

# Pareto-Improving Unemployment Policies

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We investigate how continental European unemployment can be reduced without reducing unemployment benefits and without reducing the net income of low-wage earners. Lower unemployment replacement rates reduce unemployment, the net wage and unemployment benefits. A lower tax on labour increases net wages and unemployment benefits. Combining these two policies allows to reduce unemployment without reducing net income of workers or of the unemployed. Such a policy becomes self-financing under realistic parameter constellations when taxes are reduced only for low-income workers.

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## 1 Introduction

Many European countries are still struggling with high unemployment rates. Sufficiently many analysts agree on two facts: Unemployment is heavily concentrated among low-skill individuals and demand for low-skill individuals could be increased by reducing their labour costs. Labour costs can be influenced by the government directly by reducing taxes or social security payments or indirectly by reducing unemployment payments in order to decrease bargained wages. What should the government do?

The starting point of this paper is a certain concern for income levels at the lower end of the income distribution. This could be justified on pure egalitarian grounds, on considerations based on social welfare maximization (where income uncertainty would require 100% insurance under risk aversion unless there is moral hazard), on efficiency arguments (less inequality implies less crime; see e.g. Thorbecke and Charumilind (2002), for a survey) or on political economy considerations (income effects for the low-skilled or for insiders can be crucial for the acceptance of reforms, see e.g. Grüner (2002)). Whatever the specific reasoning, the question would always be whether unemployment can be reduced without decreasing the

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net wage of the low skilled or net benefits of the unemployed. This is the question of this paper.

While reducing unemployment with higher income for everybody is obviously possible from a theoretical perspective (with lump-sum taxation, any increase in efficiency can be made Pareto-improving; see Roed and Strom (2002) for a more general discussion in second-best worlds), can this also be achieved with the existing instruments a typical government has at its disposal? Could Germany, to provide an example, have implemented labour market reforms - different from the 2005 Hartz IV reforms - having a more Pareto-improving spirit? To find an answer, we use the simplest theoretical framework which allows to treat these issues. Our static economy, presented in section 2, produces one homogenous good by employing high-skill and low-skill workers. Only the low-skilled are organized in unions.<sup>2</sup> Unions ration labour and thereby cause unemployment. The government provides unemployment benefits, which amplifies unemployment, and taxes labour. Taxation should be understood in a broad sense and includes labour taxes per se and social security contributions. In equilibrium, there will be three groups: the high-skilled, employed low-skilled and unemployed low-skilled.

The policy experiments we analyze imply a simultaneous reduction of unemployment benefits and the tax rate.<sup>3</sup> The objectives of the experiments are to (i) reduce unemployment, (ii) keep either the net-wage of a worker or the net payment to an unemployed worker at its current level and (iii) preserve the current budget balance of the government, i.e. policy reforms must be self-financing. As instruments, we use the tax rate on labour and the replacement rate.<sup>4</sup> We also vary the progressiveness of labour taxation. A policy reform that preserves net wages of workers will be called an equality-preserving reform (EPR), a reform that preserves net payments to the unemployed will be called ambitious EPR.<sup>5</sup> Given our institutional setup, a self-financing ambitious EPR is Pareto-improving. We will therefore use “self-financing ambitious EPR” and Pareto-improving reform synonymously.

Section 3 shows that a reduction in payments to the unemployed and a contemporaneous reduction in labour taxes reduces unemployment and keeps net wages of workers at the pre-

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<sup>2</sup>When defining skill by educational level, empirical support for this assumption is fairly overwhelming (e.g. Schnabel (2002)). See Sørensen (1997), p. 238 for a similar assumption.

<sup>3</sup>The first-best policy to restore efficiency in our economy would be to abolish unemployment benefits and trade unions. We take the existence of trade unions as given which, given constitutions of many countries, is a realistic description of reality. For countries where unions play a less prominent role, we believe that our comparative static results are robust to other reasons for unemployment like efficiency wages, insider-outsider aspects or matching. The justification for unemployment benefits comes from some equality considerations which could be modelled by a social welfare function (see e.g. Atkinson, 2000). We assume here that policy makers can only undertake “marginal” reforms, given historically grown welfare and tax systems.

<sup>4</sup>These are two of the measures which the empirical literature on the effect of institutions on unemployment uses regularly (see e.g. Belot and van Ours (2004) for a recent contribution and the references therein). Labour taxes are generally found to have a negative impact on unemployment while the replacement rate is not always significant. The duration of unemployment payments, however, is highly significant. As we use a static model, we view our theoretical replacement rate as a joint present-value measure of the level and the length of unemployment payments. See the conclusion for further discussion.

<sup>5</sup>Our objective is to keep welfare of individuals at certain levels that are not affected by some reform. In an envy-free non-growing world (which we model), this requires constant net income and is independent of other individuals' welfare. Hence, we somewhat misuse the term 'equality' as equality is a relative concept and we are analysing absolute levels.

reform level. Reducing the replacement rate increases employment and both the gross and the net wage fall. As in our institutional setup the labour tax has no effect on the gross wage, the tax can be reduced such that the fall of the net wage is just compensated.<sup>6</sup> In some cases, depending on parameter values, an EPR is also self-financing.

Needless to say that an EPR generally hurts the unemployed: the reduction in the labour tax is designed to compensate workers for lower net wages. The unemployed are directly affected by the reduction in the replacement rate whose effect on unemployment payments is usually not compensated for by lower taxation. Falling net payments to the unemployed could be avoided by reducing taxes on labour even further. An ambitious EPR would result.

When analyzing the effects of EPRs and ambitious EPRs in section 4, they are self-financing only in “rare cases”. EPRs are generally self-financing for a larger set of parameters characterizing the share of skilled workers in the work force and the pre-reform tax rate. Ambitious EPRs often require implausible parameter assumptions in order to be self-financing. Policy reforms that are based on broad tax reductions in order to alleviate net-wage losses following cuts in replacement rates are therefore difficult to be put in place.

We therefore extend policy options in section 5 by allowing to reduce labour taxes only for the low-skilled and keeping them at the pre-reform level for high-skilled workers. It turns out that with this way of introducing more progressiveness in taxation, the EPR is always self-financing and that the ambitious EPR is self-financing for realistic parameter values. Pareto-improving reforms are possible.

We finally ask whether our policy proposals preserve existing relative net wages. This is important as we would like to avoid that incentives to accumulate human capital (even though not explicitly modelled) decrease. We find that a self-financing ambitious EPR increases, under realistic parameter values, net-wage inequality. Hence, incentives to invest in education are preserved under Pareto-improving policies.

The paper is related to two strands of the literature. First, it is in the spirit of the literature which analyses the effects of tax reforms on unemployment in imperfectly competitive labour markets, see for example Koskela and Vilmunen (1996) who analyze tax progression, Kolm (2000) who analyses the tax structure in an economy with home production or, more recently Kleven and Sørensen (2004) who model tax shifts in a dual labour market. All these models derive employment and welfare effects of fairly sophisticated tax reforms. Contrasting this, our tax reform is simpler, but it is combined with a reform of the benefit system. This allows us to achieve multiple objectives: Reduce unemployment while keeping income of certain groups constant.<sup>7</sup> Technically speaking, we undertake a comparative static analysis under equality constraints. These constraints were not explicitly analyzed in previous work. They are, however, central for many policy makers.

Second, our paper is related to the literature which models proposals that aim at preserving certain minimum incomes without causing too strong efficiency losses. Most of these proposals were developed for countries like the US where the institutional background differs from Europe. The most well-known is probably the negative income tax (NIT) proposal going back to Friedman (1962). Its main objective is to provide low-income workers with some

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<sup>6</sup>An analysis of other institutional setups was undertaken in Lingens and Wälde (2006). Due to space constraints, they are not presented here. See also footnote 14.

<sup>7</sup>Lommerud et al. (2004) discuss optimal taxation when the policy maker is inequality averse. This is the only goal which tax policy must achieve since there is no unemployment in the economy.

guaranteed basic income without reducing incentives to work.<sup>8</sup> An alternative approach is a wage-subsidy to workers or to firms (for example Snower (1994) or Phelps (1994, 1997)), known as Earned Income Tax Credits (EITC).<sup>9</sup>

The NIT or EITC proposals are sometimes applied to continental European countries. Unemployment could be reduced without increasing inequality, the argument at least implicitly goes, if on the one hand, the institutional background in, say, France, Germany and Italy is changed, i.e. if e.g. bargaining power of unions is reduced, and, on the other hand, if wage subsidies or negative income taxes are introduced. Such an approach has several disadvantages, however. First, it is politically not credible; individuals proposing a reduction in union power are typically not those who favour certain minimum net-wage levels. Second, while some institutions would be removed, new institutions would have to be created (apart from countries that already have e.g. certain forms of subsidies to low-wage earners). On a continent caught by many institutional details, this is not desirable. Further, as Snower (1994) and Phelps (1994) write themselves, these proposals are not necessarily equality preserving and the question of self-financing has not been investigated.<sup>10</sup> We therefore believe that it is useful to preserve the existing institutional setup in many European countries and use existing instruments to reduce unemployment without increasing poverty.<sup>11</sup>

A further important difference of our suggestion compared to the negative income tax proposal is the view about the origins of unemployment. If a certain income is guaranteed to individuals independently of whether they work, this is generally argued to create unemployment at the lower wage income as it is not rational for agents to accept a job that pays lower net income than, say, social welfare payments. While any increase in work incentives at unchanged net-income is desirable, we think that unemployment caused by social welfare payments is only part of the story. Only about 1/3 of the unemployed (e.g. in Germany in 2004) had been unemployed for 1 year or more. The majority therefore receives unemployment insurance payments and we capture this (in our view more relevant) type of unemployment by rationing effects of union wage setting (which is especially relevant for Continental Europe).

Finally, the same concern for not reducing the welfare state in an inappropriate way is shared by Atkinson (2000). He analyses the optimal size and structure of social transfers when a country is subject to budgetary pressure and labour market shifts against unskilled workers. He especially focuses on optimal reactions when societies differ in their attitude towards distribution (where examples are labeled “United States” and “Continental Europe”). We do not employ (different cases of) a social welfare function as he does but rather focus on

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<sup>8</sup>A less expensive variety of the NIT proposal is the targeted NIT, where only a certain group falls under a NIT scheme. This could be the long-term unemployed as in Jerger and Sperman (1997) or those participating in the labour market as in Van der Linden (2004).

<sup>9</sup>Both concepts and their implementation in US welfare policy are presented by Moffitt (2003). An analysis of which of these concepts is preferable from an optimal taxation perspective is provided by Saez (2002). An overview over different implementations of the Earned-Income Tax Credit in OECD countries is provided by EEAG (2002).

<sup>10</sup>There is evidence that programs that provide tax incentives to increase employment can be self-financing indeed, see Michalopoulos, Robins and Card (2005). Even though this is micro-economic evidence, it suggests that the search for self-financing reforms on the aggregate level is worth being undertaken.

<sup>11</sup>Unemployment in European countries is certainly also due to efficiency wage aspects. The effect of low-wage subsidies in such a framework is analysed in Hoon and Phelps (2003), sect. 2.

an EPR or of an ambitious EPR. This can be viewed as examples for what he calls “Rawlsian government”.

## 2 The model

### 2.1 Technology

Imagine an economy where an aggregate technology is used for producing a consumption good. Factors of production are high-skilled and low-skilled labour. The two groups of labour can be defined according to educational achievement or their labour income. The aggregate technology is given by

$$Y = F(H, L), \quad (1)$$

where  $F(\cdot)$  has constant returns to scale. Firms act under perfect competition and their implicit labour demand functions are

$$F_L(H, L) = w_L, \quad F_H(H, L) = w_H, \quad (2)$$

where gross factor rewards, including taxes and social security contributions, are  $w_H$  and  $w_L$ .

Most of the time, we work with a CES production function. Normalizing a TFP measure to unity and denoting the share-parameter by  $\beta$ , we have

$$Y = (\beta H^\theta + (1 - \beta) L^\theta)^{1/\theta}, \quad (3)$$

where  $\theta$  determines the elasticity of substitution  $\sigma$  between high-skilled and low-skilled labour,

$$\left. \begin{array}{l} 1 > \theta > 0 \\ \theta = 0 \\ \theta < 0 \end{array} \right\} \Leftrightarrow \sigma \equiv \frac{1}{1 - \theta} \begin{array}{l} \geq \\ = \\ < \end{array} 1. \quad (4)$$

In some cases, we also restrict attention to the Cobb-Douglas (CD) case, where, for  $\theta = 0$  in (3),

$$Y = H^\beta L^{1-\beta}. \quad (5)$$

### 2.2 Households

There are two types of households. The high-skill households and the low-skill households. Labour supply of the high-skilled is determined by utility maximization. Their preferences are captured by  $U = U(C, H)$ , where  $U(\cdot)$  has the usual properties. The budget restriction of such a household is  $(1 - \tau_H) w_H H = C$ . There are  $L_s$  households that are less skilled and their preferences depend on consumption only; employment  $L$  is determined by unions and will be presented in the next subsection.<sup>12</sup>

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<sup>12</sup>An earlier draft had endogenous labour supply of low-skilled in addition to union labour rationing. While principles remained the same, tractability became much more difficult.

Utility maximizing labour supply of highly-skilled is determined, apart from parameters, by net wages only. It can be expressed by an implicit human-capital supply curve  $w_H^s$  with the tax on high-skill income and human capital as arguments,

$$H = H((1 - \tau_H) w_H) \Leftrightarrow w_H = w_H^s(\tau_H, H). \quad (6)$$

Assuming a CES utility function of the form  $U = (\gamma C^\lambda + (1 - \gamma)(T - H)^\lambda)^{1/\lambda}$ , we get a human capital supply curve of (app. 8.1)

$$w_H = \frac{1}{1 - \tau_H} \left( \frac{1 - \gamma}{\gamma} \right)^{1/\lambda} \left( \frac{T - H}{H} \right)^{(\lambda-1)/\lambda}. \quad (7)$$

Human capital supply increases in the net wage when  $0 < \lambda < 1$  and decreases when  $\lambda < 0$ . In what follows, we will always assume an upward sloping supply curve for human capital, i.e.  $0 < \lambda < 1$ .

With a CD example like  $U = C^\gamma (T - H)^{1-\gamma}$ , human capital supply is fix (app. 8.1),

$$H = \gamma T. \quad (8)$$

## 2.3 Unions

Low-skill individuals are organized in unions. Unions operate at the level of a sector or firm  $i$ . The objective of the unions is to maximize net labour income of its members in excess of alternative income a worker would earn in case of employment in other firms or unemployment. Union preferences can be expressed by  $(1 - \tau_L) w_i L_i + B_i [M_i - L_i]$ , where  $w_i$  is the gross wage of low-skill workers in sector  $i$  and  $B_i$  and  $M_i$  denote alternative income and the number of members, respectively. Taking  $B_i$  and  $M_i$  as parametric, the objective function can be expressed in the more simple form  $u_i = L_i(w_i) [(1 - \tau_L) w_i - B_i]$ . Maximization subject to labour demand in sector  $i$  similar to (2) yields (app. 8.2) the usual markup of the net wage over alternative income<sup>13</sup>,

$$(1 - \tau_L) w_i = B_i / (1 - \eta_L^{-1}), \quad (9)$$

where the markup  $(1 - \eta_L^{-1})^{-1}$  is the lower, the larger the wage elasticity  $\eta_L$  of demand for low-skilled,

$$\eta_L \equiv - \frac{\partial L_i(w_i)}{\partial w_i} \frac{w_i}{L_i(w_i)} > 0. \quad (10)$$

Alternative income  $B_i$  of workers is given by income from other sectors or from unemployment benefits  $b$  when not employed. Assuming identical probabilities for a worker not employed in  $i$  to find work in another sector  $s$  or to become unemployed, alternative income amounts to  $B_i = \sum_{j=1}^s (1 - \tau_L) w_j \frac{L_j}{L_s} + b \frac{L_s - L}{L_s}$ . In a symmetric equilibrium, where every firm and every union behaves the same, the alternative income is given by

$$B_i = (1 - \tau_L) w_L \frac{\sum_{j=1}^s L_j}{L_s} + b \frac{L_s - L}{L_s} \equiv (1 - \tau_L) w_L [1 - u] + bu, \quad (11)$$

<sup>13</sup>This markup expressions requires a labour demand elasticity that is larger than unity,  $\eta_L > 1$ . This is due to the monopoly union setup. More elaborate approaches to unions than this simple right-to-manage model exist. Again, we believe that our main results are valid for other specifications as well.

where the second equality defines the unemployment rate  $u$  of low-skilled.

To determine the unemployment rate, we need the wage setting curve of the unions. This curve shows the wage the unions will set as a function of low-skill employment, hence as a function of the overall low-skill labour market situation. Plugging (11) into (9) gives the general wage setting curve,

$$(1 - \tau_L) w_L = (1 - \eta_L^{-1})^{-1} ((1 - \tau_L) w_L [1 - u] + bu). \quad (12)$$

The unemployment benefit system in this paper is modelled as a “net-Bismarck” system. This system is the most prevalent institutional setting in OECD countries. This is also the system where we can present our central argument in the most straightforward way.<sup>14</sup> In “net-Bismarck” systems, unemployment benefits are a fixed fraction  $\zeta$  (which is the replacement rate) of the net wage in the economy,

$$b = \zeta [1 - \tau_L] w_L. \quad (13)$$

Inserting  $b$  into (12) gives the wage setting curve

$$(1 - \zeta) u = \eta_L^{-1}. \quad (14)$$

For later purposes, we compute the demand elasticity  $\eta_L$  for our CES and CD technologies. When we assume unions to take  $H$  as parametric, we compute  $\eta_L^{-1}$  from the CES version of (2) and get (app. 8.3)<sup>15</sup>

$$\eta_L^{-1} = (1 - \theta) \frac{\beta}{\beta + (1 - \beta) (L/H)^\theta}. \quad (15)$$

As  $0 < H/L < \infty$ ,  $\eta_L^{-1}$  is bounded by  $0 < \eta_L^{-1} < 1 - \theta$ . Note that  $\theta < 1$  from (4). For the Cobb-Douglas case, the (inverse) labour demand elasticity is (app. 8.3), considering again  $H$  as parametric for the union,

$$\eta_L^{-1} = \beta. \quad (16)$$

This is a special case of (15) for  $\theta = 0$ .

## 3 Equilibrium analysis of EPRs

### 3.1 Equilibrium and comparative statics

We now analyze the unemployment equilibrium in the economy. Market equilibrium for highly skilled individuals follows from the demand function (2) and the supply function (6)

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<sup>14</sup>Unemployment benefits in OECD countries are computed in at least three different ways. One can distinguish between institutional setups that can be called Beveridge system (unemployment payments are wage independent), net-Bismarck system (unemployment payments are proportional to net wages) and gross-Bismarck systems (unemployment payments are proportional to gross wages). Following OECD (2002, tab. 2.2 and 2.3), Canada, France, Germany, Italy, Spain, Sweden and the USA have a predominantly net-Bismarck system, Austria, Japan and Portugal have a gross-Bismarck system and Australia, Ireland, New Zealand and the UK have a Beveridge system. The analysis performed here for the net-Bismarck system is performed also for the gross-Bismarck and Beveridge systems in Lingens and Wälde (2006).

<sup>15</sup>When computing the demand elasticity  $\eta_L$ , we take  $H$  as parametric: the union neglects the effects of its wage setting on employment of high-skilled but does take into account output effects through changes in employment of low-skilled.

or (7). The labour-demand equation for low-skilled workers is given by (2) and the wage setting curve is (14). Reproducing all three equations here gives

$$F_H(H, L) = w_H^s(\tau_H, H), \quad F_L(H, L) = w_L, \quad (1 - \zeta)u = \eta_L^{-1}. \quad (17)$$

This system determines high-skill employment  $H$ , low-skill employment  $L$  and the gross wage  $w_L$  for low-skilled (noting that  $u \equiv (L_s - L)/L_s$  by definition and  $\eta_L$  is either a constant or a function of  $H$  and  $L$  - see (15) and (16)). These equilibrium quantities depend on the replacement rate  $\zeta$  and the tax  $\tau_H$  for high-skill wages.

We focus on labour taxation and the replacement rate in our policy analysis. When we do a comparative static analysis, totally differentiating gives after some steps (app. 9)

$$dH = -\frac{(a_2 + (1 - \zeta)L_s^{-1})\frac{L}{w_L}\epsilon_H a_1}{N}d\tau_H - \frac{\epsilon_H \eta_L^{-1} \frac{L}{w_H} u}{N}d\zeta, \quad (18)$$

$$dL = -\frac{\epsilon_H a_1 \frac{L}{w_L} a_2 \frac{L}{H}}{N}d\tau_H - \frac{u \frac{L}{w_L} (\epsilon_H \eta_H^{-1} + 1)}{N}d\zeta, \quad (19)$$

$$dw_L = -\frac{\epsilon_H a_1 \eta_H^{-1} \frac{w_H}{w_L} (1 - \zeta) L_s^{-1}}{N}d\tau_H + \frac{u \eta_L^{-1}}{N}d\zeta, \quad (20)$$

where the coefficients and the determinant  $N$  are given by

$$a_1 = \frac{\partial w_H^s}{\partial \tau_H} \frac{H}{w_H} \geq 0, \quad a_2 = \frac{\partial \eta_L^{-1}}{\partial L} \geq 0 \Leftrightarrow \theta \leq 0, \quad (21)$$

$$\eta_H^{-1} \equiv \frac{\partial w_H}{\partial H} \frac{H}{w_H}, \quad \epsilon_H \equiv \frac{\partial H}{\partial w_H} \frac{w_H}{H},$$

$$N = \frac{L}{w_L} [a_2 + (1 - \zeta) L_s^{-1} (\epsilon_H \eta_H^{-1} + 1)]. \quad (22)$$

The abbreviation  $a_1$  captures the effect of taxation on the supply of human capital,  $a_2$  captures the change of (the inverse of) the  $w_L$  wage elasticity of labour demand with respect to employment  $L$ . In analogy to  $\eta_L^{-1}$  in (10),  $\eta_H^{-1}$  is the inverse of the  $w_H$  wage elasticity of human capital demand. The supply elasticity of human capital is denoted by  $\epsilon_H$ .

	<i>CD-utility</i>	<i>CD-technology</i>	general
$a_1$	0		$> 0$
$a_2$		0	$\geq 0$ for $\sigma \leq 1$
$\epsilon_H$	0		

**Table 1** *Parameter implications for special Cobb-Douglas cases*

Table 1 shows special cases for the above system (17). When human capital supply is completely inelastic as in (8), then  $a_1 = \epsilon_H = 0$ : labour income does not have any impact on human capital supply. When the technology is Cobb-Douglas, demand elasticities  $\eta_H$  and  $\eta_L$  are constant and  $a_2 = 0$ . Further, the determinant  $N$  is unambiguously positive.

Generally speaking, the sign of  $a_1$  is non-negative (for upward-sloping human capital supply) and the sign of  $a_2$  is positive if the elasticity of substitution  $\sigma$  between factors of



production is smaller than unity and negative for  $\sigma > 1$  (cf. app. 9). In general, the sign of  $N$  is ambiguous as well. When  $a_2$  is not too negative,  $N$  is positive.<sup>16</sup>

		unemployment	net wage $(1 - \tau_L) w_L$	benefits $b$
$\tau_H$	CDCD	0	0	0
	general	$+$ <sup>(1)</sup>	$-$	$-$
$\tau_L$	CDCD/ general	0	$-$	$-$
$\zeta$	CDCD	$+$	$+$	$+$
	general	$+$ <sup>(1)</sup>	$+$ <sup>(1)</sup>	$+$ <sup>(1)</sup>

**Table 2** : *General equilibrium effects of taxation and the replacement rate*

(1) *An elasticity of substitution  $\sigma$  between  $H$  and  $L$  smaller than one (i.e.  $a_2 > 0$ ) is a sufficient condition*

A summary of our comparative statics results is in tab. 2. It covers the effects of the two policy instruments benefit replacement rate  $\zeta$  and taxation  $\tau_L$  and  $\tau_H$  on unemployment, the net wage and benefit payments. We focus on two polar cases, the simplest one where both the technology and the utility function of high skilled are of the Cobb-Douglas type (CDCD) and the general case. The discussion below covers some intermediate cases as well.

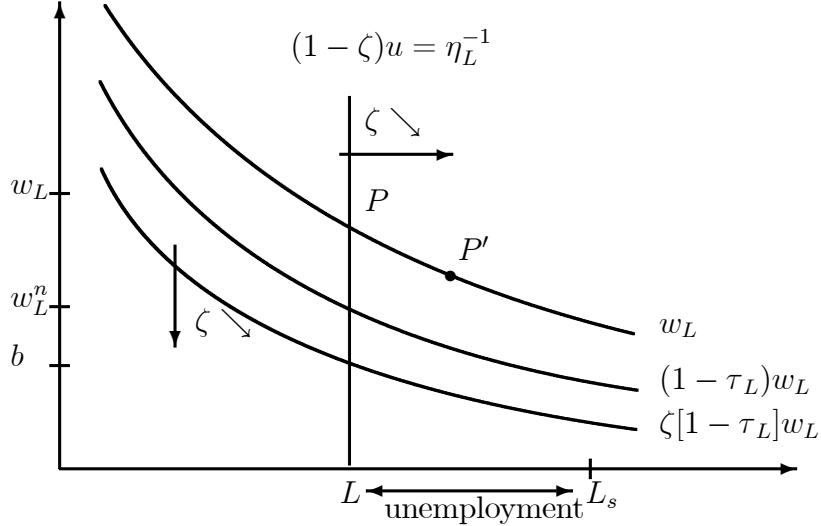
- The effects of taxation

These analytical results are illustrated in fig. 1 which plots low-skill labour on the horizontal and wages on the vertical axis. It shows the labour demand curve marked by  $w_L$ , the corresponding net-wage curve  $(1 - \tau_L) w_L$  and the benefit curve  $\zeta [1 - \tau_L] w_L$ . The wage setting curve is the vertical line. When the technology is CD as in (5),  $a_2 = 0$  and (19) shows that employment is not affected by taxation  $\tau_L$  of low-skilled. Even when employment of high-skilled  $H$  changes due to a variation in  $\tau_H$ , this only shifts the labour demand curve  $w_L$  (and the other two curves below  $w_L$ ) in fig. 1 but not the vertical wage setting curve. When human capital supply is constant as in (8), due to e.g. a Cobb-Douglas utility function,  $a_1 = \epsilon_H = 0$  as well and taxation by (20) does not affect gross wages either. Hence, only net wages and benefit payments are affected by taxation in this CDCD case.

In more general cases for positive  $a_1$  and  $a_2$ , (18) to (20) show that a higher tax  $\tau_H$  on high-skill wages decreases employment of low- (and high)-skill individuals and, due to fewer high-skilled, also the gross wage for low-skilled. The net wage and benefit payments therefore also fall. Note that the negative employment effect for low-skilled due to taxation  $\tau_H$  results from the change in the inverse demand elasticity  $\eta_L^{-1}$  in (15) which in turn is caused by a lower equilibrium high-skilled employment.<sup>17</sup> When  $a_2$  is negative (and the determinant  $N$  still positive), the employment effects for low-skilled change, but the effect on the gross and thereby net wage and benefits remain unchanged.

<sup>16</sup>As equation (A.13) in the appendix shows,  $a_2(\theta)$  is bounded from below. It intersects the horizontal  $\theta$  line at  $\theta = 0$  and  $\theta = 1$ . It approaches plus infinity for  $\theta$  going to minus infinity. This shows that certain parameter restrictions would suffice to obtain a positive determinant.

<sup>17</sup>Lower employment of  $L$ , however, moves  $\eta_L^{-1}$  in the opposite direction as can be seen e.g. from (15). The overall effect on the position of the wage setting line in figure 2 remains a shift to the left as could be seen from totally differentiating (15).



**Figure 1** : *The labour market for low-skilled workers*

While the very weak link between taxation and low-skill employment is clearly due to the fact that individual labour supply is fix, it stresses the role of institutional arrangements in explaining cross-country differences in employment-taxation elasticities.

- Replacement rate

The effects of the replacement rate are more straightforward from (18) to (20). As long as  $a_2 \geq 0$ , a higher replacement rate  $\zeta$  increases the gross wage, reduces employment of low-skilled and thereby also employment of high-skilled. The net wage increases and benefit payments increase because of the increase in the gross wage and directly through the increase of the replacement rate. With a negative  $a_2$ , results remain unchanged as long as the determinant remains positive. Figure 1 illustrates the case of a reduction of  $\zeta$  and shows how the shift of the wage setting curve to the right increases employment at lower gross and net wages.

### 3.2 How to preserve equality

Given the comparative static results obtained so far, an employment increasing and equality-preserving tax reform seems straightforward. A lower replacement rate shifts the wage setting curve to the right and increases employment at lower gross wages.<sup>18</sup> Net wages and unemployment benefits fall as well, requiring a reduction in labour taxation for low-skilled. If this reduction is only sufficiently strong (at the risk of ending up with negative taxation), more employment goes hand in hand with unchanged net wages or benefit payments. We

<sup>18</sup>Lowering the replacement rate increases employment but not necessarily welfare. While this is well-understood in models where employment paths are uncertain and unemployment benefits play an insurance role, this is also true here: A social welfare function that aggregates utilities of the high-skilled and the unskilled workers plus the unemployed would require that in a social optimum marginal utilities of the unskilled must not be too high, i.e. their consumption levels, determined by the replacement rate, must not be too low.

define a reform to be equality-preserving (EPR) if the net-wage does not decrease as a consequence of this reform,

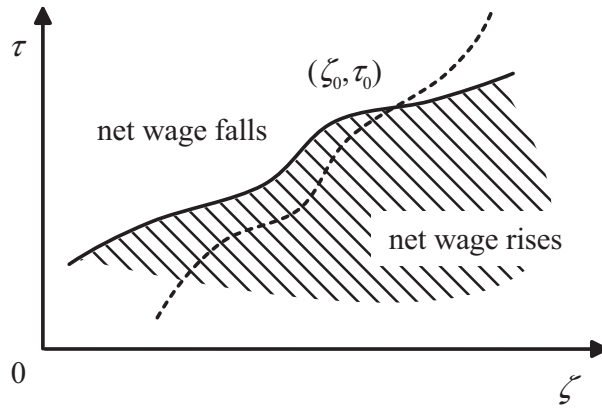
$$d[(1 - \tau_L) w_L] \geq 0. \quad (23)$$

We will talk about an ambitious EPR when the reform keeps unemployment benefits unchanged or increases them,

$$db = d[\zeta [1 - \tau_L] w_L] \geq 0. \quad (24)$$

- Implementation of the EPR

The equality constraint (23) can best be illustrated by a iso-netwage curve depicted in the policy space  $(\zeta, \tau)$ .<sup>19</sup> We assume here that labour taxes are flat,  $\tau_H = \tau_L \equiv \tau$ . They can therefore be reduced for high-skilled and low-skilled only simultaneously. Section 5 treats the progressive tax case, where only  $\tau_L$  is reduced.



**Figure 2** : *Iso-netwage and iso-benefit curves in the policy space*

The iso-netwage curve draws combinations of  $\zeta$  and  $\tau$  where the net wage remains unchanged. By using (20) in (23) gives, assuming again a sufficiently large  $a_2$ , (cf. app. 9.2)

$$d[(1 - \tau) w_L] \geq 0 \Leftrightarrow d\tau \leq \frac{(1 - \tau) u \eta_L^{-1}}{(1 - \tau) \epsilon_H a_1 \eta_H^{-1} \frac{w_H}{w_L} (1 - \zeta) L_s^{-1} + w_L N} d\zeta. \quad (25)$$

As  $N > 0$  for  $a_2$  not too small, the slope of the iso-netwage curve is positive and we obtain the following figure. Note that the concept of these curves is identical to iso-cost or iso-output curves. While the latter shows by how much one factor of production needs to be increased at unchanged output when the other factor of production is marginally decreased, the iso-net wage curve shows by how much taxes need to be decreased at unchanged net wages when the replacement rate is marginally decreased.

Summarizing, any policy reform that starts from the current policy  $(\zeta_0, \tau_0)$  lowers net wages when moving into the non-shaded area. Remaining on the iso-netwage curve keeps net wages constant and moving into the shaded area increases net wages.

<sup>19</sup>See Fig. 2 in Atkinson (2000) which also depicts the policy space.

- Implementation of the ambitious EPR

A more ambitious EPR changes  $\zeta$  and  $\tau$  such that unemployment benefits (13) do not decrease. When we compute (24) with (20), we obtain (cf. app. 9.2)

$$db = d[\zeta [1 - \tau_L] w_L] \geq 0 \Leftrightarrow d\tau \leq \frac{[1 - \tau] w_L N / \zeta + [1 - \tau] u \eta_L^{-1}}{w_L N + [1 - \tau] \epsilon_H a_1 \eta_H^{-1} \frac{w_H}{w_L} (1 - \zeta) L_s^{-1}} d\zeta. \quad (26)$$

Compared to the iso-netwage curve (25), we have an additional term,  $[1 - \tau_L] w_L N / \zeta$  in the numerator. As  $N$  is positive, however, the slope remains positive and, as the denominator is unchanged, the slope is larger. This is captured in the policy space in fig. 2 by the dashed iso-benefit line. This means that taxes need to fall faster given a certain decrease in the replacement rate if benefits are to be kept constant.

Looking again at fig. 1 illustrates why keeping net income of the unemployed constant is more ambitious than preserving constant net wages: A reduction in  $\zeta$  not only shifts the wage setting curve to the right but also the benefit curve  $\zeta [1 - \tau_L] w_L$  down. Hence, a tax-reduction must be much stronger in order to keep  $\zeta [1 - \tau_L] w_L$  at its pre-reform level.

## 4 Towards self-financing reforms

The previous analysis provided suggestions for policy reforms that reduce unemployment without reducing net income of workers or the unemployed. We did not analyze the effects of a joint change in the replacement rate and taxation on the government's budget balance. Needless to say that this effect is of crucial importance for the political feasibility.

Our proposals are constructed such that they have the potential to be self-financing. An EPR (and an ambitious EPR) consists of two components: a reduction in the replacement rate and a reduction in labour taxation. The reduction in labour taxation decreases tax revenue of the government while a reduction in the replacement rate reduces government expenditure. The first effect is a negative one for the government budget, the second one is positive. In principle, they could cancel out.<sup>20</sup> Clearly, only a reform that reduces unemployment, that does not reduce net-income of any agent and that does not increase the government's budget deficit is a Pareto-improving reform.

### 4.1 The government budget and self-financing conditions

Policy reforms are self-financing when the government budget does not deteriorate due to the reform. To find out whether this is the case, we start from the government budget constraint

$$B = \tau Y - bU = \tau Y - \zeta w_L^n U. \quad (27)$$

The number of unemployed is denoted by  $U$ , the net wage by  $w_L^n$  and taxes are flat,  $\tau_H = \tau_L \equiv \tau$ , an assumption to be relaxed again in the next section.

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<sup>20</sup>We do assume (and even show for one example in app. 10.2) that we are on the "correct side" of the Laffer curve, i.e.  $d(\tau Y) / d\tau > 0$ . While lower taxation might lead to more employment, we do not assume that this increase in employment and the implied increase in tax income would overcompensate the losses due to a lower tax rate. It is the decrease in the replacement rate and the induced effect of less spending (leaving more employment apart) that might compensate reduced tax income.

#### 4.1.1 The EPR condition

When we want to perform an EPR and assume that human capital supply is inelastic, i.e. the high-skilled have a CD utility function, the equality constraint (23) imposes a certain relationship between a change in the replacement rate and the tax rate,

$$\begin{aligned} d[(1 - \tau) w_L] = 0 &\Leftrightarrow (1 - \tau) dw_L = w_L d\tau \\ \Leftrightarrow (1 - \tau) \frac{w_L}{\zeta} \eta_\zeta d\zeta = w_L d\tau &\Leftrightarrow d\tau = \frac{1 - \tau}{\zeta} \eta_\zeta d\zeta, \end{aligned} \quad (28)$$

where

$$\eta_\zeta \equiv \frac{\partial w^L}{\partial \zeta} \frac{\zeta}{w_L}. \quad (29)$$

When differentiating, we used the fact that in the net-Bismarck case with equations (2) and (14), the gross wage is only a function of  $\zeta$  and not a function of the tax rate as long as human capital supply is fixed (see Lingens and Wälde (2006) for a treatment of the gross-Bismarck and the Beveridge system). The equality constraint simply says that when the replacement rate is decreased, the tax must be decreased as well by the amount  $(1 - \tau) \zeta^{-1} \eta_\zeta > 0$  to keep the net wage constant. An EPR is then self-financing when the differential of the government budget, taking this required decrease in taxation, captured by constraint (28), into account, is non-negative.

Observing that  $dw_L^n = 0$ , the differential of the budget constraint is

$$\begin{aligned} dB &= Y d\tau + \tau dY - w_L^n U d\zeta - \zeta w_L^n dU \\ &= Y d\tau + \tau \frac{\partial Y}{\partial \zeta} d\zeta - w_L^n U d\zeta - \zeta w_L^n \frac{\partial U}{\partial \zeta} d\zeta, \end{aligned} \quad (30)$$

where we use, similar to above, that in the net-Bismarck case output through labour and through the gross wage  $w_L$  is only a function of  $\zeta$  as long as high-skilled supply is fixed. Inserting the equality constraint (28) gives

$$\begin{aligned} dB &= \left( Y \frac{1 - \tau}{\zeta} \eta_\zeta + \tau \frac{\partial Y}{\partial \zeta} - w_L^n U - \zeta w_L^n \frac{\partial U}{\partial \zeta} \right) d\zeta \\ &= \left( Y \frac{1 - \tau}{\zeta} \eta_\zeta + \tau \frac{\partial Y}{\partial \zeta} - w_L^n U \left[ 1 + \frac{\partial U}{\partial \zeta} \frac{\zeta}{U} \right] \right) d\zeta \end{aligned} \quad (31)$$

The effect of a policy reform that changes  $\zeta$  and  $\tau$  on the budget is now a function of the change in  $\zeta$  only. The change in  $\tau$  was replaced by the relationship between  $d\tau$  and  $d\zeta$ , imposed by the equality constraint (28). An EPR is self-financing when  $dB \geq 0$  as a result of  $d\zeta < 0$ . This requires the expression in brackets (.) to be negative.

This equation shows various channels through which a policy reform acts. The first two expressions show the change in income of the government, the last two expressions show changes in expenditure. An increase (decrease) in the replacement rate increases (decreases) expenditure because more (less) is paid per unemployed person (given a constant net wage), the  $w_L^n U$  term, and because the gross wage increases (decreases), the last term. An increase (decrease) in the replacement rate also decreases (increases) output and thereby reduces

(increases) tax income, the second term. Finally, given our equality constraint (28), a higher (lower) replacement rate requires higher (lower) taxation and therefore leads to an increase (decrease) in tax income, the first term. We therefore have three negative terms and one positive term within the brackets.

#### 4.1.2 The ambitious EPR condition

If we want to perform an ambitious EPR, we need to replace the iso-net wage constraint (28) by the iso-benefit constraint (24),  $db \geq 0$ . The policy constraint implied by an invariant benefit is

$$db \geq 0 \Leftrightarrow [1 - \tau] w_L d\zeta - \zeta w_L d\tau + \zeta [1 - \tau] \frac{\partial w_L}{\partial \zeta} d\zeta \geq 0$$

where again, as in (28), the differential of  $w_L$  used the fact that in the net-Bismarck case and with inelastic  $H$  the gross wage is only a function of  $\zeta$ . Instead of (28), we now have

$$[1 - \tau] \left( w_L + \zeta \frac{\partial w_L}{\partial \zeta} \right) d\zeta = \zeta w_L d\tau \Leftrightarrow [1 - \tau] (1 + \eta_\zeta) d\zeta = \zeta d\tau. \quad (32)$$

The differential of the budget (27) now reads instead of (30)  $dB = \tau dY + Y d\tau - b dU$  as  $b$  is constant by policy design. The subsequent steps remain unchanged and we obtain

$$dB = Y d\tau + \tau \frac{\partial Y}{\partial L} \frac{\partial L}{\partial w_L} \frac{\partial w_L}{\partial \zeta} d\zeta - b \frac{\partial U}{\partial L} \frac{\partial L}{\partial w_L} \frac{\partial w_L}{\partial \zeta} d\zeta.$$

This means we only “lose” the term  $-w_L^n U d\zeta$ . The economics behind this effect is that the governmental budget cannot take advantage of lower payments to the unemployment after the reform as was the case in the previously analyzed case. But this in turn implies that *ceteris paribus* the condition for the funded, ambitious EPR to be successful becomes harder to fulfil.

Plugging in the iso-benefit condition (32) into the iso-budget relation gives

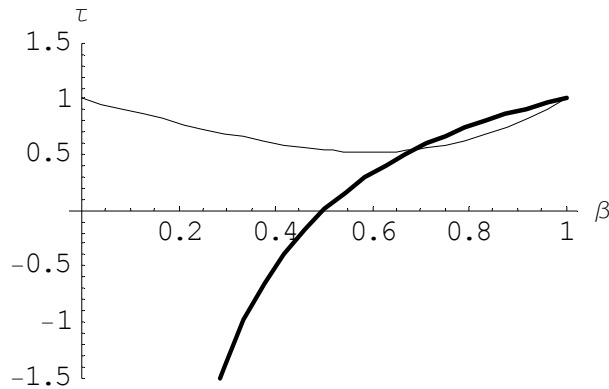
$$dB = \left( Y \frac{1 - \tau}{\zeta} (1 + \eta_\zeta) + \tau \frac{\partial Y}{\partial \zeta} - \zeta w_L^n \frac{\partial U}{\partial \zeta} \right) d\zeta. \quad (33)$$

This equation nicely contrasts the condition for the funded reform to hold in the case in which only the net wage has been kept constant. Firstly, there is an additional term in the part which depicts the revenue decline due to the decrease in the tax rate. This implies that the tax rate has to decrease by a larger amount to keep the unemployment income constant than it was the case in the previous section. Secondly, the expenditure saving effect (depicted by the second term) is smaller than before. This is because only the employment decrease leads to less governmental expenditure not the decrease of the unemployment payment as before (by definition). Again, an ambitious EPR is self-financing, i.e. it is a Pareto-improving reform, when  $dB \geq 0$  as a result of  $d\zeta < 0$ .

## 4.2 The EPR

Let us now analyze the EPR condition (31) in more detail for the CDCD case<sup>21</sup>. We derive in app. 10.1 a sufficient (and necessary) condition for the tax rate  $\tau$  and the parameter  $\beta$  from the CD technology (5) under which an EPR is self-financing. This condition guarantees that the derivatives in (31) are negative, i.e. a decrease in  $\zeta$  (which decreases unemployment) - at constant net wages given the contemporaneous tax cut - increases the budget balance. The condition reads

$$\tau > 2 - \beta^{-1}. \quad (34)$$



**Figure 3** *Minimum tax rates for self-financing*

Fig. 3 plots (34) as the thick line in its equality version, i.e.  $\tau = 2 - \beta^{-1}$ . Parameter combinations which lie on or above the thick line imply a self-financing EPR: The higher the tax rate and the lower  $\beta$ , the more likely self-financing becomes. Note that this condition is independent of  $\zeta$  and thereby independent of the unemployment in the economy under consideration.<sup>22</sup>

This figure also shows that wage subsidies could also be self-financing: if we think of low-income groups that do not pay taxes and whose social-security contributions are also very low, one might have to pay subsidies in order to preserve their pre-reform net income. If  $\beta$  is, say, .2, the tax on labour could become negative and the reform would still be self-financing.

Is this condition bounded to be fulfilled in practice? The parameter  $\beta$  captures in our CDCD case both the inverse of the (absolute) demand elasticity of labour,  $\eta_L^{-1} = \beta$  from (16), and the share of labour income going to the high-skilled (5). The demand elasticity  $\eta_L$  is usually estimated to lie in the long-run at between .4 and .7 (Hamermesh, 1993, p. 272), maybe between .15 and .75 (Hamermesh, 1993, p. 135). This would require in our specification a  $\beta$  larger than unity which, given the production function (5) makes no sense. We will therefore take the share of high-skill income in total labour income as interpretational background for  $\beta$ . This share should be smaller than .5 and the condition would then always be satisfied. Given the ambiguity on which interpretation to give for  $\beta$ , we do not put too much emphasis on this result at this stage.

<sup>21</sup>Here and in what follows we restrict attention to the CDCD case where both the utility function of high-skilled and the technology are of the Cobb-Douglas type.

<sup>22</sup>This follows from the fact that the rate of unemployment in net-Bismarck systems depends only on  $\zeta$ .

### 4.3 The ambitious EPR

The condition (33) for the ambitious EPR to hold reads for the CDCD case (app. 10.3)

$$\tau > 1 - \frac{(1 - \beta)\beta\zeta}{(1 - \beta)(1 - \zeta)^2 + \beta^2\zeta^2}. \quad (35)$$

The thin line in Figure 3 plots this condition for  $\zeta = 0.4$ . This value is a rough guess of the average replacement rate in net-Bismarck countries from OECD (2002, tab. 2.2 and 2.3) and with a tax rate of around .2 for the unemployed. What can be seen is that the condition for the ambitious EPR is, for most of the parameter range of  $\beta$ , more restrictive than the condition for the EPR. What is worse, the curve never falls below .5. It seems therefore highly implausible that an ambitious self-financing EPR is possible when taxes are decreased for all skill groups.

## 5 Self-financing reforms

The analysis so far confined itself to identical tax rates for all labour groups. We found that self-financing EPRs and self-financing ambitious EPRs are possible only for certain parameter constellations; in gross-Beveridge systems, an ambitious EPR is not possible at all. This section therefore studies a more sophisticated policy change and investigates the conditions under which self-financing is possible when tax cuts are made only for low-income groups.

### 5.1 Progressive taxation

One reason for potentially harmful effects on the government budget is the fact that labour taxation decreases for all groups of labour, whether skilled or unskilled, whether employed or unemployed. If the objective is to create employment at unchanged net wages or benefits, it would be enough to reduce labour taxation only for the unskilled. We will therefore analyze in this subsection the effect of a more progressive tax system.

There are many ways how progressivity of a tax system can be modelled. We use a very simple one where we reduce the tax rate for low-skilled and keep the tax rate for the high-skilled unchanged.<sup>23</sup> More progression therefore does not mean “taxing the rich” and “giving it to the poor”. The high-skilled have the same tax rates before and after the reform. We will see, however, that high-skilled nevertheless benefit from the reform through more employment of the low-skilled.

#### 5.1.1 The EPR

In deriving a condition for a self-financing EPR, we follow the steps as in the previous analysis. The budget is now expressed by  $B = \tau_L w_L L + \tau_H w_H H - \zeta w_L^n U$ , where  $\tau_H$  is

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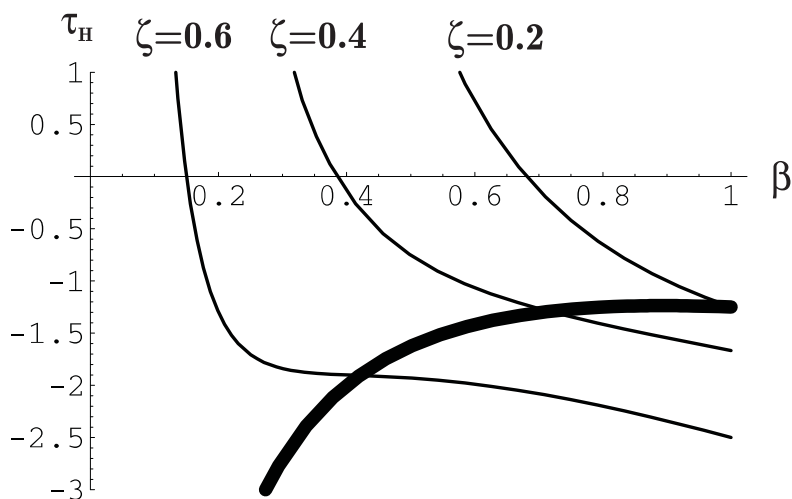
<sup>23</sup>While this is in a modelling sense simply a skill-specific linear tax schedule, it is intended to reflect rising marginal tax rates in a world with many skill groups.



constant. After various steps (cf. app. 11.1), we obtain as a condition, comparable to (34) above,

$$\tau_H > 1 - u - \beta^{-1}. \quad (36)$$

As  $\beta$  is smaller than unity, this condition is always satisfied. Illustrating it as the thick line for  $\zeta = .2$  gives fig. 4. A reduction in the replacement rate can always be accompanied by a reduction in taxation for low-skilled such that net wages remain unchanged and the government deficit is not increased. A self-financing EPR is possible with more progressive taxation.



**Figure 4** *Self-financing conditions for an EPR and for ambitious EPRs*

### 5.1.2 The ambitious EPR

Let us analyze whether keeping net benefits constant can more easily be achieved as well when only taxes for low-skilled are reduced. We obtain as our new condition (app. 11.1)

$$\tau_H > (1 - u) \left( [1 - \tau_L] (1 - \zeta) \frac{1}{u\zeta\beta} + 1 \right) - \beta^{-1} (\tau_L + \zeta (1 - \tau_L)). \quad (37)$$

This condition is plotted in fig. 4 three times as the thin lines with a pre-reform tax for labour of  $\tau_L = .4$ . The line to the left is obtained for  $\zeta = .6$ , the one in the middle has  $\zeta = .4$  and the one to the right has a  $\zeta$  of  $.2$ . We see here again that a self-financing ambitious EPR is indeed more difficult to implement than an EPR, as it requires a larger pre-reform tax than a self-financing EPR. For shares  $\beta$  of high-skill income in total labour income that are low,  $\tau_H$  needs to be sufficiently large for self-financing to work. If, however,  $\beta$  is larger than  $.5$ , self-financing ambitious EPRs are possible as well. Efficiency gains obtained through lower replacement rates can be distributed by using the existing tax system among all economic agents such that policy reforms do not only create efficiency gains but are even Pareto improving.

## 5.2 Are incentives right?

The purpose of our policy proposal is to decrease unemployment without changing the absolute situation of the low-skilled or the unemployed, respectively. Thus, we implement a “policy vector”  $(\zeta, \tau_L)$  that either leaves the low-skill wage constant or even increases it. One could be tempted to argue that this gives rise to a long-run incentive problem in the economy. If the policy proposal decreases the net high-skill wage at invariant low-skill wages, the incentive to invest into skill-formation will decline. This would distort the long-run evolution of the economy in an unfavourable way. Although these dynamic considerations are not modelled in this paper, we analyze whether our policy could generate these disincentive effects. We therefore analyze the effects of our policy proposal on the relative net wage  $(1 - \tau_H) w_H / [(1 - \tau_L) w_L]$ .

In the EPR case, the net wage  $(1 - \tau_L) w_L$  is constant by construction and the tax on  $w_H$  is also held constant in the tax progression case. The gross wage for high-skilled  $w_H$  goes up as higher employment increases the marginal productivity of human capital. Hence, in this case, incentives to invest in human capital are even improving.

In the ambitious EPR case, relative wages can be expressed by  $\zeta (1 - \tau_H) w_H / [\zeta (1 - \tau_L) w_L]$ . A tax-progression policy reform keeps the denominator constant and changes  $\zeta$  and  $w_H$ . The change in the relative net wage is therefore

$$d \frac{\zeta (1 - \tau_H) w_H}{\zeta (1 - \tau_L) w_L} = \frac{1 - \tau_H}{\zeta (1 - \tau_L) w_L} (\zeta dw_H + w_H d\zeta) \geq 0 \Leftrightarrow \frac{\zeta}{w_H} \frac{dw_H}{d\zeta} \geq -1. \quad (38)$$

Apparently, an ambitious EPR does not decrease the net wage ratio if the elasticity of gross wages for human capital with respect to the replacement rate is larger than minus one. Intuitively, one would expect this elasticity to be negative: A higher replacement rate implies lower employment of low-skilled which decreases marginal productivity of high-skilled. The question is, how strong the reaction of high-skill wages to low-skill unemployment is.

Let us now look again at the CDCD case. From app. 11.2, the elasticity is

$$\frac{\zeta}{w_H} \frac{dw_H}{d\zeta} = - (1 - \beta) \frac{\zeta}{1 - \zeta} \frac{u}{1 - u}.$$

As the unemployment rate is below 50%,  $u / (1 - u) < 1$ . The replacement rate in net-Bismarck countries is around .5 and therefore  $\zeta / (1 - \zeta) \approx 1$ . As  $1 - \beta < 1$  as well, we conclude that one can reasonably expect that  $\frac{\zeta}{w_H} \frac{dw_H}{d\zeta} > -1$  such that even the ambitious EPR keeps incentives for human capital investment in place.

## 6 Conclusion

Can a reduction in unemployment originating from a reduction in the replacement rate or unemployment benefits be accompanied by changes in the tax system such that a reduction of net income of low-income groups can be avoided? Two versions of constant low-income are considered: On the one hand, we ask under which conditions an equality preserving reform (EPR) can be implemented, i.e. a policy reform that reduces unemployment without reducing the net-wage of low-skill workers. On the other hand, we analyze ambitious EPRs,

i.e. policy reforms that also reduce unemployment but keep net-income of the unemployed constant. We show that EPRs as well as ambitious EPRs are possible.

When analyzing the budgetary requirements for the government, we find that EPRs are self-financing for some parameter constellations. Ambitious EPRs, however, are hardly self-financing. The budgetary cost implied by the reduction in labour taxes required to keep income of the unemployed at their pre-reform level are just too high and can not be compensated by lower expenditure due to the reduced number of unemployed.

We therefore analyze the effect of reducing tax rates only for low-income workers. This implies a more progressive tax and social security contributions system and makes EPRs always self-financing. Ambitious EPRs also become much more likely to be self-financing - Pareto-improving unemployment reductions are possible. Finally, incentives to become skilled are not distorted by more progressive tax systems - the ratio of net wages should actually increase when policies are implemented that reduce unemployment and keep net income of the unemployed constant. Efficiency gains through lower unemployment can therefore be distributed within existing system such that everybody benefits from these efficiency gains.

One can think of various extensions of our approach. While we did show that self-financing ambitious EPRs and EPRs are possible in principle, more complex models than the ones we used are required before reliable policy recommendations can be made. One would need models that allow for serious calibration (as e.g. Sørensen, 1997) and detailed comparison of e.g. real world unemployment rates and those predicted by the model. Other forms of unemployment than trade union unemployment would be required for countries where trade union density is not so high.

Modelling the duration of unemployment would be very interesting as well (for a recent excellent overview and analysis, see Ljungqvist and Sargent, 2002). Given that the replacement rate is not always a highly significant determinant of unemployment in empirical work (see footnote 4), the joint effect of the length of unemployment payments and of the replacement rate on unemployment could be better understood. From a policy perspective, a dynamic approach would allow to jointly analyze negative income tax features and the measures we propose.

These more elaborate models could then be used to see quantitatively by how much taxes must fall in order to keep net income of various groups constant and by how much and how fast (in a dynamic setup) the contemporaneous decrease in the replacement rate would affect unemployment. One could also investigate how endogenous labour supply decisions of unskilled workers or the effect of additional taxes help to fulfil the self-financing objective. If there was a, say, value-added tax in our model, less unemployment would cause higher tax income directly because of higher employment (this channel is included in our analysis) but also indirectly because of higher consumption and the implied value-added taxes. This should generally allow to design self-financing reforms more easily.

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