How to Finance Unemployment Benefits in an Economy with Search Generated Equilibrium Unemployment

Pia Weiß*

Abstract

The paper studies the effects of alternatives to finance the unemployment benefits on employment and wages in a model with search generated equilibrium unemployment. It is demonstrated that employment improves if a value added tax as compared to a social system contribution, where employees bear part of the contribution, is levied. In addition, it is shown that shifting the burden of the contribution to the Social Security system from employers to employees may have negative employment effects if the benefits are not taxed. This effect vanishes if the benefits are taxed.

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1 Introduction

The policymaker confronted by the question how to design or to reform the Social Security system faces a considerable choice of alternatives. On the one hand, he or she can set different structures for the expenditures of the Social Security system. Examples are the conditions for the receipt of the unemployment benefits or the calculation method. On the other hand, the government has a discretionary choice concerning the revenues. It can levy different taxes, as e. g. a lump sum tax, a consumption tax, an income tax, or a profit tax. In a closed economic system, different structures of the expenditures and the revenues may influence the employment as well as the wages differently. Consequently, a benevolent policymaker will take these effects into account

Clearly, the necessity to decide on the structure of the Social Security system goes hand–in–hand with the occurrence of unemployment. Depending on the reason of unemployment, the same structure of the Social Security system may have other effects on employment and wages. Accordingly, each investigation of a potential reform of the Social Security system has to present an answer for the question of what causes unemployment. Various microeconomic explanations have become popular in the literature. Among them is the theory of efficiency wages, union–firm wage bargaining, and cost intensive search processes on the labour market. So far, there is no consensus as to which model best explains unemployment.

Therefore, it is not surprising that a number of papers focusing on the optimal form of the Social Security system use alternative assumptions referring to the causes of unemployment.

*Financial aid from the Fritz Thyssen Stiftung is gratefully acknowledged. Institute for Economic Policy, Pohligstraße 1, D–50969 Cologne; tel.: +49 221/470–5356; fax: +49 221/470–5350; email: weiss@wiso.uni–koeln.de.

The papers are concerned with the relation between either the structure of the expenditure side or the revenue side and employment. Goerke (1998) e. g. demonstrates that a stronger dependence of the unemployment compensation on income has positive employment effects in an efficiency wage model. In contrast, Vijlbrief and van"nobreakspace –˝de Wijngaert (1995) show that a stronger dependence of the benefits on income may yield negative employment effects in a monopoly union model.

Papers concentrating on the revenue side of the Social Security system take the expenditure structure and the reason for unemployment as given. Pissarides (1998) e. g. studies the impact of employment tax cuts under alternative assumptions on the causes of unemployment. He finds that the tax cut has substantial positive effects on the employment level if the compensation is a fixed payment. He also demonstrates a positive employment effect for reforms strengthening the progression of the tax. Goerke (1999) considers the influence of a shift from a payroll tax to a consumption tax. Using an efficiency wage model, he shows that the reform improves employment if the rise in the consumption tax leaves the consumer prices unchanged. Pflüger (1997) analyses the same problem in the union wage bargaining model. He also finds a positive employment effect if benefits are not taxed. On the contrary, Smith (1994) shows that the wage tax reduces unemployment if the benefits are taxed in a search model.

The present paper compares search generated unemployment levels and wages under alternative options of financing the unemployment compensation. It is assumed that the policymaker has only two excluding alternatives to raise the revenues necessary to finance a given structure of the expenditures: imposing an indirect value added tax or levying a Social Security compensation. In case the policymaker decides in favour of a Social Security system, he or she additionally chooses the share of the contribution paid by the employees. The alternative of raising a lump–sum tax forms the reference point of the comparison.

It is demonstrated that a shift from a Social Security compensation to a value added tax improves employment only if i) the employees pay at least a share of the contribution to the Social Security system *and* ii) if the benefits are not taxed. In case the employers pay the contribution alone, the unemployment rate and the welfare is identical in economies with a Social Security contribution and a value added tax. The same result can be derived if the benefits are taxed.

The paper is organised as follows. The next section introduces the base model and discusses the alternatives of financing the unemployment benefits. Section 3 considers the wage setting rules under the alternatives and present some preliminary results. Section 4 studies the equilibrium employment effects of the alternatives of financing the benefits and draws some policy conclusions. Section 5 focuses on the welfare analysis. Finally, section 6 discusses potential reforms and the limitations of the model.

2 The economy with search frictions

Suppose, a policymaker has two possibilities of raising the revenues necessary to finance the given structure of the Social Security system's (SSS) expenditures: to levy a value added tax (VAT) or to impose a Social Security compensation (SSC). At the same time, he or she observes

that unemployment is caused by costly search and matching processes on the labour market. The benevolent government knows perfectly well that deciding for one or the other option may affect the employment level and the wages. Which alternative is chosen by the policymaker if he or she desires a high level of welfare?

To answer this question, it has to be determined how the VAT or the SSC influences the employment level and the wages. Therefore, this section introduces the basic assumptions and sketches the channels which transmit the individual's and firm's decisions into employment and wages effects.

2.1 The basic assumptions

The model is based on a simple Mortenson–Pissarides matching model.[1] The following assumptions characterise the model economy.

Individuals: There is a fixed number of risk–neutral individuals (n) having an infinite life span. They are all alike except for the fact that they may find themselves in different employment positions. They are either employed or unemployed. Let e and u denote the total number of employed and unemployed persons, it follows that $n = e + u$.

Firms: There is a fixed number of firms (k) in the economy. Each firm has exactly one job on offer, which can be either filled or unfilled. If v denotes the total number of vacancies available in the economy, $k = e + v$.

Production function: Given that each firm can employ exactly one worker, an employee–employer pair produces y units of the homogenous, non–storable consumption good.

Searching: Only unemployed persons and vacant firms actively search for a new partner. Whereas the search activity is not associated with direct costs for the job seekers, posting a vacancy costs a firm γ units per period.

Matching: Let the function $m(u,v)$ describe the market mechanism matching job seekers and vacant firms.[2] It is assumed that this function is linear homogenous and increasing in the number of unemployed persons and the number of vacancies. Consequently, m denotes the number of newly formed employee–employer pairs during a period. From the individual's and the firm's point of view, matching follows a Poisson process. Let p and q denote the probability of finding a new partner for an unemployed person and a vacant firm respectively. Then, it is reasonable to specify $p = m/u$ and $q = m/v$.

Separation: Existing employee–employer pairs are dissolved for exogenous reasons. Accordingly, each worker–firm pair faces a constant probability that the labour contract terminates so that se workers enter the unemployment pool in each period. As a consequence, the evolution of the employment can be described by $\dot{e} = m(u,v) - se$, where $\dot{e} = 0$ in a steady state.

In order to fully characterise the model economy, the structure of the expenditures and the revenues as well as their impact on the wages have to be specified.

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[1] See e. g. Pissarides (1990, ch. 1) or Hosios (1990a,b).

[2] See e. g. Burda and Wyplosz (1994), Berman (1997), Blanchard and Diamond (1989) or Pissarides (1986) for empirical studies on matching functions.

2.2 The unemployment compensation

It was assumed that the policymaker has the choice between imposing a VAT or an SSC to finance the unemployment benefits, but he or she regards the structure of the expenditures as given. In principle, the unemployment compensation can take the form of a fixed payment, a fixed replacement ratio, or a combination of both. In addition, each of the three alternatives can either be specified in real or nominal terms. As it can be seen in table 1, only Poland frequently revises the unemployment compensation. All other countries grant nominal benefits.

Table 1 also shows that the majority of the OECD countries grant unemployment benefits proportional to the previous earnings. Again, in the greater number of countries out of the number of those specifying a constant replacement ratio, the compensation is calculated on the basis of the previous gross income.

As the unemployment compensation is the income of an unemployed person, it may be subject to the normal tax schedule. Indeed, the benefit payments are principally taxable in a number of OECD countries. However, this regulation does not imply that job seekers actually pay taxes. If part of the income is tax–free the unemployment benefits may be lower than this limit.

Summarising the evidence given in table 1, it is henceforward assumed that the expenditure structure is determined by a nominally fixed replacement ratio. Furthermore, no SSC is raised on the benefit payments. Therefore, the nominal unemployment benefits are given by

$$b = b_0 w, \tag{1}$$

where b_0, $b_0 \in [0,1]$, and w stand for the nominally fixed replacement ratio and the gross wages respectively.

2.3 The alternative financing options

The government pursues only one task — collecting taxes to finance the granted unemployment benefits. However, it has a discretionary choice regarding the revenue structure. Naturally, choosing one or the other alternative to finance the SSS expenditures changes the individual's and firm's variables. As a consequence, the policymaker's decision indirectly influences the wages determined as the outcome of an individual bargaining process and thereby the employment level in an economic system. The present work sketches a situation in which the policymaker has only two options: levying a VAT or imposing a SSC. To establish a reference point, the alternative of raising a lump–sum tax is part of the analysis.

The policymaker's decision changes the firm's and individual's variables. Choosing different alternatives to finance the unemployment benefits yields other values for the producer price p_p that a firm receives and the total labour costs w_c. Similarly, the consumer price p_c and the disposable income $\tilde{y}$ for employed and unemployed individuals are directly influenced by the policymaker's choice. As a consequence, the employee's consumption c_e, the unemployed person's one c_u, and the indirect utility depends on the chosen financial option. This can be seen by noting first that the consumption equals the real disposable income $\tilde{y}/p_c$ since there is only one homogenous good in the economy. As both the disposable income and the consumer price vary

Country	Benefits	Ceilings		Earnings		Taxable	
		min	max	gross	net	yes	no
Australia	fixed	–	–	–	–		X
Austria	proportional	X	(X)		X[a]		X
Belgium	proportional		(X)	X		X[b,c]	
Canada	proportional		(X)	X		X	
Czech Republic	proportional				X		X
Denmark	proportional		X	X[d]		X[b,c]	
Finland	linear				X[e]	X[f]	
France	gen. linear		(X)	X*		X[b]	
Germany	proportional		(X)		X		X
Greece	proportional	X	X	X*		X[b]	
Hungary	proportional	X	X	X		X[c]	
Ireland	fixed	–	–	–	–	X[c]	
Italy	proportional		X	X		X[c]	
Japan	proportional		X	X			X
Korea	proportional	X	X	X			X
Luxembourg	proportional	(X)	X	X		X	
Netherlands	proportional		(X)	X		X	
Norway	proportional		(X)	X*		X	
Poland	fixed[g]	–	–	–	–	X	
Portugal	proportional	X	(X)	X*			X
Spain	proportional	X	X	X		X	X
Sweden	proportional	X	X	X*		X	
Switzerland	proportional		(X)	X		X[c]	
United Kingdom	fixed	–	–	–	–		X
United States	proportional			X		X[c]	

Table 1: Unemployment compensation in OECD counties

Source: Organization of Economic Co–operation and Development (2000)
(X): implicit ceiling by restrictions on the earnings; X*: not explicitly mentioned in the OECD–database
[a]: after income tax
[b]: with exceptions
[c]: no SSC is imposed
[d]: without SSC
[e]: special tax
[f]: special SSC
[g]: indexed

with the choice of the financial alternative, the consumption will differ as well. Secondly, the utility function for the risk–neutral individuals can be transformed without loss of generality so that the indirect utility function ensues with

$$\max_c \; u(c) = c = \tilde{y}/p_c. \tag{2}$$

Let us give a short remark on the relation between prices before presenting the firms's and the individual's variables for the alternative financing options. Here, the product price is chosen as the numeraire. There are two reasons for the price which a producer receives and a consumer pays to deviate from the product price. First, the government may impose a tax on consumption or on revenues. Second, even in absence of a consumption tax, the consumer price may exceed the product price if the entrepreneurs pass part of their tax burden to the consumer price. The following analysis allows for this possibility by introducing σ, $\sigma \in [0,1]$, when the VAT or the SSC is considered. This variable denotes the extent to which the producer can shift the tax burden forward and is here endogenously determined.

A lump–sum tax λ

If the government chooses a lump–sum tax, the disposable income of employed and unemployed individuals is equally affected. All other variables are not directly influenced. The consumer and the producer price are equivalent to the product price, i. e. $p_c = p_p = 1$. The total labour costs w_c equal the gross wages w. By equation (2), the consumption and the indirect utility for employed and unemployed persons is given by

$$c^{LS} = \begin{cases} w - \lambda & \text{if employed,} \\ b - \lambda & \text{if unemployed.} \end{cases} \tag{3}$$

The government chooses the tax λ so that the total tax revenues equal the total unemployment benefits, i. e. the government is supposed to run a balanced budget. Consequently, the government's budget restriction reads

$$\lambda n = bu. \tag{4}$$

A value added tax χ

Suppose now, the government decides in favour of a VAT χ, $\chi \in [0,1)$. As the factor labour is the only input, a VAT can be modelled as a tax on revenues so that the total labour costs w_c equal the gross wages w. In the first place, only the producer price is affected by the introduction of a VAT. Given that the entrepreneurs pass part of their tax burden to consumer prices, the latter is as well influenced by a VAT. The after–tax price which the producer actually receives reads $p_p = 1-(1-\sigma)\chi$ and the consumer price is $p_c = 1+\sigma\chi$. As it can be seen in equation (2), this renders the consumption and the indirect utility with

$$c^{VAT} = \begin{cases} w/(1+\sigma\chi) & \text{if employed,} \\ b/(1+\sigma\chi) & \text{if unemployed.} \end{cases} \tag{5}$$

Again, a balanced budget requires the tax revenues to cover the expenditures for the granted unemployment benefits, so that the government's budget constraint can be written as

$$e\chi y = b_0 wu. \tag{6}$$

A social security contribution ϑ

If the government favours an unemployment insurance, the insurance receives contributions in the amount of a constant fraction ϑ, $\vartheta \in [0,1]$, of the gross wages. Employees pay a share ρ, $\rho \in [0,1]$, of the contribution. The firm's share is $\phi = (1-\rho)$. As ρ can equal one as well as zero, the analysis also includes the special cases in which either the employee or the employer alone bears the burden of the contribution. To distinguish both, we refer to the former case ($\rho = 1$) as income tax and to the latter one ($\rho = 0$) as payroll tax.

Given this setup, the labour costs w_c and the disposable income of employed persons is directly affected by the introduction of a SSC. The firm's total labour costs are given by $w_c = (1+\phi\vartheta)w$. Since the entrepreneurs may shift part of the contribution to the consumer price, consumer and the producer price are $p_c = p_p = (1+\sigma\phi\vartheta w/y)$.

With a SSC, the disposable income of employed and unemployed persons is asymmetrically affected. Whereas job seekers do not pay a contribution to the SSS, workers do. Therefore, the net wage is $(1-\rho\vartheta)w$. The individual's consumption and the indirect utility is determined by

$$c^{SSC} = \begin{cases} (1-\rho\vartheta)w/(1+\sigma\phi\vartheta) & \text{if employed,} \\ b/(1+\sigma\phi\vartheta) & \text{if unemployed.} \end{cases} \tag{7}$$

In absence of alternative revenues to finance the unemployment benefits, the government's budget restriction reads

$$\vartheta e = b_0 u. \tag{8}$$

Equation (4), (6), and (8) specify the financial restrictions of the government. Given the government fixes the replacement ratio b_0, these equations determine the tax rate necessary to run a balanced budget. Equation (3), (5), and (7) specify the indirect utility for the considered options to finance the unemployment benefits. These equations are important for studying the effects of the government's decision on the wages in the next section.

3 The wage sharing rule

A matched employer–employee pair has an advantage over the unmatched vacant firms and the job seekers: They do not need to continue the cost and time consuming search activity. Consequently, the matching process generates a surplus to the insiders. Its existence generated by a match constitutes the possibility of wage negotiations. Therefore, the bargaining process between a potential worker and a firm determines the wages and thereby the distribution of the

common surplus. To characterise the unique outcome of the bargaining procedure, an asymmetric Nash bargaining is employed.[3]

The solution reasonably presupposes that the wage negotiation immediately starts when the potential employee and the employer meet. While negotiating, both partners take into account that the best outside option is to continue the search process, i. e. the potential worker reenters the unemployment pool and the firm once again posts the vacant job. However, the evaluation of the outside option depends on the chance to find another partner. As the arrival of a match to an individual or a firm follows a Poisson process, p and q denote the rate at which employers reach job seekers and vice versa. Using the properties of the matching function, the relation $p/q = \theta$, $\theta = v/u$, can be obtained. θ is also known as the vacancy–unemployment ratio or the Beveridge ratio and is a measure for the labour market tightness. The appendix shows that the wage has to satisfy the following sharing rule[4]

$$(1-\beta)(c_e - c_u) = \beta(p_p y - w_c + \gamma\theta), \tag{9}$$

where β, $\beta \in [0,1]$ is the individual's bargaining power in the wage negotiation.

The sharing rule (9) is expressed in a general form so that it is valid for a lump–sum tax, a VAT, or a SSC. Replacing the consumption for employed and unemployed persons c_e and c_u, the producer price p_p, and the labour costs w_c by the specific values described in the last section yields the appropriate sharing rules for the alternative financing options.

4 The employment effects of alternative financing options

In this section, the equilibrium levels of employment are compared for a lump–sum tax, aVAT, and a SSC. For each financial option, the equilibrium can be characterised by two equations. The first describes the aggregated labour demand and the second one is the labour market equilibrium condition.

In the presence of time consuming search and matching processes, the equilibrium on the labour market is determined by a situation in which the unemployment level remains constant. Consequently, the number of matched individuals m has to equal the number of persons entering the unemployment pool se, i. e. $m(u,v) = se$. Using the labour accounting condition $n = e + u$, the labour market equilibrium can be rewritten to

$$m(1,\theta) = s\frac{1-\bar{u}}{\bar{u}}, \quad \bar{u} = \frac{u}{n}, \tag{10}$$

and is better known as the Beveridge curve. The Beveridge curve is negatively sloped and convex to in the $\theta/\bar{u}$–space. It can be seen in equation (10) that the labour market equilibrium is independent of the chosen alternative to finance the unemployment benefits.

[3] The wage can be the modelled as the outcome of either a sequential bargaining game or an axiomatic Nash bargaining problem. However, Binmore, Rubinstein, and Wolinsky (1986) show that an asymmetric Nash bargaining process and a sequential bargaining process yielding identical steady state results under certain circumstances. Coles and Wright (1998) study the dynamics of sequential bargaining problems and show that both alternatives yield equivalent results during adjustment processes if individuals are risk–neutral and the time preference rate is identical for both players. Therefore, an asymmetric Nash bargaining problem can be used to characterise the wage setting rule.

[4] See e. g. Roth (1979) or Osborne and Rubinstein (1990) for asymmetric Nash bargaining problems.

In contrast, the condition for the aggregated labour demand differs for the alternative financial options. The conditions for a lump–sum tax, a VAT, and a SSC are derived in the appendix. For a lump–sum tax, the condition reads

$$\beta\gamma\left(\frac{r+s}{q(\theta)}+\theta\right)=(1-\beta)(1-b_0)y. \tag{11}$$

Since the aggregated labour demand is independent of the unemployment rate $\bar{u}$, it is a horizontal line in the $\theta/\bar{u}$–space. For a lump–sum tax, the condition determines the equilibrium number of vacancies per unemployed person. From the Beveridge curve follows the equilibrium unemployment rate and, hence, the equilibrium employment level.

When the policymaker introduces a VAT, the aggregated labour demand is ensued with

$$\beta\gamma\left(\frac{r+s}{q(\theta)}+\theta\right)=(1-\beta)(1-b_0)\frac{1-\bar{u}}{1-(1-b_0)\bar{u}}y. \tag{12}$$

The graph of this condition is negatively sloped and concave to the origin in the $\theta/\bar{u}$–space. Since $(1-\bar{u})/(1-(1-b_0)\bar{u})$ is smaller than one, the graph lies everywhere below the one for a lump–sum tax. As the economy reaches full employment, i. e. $\bar{u}\to 0$ the graph approaches the one for a lump–sum tax. However, this point is not a feasible equilibrium, since the equilibrium on the labour market is always characterised by a strictly positive number of unemployed persons. With the unemployment rate approaching one, the vacancy rate grows to zero, i. e. $\theta\to 0$ and the graph crosses the *x*–axis.

Finally, for a SSC, the aggregated labour demand is given by

$$\beta\gamma\left(\frac{r+s}{q(\theta)}+\theta\right)=(1-\beta)\left(1-b_0-\rho\frac{\bar{u}}{1-\bar{u}}\right)\frac{1-\bar{u}}{1-(1-b_0)\bar{u}-\rho b_0\bar{u}}y. \tag{13}$$

The graph of the aggregated labour demand for a SSC is also negatively sloped and concave tot he origin in a $\theta/\bar{u}$–space. It lies below the appropriate graph for a lump–sum tax and approaches the latter as full employment is reached, i. e. if $\bar{u}\to 0$. Again, full employment is not a feasible equilibrium outcome. When the unemployment rate grows larger, the vacancy rate approaches zero, i. e. $\theta\to 0$ for $\bar{u}<1$. Equation (34) shows that the graph coincides with the one of a VAT, when the employer alone pays the contribution to the unemployment benefits, i. e. if $\rho=0$. In contrast, if workers pay at least part of the contribution to the SSS, the graph for a SSC lies everywhere below the one for a VAT.

Figure 4.1 illustrates the equilibrium in an economy for the three alternative financing options. The Beveridge curve labelled *BC* is represented by the downward sloped curve. The superscripts *ls*, *VAT*, and *SSC* are used to distinguish the alternative aggregated labour demand curves *LM*. In addition, the subscripts indicate the restriction under which the particular labour demand curve is valid.

Figure 4.1 shows that introducing a VAT yields a lower employment level and a lower Beveridge ratio (θ) compared to a lump–sum tax. If an economy with a lump–sum tax is regarded as reference point imposing a VAT biases the employment level. Since the graph of the aggregated labour demand curve for a pure payroll tax ($\rho=0$) coincides with that of a VAT, the

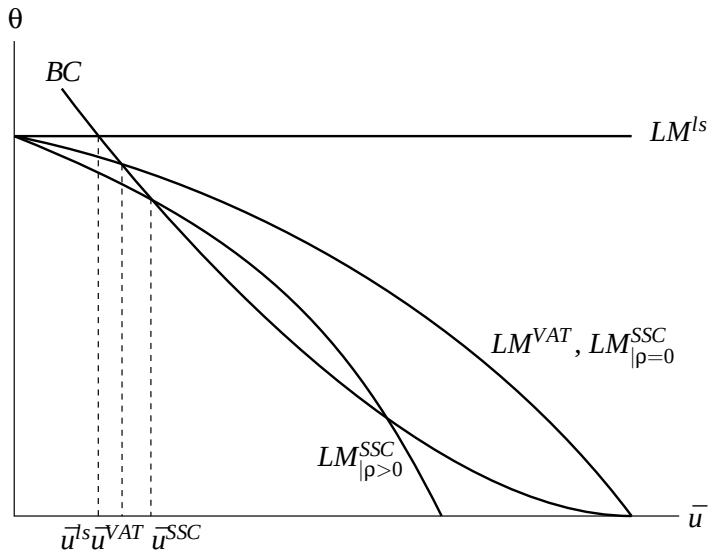

Figure 4.1: The equilibrium for alternative financing options

same is valid for a payroll tax. The figure also reveals that t SSC, where workers bear part of the contribution ($\rho > 0$), results in an even lower level of employment and the Beveridge ratio. Both reach their lowest level for a pure income tax, i. e. for $\rho = 1$. Accordingly, the employment level is also biased for a SSC.

To look for the reasons of the employment bias, it is useful to examine the wage sharing rule (9). Rearranging, it can be written as

$$\begin{aligned} c_e - c_u &= \beta\Sigma \\ \Sigma &= c_e - c_u + p_p y - w_c + \gamma\theta \end{aligned} \tag{14}$$

Σ denotes the total surplus generated by the match. A wage satisfying equation (14) leaves the potential employee with a share of the common surplus which is proportional to its bargaining power. Accordingly, the employer receives

$$F = (1-\beta)\Sigma, \tag{15}$$

where F is the firm's evaluation of a job.

Using equations (3), (28), and (31), the common surplus of a match for a lump–sum tax can be derived with

$$\Sigma^{LS} = (1-b_0)y + \frac{r+s}{q(\theta)}\gamma + \gamma\theta. \tag{16}$$

Similarly, with equations (7), (28), and (31), the common surplus for a VAT can be specified as

$$\Sigma^{VAT} = (1-b_0)\frac{1-\bar{u}}{1-(1-b_0)\bar{u}}y + \frac{r+s}{q(\theta)}\gamma + \gamma\theta. \tag{17}$$

Since $(1-\bar{u})/(1-(1-b_0)\bar{u})$ is smaller than one, the common surplus of a match smaller when a VAT as opposed to a lump–sum tax is introduced. According to equation (15), the firm's evaluation of a job F is lower when a VAT as compared to a lump–sum tax is used to finance the unemployment benefits. The firm's value of a job is also the return on a vacancy when the latter

is matched to an unemployed person. Since q denotes the probability that the event happens to an unfilled job, qF is the expected return on a vacancy. In an equilibrium state, there are offered as many vacancies so that the expected return on the last one equals the cost of opening an unfilled job. Since the return on a vacancy F is smaller when a VAT instead of a lump–sum tax is imposed, fewer vacancies per unemployed person are offered in the former case. In addition, the common surplus of a match becomes the smaller the higher the unemployment rate if a VAT is chosen. As a consequence, firms find it increasingly unprofitable to offer vacancies when the unemployment rate rises. This describes the form of the graph LM^{VAT}.

The same argument applies to a situation in which a pure payroll tax is introduced, i. e. a SSC with $\rho = 0$. When a policymaker decides in favour of a SSC and the employees have to bear part of the contribution ($\rho > 0$), an additional employment bias emerges.

We implicitly assumed that potential workers and potential employers behave rationally during the wage bargaining (cf. appendix). In particular, this means that both partners won't accept an offer generating a negative surplus. If a lump–sum tax is levied, the surplus of a match to a potential worker in an equilibrium is given by $c_e - c_u = (1 - b_0)w$. The surplus is positive and, hence, the individual is willing to accept a job at reasonable conditions if $1 - b_0 > 0$. Since this condition is satisfied per definition, the worker is prepared to work even for a low wage. Similarly, the firm's surplus of a match is given by $F = (p_p y - w_c + \gamma)/(r + s + q)$ (cf. appendix). The employers will reject all wage offers inducing the total labour costs to exceed $p_p y + \gamma$. Therefore, the employer is willing to hire a worker in an equilibrium if $w_c < p_p y + \gamma$. Summarising both conditions shows that the bargaining partners will consent to a wage or equivalently total labour costs from the interval $w_c \in [0, p_p y + \gamma]$.

Suppose now, an SSC is imposed. Then, the entrepreneur's surplus of a match is still given by $F = (p_p y - w_c)/(r + s + q)$. The employers will reject all wage offers inducing the total labour costs to exceed $p_p y + \gamma$. The employee's surplus of a match reads $c_e - c_u = (1 - b_0 - \rho\vartheta)w/p_c$. As it can be seen, the surplus is positive if the wage is positive and $1 - b_0 > \rho\vartheta$. The latter condition is identical to the one in an economy with a lump–sum tax or a VAT if $\rho = 0$, i. e. if a payroll tax is raised, and is satisfied per definition. In this special case, the employment level bias has proved to be the same as for a VAT. For the more general case of $\rho > 0$, the condition differs from the one with a lump–sum tax or a VAT. In contrast to the condition with a lump–sum tax or a VAT, the one with a SSC is not satisfied per definition. Rather, it imposes an additional restriction on the economy. Clearly, the $1 - b_0 > \rho\vartheta > 0$ is satisfied in an equilibrium. However, the latter is compatible with only certain values of the contribution ϑ determined endogenously. If the condition is violated no individual will find it profitable to work. The fact that the contribution ϑ influences the surplus of a match introduces the additional employment bias for $\rho > 0$.

One possibility of dealing with the additional bias is to change the structure of the SSC. Suppose, the policymaker imposes the contribution to the SSS on the employed and unemployed person's income. Then, the consumption and the indirect utility of a job seeker changes to $c_u = (1 - \rho\vartheta)b_0 w/p_c$. It follows that the common surplus of a match is now identical to that for a VAT. When the SSC is levied on both the employee's and the unemployed person's income no additional restriction is imposed. This can be verified by noting the workers share of the

common surplus is positive if the wage, $1-\rho\vartheta$, and $1-b_0$ are positive. The last two conditions are satisfied by definition. A recalculation of the model reveals that the labour demand curve is independent of ρ and coincides with the one for a VATÀccordingly, if the job seeker's income is normally taxed, the employment level is identical to that reached with VAT.

5 Welfare

As mentioned above, the policymaker only determines the revenue structure of the SSS. He or she may introduce a VAT or a SSC. If the policymaker favours the latter he or she as well decides on the share which a firm and an employee bears. However, the policymaker cannot influence the expenditure structure of the SSS and does not intervene into private decisions. Firms decide whether they offer a vacancy and wages are the outcome of a bilateral negotiation between workers and employers.

Suppose, the government desires a low unemployment rate and has only two alternatives to finance the unemployment benefits — a VAT or a SSC. The last section has shown that the policymaker is indifferent between a VAT and a payroll tax, i. e. a SSC with $\rho = 0$. However, he or she prefers both financing options to a SSC, where the workers bear part of the contribution. Would a policymaker differently decide when he or she desires to maximise the welfare?

The appendix shows that the policymaker's welfare function reads

$$W = n(1-\bar{u})\left(y + \frac{r+s}{q(\theta)}\gamma\right) \quad \text{with}$$
$$\frac{dW}{d\bar{u}} < 0 \quad \text{and} \quad \frac{dW}{d\theta} > 0. \tag{18}$$

Since introducing a payroll tax, i. e. a SSC with $\rho = 0$, as opposed to a SSC with $\rho > 0$ renders the lower unemployment rate and the higher Beveridge ratio θ, the welfare is higher for the former alternative. A comparison between a VAT and a payroll tax show that both options yield identical unemployment rates and Beveridge ratios so that the same welfare levels are reached. As a consequence, the policymaker is indifferent between a VAT and a payroll tax, but would not introduce a SSC, where a share of the contribution to the SSSis imposed on the employee's income but not on that of the unemployment person's. In contrast, if part of the SSC is levied on the employed and unemployed individual's income the policymaker is again indifferent between introducing a VAT and a SSC.

6 Potential reforms

Before discussion potential reforms of an SSS's revenue structure, the derived results are summarised. First, a policymaker's decision problem was considered consisting in choosing between a VAT and an SSC to finance the unemployment benefits. However, the policymaker was assumed to face several restrictions: I) In accordance to most OECD countries, the benefits were assumed to ge a fixed fraction of the previous earnings. II) The benefits are not taxed. III) The government has to run a balanced budget. Assuming that the government desires a high welfare, it can be shown that:

- The government is indifferent between a VAT and a payroll tax, i. e. a SSC only imposed on entrepreneurs.

- The policymaker favours a VAT or a payroll tax to a SSC imposed on employees and employers.

This model can be associated to Japan, However as in Belgium, Denmark, Italy, and Switzerland unemployed persons do not pay the SSC, the model may also represent these countries (cf. table 1).

Second, the policymaker's decision problem was reconsidered under a slightly different set of restrictions. The second was replaced by the assumption that the benefits are normally taxed. Then, it can be demonstrated that the policymaker is indifferent between a VAT a payroll tax or a 'normal' SSC. The modified model is e. g. applicable to Canada, the Netherlands, and Norway, (cf. table 1).

Given a country imposes the a SSC on employees and employers but not on unemployed persons, the reforms suggestions for the revenue structure of an SSScomprise two mutually excluding activities. The first is a change from direct to indirect taxation and the second focuses on potential changes within a direct taxation. The derived results in a matching framework show that a policymaker may well decide for a VATsince employment and welfare increases by the shift.

If the government is not prepared to change from direct to indirect taxation it can also improve the employment level. The second option consists in equally taxing the employed and unemployed person's income. This in particular means that if employees and employers share the SSC the contribution should also be imposed on benefits. However, this contradicts the intention of an unemployment insurance, according to which workers insure themselves against the risk of unemployment and the inevitable loss of income. Consequently, the policymaker can transform the SSC shared by employers and employees into a payroll taxy. In this situation, the employer alone pays for the unemployment benefits and the individual's income is not directly influenced. However the real earnings for workers and job seekers are equally affected if the entrepreneurs shift part of the tax into consumer prices. On the other hand, the policymaker may change the ø to the income tax levied equally on employed and unemployed person's income.

The present analysis has neglected a number of aspects which may affect the results. First, we did not consider the individual's decision between working and leisure. A high direct tax, whether in form of an income tax of a shared SSC, may discourage the search for a job. Second, capital played no effective role in the model. However, a VAT broadens the tax base by including capital income. Third, as a saving decision was not considered, the effects of the alternative options to finance the unemployment benefits on investment were not studied. Finally, the enforcement efficiency of the different taxes were not taken into account. As the tax evasion seems more problematic for the income related taxes, a VAT appears even more preferable.

Appendix

The sharing rule

The sharing rule which a wage has to satisfy is derived here is the solution of an asymmetric Nash bargaining problem. Therefore, the expected returns for individuals and firms have to be determined. A general formulation is here chosen so that the sharing rule is valid for a lump–sum tax, a VAT, and a SSC. Since a person can be employed or unemployed, dynamic programming specifies the return on being employed and unemployed respectively. Similarly, each firm has exactly one job to be either filled or unfilled. Hence, there is a return on a filled and vacant job respectively.

A worker's return on being employed E has to satisfy

$$rE = c_e + s(U - E), \tag{19}$$

where U stands for a job seeker's return on being unemployed. rE is a worker's permanent income that has to equal the sum of the indirect utility for an employee c_e and the 'gain' from changing the employment status occurring with probability s. This formulation implicitly assumes the existence of a perfect capital market with an interest rate r.

By analogy, the job seeker's return on being unemployed can be determined with

$$rU = c_u + p(E - U). \tag{20}$$

Again, the permanent income of an unemployed person depends on the indirect utility of an unemployed person c_u. The interpretation of this equation is similar to the one above.

The return on a filled job F is given by

$$rF = p_p y - w_c + s(V - F), \tag{21}$$

where V is the return on a vacancy. The equation states that the permanent income from a filled job rF has to equal the sum of the immediate return $p_p y - w_c$ (the profit obtained from the job) and the expected loss from the destruction of the employee–employer pair $s(V - F)$.

Finally, the return on a vacant job V has to satisfy

$$rV = -\gamma + q(F - V), \tag{22}$$

where γ is the cost of keeping the vacancy.

In an equilibrium, the expected net return on an additionally offered vacancy has to be zero if there are no difficulties in generating these. Hence, the condition $V = 0$ has to be satisfied. Using this fact in equation (21) results in

$$qF = \gamma \tag{23}$$

stating that the expected return on a vacancy qF equals the cost of offering the vacancy γ. This equation implicitly determines the number of vacancies offered in an equilibrium and, hence also the labour demand.

The solution of an asymmetric bargaining process will maximise the Nash product $\Omega = [E-U]^{\beta}[F-V]^{1-\beta}$, where β denotes the bargaining power of an individual. Differentiating the Nash product with respect to the wages and using the result that $V = 0$ in an equilibrium yields the first–order condition for the wage negotiation:

$$\begin{aligned} [E-U] &= \beta\Sigma \\ \Sigma &= E-U+F. \end{aligned} \tag{24}$$

Σ denotes the common surplus of the match. Then, the first–order condition of the Nash bargaining problem states that the individual's surplus of the match $(E-U)$ equals the share of the common surplus equivalent to their bargaining power. Accordingly, the employer's share F of the common surplus is given by

$$F = (1-\beta)\Sigma. \tag{25}$$

Using the value functions (19) and (20), determines the individual's surplus with $E-U = (c_e - c_u)/(r+s+p)$. From equation (21) and (23) ensues the firm's surplus of the match, $F = (p_p y - w_c + \gamma\theta)/(r+s+p)$. The two conditions can be used to replace the appropriate value function in the sharing rule (24). The general formulation of the sharing rule reads

$$(1-\beta)(c_e - c_u) = \beta(p_p y - w_c + \gamma\theta). \tag{26}$$

The aggregated labour demand curve

The aggregated labour demand curve for a lump–sum tax, a VAT, and a SSC is derived from four equations: the product market equilibrium, the sharing rule, the labour demand and the government's budget restriction. The sharing rule is given by equation (9) and the government's budget constraints by equations (3), (5), and (7). To specify the aggregated labour demand condition for each financing option, the product market equilibrium and the labour demand has to be determined in a general form fist.

The product market equilibrium equates supply and demand for the single consumer good. Employed and unemployed person's disposable income is different so that they will realise other consumption levels. The aggregated demand is $ec_e + uc_u$. Since each firm can hire exactly one worker, the number of active firms equals the number employed persons. Hence, the supply is given by ey. It follows that the product market equilibrium reads in a general form

$$ec_e + u_c u = ey. \tag{27}$$

Rearranging equation (21) and noting that $V = 0$ in an equilibrium yields $(r+s)F = (p_p y - w_c)$. Inserting (23) into the latter expression leads to the labour demand

$$\frac{r+s}{q(\theta)}\gamma = p_p y - w_c. \tag{28}$$

The aggregated labour demand for a lump–sum tax

Using the equation (3) in the product market equilibrium condition (27) ensues in $ew + b_0 wu - n\lambda = ey$. According to the government's budget constraint (4) second term on the left–hand side equals the third term so that

$$w = y. \tag{29}$$

Replacing the consumption levels for employed and unemployed persons and the firm's profits by equation (3) and (28) yields $(1-\beta)(1-b_0)w = \beta\gamma(\theta + (r+s/q))$. Inserting identity (29) renders the following aggregated labour demand condition

$$\beta\gamma\left(\frac{r+s}{q(\theta)} + \theta\right) = (1-\beta)(1-b_0)y. \tag{30}$$

The aggregated labour demand for a VAT

Again, we start by deriving the real wage for an economy with a VAT. Replacing the consumption levels in the product market equilibrium condition (27) by the equation (5) and rearranging yields

$$\frac{w}{p_c} = \frac{1-\bar{u}}{1-(1-b_0)\bar{u}}y. \tag{31}$$

The identities $\bar{u} = u/n$ and $e/n = 1-\bar{u}$ were used in addition.

Equations (5) and o(28) can be used in the sharing rule to derive $(1-\beta)(1-b_0)w/p_c = \beta\gamma(\theta + (r+s)/q)$. Inserting the real wage (31) into the latter expression gives the aggregated labour demand for an economy introducing a VAT

$$\beta\gamma\left(\frac{r+s}{q(\theta)} + \theta\right) = (1-\beta)(1-b_0)\frac{1-\bar{u}}{1-(1-b_0)\bar{u}}y. \tag{32}$$

The aggregated labour demand for a SSC

Using equation (7), the product market equilibrium condition can be written as $(e(1-\rho\vartheta) + b_0 u)w/p_c = ey$. With the government's budget constraint (8), the real wage can be determined with

$$\frac{w}{p_c} = \frac{1-\bar{u}}{1-(1-b_0)\bar{u}-\rho b_0\bar{u}}y. \tag{33}$$

Inserting equation (7) and (28) into the product market equilibrium condition gives $(1-\beta)(1-b_0-\rho\vartheta)w/p_c = \beta\gamma(\theta + (r+s)/q)$. The contribution ϑ and the real wage can be eliminated in the latter expression by inserting equations (8) and (33). Then, the aggregated labour demand for a SSC reads

$$\beta\gamma\left(\frac{r+s}{q(\theta)+\theta}\right) = (1-\beta)\left(1-b_0-\rho b_0\frac{\bar{u}}{1-\bar{u}}\right)\frac{1-\bar{u}}{1-(1-b_0)-\rho b_0\bar{u}}y. \tag{34}$$

The welfare function

Let W denote the welfare comprising the individuals and firms equilibrium utility. rE and rU are the equilibrium utility for an employed and unemployed person respectively. Similarly, rF and rV are the equilibrium utility for a firm having a filled job and a vacancy respectively.

As each entrepreneur can only hire one worker, there are e employees and e active firms in the economy. The welfare function can be written as

$$W = erE + urU + erF + vrV$$

Using the equations (19) and (20), it follows that

$$erE + urU = ec_e + uc_u = ey,$$

where the last identity follows from the product market equilibrium. Noting that $V = 0$ if each firm offers the optimal number of vacancies in an equilibrium, the welfare function becomes

$$W = n(1-\bar{u})\left(y + r\frac{\gamma}{q(\theta)}\right).$$

The derivatives of the welfare function with respect to the unemployment rate and the Beveridge ratio are given by

$$\frac{dW}{d\bar{u}} = -n\left(y + r\frac{\gamma}{q(\theta)}\right) < 0$$
$$\frac{dW}{d\theta} = -n(1-\bar{u})r\gamma\frac{q'}{q^2} > 0.$$

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