, 1989). See also Sen (1997, p. 132–138).

[24]Both necessary conditions relate to special cases of the class of SWFs under consideration. The first condition must be met for the utilitarian social welfare criterion to increase with welfare. The second condition is derived from the Rawlsian SWF.

[25]As social welfare is based on intertemporal individual utility, unemployment assistance z_u could in fact be reduced, but only to the extent that it is compensated by the increase in z_w, in terms of the present value of an unemployed's expected income streams. However, for such a compensation not to result in a utility loss, the unemployed must be able to borrow against his future labor income. As this assumption would be unrealistic for low-skill unemployed, we do not focus on such a reform.

From the point of view of economic efficiency, there are two counterbalancing effects: labor market tightness evolves towards greater efficiency (the aggregate unemployment rate falls from 3.9 to 3.7 percent), but increasing redistribution among skill categories biases participation decisions in an inefficient manner (the participation rate increases by 1.1% for the low-skilled, and decreases by 0.5% for the high-skilled). The simulations described above suggest that in the Swiss case, the former effect dominates the latter if z_w is not too close to z_u.

As we want to check for social welfare dominance, we compare Generalized Lorenz curves of the pre- and post-reform situations. In order to make small differences more visible, Figure 4 shows the vertical distance between two post-reform GL curves (partial reform with $z_w = 0.1$; full reform with $z_w = z_u$) and the pre-reform GL curve (base case with $z_u = 0.4$ and $z_w = 0$).[26] Both reforms produce an efficiency gain since their GL curves end up at a higher level than the pre-reform GL curve. The incremental efficiency gain that can be achieved by adopting the full instead of the partial reform seems, however, to be rather small since the favorable reduction in unemployment is counterbalanced by increased distortion in the participation decision.

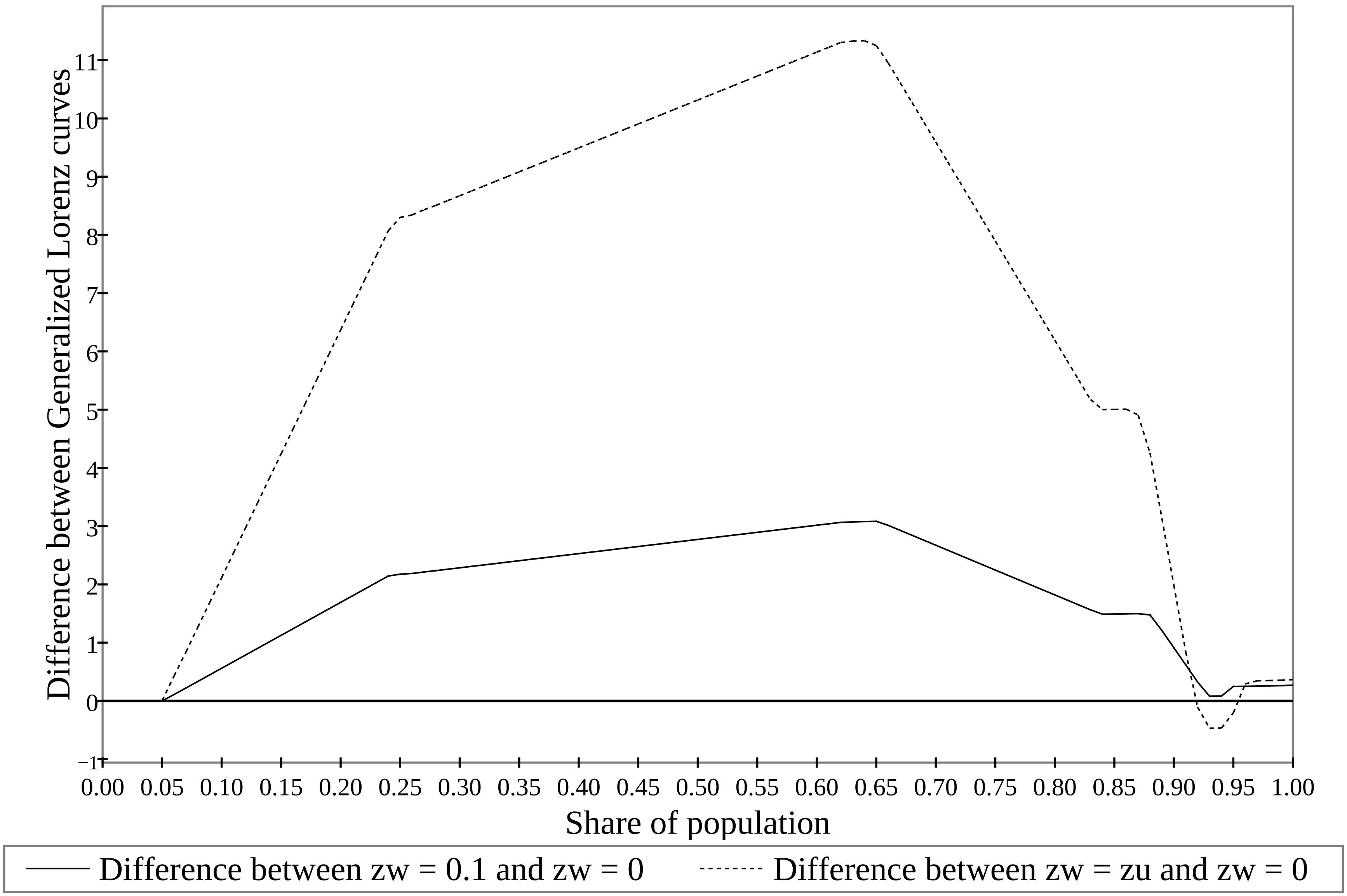
Most importantly, Figure 4 makes clear that the partial reform dominates the pre-reform situation, whereas this is not the case for the full reform (the GL curves intersect twice above the 90th percentile). How can this result be explained? The parallel increase of z_w and τ entails not only redistribution among workers of different skills, but also from workers to entrepreneurs. Entrepreneurs gain from the reform since unemployment falls and the value of an occupied job rises with increased labor market tightness. In the full reform, this gain is so strong that the resulting increase in inequality makes social welfare comparisons ambiguous. It should be noted that this result depends on our assumptions on firm ownership (entrepreneurs form a separate population group and are initially "richer" than workers) and on tax structure (firm profits are not taxed). Alternative assumptions might lead to the conclusion that even the full reform dominates the initial situation according to the GL criterion.[27]

One can therefore conclude from the preceding discussion that the introduction of a partial participation income (with z_w lower than z_u) is an uncontroversial reform in

[26]Figures 4 to 6 were drawn with the help of the DAD 4.2 software (see Duclos et al. (2001).

[27]To see this, consider the two following examples. First, if firms were owned by all individuals in equal shares, the gain in firm profits would be distributed equally without increasing inequality. Second, if firm profits were taxed at a rate of 100%, the tax rate on labor income could be reduced by the corresponding amount and the firms' gains would then be redistributed among all employed workers. Note that a tax on profits (i.e. on the rent created by occupied jobs) does not create any distortion in the present model.

Figure 4: Second−order social welfare dominance



the sense that it is preferred to the current situation in Switzerland by any observer using a social welfare criterion embodying some degree of inequality aversion.

Although we concluded in Section 4 that transfers to individuals outside the labor force are likely to be controversial, it is instructive to explore their implications in terms of GL-curves. Consider first the case of a basic income (BI) which, by contrast to a participation income (PI), is paid also to the inactive. The discussion of the preceding section makes clear that a universal transfer to the inactive, a very heterogeneous population group, increases social welfare only if inequality aversion is very pronounced. This is due in particular to the efficiency loss produced by a BI scheme which taxes more heavily the working population in order to finance the benefits paid to the individuals outside the labor force. Both higher taxes and transfers to the inactive tend to reduce labor market participation. Consider for example, a partial BI equivalent to 25% of the current unemployment benefit ($z_n = z_w = 0.1$, $z_u = 0.4$) and a partial PI of the same level ($z_w = 0.1$, $z_n = 0$). Participation rates are lower for all skill levels with a BI (compared to the PI by 3.5% on average, and by 5.4% for the low-skilled). As to social welfare, Figure 5 illustrates the difference between (partial) BI and PI schemes by depicting the difference between GL-curves produced by the two schemes and the pre-reform GL curve.

As the BI includes transfers to the poorest population group (the disabled), its GL-curve lies above the GL-curve produced by a PI for low incomes. However, because of the higher tax rate implied by the BI, the two GL-curves cross already around the 35th percentile (see Figure 5). The BI scheme does not dominate the pre-reform situation either, according to the GL criterion: the two GL-curves cross above the 70th percentile. This is mainly due to the efficiency loss produced by the BI scheme.

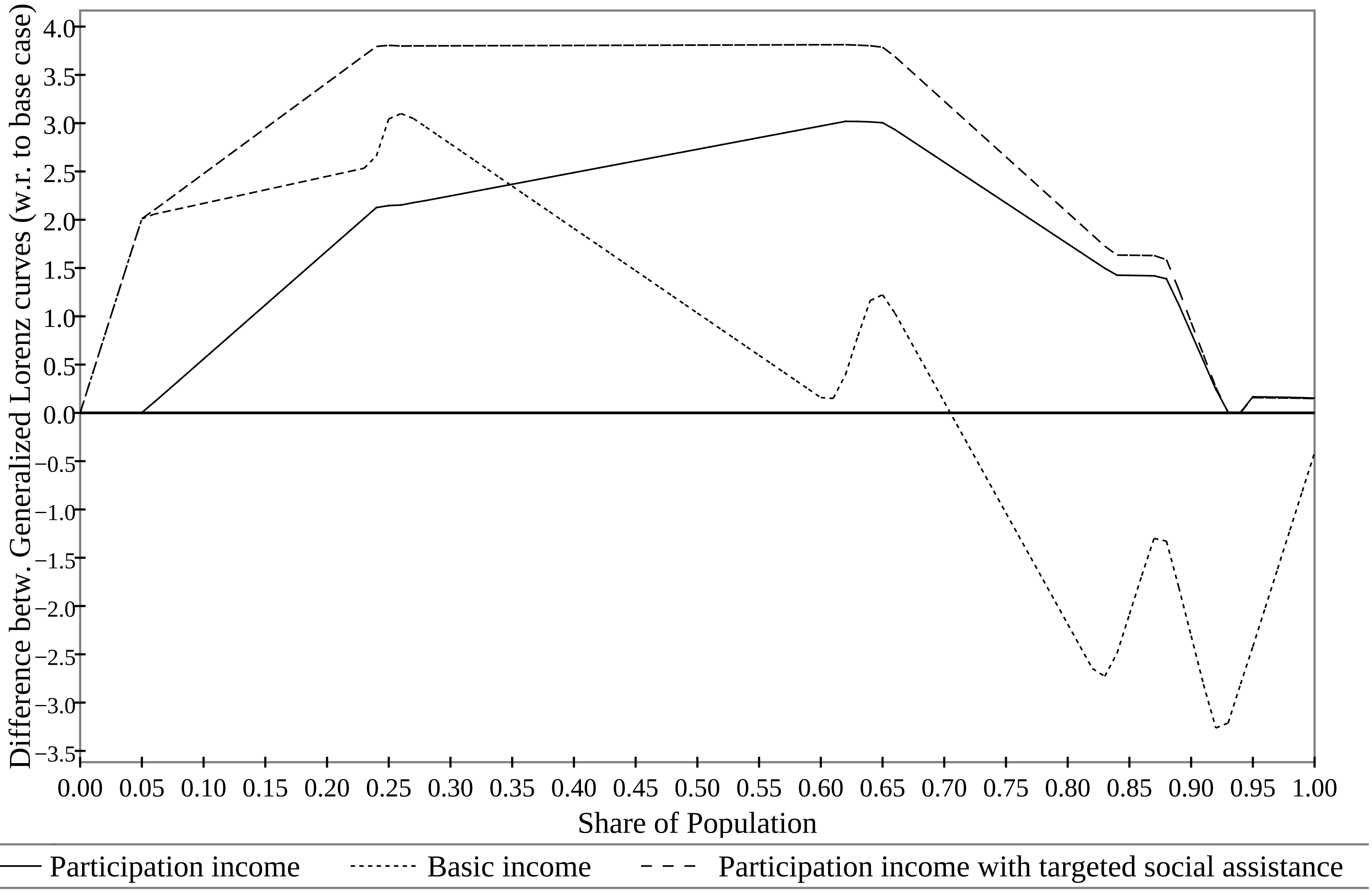
In conclusion, a partial BI scheme is not an uncontroversial reform. For illustration purposes, we report in Figure 5 also a scheme which combines a partial PI with targeted transfers to the disabled, assuming irrealistically that perfect tagging is possible. This scheme dominates the pre-reform situation, but not (in a strict sense) the ”pure” partial PI because economic efficiency is slightly lower.

6 Extensions

Several simplifying assumptions have been adopted in the construction of the theoretical model and in the simulations. In this section we explore the consequences of relaxing Hosios' condition and the possibility of non linear taxation.

Figure 5: Basic income vs. participation income

Second−order social welfare dominance



6.1 Reform policies when $\eta \neq \beta$

In the simulations of the previous sections, we assumed that the worker's relative bargaining strength, β_i, is equal to the elasticity of the matching function, $\eta(\theta_i)$, for all skill levels. This condition ensures that the level of unemployment is "efficient" in the absence of government intervention. If the two parameters do no take identical values, government intervention is required to restore efficiency. However, as discussed in section 3, our policy instruments do not allow to achieve the efficient level of labor market tightness for all skill levels.

In order to address this problem, we expand the set of policy instruments available to the government by assuming that the fixed unemployment benefit z_u is replaced by a benefit conditioned on the former net wage of the unemployed worker: $z_u(w_i) = \bar{z}_u + \bar{\rho} w_i$.[28] Then the optimality condition (23) can be rewritten as follows

$$\bar{\rho} + \frac{\bar{z}_u - z_w}{w_i} = \frac{\eta(\theta_i) - \beta}{(1-\beta)\eta(\theta_i)}. \tag{29}$$

If we assume furthermore that η does not depend on θ_i (as in the popular Cobb-Douglas specification of the matching function), then θ_i will be optimal for all skill levels if the government chooses the following policy:

$$\bar{z}_u = z_w \qquad \text{and} \qquad \bar{\rho} = \frac{\eta - \beta}{(1-\beta)\eta}. \tag{30}$$

If $\eta > \beta$, this policy is reminiscent of the unemployment insurance and assistance schemes operating in most countries: $\bar{\rho}$ can be interpreted as the replacement rate (in terms of the net wage) of unemployment insurance and $\bar{z}_u$ is the expected unemployment assistance, paid in fixed amounts.[29] Optimality with respect to labor market tightness requires the introduction of a PI at the level of unemployment assistance. Note, however, that such a policy is not optimal from the point of view of the participation decision.

To analyze how a PI fares in such a context, we recalibrate the model with $\beta = 0.4$, $\eta = 0.5$, $\bar{\rho} = 0$ and $\bar{z}_u$ is set at the same level as z_u in the preceding section. Figure 6 depicts differences of GL curves for four reform scenarios: partial or full PI

[28] As we assume that the government is unable to observe the skill type of an inactive worker, there is the problem that the potential wage of an individual who enters the labor market at the onset of the reform is not known to the government. For these workers, the unemployment benefit would have to be paid conditional on their future wage which would be revealed at the moment the individual finds a job.

[29] See section 6.2 for a discussion of the equivalence between an economy with two separate states of unemployment — insurance and assistance — and the precise interpretation of $\bar{\rho}$ and $\bar{z}_u$.

with $\bar{\rho}$ set to 0 or 1/3 (the optimal level according to equation (30)). There are no transfers to individuals outside the labor force.

It turns out that none of these reform policies is uncontroversial. By contrast to the "standard" case with $\beta = \eta$, the full PI results in an efficiency loss, even if $\bar{\rho}$ is set to the optimal level. This can be explained by the fact that the higher unemployment benefits require a greater tax rate ($\tau = 0.7$ instead of 0.6), reinforcing the distortion on the participation side. With a partial PI, pure efficiency considerations would lead one to prefer the $\bar{\rho} = 0$ scheme. This does not come as a surprise, since (29) shows that in the case of a partial PI, $\bar{\rho} = 1/3$ cannot be expected to be optimal in a second-best sense. In conclusion, the partial PI with $\bar{\rho} = 0$ seems to be the least controversial reform among the four, since it would be judged to be preferable to the status quo according to almost all social welfare criteria with inequality aversion.

6.2 Non linear taxation and unemployment insurance

The assumptions of linear taxation and fixed unemployment benefit do not describe well the Swiss tax-benefit system. Here we want to check whether the introduction of a PI remains an uncontroversial reform in a more realistic setting.

Consider first the problem of unemployment benefits. In Switzerland, unemployment insurance provides the unemployed worker with a fraction of his former wage (70 percent for an individual without children, 80 percent with children), but this benefit is limited in time (the benefit period extends up to 18 months under certain conditions). If a worker has not succeeded in finding a job during that period, he is eligible for social assistance which is supposed to cover the individual's basic needs (in some cantons, there are special transitional regimes for the long-term unemployed).

Within our model, this system is better described by distinguishing two unemployment states, corresponding to the two benefit regimes. Equation (5) should therefore be replaced by the two following equations

$$rU_i = \rho w_i + \theta_i m(\theta_i)(W_i - U_i) + \lambda(S_i - U_i), \tag{31}$$

$$rS_i = z_s + \theta_i m(\theta_i)(W_i - S_i), \tag{32}$$

where U and S denote utility levels attained with unemployment insurance and social assistance respectively, λ is the inverse of the expected duration of unemployment insurance benefits, ρ is the replacement rate and z_s the fixed social assistance benefit.

Figure 6: Reform policies without Hosios' condition (eta = 0.5, beta = 0.4)

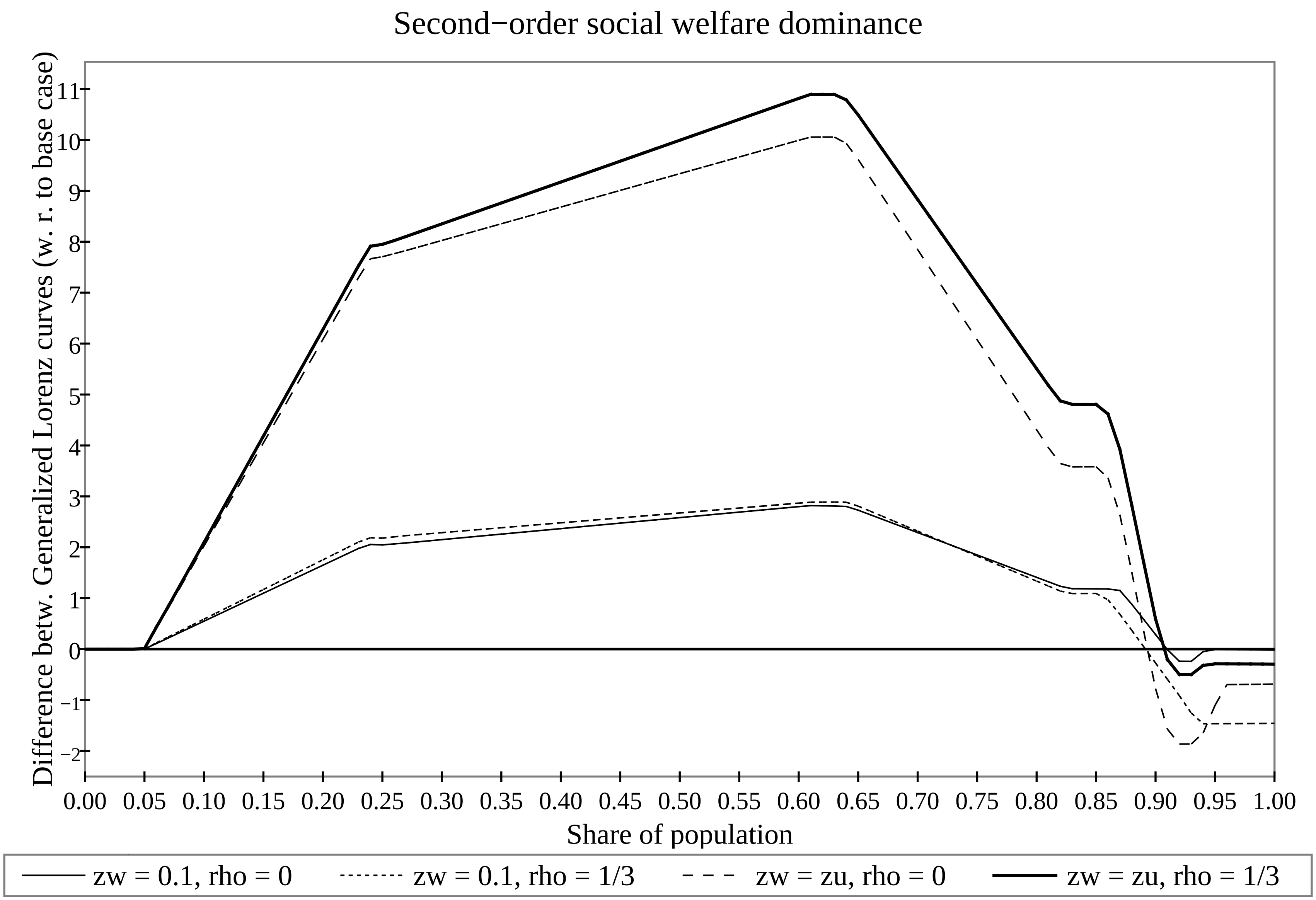


Table 5: Current tax structure in Switzerland and simulated change to participation income / flat tax[a]

Skill level	Initial yearly wage (Sfr.)	Current tax-benefit structure marginal tax rate	average tax rate	implicit z_w	unemployment benefit	PI / FT[b] average tax rate
University	115640	0.435	0.319	13371	35873	0.357
Superior education	74600	0.376	0.276	7507	29003	0.299
Apprenticeship	53770	0.336	0.246	4844	25060	0.236
Basic skills	37420	0.298	0.214	3111	21633	0.137

[a] All tax rates are defined on the basis of pre-tax income, e.g. the marginal tax rates correspond to $\tau_i/(1+\tau_i)$ in the model. The current Swiss tax rates include personal income taxes at the federal, cantonal and communal levels, and social security contributions by employers and employees (13%; including the public "pay-as-you-go" AVS/AI; excluding contributions to pension funds). Source: Administration fédérale des contributions, Charge fiscale en Suisse 2000, Berne.

[b] The marginal (flat) tax rate is 0.461. It is determined endogenously through the government's balanced budget requirement. The participation income is 12'000 Sfr. per year.

It is straightforward to show that these two equations are equivalent to

$$rU_i = \delta_i z_s + (1-\delta_i)\rho w_i + \theta_i m(\theta_i)(W_i - U_i) \tag{33}$$

with $\delta_i = \lambda/[r+\theta_i m(\theta_i)+\lambda]$. Thus the dual system currently applied in Switzerland can be represented by a unique benefit regime with a fixed and a variable (wage-dependent) component. In the simulations below, we set $\rho = 0.73$, z_s is equivalent to 20'000 Sfr. per year, and λ^{-1} is set to 7 months.[30]

Turn now to the non linear tax structure. If personal income taxes are consolidated with contributions to social security, the Swiss tax system is characterized by a marginal tax rate which rises from 13 percent for low incomes to about 50 percent. Table 5 shows average and marginal tax rates for four levels of income. Our model can be extended to account for this tax structure by assuming that the tax schedule is represented by several linear segments. This amounts to differentiating τ and z_w by skill level i. For each skill level, there is an implicit z_w that is consistent with the observed average and marginal tax rates (see fifth column of Table 5).[31]

In the Swiss tax system, the implicit z_w rises proportionally more than income. By contrast, the schedule of unemployment benefits is more compressed because of

[30] Note that the values for ρ and z_s are defined net of taxes. For example, the pre-tax replacement rate of 70% results for all skill levels in post-tax replacement rates of around 73%.

[31] The exact relationship between these variables is given by $z_w = (\tilde{\tau} - \tilde{t})\tilde{w}$, where $\tilde{\tau} = \tau/(1+\tau)$ and $\tilde{t}$ denote the marginal and average tax rates (based on pre-tax income) and $\tilde{w}$ is the gross wage rate.

Table 6: Impact of the simulated change to participation income / flat tax on the labor market

Skill level	Current tax structure		PI / Flat tax	
	Particip. rate	Unempl. rate	Particip. rate	Unempl. rate
University	0.937	0.031	0.931	0.031
Superior education	0.891	0.033	0.886	0.031
Apprenticeship	0.843	0.036	0.845	0.030
Basic skills	0.776	0.042	0.795	0.029

the minimum income guarantee. When the model is recalibrated for the four skill categories, the combination of these two schedules results in unemployment rates that are inversely correlated to skill levels (see Table 6).

Consider now the introduction of a PI, financed by a flat tax (FT). The PI is set to 12'000 Sfr. per year, close to the implicit z_w of the most highly skilled individuals. The unemployment benefit system is kept unchanged. The flat tax rate, which replaces the entire direct tax schedule, is determined endogenously in such a way that it generates enough revenues to cover both the outlay on the PI and the initial expenditure level of the government. The resulting tax rate (46.1%, or 33% if social security contributions are excluded) turns out to be slightly higher than the current marginal tax rate for University-educated workers, but it is lower than the current maximum marginal tax rate.

The PI/FT scheme has a considerable impact on unemployment and participation rates of the least-skilled workers. Their participation rates increase by almost two percentage points and the unemployment rate is cut by almost a third (see Table 6). Steady-state unemployment rates are reduced for the three lower skill levels (94% of population), a result that can be explained by the greatly reduced divergence between z_u and z_w. Note that unemployment rates react differently in the short run. For example, as the participation rate of workers with basic skills increases immediately with the PI/FT reform, they queue up for new jobs and their unemployment rate rises to 6.5% in the very short run, before decreasing progressively to the steady-state value of 2.9%. The only detrimental effect on labor market indicators is the slight fall (by half a percentage point) in the participation rates of the two highest skill categories. This is a consequence mainly of the increased average tax rates faced by these workers.

Compared to the current situation, the PI/FT scheme achieves more equality and greater efficiency. The PI/FT scheme turns out to be an uncontroversial reform

Table 7: Impact of the simulated change to participation income / flat tax on social welfare and inequality

	Indicator		Current tax structure	PI / Flat tax	Change (%)
Social welfare	Atkinson[a]	$\epsilon = 0$	339.27	340.05	+0.2
		$\epsilon = 0.5$	315.47	317.44	+0.6
		$\epsilon = 2.0$	274.80	279.88	+1.8
Inequality	Atkinson	$\epsilon = 0.5$	0.0702	0.0665	-5.3
		$\epsilon = 2.0$	0.1900	0.1769	-6.9
	Gini		0.2620	0.2480	-5.3

[a]Equally distributed equivalent utility. If $\epsilon = 0$, this indicator is equal to mean utility.

according to the criterion of second-order social welfare dominance. This is reflected in the improvement of social welfare and inequality indicators reported in Table 7. Note that these indicators are calculated on the basis of the utilities of all individuals (including those outside the labor force), allowing to define a consistent indicator of economic efficiency. Although no poverty index is calculated (because of the discrete distribution of skills), it is clear that the PI/FT scheme would tend to decrease the poverty rate among working individuals.

Despite the detailed representation of the Swiss direct tax system, the results of this section should be taken with a grain of salt. In particular, the four skill categories give only a very rough approximation of the true distribution of individual productivities, neglecting in particular the extremes of the distribution. Our estimation of the required flat tax rate is therefore rather unprecise. Moreover, as part-time employment is not taken into account in the simulations, we avoided to address the awkward issue of spelling out exactly the conditions that a worker has to fulfill in order to be eligible for the PI.

7 Conclusion

This paper analyzes the effects of tax-benefit reforms on social welfare in a model integrating endogenous labor supply and unemployment. By contrast to the traditional analysis of income taxation, more redistribution does not necessarily come at the expense of economic efficiency in our framework. Having explored numerically the consequences of different tax structures for social welfare, we show that in the Swiss context a participation income would be an ethically uncontroversial reform in the sense that it would be unanimously preferred to the current situation according to all SWFs based on the criterion of Pareto and the principle of transfers.

In our framework, the introduction of an EITC or of low-wage subsidies would lead to similar results than a participation income. It should, however, be emphasized that unanimous judgments on the social welfare effects of these policies can only be obtained if the situation of the unemployed does not deteriorate with the reform. Akin to the participation income, an EITC or low-wages subsidies would reduce the unemployment trap inherent to the Swiss tax-benefit system. Interestingly, this argument recalls the result obtained by Saez (2002) in an optimal taxation setting without unemployment: if labor market responses are concentrated along the extensive margin, the optimal tax schedule is similar to an EITC. Our results suggest that the presence of unemployment benefits is likely to reinforce this result, since the introduction of an EITC then also leads to an efficiency gain.

The case for a participation income or an EITC should however not be overstated, for three reasons. First, we have implicitly assumed that the participation conditionality can be enforced without cost. Van der Linden (2004) assumes that job search effort by the unemployed can only be imperfectly observed by the government. In this case, a basic income induces lower monitoring costs than a participation income, but the simulations of Van der Linden (2004) suggest that these cost savings are not sufficient to compensate for the higher financing requirements of a basic income.

Second, the existence of a dual labor market is not taken into account in our analysis. If there are "good" and "bad" jobs in the economy because of different (sunk) capital costs, Acemoglu (2001) shows that the composition of jobs is always inefficiently biased toward low-wage jobs because of "hold-up" problems. In this context, the reduction in the average tax rates for low incomes implied by a participation income or EITC is likely to shift the composition of low-skill employment even further towards the "bad jobs", leading to an efficiency loss. Kleven and Sørensen (2004) obtain an analogous result in a dual labor market with efficiency wages.

Third, the participation income, the EITC and low-wage subsidies do not address the problem of the low take-up rates of social assistance. In Switzerland, social assistance schemes are operated at the municipal level, in ways that create stigmatization and entail low take-up rates. Neither of these reform policies is likely to fill in these holes in the social safety net. The EITC might even convey the message that only the working poor are worthy of help and thereby increase stigmatization of beneficiaries of social assistance.

Appendix

Contribution of the inactive to social welfare

This appendix describes how to approximate the contribution of individuals outside the labor force, Y_{iN}, to social welfare (see equation (28) in the main text). The utility of a non participant depends on the value of x and z_n as given by (10). The contribution of all non-participants of skill i to social welfare is the mathematical expectation of (10) over all the non-participants of the same skill.

With a Log-normal distribution for x, such as $\log(x) \sim N(\mu, \sigma^2)$, we have:

$$(1-\pi_i)\ (r\ Y_{iN})^{1-\ \epsilon} = \int_{\xi_i}^{\infty} \frac{(x+z_n)^{1-\ \epsilon}}{\sqrt{2\pi}\ \sigma\ x}\ \mathrm{e}^{\left(-\frac{1}{2}\frac{\log(x)-\mu}{\sigma}\right)}\ \mathrm{d}x,\ \ \epsilon \neq 1. \tag{A1}$$

To be able to compute the integrand, we use Taylor's expansion of the function $f(z_n) = (x+z_n)^{1-\ \epsilon}$ around $z_n = 0$:

$$f(z_n) = x^{1-\ \epsilon} + (1-\ \epsilon)\ z_n\ x^{-\ \epsilon} - \frac{\epsilon(1-\ \epsilon)}{2} z_n^2 x^{\ \epsilon - 1}. \tag{A2}$$

This gives the following expression for (A1):

$$\begin{aligned}(1-\pi_i)\ (r\ Y_{iN})^{1-\ \epsilon} \ =\ & \mathrm{e}^{\mu(1-\ \epsilon)+\frac{\sigma^2}{2}(1-\epsilon)^2}\left[1-\Phi\left(\tfrac{\log(\xi_i)-\mu-\sigma^2(1-\ \epsilon)}{\sigma}\right)\right] \\ & +(1-\ \epsilon)x\mathrm{e}^{-\mu\ \epsilon+\frac{\sigma^2}{2}\epsilon^2}\left[1-\Phi\left(\tfrac{\log(\xi_i)-\mu+\sigma^2\ \epsilon}{\sigma}\right)\right] \\ & +\tfrac{\epsilon\ (1-\ \epsilon)}{2}x^2\mathrm{e}^{-\mu(1+\ \epsilon)+\frac{\sigma^2}{2}(-1-\epsilon)^2}\left[1-\Phi\left(\tfrac{\log(\xi_i)-\mu+\sigma^2(1+\ \epsilon)}{\sigma}\right)\right],\end{aligned} \tag{A3}$$

where $\Phi(\cdot)$ is the cdf for the $N(0,1)$ distribution.

From this, we can extract the expression for Y_{iN}:

$$\begin{aligned}Y_{iN} \ =\ & \tfrac{1}{r}\left\{\tfrac{1}{1-\pi_i}\left[\mathrm{e}^{\mu(1-\ \epsilon)+\frac{\sigma^2}{2}(1-\epsilon)^2}\left[1-\Phi\left(\tfrac{\log(\xi_i)-\mu-\sigma^2(1-\ \epsilon)}{\sigma}\right)\right]\right.\right. \\ & +(1-\ \epsilon)x\mathrm{e}^{-\mu\ \epsilon+\frac{\sigma^2}{2}\epsilon^2}\left[1-\Phi\left(\tfrac{\log(\xi_i)-\mu+\sigma^2\ \epsilon}{\sigma}\right)\right] \\ & \left.\left.+\tfrac{\epsilon\ (1-\ \epsilon)}{2}x^2\mathrm{e}^{-\mu(1+\ \epsilon)+\frac{\sigma^2}{2}(-1-\epsilon)^2}\left[1-\Phi\left(\tfrac{\log(\xi_i)-\mu+\sigma^2(1+\ \epsilon)}{\sigma}\right)\right]\right]\right\}^{\frac{1}{1-\ \epsilon}}.\end{aligned} \tag{A4}$$

When $z_n = 0$, the last expression boils down to:

$$Y_{iN} = \frac{1}{r}\left\{\frac{1}{1-\pi_i}\left[\mathrm{e}^{\ \mu(1-\ \epsilon)+\frac{\sigma^2}{2}(1-\ \epsilon)^2}\left[1-\Phi\left(\frac{\log(\xi_i)-\mu-\sigma^2(1-\ \epsilon)}{\sigma}\right)\right]\right]\right\}^{\frac{1}{1-\ \epsilon}}. \tag{A5}$$

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