Wage Effects of Mobility, Unemployment Benefits and Benefit Financing

Hans Lindblad*
Sveriges Riksbank
Department of Economics
103 37 Stockholm
Sweden
e-mail: hans.lindblad@riksbank.se

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Abstract

This paper studies how wages and employment are affected by unemployment insurance when there is endogenous labor mobility. In a simple model with symmetric sectors, it is shown that introducing labor mobility reduces the wage level, and thereby also unemployment. It is also shown that an increased benefit level has an ambiguous effect on the wage level, contrary to the standard result in the literature. The finding in the literature that an increase in the fraction of unemployment costs borne by the own sector reduces the wage level is shown to hold when labor is mobile as well.

Another result is that wage costs in general are higher when unemployment benefits are financed through pay-roll taxes compared to the case when they are financed through income taxes. Thus in general, the tax equivalence result in the literature does not hold.

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1. Introduction

The main purpose of this paper is to analyze how unemployment insurance affects wages and employment in a model where labor can move freely between different sectors in the economy. The aim is to examine the robustness of some earlier results in the literature.

The wage and employment effects of changes in unemployment benefits has been analyzed in a number of studies, (e.g. Oswald, 1982; Calmfors and Forslund, 1990; Atkinson and Micklewright, 1991; Layard *et al.,* 1991). The theoretical analysis shows that wages are set as a mark-up on the unemployment benefit level. Thus, higher benefits raise wages and thereby reduce employment. The empirical results are, however, not that clear-cut (e.g. Atkinson and Micklewright, 1991; Forslund, 1995; Forslund and Kolm, 1999).

Thus the provision of unemployment benefits has, at least theoretically, adverse effects on wages and employment. One way of getting around this adverse effect is to finance unemployment benefits in such a way that incentives for lower wages are created. An example is the experience-rated pay-roll tax system in the US, where the pay-roll tax, at least to some extent, is set to reflect individual employers' lay-off history (e.g. Anderson and Meyer, 1995). Such a tax scheme increases firing costs and creates a disincentive to lay off workers. However, at the same time hiring costs are increased which reduces the incentive to hire workers (Hamermesh, 1993).

An alternative to the experienced-rated pay-roll tax system is pointed out by Holmlund and Lundborg (1988, 1989) and Calmfors (1993, 1995). They suggest that wage setting and employment can be influenced by differentiating the contributions to unemployment support according to bargaining areas. Calmfors (1995) notes that "this approach should be of relevance for Europe where bargaining often occurs at an intermediate (usually industry) level, in which case hiring and firing costs of firms are not directly affected". The idea is to face the parties to bargaining with some of the costs for unemployment, thereby increasing the perceived benefits of wage moderation.

In Sweden the unemployment insurance system is combined with active labor market policies, which in fact have created a system where an unemployed person can receive benefits indefinitely. There have been several attempts to change the unemployment insurance system, without any substantial results. The Swedish unemployment insurance system is by tradition administrated by the unions. Thus, different sectors already have their own unemployment insurance administration and the fees from the insured members differ among sectors. The insurance is however heavily subsidized by the central government in Sweden, in fact more than 90 per cent of the costs in the insurance system is covered by the government. On the margin the contribution from the government is effectivily 100 percent (Holmlund, 1998 and 1999). Thus, the employee contributions only cover a small fraction of the unemployment costs. Similare systems exist in Belgium, Denmark and Finland.

Hence in the prevailing system the bargaining parties in one industry can settle for high wages disregarding the consequences for their members and other industries. The costs will be borne by all workers via the tax system. An institutional set-up with sector specific insurance administrations, however, makes it possible to differentiate contributions from both insured members and from firms operating within the sector.

A related question, when discussing sector specific funding, is if it matters if the costs for unemployment benefits are paid by the insured employees or by the employers through a pay-roll tax. The tax incidence of financing unemployment benefits has been discussed in a number of papers (Oswald, 1982; Holmlund and Lundborg, 1989 a, b, 1990; Layard *et al.,* 1991; Calmfors, 1995; Holmlund, 1998). An established conclusion is that it does not matter in terms of wage costs and employment if the benefits are financed through employee contributions or a payroll tax. Holmlund (1981) and Koskela and Vilmunen (1994), however, show that this result is not valid if the tax bases differ or if there is uncertainty about the wage rate.

These results are usually obtained from monopoly union models or bargaining models where the union maximizes the expected income of a representative member, but where no distinction is made between insiders and outsiders and taxes are treated as exogenuous when wages are set. Moreover, labor supply to each sector is assumed to be fixed and all sectors to be symmetric. An exception of the treatment of fixed labor supply is Holmlund and Lundborg (1990) who model a segmented labor market with one unionized sector and one non-unionized sector. Another exception is found in Topel and Welch (1980).

In this paper the wage effects of mobility, unemployment benefits and benefit financing are analyzed in a simple model where labor can move freely between different sectors in the economy. In the next section I examine the robustness of some previous results in the literature. First I study how wages and employment are affected by the level of unemployment compensation. Second, the tax equivalence result is tested, i.e. I examine whether it matters if unemployment benefits are financed through employee contributions or pay-roll taxes. The analysis is carried out in a unionized multi-sector economy where all sectors are identical. In the last part of the paper I study how wages and employment are affected by unemployment insurance when there is labor mobility between different sectors. Labor is free to move between sectors, and sector specific unemployment is determined by both labor supply and employment effects.

2. A model of wage setting without labor mobility

2.1. Employee contributions

I assume an open economy that consists of a number of sectors. In each sector there are many firms, and prices are given from the world market. Moreover, there is one union, which organizes all workers, and one employer organization in each sector. A common assumption in the literature is that wages are set as a mark-up over some alternative, reference, utility (c.f. McDonald and Solow, 1981; Oswald, 1982, 1985; Layard *et al*, 1991 and Holmlund and Kolm, 1995). Thus in each sector, the union's single objective is to maximize the difference between the after tax wage level and an alternative utility. The alternative utility is in equilibrium assumed to be a weighted average of the wage level and the unemployment compensation. However, the alternative utility can also be zero (or irrelevant as a benchmark). This would generate a utlilty function where the union only care about the after tax wage, which could be the case where the majority of the union members are insiders with full jobb security. The assumptions implies both that unions do not explicitly care about employment when setting wages and that unions are risk neutral.

In the economy there is only one type of public expenditure, namely unemployment benefits. The benefit is the same in all sectors. The unemployment insurance (UI) costs are financed through contributions from the employees. The contribution is modelled as a proportional income tax levied on employed workers.

Thus the utility u_i of union i can be written as

$$u_i = w_i(1 - t_i) - \overline{w},$$

where w_i is the prevailing wage level for all employees, t_i is the income tax rate and $\overline{w}$ is the alternative utility

The tax rate for the employees in a sector consists of two components; a component, t_0, which is the same for all sectors and a sector-specific component,

$\overline{t_i}$, i.e.,

$$t_i = t_0 + \overline{t_i}.$$

The sector specific component, $\overline{t_i}$, is chosen such that the employees in a given sector cover a certain fraction, γ, of the costs of unemployment in the sector, $b(m_i - l_i)$, where b is the unemployment benefit, m_i and l_i the labor supply in sector i and employment in the sector i respectively. More specifically, it holds that

$$w_i l_i \overline{t_i} = \gamma b(m_i - l_i)$$

or

$$\overline{t_i} = \gamma b \frac{(m_i - l_i)}{w_i l_i}.$$

Thus, the tax rate t_i can be written as

$$t_i = t_0 + \gamma b \frac{m_i - l_i}{w_i l_i}. \tag{2.1}$$

The parameter, γ, determines to what degree sector-specific unemployment costs are taken into account in the wage setting procedure, even though unions do not explicitly care about unemployment. If $\gamma = 0$ there will be no such consideration, if $\gamma = 1$ the unemployment cost are fully taken into account.

Firms are assumed to maximize profits and the employer organization in sector i maximizes aggregate profit in the sector, denoted Π_i.

Wages are determined by negotiations between the union and the employer organization at the sector level. In case of disagreement it is assumed that the union obtains zero utility and the firms' profits are zero. Wages are assumed to be set so as to maximize the Nash bargaining product

$$\Omega = [w_i(1 - t_i) - \overline{w}]^a \, \Pi_i^{1-a} \tag{2.2}$$

subject to equation (2.1) and the labor demand equation

$$l_i = l\,(w_i)\,, \tag{2.3}$$

which follows from profit maximization of the individual firms.

Assuming an interior solution, the FOC can be written as

$$\Omega_{w_i} = \frac{1}{w_i(1 - t_i) - \overline{w}} \left(1 - t_i - w_i \frac{\partial t_i}{\partial w_i}\right) - \frac{(1 - a)\, l_i}{a \Pi_i} = 0 \tag{2.4}$$

or

$$\Omega_{w_i} = \frac{1}{w_i(1-t_i) - \overline{w}}\left(1 - t_0 - \frac{\gamma b m_i \varepsilon_i}{w_i l_i}\right) - \frac{(1-a)\, l_i}{a\Pi_i} = 0,$$

where the envelope theorem result

$$\frac{\partial \Pi_i}{\partial w_i} = -l_i$$

has been used[1] and ε_i is the elasticity of labor demand, i.e.,

$$\varepsilon_i = -\frac{\partial l_i}{\partial w_i}\frac{w_i}{l_i}.$$

The FOC is standard, and shows that the marginal increase in the unions' utility (captured by the first part of the equation) is traded off against the marginal loss of profits (captured by the second part of the FOC).

In order to analyze the general equilibrium implications on the wage level of a change in b or γ, I assume symmetry, that is, that all sectors are alike ($w_i = w$, $l_i = l$, $m_i = m$), insert a balanced budget condition in the FOC and specify worker's outside opportunities.

A balanced budget requires

$$wlt = (m - l)b. \tag{2.5}$$

Using this requirement together with equation (2.1) gives the common component of the tax rate, t_0, as

$$t_0 = (1-\gamma)\,\frac{m-l}{wl}b. \tag{2.6}$$

[1] To se this note that profits, Π_i, is

$$\Pi_i = N_i\left[F(l_{ji}) - w_i l_{ji}\right]$$

where N_i is the number of firms in sector i, and l_{ji} is employment in firm j in sector i. Profit maximization gives that

$$F'(l_{ji}) - w_i = 0.$$

The wage setting parties take into account that firms set employment according to profit maximization. Thus

$$\frac{\partial \Pi_i}{\partial w_i} = N_i\left[\left(F'(l_{ji}) - w_i\right)\frac{\partial l_{ji}}{\partial w} - l_{ji}\right] = -l_i.$$

Equation (2.6) shows that the common tax finances a fraction $(1-\gamma)$ of the aggregate unemployment costs. If $\gamma = 0$ then the total UI costs are borne in the same way by all employees. If $\gamma = 1$ the common part of the tax rate is zero and the UI costs emerging in each sector are completely borne within the same sector.

The alternative utility, $\overline{w}$, is taken to be a weighted average of after tax real wages outside the sector and unemployment benefits. The weights are assumed to be determined by the aggregate employment rate in the economy. More precisely:

$$\overline{w} = \frac{l}{m} w (1-t) + \left(1 - \frac{l}{m}\right) b, \tag{2.7}$$

which can be rewritten as

$$\overline{w} = \frac{l}{m} w \tag{2.8}$$

when imposing the balanced budget condition.

As noted in the introduction, it is a standard result that an increase in the benefit level, b, pushes up the wage level. Another result is that an increase in the share of sector specific unemployment costs borne by the sector, γ, increases the incentive for wage moderation and thus reduces the wage level. The robustness of these previous results are now to be checked.

In order to facilitate the calculations the FOC can, by using equation (2.6), be rewritten as

$$\Lambda_w = [wl - (m-l)\, b] \left[\frac{a\Pi}{wl} - (1-a)\right] - \frac{a\gamma b m \Pi}{wl} \left(\varepsilon - \left(1 - \frac{l}{m}\right)\right) + (1-a) \frac{wl^2}{m} = 0, \tag{2.9}$$

where it should be noted that

$$wl - (m-l)\, b = wl(1-t) > 0,$$

if the model is to be meaningful.

The comparative statics are given by

$$\frac{dw}{db} = -\frac{\Lambda_{wb}}{\Lambda_{ww}}$$

and

$$\frac{dw}{d\gamma} = -\frac{\Lambda_{w\gamma}}{\Lambda_{ww}}.$$

The expression for Λ_{ww} is not a second order condition for a maximum and is often complicated to sign without further assumptions. However a standard way around this problem is to use Samuelson's correspondence principle or "dynamic stability" (Sargent, 1987), which requires that the static equilibrium also fulfills the requirement of stability in a dynamic setting. This requires that

$$\Lambda_{ww} < 0.$$

Thus the comparative statics are determined by the signs of Λ_{wb} and $\Lambda_{w\gamma}$.

$$\Lambda_{wb} = -(m-l)\left[\frac{a\Pi}{wl} - (1-a)\right] - \frac{a\gamma m\Pi}{wl}\left(\varepsilon - \left(1 - \frac{l}{m}\right)\right) \tag{2.10}$$

which can, by using equation (2.9), be rewritten as

$$\Lambda_{wb} = \frac{1-a}{1-t}\left[\left(1 - \frac{l}{m}\right)l - \frac{a\gamma m\Pi}{wl(1-a)}\left(\varepsilon - \left(1 - \frac{l}{m}\right)\right)\right]. \tag{2.11}$$

An increase in the benefit level will affect the wage througt both the alternative utility and through the tax rate. The first term in equation (2.11) is always positive and captures the standard effect from the literature: an increase in the benefit level raises the the alternative utility and thus pushes the wage. A special case occurs, however, if the alternative utility is zero, which could be the case when a union is dominated by insiders who have full job security. In that case the first term vanishes, and the wage effect from an increased benefit level is entirely determined by the second term.

The second term inside the bracket in equation (2.11) captures the wage effect due to a change in the tax rate when the benefit level is increased. This effect can not be signed without further assumptions. The reason for this is that an increased wage level will affect both the tax base, wl, and the level of unemployment, m-l. That is, a wage increase will affect both the denominator and the nominator in the tax rate expression.

It is straightforward to show that a wage increase will raise the tax rate if the elasticity of labor demand is not too small or more precisely that

$$\varepsilon > 1 - \frac{l}{m},$$

where $1 - l/m$ is the unemployment rate. This requirement, that the elasticity of labor demand is larger than the unemployment rate, is not especially restrictive since I am modelling economies near full employment. Using this elasticity condition, the second term in equation (2.11) is negative capturing the following effect: when γ is larger than zero a higher unemployment benefit means a smaller gain from a wage rise because the latter will trigger a larger rise in the sector specific tax rate. This reduces the willingness to increase wages.

The net effect of the two terms is ambiguous, unless labor demand is very inelastic or the alternative utility is zero, and can not be signed without additional assumptions. Thus the standard result in the literature that an increased benefit level increases the wage level does not hold in general. Hence the introduction of a tax scheme where the bargaining parties are forced to consider that their actions affect the tax rate, will mitigate the adverse effects on wages and employment from unemployment benefits. Moreover, if the majority of union members have full job security, and thus the alternative utlilty is zero, an increased benefit level will reduce the wage level.

Turning to the wage effect of a change in the share of sector specific unemployment costs borne by the sector, γ,

$$\Lambda_{w\gamma} = -\frac{abm\Pi}{wl}\left(\varepsilon - \left(1 - \frac{l}{m}\right)\right) < 0,$$

and thus

$$\frac{dw}{d\gamma} = -\frac{\Lambda_{w\gamma}}{\Lambda_{ww}} < 0.$$

Thus if γ is increased, this raises the marginal cost of a wage increase since there will be a larger tax rate increase unless the elasticity of labor demand is very small. The higher the parameter γ, the more the unions are forced to take the level of unemployment into account even though they do not care about the level of employment *per se*. Hence, a rise in the share of sector specific unemployment costs borne by the sector creates an incentive to reduce wages. This result is what to expect and has also been shown previously (Holmlund and Lundborg, 1989; Calmfors, 1995).

2.2. Pay-roll taxes

An alternative to cover the unemployment costs by contributions from the employees is to finance the system through pay-roll taxes levied on the employers. In the literature there is a tax equivalence proposition that states that the level of wage costs and thus employment is not affected whether the unemployment insurance is financed through an income tax or through a pay-roll tax (Oswald, 1982; Holmlund and Lundborg, 1990). The question in this section is if this tax equivalence result is robust.

In the case of pay-roll taxes, profit maximization of individual firms, which take the wage level and the pay-roll tax rate p_i as given, give labor demand in a sector as a function of the wage cost, i.e.,

$$l_i = l\left(w_i\left(1+p_i\right)\right).$$

Thus, the tax now enters through the labor demand and the profit function rather than through the take-home wage.

Similar to the income-tax case, the pay-roll tax, p_i, is assumed to consist of two components, one that is common for all sectors, p_0, and one that is sector specific, $\overline{p}_i$, i.e.,

$$p_i = p_0 + \overline{p_i}.$$

The sector specific component, $\overline{p_i}$, is chosen so that all the firms in a given sector cover a certain fraction, γ, of the costs of unemployment in the sector, i.e.,

$$w_i l_i \overline{p_i} = \gamma b(m_i - l_i)$$

or

$$\overline{p_i} = \gamma b \frac{(m_i - l_i)}{w_i l_i}.$$

Thus, the pay-roll tax rate p_i can be written as

$$p_i = p_0 + \gamma \frac{m_i - l_i}{w_i l_i} b,$$

Again, the parameter, γ, determines to what degree sector specific unemployment costs are taken into account in the wage setting procedure.

Wages are, as before, set by maximizing the Nash bargaining product

$$\Omega_i = \left[w_i - \overline{w}^p\right]^a \Pi_i^{1-a},$$

where $\overline{w}^p$ is the alternative utility in the pay-roll tax case. The FOC can, assuming an interior solution, be written as

$$\Omega_{w_i} = \frac{a\Pi_i}{w_i - \overline{w}^p} + (1-a)\frac{\partial \Pi_i}{\partial w_i} = 0,$$

which, again, shows that the marginal increase in the unions' utility is traded off against the marginal loss of profits.

Applying the envelope theorem[2] gives

$$\frac{\partial \Pi_i}{\partial w_i} = -l\left(1 + p_i + w_i \frac{\partial p_i}{\partial w_i}\right), \tag{2.12}$$

where

$$\frac{\partial p_i}{\partial w_i} = \frac{\gamma b m_i}{w_i^2 l_i}\left(\varepsilon_i - \left(1 - \frac{l_i}{m_i}\right)\right).$$

The elasticity of labor demand is now

$$\varepsilon_i = -\frac{\partial l_i}{\partial w_i\left(1 + p_i\right)} \frac{w_i\left(1 + p_i\right)}{l_i}.$$

Making use of the envelope result, the FOC can be written as

$$\Omega_{w_i} = \frac{1}{w_i - \overline{w}^p} - \frac{\left(1 - a\right) l_i}{a \Pi_i}\left[1 + p_i + \frac{\gamma b m_i}{w_i l_i}\left(\varepsilon_i - \left(1 - \frac{l_i}{m_i}\right)\right)\right] = 0. \tag{2.13}$$

The tax equivalence proposition can be checked by comparing the FOC in the income tax case (2.4) with the FOC in the pay-roll tax rate case (2.13). The strategy is as follows: First, note that equation (2.4) defines a certain wage cost in the income tax case. Next, I take this wage cost and insert it into the FOC in the pay-roll tax case. If this procedure gives that the equality in equation (2.13) no

[2] To se this, note that aggegate profits can be written as

$$\Pi_i = N_i\left[F(l_{ji}) - w_i\left(1 + p_i\right) l_{ji}\right].$$

Profit maximization, taking $w_i(1 + p_i)$ as given, gives that

$$F'(l_{ji}) - w_i\left(1 + p_i\right) = 0.$$

The wage setting parties takes into account both that firms set employment according to profit maximization, and that p_i will depend on the wage level. Thus

$$\begin{aligned} \frac{\partial \Pi_i}{\partial w_i} &= N_i\left[\left(F'(l_{ji}) - w_i\left(1 + p_i\right)\right)\frac{\partial l_{ji}}{\partial w} - l_{ji}\left(1 + p_i + w_i \frac{\partial p_i}{\partial w_i}\right)\right] \\ &= -l_i\left(1 + p_i + w_i \frac{\partial p_i}{\partial w_i}\right). \end{aligned}$$

longer holds and instead is larger than zero this implies, provided that $\Omega_{w_i w_i} < 0$, that the wage cost has to increase and employment to decrease in order to fulfill $\Omega_{w_i} = 0$ in the pay-roll tax case.

To facilitate the comparison I denote the wage cost in both cases by $\widetilde{w}_i$. In the income tax case $\widetilde{w}_i = w_i$ and in the pay-roll tax case $\widetilde{w}_i = w_i\,(1 + p_i)$. By doing this and imposing symmetry, I can rewrite equations (2.4 and 2.13) as

$$\frac{1}{\widetilde{w}(1-t) - \overline{w}}\left(1 - t - \frac{\gamma bm}{\widetilde{w}l}\left(\varepsilon - \left(1 - \frac{l}{m}\right)\right)\right) - \frac{(1-a)\,l}{a\Pi} = 0 \qquad (2.14)$$

and

$$\frac{1}{\left[\widetilde{w} - (1+p)\overline{w}^p\right]\left[1 + \frac{\gamma bm}{\widetilde{w}l}\left(\varepsilon - \left(1 - \frac{l}{m}\right)\right)\right]} - \frac{(1-a)\,l}{a\Pi} = 0. \qquad (2.15)$$

Next, not that the alternative utility in the income-tax case in equilibruim was defined as

$$\overline{w} = \frac{l}{m}\widetilde{w}(1-t) + (1 - \frac{l}{m})b.$$

By the same reasoning as in the income-tax case, the alternative utility in the pay-roll tax case can be written as

$$\overline{w}^p = \frac{l}{m}w + (1 - \frac{l}{m})b.$$

Taking equation (2.15) minus equation (2.14), using the expessions for the alternative utility and simplifying gives

$$\frac{1}{1 - \frac{l}{m}}\left[\frac{1}{\left[\widetilde{w} - b(1+p)\right](1+\alpha)} - \frac{(1-t-\alpha)}{\widetilde{w}\,(1-t) - b}\right], \qquad (2.16)$$

where

$$\alpha = \frac{\gamma bm}{\widetilde{w}l}\left(\varepsilon - \left(1 - \frac{l}{m}\right)\right).$$

Using the balanced budget condition in the income-tax case, i.e.,

$$t = \frac{m-l}{\widetilde{w}l}b$$

and in the pay-roll tax case

$$p = \frac{m-l}{\widetilde{w}l}b(1+p),$$

equation (2.16) can be rewritten as

$$\frac{\alpha\left(\alpha+t\right)}{\left(1+\alpha\right)\left(\widetilde{w}\left(1-t\right)-\overline{w}\right)}. \tag{2.17}$$

It is immediately clear that this expression is zero when $\gamma = 0$ and thereby also $\alpha = 0$, and thus there is tax equivalence.

However, in general when $\gamma > 0$ the expression in equation (2.17) is unambiguously larger than zero, and thus the wage costs are higher and employment lower in the case of pay-roll taxes compared to the case of income taxes. Only in the special case when the parameter $\gamma = 0$, that is when the tax rates, t_i and p_i, are treated as constants when setting wages and employment, the wage levels are indifferent to the type of taxation. Thus, the previous result that wages and employment are indifferent to whether taxes are levied on employees or on employers does not hold in general.

In order to interpret this result, note that equations (2.16 and 2.17) expresses the difference between unions' marginal utility of a one percent increase in the wage in the pay-roll tax case and in the income-tax case. When $\gamma = 0$, a one percent increase in the wage will result in the same change in utility in both cases. However, when $\gamma > 0$, a one percent increase in the wage will result in different relative increases in the utility. The reslut in equation (2.17) shows that, at any given wage cost level, the marginal revenue of a wage increase is in general larger in the pay-roll tax case compared to the income-tax case.

In the empirical literature the two tax rates are often merged into a tax-wedge variable, $\theta = (1+p)/(1-t)$, the analysis above suggests that the two tax rates should be treated separately.

3. A model with endogenous mobility

The purpose in this section is to introduce endogenous mobility in my model. This is done by letting employees move freely between the sectors, using that the objective is to maximize expected utility.

Wage setters are assumed to be aware of the possibility that employees can move and will consider this when setting the wage level. Thus the sequence can be described in the following way. Assume that there exists a union and an employer organization in each sector and that these two organizations negotiate and determine the after-tax wage in the sector. The negotiating parties know, when setting the wage, that the outcome will influence the attractiveness of working in the sector. After the wage is set firms determine employment given the wage, and last, employees, in order to maximize there expected utility, decide whether to stay or to leave the sector.

The labor force in the whole economy is fixed. To facilitate the analysis, the economy is modelled as if there where only two sectors.

Taxes Taxes are collected according to the same principles as in the preceding sections; see equation (2.1). Thus, the tax rate in a sector consists of a common part and a sector specific part.

The balanced budget condition for the economy is now given by

$$(m - l_1 - l_2)\, b = w_1 l_1 t_1 + w_2 l_2 t_2, \tag{3.1}$$

where m now is the fixed labor supply in the whole economy.

Combining equations (2.1) and (3.1) gives the common part of the tax rate as

$$t_0 = (1 - \gamma)\, \frac{m - l_1 - l_2}{w_1 l_1 + w_2 l_2} b. \tag{3.2}$$

Labor mobility In equilibrium the sector-specific labor supply is determined by two relationships. The first shows that the sum of the supplies of labor in the two sectors is constant, i.e.,

$$m = m_1 + m_2. \tag{3.3}$$

The second relationship divides total labor supply between the two sectors. Workers are assumed to join the sector where the expected utility is highest. The expected utility in a sector can be written as the weighted sum of incomes in the two states; employed and or unemployed. The probability of beeing employed and thus recieving the after-tax wage is l_i/m_i. Hence, the probability of beeing unemployed and recieving unemployment benefit is $1 - l_i/m_i$. Thus, the expected income of a representative union member in sector i can be written as,

$$\frac{l_i}{m_i} w_i (1 - t_i) + \left(1 - \frac{l_i}{m_i}\right) b.$$

In equilibrium expected utility in the two sectors must be equal so that there are now unexploited gains to be made from moving from one sector to the other. Thus, relative supply is determined by the following "arbitrage condition"

$$\frac{l_1}{m_1} w_1 (1 - t_1) + \left(1 - \frac{l_1}{m_1}\right) b = \frac{l_2}{m_2} w_2 (1 - t_2) + \left(1 - \frac{l_2}{m_2}\right) b. \tag{3.4}$$

The interpretation of this arbitrage condition is that; if the take-home wage is higher in sector 1 then unemployment must also be higher in the same sector otherwise expected income can not be equal. The larger unemployment level can be achieved through both lower employment and higher labor supply. Equation (3.4) can be rearranged to

$$\frac{m_1}{m_2} = \frac{l_1 \left[w_1 (1 - t_1) - b\right]}{l_2 \left[w_2 (1 - t_2) - b\right]}, \tag{3.5}$$

thus the relative rate of employment is determined by the relative mark-up of after-tax wages over the level of unemployment benefit.[3] In order to rule out corner solutions, it is assumed that the union members always prefers to work compared to beeing unemployed, i.e.,

$$w_i (1 - t_i) - b > 0. \tag{3.6a}$$

Thus equation (3.5) shows that the relative labor supply is determined by relative employment and the relative difference between take-home wage and unemployment benefits.

To express the sector specific labor supply in terms of the wage levels and the exogenous parameters (b and γ) and variables (t_0 and m), I combine equations (2.1) and (3.5) and obtain

$$m_1 = \frac{w_1 l_1 (1 - t_0) - (1 - \gamma) b l_1}{(w_1 l_1 + w_2 l_2)(1 - t_0) - (1 - \gamma) b (l_1 + l_2)} m. \tag{3.7}$$

Note that the denominator of equation (3.7) is always positive from the assumption that labor supply in each sector is positive (equation 3.6a).

3.1. A symmetric case

The set up in this sub-section is largely the same as in Section 2.1. There are two exceptions. First, I make the simplifying assumption that the economy consists of only two sectors. Second, free mobility between the different sectors is introduced.

[3] Note that when the unemployment costs are fully considered, that is when $\gamma = 1$, the relative labor supply collapses to

$$\frac{m_1}{m_2} = \frac{w_1 l_1}{w_2 l_2}.$$

Thus, the wage in each sector is determined through negotiation between two parties, the union and the employer organizations, which both are assumed to take the common part of the tax rate, t_0, the wage and thus the employment level in the other sector as given.[4] Thus, the problem for wage setters in sector 1 is to maximize equation (2.2) subject to equations (2.1, 2.3 and 3.7). Assuming an interior solution, the FOC is

$$\Omega_1 = \frac{1}{w_1(1-t_1) - \overline{w}_1}\left(1 - t_1 - w_1\frac{\partial t_1}{\partial w_1}\right) - \frac{(1-a)\, l_1}{a\Pi_1} = 0,$$

which I can rewrite as

$$\Omega_1 = \frac{1}{w_1(1-t_1) - \overline{w}_1}\left(1 - t_0 - \frac{\gamma b m_1 \varepsilon}{w_1 l_1} - \frac{\gamma b}{l_1}\frac{\partial m_1}{\partial w_1}\right) - \frac{(1-a)\, l_1}{a\Pi_1} = 0. \tag{3.8}$$

Compared to the analysis in the model without endogenous labor supply above, a new term (the last term inside the parentheses) enters the FOC. This term shows how a wage increase in sector 1 affects the labor supply in the same sector. This additional component captures the effect on the marginal utility of a wage increase from a change in sector-specific labor supply. If this component is positive it shows that the marginal utility of a wage increase is reduced, through an increased tax rate, because labor supply and thus unemployment increases, in addition to the reduction in employment.

From equation (3.7) I have

$$\frac{\partial m_1}{\partial w_1} = \frac{w_1\,(1-\varepsilon_1)\,(1-t_0) + (1-\gamma)\, b\varepsilon_1}{w_1\left[(w_1 l_1 + w_2 l_2)\,(1-t_0) - (1-\gamma)\, b\,(l_1+l_2)\right]^2}\left[w_2\,(1-t_0) - (1-\gamma)\, b\right] m l_1 l_2. \tag{3.9}$$

In general, the sign is ambiguous. Thus, the supply effect can decrease or increase wage pressure. A necessary condition for

$$\frac{\partial m_1}{\partial w_1} > 0$$

is

$$\varepsilon_1 < \frac{w_1\,(1-t_0)}{w_1\,(1-t_0) - (1-\gamma)\, b} = \frac{1}{1 - \frac{(1-\gamma)b}{w_1(1-t_0)}}. \tag{3.10}$$

[4] Taking the two-sector case more seriously, it is more reasonable to assume that the wage setting parties are large enough to realize that the negotiation outcome will affect not only the sector specific part of the tax rate, $\overline{t_i}$, but also the common part of the tax rate, t_0. However, such an analysis does not change the results below in any qualitative way.

Thus, the supply effect is positive as long as the elasticity of labor demand is not too large. Otherwise labor supply would fall due to a fall in expected utility triggered off by a large reduction in employment as wages increase. A sufficient condition for the supply effect to be positive is that $\varepsilon_1 \leq 1$. Such an assumption is in line with the empirical literature where the elasticity of labor demand is often estimated to be less than unity (Hamermesh, 1993; Blanchflower and Oswald, 1994). The necessary condition for the supply effect to be positive is actually much weaker since the right hand side of equation (3.10) is always larger than unity.[5] Recall that I have previously assumed that the elasticity of labor demand is not too small. Hence, the analysis is undertaken the assumption that the elasticity of labor demand keaps within a band, i.e.,

$$1 - \frac{l_i}{m_i} < \varepsilon \leq 1,$$

where the upper end is a sufficient condition, the necessary condition is often weaker.

Making use of the alternative utility given in equation (2.7), the balanced budget condition, given by equation (3.2), and imposing symmetry, that is $l_1 = l_2 = l$, $w_1 = w_2 = w$, $m_1 = m_2 = \overline{m}$, $\Pi_1 = \Pi_2 = \Pi$ and $m = 2\overline{m}$, gives that equation (3.9) and the FOC can be rewritten as

$$\frac{\partial m_1}{\partial w_1} = \frac{\overline{m}}{2w} \left[(1-\varepsilon) + \frac{(1-\gamma)\, lb}{(wl - (1-\gamma)\, \overline{m}b)} \right]$$

and

$$\begin{aligned} \Lambda_w &= [wl - (\overline{m} - l)\, b] \left[\frac{a\Pi}{wl} - (1-a) \right] - \frac{a\gamma b \overline{m} \Pi}{wl} \left(\varepsilon - \left(1 - \frac{l}{\overline{m}} \right) \right) + (1-a) \frac{wl^2}{\overline{m}} \\ & \quad - \frac{a\gamma b \overline{m} \Pi}{2wl} \left[(1-\varepsilon) + \frac{(1-\gamma)\, lb}{(wl - (1-\gamma)\, \overline{m}b)} \right] = 0. \end{aligned} \tag{3.11}$$

The first line in equation(3.11) is the same as in the model without supply effects, see equation (2.9). The second line captures the supply effect. Imposing symmetry in equation (3.6a) gives that

$$wl - (1-\gamma)\, \overline{m}b > 0.$$

[5] In the case of Sweden $\gamma \approx 0$ and $\frac{b}{w_1(1-t_0)} \approx 0.7$, so the necessary condition is roughly that $\varepsilon_1 < 3$.

Thus, from equation (3.11) it is obvious that $\varepsilon \leq 1$ is a sufficient condition for the supply effect to reduce the marginal utility of a wage increase.[6] The reason for this is that a wage increase increases expected utility because employment does not decrease too much. Thus, as long as this wage effect dominates, labor supply will increase in the sector and thus also the unemployment and the tax rate.

An interesting question is how the wages differ between the previous model without mobility and the present model with labor-supply effects. Equation (2.9) is like the first line in equation (3.11), but the supply effect captured by the second line in the latter equation is negative given the assumption above. To sort out which wage is the higher, recall that the partial derivatives of these equations with respect to the wage are negative from "dynamic stability". Thus evaluating the present model at the optimal wage level in the model without mobility will violate (3.11). The only way of fulfilling the equality is by reducing the wage compared to the wage in the model without mobility. Thus, labor mobility reduces the wage and increases employment.

The intuition for the results is straightforward; given that labor demand is not too elastic, a wage increase in a sector raises the expected income in that sector. To equalize the expected incomes between sectors, unemployment in that sector has to increase. This is achieved through an increase in labor supply, which also raises the sector-specific tax rate. Because labor mobility gives a higher marginal cost of a wage increase, it is optimal to settle for a lower wage compared to the case without mobility. The lower wage reduces unemployment by reducing labor supply (and increasing labor demand). Thus, with a tax system where each sector has to bear a fraction of their sector-specific unemployment costs, mobility creates an incentive to settle for lower wages and thus lower unemployment.

In the model without mobility it was found that an increased benefit level, b, had an ambiguous effect on the wage level, while an increased share of unemployment costs borne by the sector, γ, reduced the wage level. To test the robustness of these results, I repeat the previous experiments.

The comparative statics are, as before, given by

$$\frac{dw}{db} = -\frac{\Lambda_{wb}}{\Lambda_{ww}}$$

[6] Again, the necessary condition is weaker and can be written as

$$\varepsilon < 1 + \frac{(1-\gamma)\, lb}{wl - (1-\gamma)\, \overline{m} b}$$

which is larger than unity, except when $\gamma = 1$.

and

$$\frac{dw}{d\gamma} = -\frac{\Lambda_{w\gamma}}{\Lambda_{ww}},$$

where $\Lambda_{ww} < 0$ from "dynamic stability". Thus, the signs of the comparative statics are, as previously, are determined by the signs of Λ_{wb} and $\Lambda_{w\gamma}$.

$$\begin{aligned}\Lambda_{wb} &= -(\overline{m} - l)\left[\frac{a\Pi}{wl} - (1-a)\right] - \frac{a\gamma\overline{m}\Pi}{wl}\left(\varepsilon - \left(1 - \frac{l}{\overline{m}}\right)\right) \\ &\quad -\frac{a\gamma\overline{m}\Pi}{2wl}\left[(1-\varepsilon) + \frac{(1-\gamma)\,lb}{(wl-(1-\gamma)\,\overline{m}b)^2}\,(2wl - (1-\gamma)\,\overline{m}b)\right]\end{aligned} \tag{3.12}$$

Using equation (3.11) this expression can be rewritten as

$$\begin{aligned}\Lambda_{wb} &= \frac{1-a}{1-t}\left[\left(1 - \frac{l}{m}\right)l - \frac{a\gamma m\Pi}{wl(1-a)}\left(\varepsilon - \left(1 - \frac{l}{m}\right)\right)\right] \\ &\quad -\frac{a\gamma m\Pi}{2wl(1-t)}(1 - \varepsilon + \frac{(1-\gamma)\,lb}{(wl-(1-\gamma)\,\overline{m}b)} + \\ &\quad \frac{(1-\gamma)\,wl^2(1-t)b}{(wl-(1-\gamma)\,\overline{m}b)^2}).\end{aligned} \tag{3.13}$$

The first line in equation (3.13) captures the wage effect of an increased benefit level in the absence of labor mobility between sectors; c.f. equation (2.11). This effect is (as previously) ambiguous, unless labor demand is very inelastic. The first term is always positive and captures that an increase in the benefit level raises the value of the alternative utility which pushes the wage level. The intuition to the second term is as before; when γ is larger than zero the higher the unemployment benefit the smaller the gain from a wage rise because the latter will trigger a larger rise in the sector specific tax rate. This reduces the willingness to increase wages.

The second and third lines in equation (3.13) captures how the supply effect in equation (3.11) is affected by a change in the benefit level. First, the supply effect is magnified by an increase b, and this is captured in the second line. Second, a change in the benefit level affects the sensitivity of labor supply w.r.t. the wage by raising the tax rate, and by lowering the take home wage mark-up over the unemployment benefit level. These effects are captured in the third line. From equation (3.13) it is clear that a sufficient condition for the total supply effect to be negative is that the elasticity of labor demand is not larger than unity. The necessary condition is weaker in the sense that the elasticity can be larger given that $\gamma < 1$.

Thus in the case of an increase in the benefit level, labor mobility gives an incentive to lower the wage since labor supply and unemployment also increase and reduce the utility gain of a wage increase. The net effect of all three lines in equation (3.13) is ambiguous and will depend on the parameters. However if the alternative utility is zero ($\overline{w} = 0$), the effect will be negative if labor demand is neither too unelastic nor too elastic.

Turning to the share of sector specific unemployment costs borne by the sector, the wage effect of an increase in γ is determined by

$$\begin{aligned} \Lambda_{w\gamma} &= -\frac{ab\overline{m}\Pi}{wl}\left(\varepsilon - \left(1 - \frac{l}{\overline{m}}\right)\right) \\ &\quad -\frac{a\gamma\overline{m}\Pi}{2wl}\left[(1-\varepsilon) + \frac{(1-\gamma)\, lb}{(wl - (1-\gamma)\,\overline{m}b)}\right] \\ &\quad +\frac{a\gamma\overline{m}\Pi b^2 l}{2\,(wl - (1-\gamma)\,\overline{m}b)^2}. \end{aligned} \tag{3.14}$$

As in the model without labor mobility, an increase in γ raises the marginal cost of a wage increase (unless labor demand is too inelastic) and thus creates an incentive to reduce the wage level. This is captured in the first line. Introducing mobility leads to two additional and counteracting effects. On the one hand (the second line) an increase i γ magnifies the labor supply effect from a change in the wage. Thus, labor mobility tends to increase the marginal cost of a wage increase due to an increase in the sector-specific tax rate and this gives an incentive to reduce the wage. On the other hand (the third line) an increase in γ tends to lower the common part of the tax rate; this lowers the supply effect from a wage increase. Thus this last effect will lower the costs of a wage increase and create an opposite incentive. It is straightforward to show that a sufficient condition for the net effect of the second and the third row to be negative is that

$$1 - \frac{l}{\overline{m}} \leq \varepsilon \leq 1.$$

The net effect of all three rows in equation (3.14) is unambiguously negative. An increase in γ will always reduce wage pressure. The sign of $\Lambda_{w\gamma}$ is determined by

$$sign\left[\Lambda_{w\gamma}\right] = -sign\left[wl\,(wl - \overline{m}b) + \varepsilon\,(wl - (1-\gamma)\,\overline{m}b)^2\right] < 0.$$

4. Summary

The purpose of this paper has been to analyze how wages, employment and unemployment are affected by introducing labor mobility in a model with different sectors. Within the same framework, I have revisited some well established results of how wages and employment respond to changes in the unemployment benefit level, to changes in the fraction of unemployment costs borne by each sector in the economy and whether or not it matters if taxes are levied on employees or employers.

The analysis is first carried out in a model without labor mobility. The unions are assumed to be risk neutral and care only about the mark-up of take-home wages over an alternative (reference) utility. In the economy there is only one type of public expenditure, on unemployment benefits. All unemployed workers are assumed to receive a fixed unemployment benefit. The cost for the unemployment insurance is covered by an income tax which to a certain fraction, γ, is determined by the sector-specific unemployment rate.

Imposing symmetry, the analysis shows that an increased benefit level has an ambiguous effect on the wage level, unless labor demand in the sectors is very inelastic. Beside the standard effect that an increase in the alternative utility raises the wage level, the introduction of a tax system where some of the unemployment costs are covered by each sector also creates an incentive to lower wages. This is so because an increased benefit raises the tax rate and thus reduces the utility gain of a wage increase. An increase in γ gives a wage reduction as in earlier models.

Second, it is shown that wage costs are in general higher when unemployment costs are financed through pay-roll taxes compared to the case with income taxes. Wage costs are neutral to income tax or pay-roll tax only if $\gamma = 0$, and thus the tax rates are treated as common constants when setting wages and employment. This is in contrast with previous results. The reason for these results are that, given the level of the wage cost and that $\gamma > 0$, the marginal revenue of a one percent wage increase is larger in the pay-roll tax case compared to the income tax case.

Third, a multi sector model, illustrated for simplicity by two sectors, with endogenous labor supply is set up. Labor is free to move between sectors and determined by an arbitrage condition stating that expected income in both sectors must be equal in equilibrium. Thus, sector-specific unemployment is determined by both labor supply and employment in the sector.

Fourth, the labor supply effects are analyzed in a symmetric version of the model. It is shown, under reasonable assumptions, that introducing mobility leads to a wage reduction compared to the case when there is no labor mobility. Moreover, the ambiguous sign of the wage effect from a change in the benefit level still holds, and so does the expected negative effect of a change in the cost fraction, γ. However, when introducing labor mobility, the wage reducing effect of an increase in γ is shown to be unambiguous.

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