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Indexation Of Unemployment Benefits To Previous Earnings, Employment And Wages

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Indexation of Unemployment Benefits to Previous Earnings, Employment and Wages

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Abstract:
In most OECD countries, unemployment benefits are tied to individual previous labor earnings. We study the progressivity of this indexation with regard to its effects on employment, output and wages in four equilibrium models of the labor market keeping the level of unemployment benefits fixed. In the two cases of competitive labor markets and decentralized wage bargaining, employment and output increase, while wages decrease with the degree of indexation. In the model with search unemployment and Nash wage bargaining, all wages, employment and output increase, while the indexation of employment benefits to previous earnings has no effect in the case of efficiency wages. In addition, our results suggest that a more progressive indexation of unemployment benefits to labor earnings is welfare-enhancing.

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1 Introduction

Unemployment insurance (UI) schemes are a distinctive feature of modern economies and have been frequently recognized to play an important role in determining labor market outcomes (for an overview, see Fredriksson/Holmlund, 1998). The general argument usually put forward is that unemployment benefits improve the payoff from not working and decrease the incentives to supply labor. As a result, wages increase and employment falls. This argument, however, only takes a narrow view of possible UI effects on employment and wages as it considers the level of benefits to be exogenous.[1] In reality, unemployment benefits are usually endogenous as they are indexed to previous earnings. It is a common feature of modern UI systems that the benefit level is, at least to some extent, tied to the last wage received during employment. The closer possible future unemployment benefits are tied to labor income, the higher will be the incentive effect to supply labor during times of employment.

In our model, unemployment benefits depend on previous labor earnings. We investigate the effects of an indexation of unemployment benefits in the framework of four simple theoretical labor market representations. We introduce UI payments which consist of both a lump sum component and a component proportional to previous labor income into a competitive labor market model, a model with decentralized bargaining of unions, a labor market model with search frictions and an efficiency wage model. Comparative statics in partial equilibrium where we do not consider the financing of the UI payments imply unanimous results, namely that, for a given benefit level, a higher indexation of UI benefits leads to lower wages and thus higher employment in the first three settings. In contrast, there is no impact at all if unemployment is caused by firms setting efficiency wages as the optimizing behavior of the firms is not affected.

We further endogenize the financing of the unemployment insurance payments. The government runs a balanced budget so that an increase in total spending on unemployment insurance necessitates an equal increase in revenues from labor income taxation (the income taxes can equally interpreted as unemployment insurance contributions). Given the balanced-budget constraint for the government, however, two counter-vailing effects on the tax

[1] A critical and comprehensive review of the analysis of unemployment compensation is given by Atkinson/Micklewright (1991). For the features of the different UI schemes in practice see OECD (1991, 1996).

base occur: (i) on the one hand, higher indexation results in higher employment, while ii) on the other hand, wages may decrease. The net effect on tax revenues is ambiguous and depends on fundamental parameters characterizing the preferences of the households and the unemployment insurance scheme. As this ambiguity cannot be resolved analytically, we follow Pissarides (1998) in choosing plausible parameters to 'estimate' the sign of the overall effect of higher wage indexation of UI benefits on tax revenues and, consequently, on the equilibrium tax rate, employment and wages. We still find a positive impact of indexation on employment in competitive labor markets as well as in the union bargaining and search unemployment model.
The paper is organized as follows. Section 2 introduces the labor demand side of the model. Section 3 to 6 consider the competitive labor market, decentralised unions, search unemployment and efficiency wages, respectively. Section 7 concludes.

2 The demand for labor

Following Pissarides (1998), we distinguish four equilibrium models of the labor market: the competitive labor market, union wage bargaining, search unemployment and efficiency wages. While the first model is intended to study variation in the individual labor supply n_t along the intensive margin, the latter three models features variation in the aggregate labor supply N_t where the individuals either work full time (normalized to one) or not at all. With the exception of the competitive labor market case and the specification of unemployment insurance, we use the same model specification as in Pissarides (1998). For this reason, we will keep the exposition of the model rather brief and refer the interest reader to Pissarides (1998).
Let $t = 0, 1, \ldots$ index time. At each date t, there is a single final commodity which is produced using a constant returns to scale technology with capital k_t and labor N_t as inputs. Any agent using k_t units of capital and N_t units of labor can produce $F(k_t, N_t)$ units of the final good at t. We assume that $F(.)$ has the following CES form:

$$y_t \equiv F(k_t, N_t) = A\left[\alpha k_t^{\frac{\sigma-1}{\sigma}} + (1-\alpha)N_t^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}, \qquad \sigma > 0. \tag{1}$$

A is a technology parameter and $\sigma > 0$ is the elasticity of substitution between labor and capital. Profit maximization implies the following first-order condition:

$$(1-\alpha)A^{\frac{\sigma-1}{\sigma}}\left(\frac{y_t}{N_t}\right)^{\frac{1}{\sigma}} = (1+\tau)w_t, \tag{2}$$

where w_t and τ denote the wage rate in period t and the wage tax rate, respectively. Following Pissarides (1998), we set the capital stock $k_t = 1$ constant in every period t as we do not study capital accumulation.

3 Competitive labor markets

Firms and households are assumed to be price takers and wages are set at the level where the labor market clears. The difference between the exogenous time endowment, which is normalized to one, and the level of labor supply n_t is interpreted as unemployment. Contrary to Pissarides (1998), we do not assume that the time not spent on labor, $1 - n_t$, generates income equal to $(1 - n_t)b_t$, where b_t denotes unemployment benefits. We do not believe this assumption to be a realistic description of the unemployment compensation system in most OECD countries. An increase of leisure time does not realistically result in an increase of unemployment benefits, but rather the opposite holds.

Our argument is as follows. Assume that agents face an exogenous probability to be employed (unemployed), which is denoted by p $(1-p)$. Assume further that an agent who was employed in period $t-1$ earning $w_{t-1}n_{t-1}$, but looses his job in period t, is entitled to unemployment compensation at the amount of $b_t = B + \vartheta w_{t-1}n_{t-1}$, $B > 0$, $0 < \vartheta < 1$, i.e. his unemployment benefits are indexed to his previous labor income. We judge this to be a more satisfying assumption with regard to the level of unemployment benefits compared to the one of Pissarides, as it accords closely with existing unemployment compensation systems in the OECD, as e.g. reviewed by Atkinson/Micklewright (1991). Obviously, in our specification, an increase of leisure does not imply higher unemployment benefits.

We further analyze a linear unemployment benefit schedule with lump-sum transfers $B > 0$ as modern unemployment compensation system also redistribute income from high-income to low-income households.[2] For example,

[2] A classification of OECD countries according to the proportionality of their unemployment compensation system with regard to previous earnings can be found in OECD (1991).

most countries provide unemployment compensation which consists of unemployment insurance and, if the household income is too low, social assistance. Consequently, even countries with a proportional earnings-related benefit such as Germany or the United States effectively provide a minimum income (even though the expenditures on unemployment compensation might be financed by different government entities; e.g. in Germany, unemployment insurance is provided by the federal government, while social assistance is paid for by the local government). In addition, existing unemployment compensation systems also specify a maximum benefit level, e.g. in Germany or in France. As the central problem of this study, we examine how a change in the progressivity of the unemployment compensation system affects equilibrium employment and wages, i.e. how a change in ϑ which is compensated for by a change in B in order to keep b unchanged affects aggregate employment N and wages w.

The utility function of the household in period t is a function of both consumption c_t and leisure $1 - n_t$. In particular, expected utility is specified as:

$$E\{u_t\} = E\left\{Dc_t^{\beta}(1-n_t)^{1-\beta}\right\}.$$

We assume that households do not save so that they consume all their income. If employed, consumption amounts to $c_t^e = (1-\tau)wn_t$, and if unemployed, consumption falls to $c_t^u = b_t$. Households maximize expected utility with regard to their labor supply n_t. In equilibrium, labor supply of employed agents and wages as well as UI benefits are constant, $n_t = n$, $w_t = w$ and $b = B + \vartheta wn$, so that expected utility is given by:

$$E\{u\} = pD\left[(c^e)^{\beta}(1-n)^{(1-\beta)}\right] + (1-p)D(c^u)^{\beta}. \tag{3}$$

The first-order condition of the household is given by:

$$p\left[\beta\left(\frac{1-n}{n}\right)^{1-\beta} - (1-\beta)\left(\frac{n}{1-n}\right)^{\beta}\right] + (1-p)\beta\vartheta\left(\frac{w}{B+\vartheta wn}\right)^{1-\beta} = 0. \tag{4}$$

We assume households to be of measure one so that, in equilibrium, aggregate employment is equal to $N = pn$. The probability to find a job p is exogenous in this section. In the following sections, the employment probability p is endogenous as we will consider union wage setting, search unemployment and efficiency wages. Furthermore, the unemployment compensation system is financed by taxes on labor income such that the government budget is balanced in every period:

$$\tau pnw = (1-p)b, \tag{5}$$

$$b = B + \vartheta wn. \tag{6}$$

The competitive labor market model cannot be solved analytically. Following Pissarides (1998), we choose structural parameters for our model which are standard and which are described in more detail in the appendix.

> *Result 1:* Given our empirically plausible choice of the parameter space, more progressive indexation of unemployment benefits to past individual labor earnings (keeping unemployment benefit levels constant) increases employment n and output y and decrease wages w. This holds for both partial equilibrium analysis (where we neglect the government budget constraint) as well as general equilibrium analysis (where the financing of UI benefits is taken into consideration).
>
> Proof:
> (1)-(6) are six simultaneous equations in the endogenous variables n, w, y, τ, B and $E\{u\}$. From the equation system, we can easily derive the partial derivatives $\frac{\partial n}{\partial \vartheta}$, $\frac{\partial y}{\partial \vartheta}$, $\frac{\partial w}{\partial \vartheta}$ and $\frac{\partial E\{u\}}{\partial \vartheta}$. As there are no clear-cut analytical results with regard to the derivatives' signs, we have simulated three cases for different values of leisure parameters and employment probabilities. See appendix for details.

The underlying argument is quite obvious. As the indexation of the unemployment benefit goes up so does the opportunity of households to increase their income and consumption in times of unemployment by working more hours when they are still on the job. This incentive to work for a greater part of the available time results in a higher overall labor supply and thus lower wages. The effect on expected utility is ambiguous. In our specification, if the household has strong preferences for consumption relative to leisure ($\beta = 0.7$), if unemployment is at 10 percent ($p = 0.9$) and if households offer about 80 percent of their available time on the labor market, we find a negative impact of a rise of ϑ on expected utility $E\{u\}$. However, if consumption and leisure are appreciated to the same extent (i.e. $\beta = 0.5$) and households offer only about half of their available time, expected utility increases (for both $p = 70\%$ and $p = 90\%$). The latter case with $\beta = 0.5$ seems a more plausible scenario, however, as agents usually do not work more than 50% of their available time in modern industrialized countries. For example, most general equilibrium models in the endogenous growth or real business cycle literature calibrate their models in order to imply a steady-state labor supply equal to 30% or 1/3 of the total time endowment (see, e.g., Cooley, 1995).

4 Decentralized unions

Unions are decentralized so that each firm negotiates with a single union and that the negotiating partners do not assume to exert any influence on aggregate employment. The firm and the union bargain over wages. Following Pissarides (1998), we apply the utilitarian approach and assume the following union objective function:[3]

$$V_i = n_i \frac{w_i^{1-\gamma}}{1-\gamma} + (m_i - n_i)\left[(1-N)\frac{b^{1-\gamma}}{1-\gamma} + N\frac{w^{1-\gamma}}{1-\gamma}\right], \tag{7}$$

where m_i is union membership and n_i is union employment ($n_i < m_i$). w_i and w denote the wage rate negotiated between the union and the firm in sector i and the wage rate elsewhere, respectively. The union objective function considers the utility of their workers employed in sector i, who receive wage w_i, and their workers not employed in sector i, who either find a job elsewhere in the economy with probability N or have to rely on unemployment benefits with probability $1 - N$. Again, N denotes aggregate employment and the measure of the labor force is normalized to one. Furthermore, the union is assumed to be risk averse, the coefficient of risk aversion being equal to $\gamma > 0$.

The surplus of the firm i is given by the difference in output from (1) and labor costs:

$$\pi_i = y_i - (1+\tau)w_i n_i. \tag{8}$$

[3] Goerke/Madsen (1999) also analyse the effects of earnings-related benefits in a unionized economy. In addition to our analysis, they also consider the case of an insider-dominated union where only the gain in utility of its employed members is considered. However, contrary to our study, Goerke/Madsen only examine a partial equilibrium and do not consider the effects of a change in unemployment benefit payments on the government budget and the tax rate, and hence, labor demand.

The wage is determined by decentralized Nash bargains:

$$w_i = \arg\max (V_i - V)^{\delta} \pi_i^{1-\delta}, \tag{9}$$

where δ denotes the bargaining power of the union and the union's fall-back position V is the utility of the union if employment among its members is zero, $n_i = 0$ (the fall-back position of the firm is the case of no production and, hence, zero profits).
In equilibrium, all unions and firms are equal so that they will negotiate the same employment levels $n_i = N$ and wages $w_i = w$ (assuming that the measure of unions is equal to one). We will restrict our attention to a production function (1) of the Cobb-Douglas form, $\sigma = 1$. In this case, the substitution of (7) and (8) into the solution of (9) implies the following wage equation:

$$\delta\alpha \left[1 - (1-N)\vartheta \left(\frac{b}{w}\right)^{-\gamma}\right] - (1-\alpha+\alpha\delta)(1-N)\frac{1}{1-\gamma}\left[1 - \left(\frac{b}{w}\right)^{1-\gamma}\right] = 0. \tag{10}$$

The effects of a rise of ϑ on equilibrium employment and wages are straightforward and can easily be understood by inspection of the maximization condition for the Nash bargain, $\delta\frac{(V_i-V)'}{V_i-V} + (1-\delta)\frac{\pi_i'}{\pi_i} = 0$, where the derivatives $(V_i - V)'$ and π_i' are taken with respect to the wage w_i. Assume $\tilde{w}_i$ to be the optimal wage rate for an initial earnings-related component ϑ of unemployment benefits. An increase of ϑ for constant b reduces $(V_i - V)'$ for the wage rate $\tilde{w}_i$ because the fall-back position of the union member improves as well. As b remains constant, however, $V_i - V$ does not change. The profits of the firms (and the derivative with respect to the wage rate) are also unaffected by a change in ϑ for given wage level $\tilde{w}_i$. As a consequence, the relative loss of the union, $-\frac{(V_i-V)'}{V_i-V}$, following a decrease in the wage rate below the level $\tilde{w}_i$ is smaller than the relative gain from an increase in profits for the firm. More intuitively, the firm takes into consideration that a decline in wages also results in a lower fall-back position of the union (compared to the case with lower earnings-related unemployment benefits) and hence a higher gain from employment for the union.

Result 2: In partial equilibrium, a more progressive indexation of unemployment benefits to previous individual labor earnings which keeps unemployment benefits constant results in a decrease of unemployment $1-N$ and wages w. Furthermore, both union utility and profits increase.

Proof:
(1), (2), (7), (8), (10) together with $b = B + \vartheta w$ are six simultaneous equations in the endogenous variables N, w, y, B, V_i and π_i. From the equation system, we can easily derive the partial derivatives $\frac{\partial N}{\partial \vartheta}$, $\frac{\partial y}{\partial \vartheta}$, $\frac{\partial w}{\partial \vartheta}$, $\frac{\partial \pi_i}{\partial \vartheta}$ and $\frac{\partial V_i}{\partial \vartheta}$.

Next consider the 'general equilibrium' case where additional government expenditures on unemployment insurance are to be financed by an offsetting increase in labor income taxation so that the government budget balances:

$$b(1-N) = \tau w N. \tag{11}$$

In 'general equilibrium', the effect of a rise in ϑ is not unanimous anymore: Again higher indexation ceteris paribus results in fewer benefit payments and a positive contribution base effect on the taxable labor income as unemployment declines. However, the fall in the individual gross labor income due to the fall in wages reduces taxable income per capita and could even make a higher unemployment insurance contribution rate necessary. As this ambiguity cannot be solved analytically, we have computed the comparative statics for (1), (2), (7), (8), (10), (11) together with $b = B + \vartheta w$ in the endogenous variables N, w, y, B, V_i, π_i, and τ and evaluated the resulting partial derivatives for standard numerical parameter values (see appendix for details). A general statement can then be made that for a 'normal' rate of employment N (i.e. $N > 0,5$) and empirically observable values of α (i.e. α around 0,3) and b/w (i.e. b/w around 0,6), the positive effect of higher employment relative to the negative effect of the lower wage rate on the tax base prevails such that the UI contribution rate τ is smaller in a high indexation equilibrium. This leads in turn to an increase in labor demand and strengthens the positive employment effect of indexation. Though wages will still be lower than for less indexation, the rise in employment will also lead to an increase of the utility for the union.
A normative analysis of unemployment insurance is complicated by the presence of unions. In the competitive case, profits are zero such that it is straightforward to measure welfare by average household utility. In the

present case, however, the wage exceeds the marginal product of labor and profits are not independent of the earnings-related component ϑ of unemployment benefits. As households are the ultimate owners of the firms, we simply use $V_i + \pi_i$ as our measure of welfare. m_i is set equal to one so that every worker is a member of a union. As N and w move in opposite directions, the effect of change in ϑ on the union's objective function V_i, the wage tax τ and profits π_i is not straightforward. However, in our numerical examples (see the appendix), it turns out that welfare increases in all cases considered. In general equilibrium, both union utility and profits go up as wages increase but labor costs decrease (due to lower taxation).

5 Search unemployment

Labor markets are subject to frictions and characterized by two-sided search. Time and transaction costs are involved in order to match vacancies with searching agents. The number of aggregate matches M is an increasing function of both aggregate vacancies v and aggregate searching agents $1 - N$, assuming that all unemployed agents are searching with the same intensity. More formally, the number of job matches M is described by the following constant-returns to scale technology:

$$M = \mu(1 - N)^{\eta} v^{1-\eta}, \quad 0 < \eta < 1. \tag{12}$$

We define $\theta = (1-N)/v$ to be the ratio of the number of searching agents and the number of vacancies implying the job filling probability $q(\theta) \equiv M/v = \mu\theta^{-\eta}$ and the job finding probability $\theta q(\theta) \equiv M/(1 - N) = \mu\theta^{1-\eta}$.
Firms are subject to idiosyncratic negative shocks which arrive at a constant rate s. If the firm is subject to the shock, workers have to be dismissed and enter the unemployment pool. If N denotes aggregate employment, the flow sN of agents enter unemployment each period. The flow into employment is equal to $\mu\theta^{1-\eta}(1 - N)$. In equilibrium, the flow into employment is equal to the flow out of employment implying the *Beveridge equation*:

$$1 - N = \frac{s}{s + \mu\theta^{1-\eta}}. \tag{13}$$

As our wage equation is slightly different from the one derived by Pissarides (1998), we will describe the wage determination in our economy in more detail. Posting a vacancy costs the firm c per unit period. Let V and J denote the expected return from a vacant job and from a filled job, respectively, satisfying :

$$rV = -c + q(\theta)(J - V), \tag{14}$$

$$rJ = y' - (1+\tau)w - s(J - V), \tag{15}$$

where r denotes the interest rate. In (14), the capital market return of a vacant job, rV, is equal to the expected capital gain $q(\theta)(J-V)$ from filling a vacancy minus the vacancy cost c. In (15), the capital return from a filled vacancy, rJ, is equal to the worker's marginal product, y', minus his labor costs, $(1+\tau)w$, and the expected loss from the destruction of the job, $s(J-V)$. In equilibrium, firms will offer vacancy until the expected return from a vacant job is zero, $V = 0$, implying:

$$J = \frac{c}{q(\theta)}. \tag{16}$$

Similarly, the worker's expected return from unemployment U and employment E satisfy:

$$rU = B + \vartheta w + \theta q(\theta)(E - U), \tag{17}$$

$$rE = w - s(E - U), \tag{18}$$

where the worker receives labor income w (compensated income $B + \vartheta w$) if employed (unemployed).

Wages result from decentralized bargaining between the firm and the worker. Both the firm and the worker receive a rent from a successful match. More specifically, the wage is determined by Nash bargaining which maximizes a product of weighted surpluses of the household and the firm:

$$w_i = \arg\max (E - U)^{\beta}(J - V)^{1-\beta}, \tag{19}$$

where the bargaining power of the workers is denoted by β with $0 < \beta < 1$. The first-order condition of the maximization problem is given by:

$$E - U = \epsilon \frac{\beta}{(1-\beta)(1+\tau)} J, \tag{20}$$

with $\epsilon = \frac{r+s+q(\theta)}{r+s+\theta q(\theta)}$.[4] For a production function of the Cobb-Douglas case, $\sigma = 1$, substitution of (16), (17) and (18) into (20) implies the wage equation:

$$w = \frac{r+s+\mu\theta^{-\eta}}{r+s+\mu\theta^{1-\eta}} \frac{\beta c}{(1-\beta)(1+\tau)} \left(\frac{r+s}{\mu} + \theta^{1-\eta} \right) \theta^{\eta} + \frac{B}{1-\vartheta}. \tag{21}$$

In addition, labor demand of the firm is affected by the presence of vacancy costs (see Pissarides, 1990) implying (for $\sigma = 1$):

$$(1-\alpha)\frac{y}{N} - (1+\tau)w - \frac{r+s}{\mu} c\theta^{\eta} = 0. \tag{22}$$

The effects of a rise in ϑ for constant unemployment benefits b are similar to the one in the case of a unionized economy as presented in the previous section. In particular, firms consider the cut in the fall-back position of workers following a decrease of negotiated wages. If we neglect any effects from funding of unemployment compensation, wages fall as a consequence of the higher earnings-related component of unemployment insurance.

> *Result 3:* In partial equilibrium, a more progressive indexation of unemployment benefits to previous individual labor earnings results in a decrease of wages w and an increase of employment N and output y.
>
> Proof:
> (1), (22), $b = B + \vartheta w$, (16), (18), (17) and (21) are seven simultaneous equations in the endogenous variables N, w, y, B, J, E and U. From the equation system, we can easily derive the partial derivatives $\frac{\partial N}{\partial \vartheta}$, $\frac{\partial y}{\partial \vartheta}$, $\frac{\partial w}{\partial \vartheta}$, $\frac{\partial J}{\partial \vartheta}$, $\frac{\partial E}{\partial \vartheta}$ and $\frac{\partial U}{\partial \vartheta}$.

In analogy to the union model, if the UI budget constraint (11) is taken into consideration, a higher indexation equilibrium is influenced by the reaction of the tax base to a change in ϑ. As there is no analytical answer about the sign of the effect, we have again evaluated the partial derivatives from comparative statics analysis of (1), (22), $b = B + \vartheta w$, (16), (18), (17), (21) and (11). For the choice of numerical parameters (see the appendix for details),

[4] Our equation (20) differs from equation (A.7) in Pissarides (1998). In particular, the two equations only coincide for $\epsilon = 1$.

it turns out that, as aggregate employment increases, the decrease in the expenditures on unemployment compensation is more pronounced than the change in the tax base. Consequently, the wage tax rate τ is reduced and firms increase labor demand and bid up wages so that the total effect of a rise in ϑ on wages w is even positive.
As our measure of welfare W, we use the sum of aggregate value of firms plus the aggregate value of employed and unemployed agents, $W \equiv NJ + NE + (1-N)U$. As there are several counterbalancing economic forces which influence welfare, only a numerical illustration is possible. For our choice of parameters, a higher indexation of UI has sufficiently positive employment and output effects to over-compensate the utility loss that workers face because of lower wages. In general equilibrium, this effect is reinforced by lower taxation. Accordingly, our results suggest that higher indexation might be welfare-improving in the presence of search unemployment.

6 Efficiency wages

In models of efficiency wages, the employer is offering the worker a premium over the competitive wage in order to motivate him to supply more effective labor. The model presented in this section is built on the work by Shapiro and Stiglitz (1984) assuming that higher wages discourage workers from shirking (supplying zero effort).
Let U, E, E^s and E^{ns} denote the expected returns from unemployment, employment, shirking and not shirking, respectively. The return of an unemployed worker is given by his unemployment compensation $b = B + \vartheta w$ and the expected gain from finding a job:

$$rU = B + \vartheta w + \frac{sN}{1-N}(E - U). \tag{23}$$

Again, N is aggregate employment, s denotes the job separation rate, and $1 - N$ is the number of unemployed workers. Accordingly, the job finding probability is given by $\frac{sN}{1-N}$.
If the worker is employed, he can either shirk supplying zero effort or he does not shirk supplying effort e. If he shirks, he gets detected with probability q and is fired, otherwise he receives the same wage w as the non-shirking worker implying:

$$rE^{ns} = w - e - s\left(E^{ns} - U\right), \tag{24}$$

$$rE^s = w - (s+q)(E^s - U). \tag{25}$$

The firm sets wages w in order to induce the agent to supply effort e. However, the firm owner has no incentive to raise the return of the non-shirking agent further above the return of the shirking agent implying:

$$E^{ns} = E^s \equiv E, \tag{26}$$

and, together with (23), (24) and (25):

$$w = rU + \left(\frac{r+s+q}{q}e\right), \tag{27}$$

which constitutes the 'no shirking' condition. From (27) it is clear that the efficiency wage has to compensate the worker for his opportunity costs rU and, additionally, includes a premium for the fact that he will exert any effort at all. More explicitly,

$$w = \frac{1}{1-\vartheta}\left(B + \frac{N}{1-N}\frac{se}{q} + \frac{r+s+q}{q}e\right). \tag{28}$$

Equation (28) implies that there is a positive relationship between the efficiency wage and the level of unemployment benefit (determined by ϑ and B). However, the equilibrium wage w does not depend on the form of indexation on previous earnings. The reason is that, contrary to the unionized economy and the search equilibrium considered in the previous two sections, wages are not bargained, but set unilaterally by the firm which only has to make sure that it pays according to (27). As long as the total amount of unemployment benefits b is held constant, rU will not change and thus there is no need to set a new efficiency wage. Therefore, the efficiency wage equilibrium will be unaffected by changes in the structure of UI benefit payments.

> *Result 4:* A more progressive indexation of unemployment benefits to previous individual labor earnings which keeps unemployment benefits constant has no effect on employment and wages.
>
> Proof:
> (1), (22), $b = B + \vartheta w$, (11) and (28) are five simultaneous equations in the endogenous variables N, w, y, B and τ. From the equation system, we can easily derive the partial derivatives $\frac{\partial N}{\partial \vartheta}$, $\frac{\partial y}{\partial \vartheta}$ and $\frac{\partial w}{\partial \vartheta}$.

Our result, in particular, is independent of our assumption that shirking workers receive unemployment compensation. Even if the government is able to distinguish workers who got dismissed because of missing effort (at rate q) from those who got dismissed because of exogenous job destruction (at rate s) and only pays unemployment compensation to the latter agents, a more progressive indexation of unemployment compensation does not have any effects on the equilibrium allocation.[5]

7 Conclusion

In this paper, we have investigated the effects of an indexation of unemployment benefits to previous earnings in four different labor market settings, namely, in a competitive labor market model, a framework of decentralized union bargaining over wages, a labor market with search frictions and an efficiency wage model. By calculating comparative statics for partial equilibrium (i.e. without imposing any finance restrictions on unemployment insurance expenditures) we find that, for a given benefit level, a higher indexation of UI benefits results in lower wages and thus higher employment in the first three cases.[6] A change in the structure of the UI payments is shown to have no effect in the efficiency wage model.

In a 'general equilibrium' context (where additional expenditure on unemployment insurance are to be financed by an increase of labor income taxes), there are no clear-cut analytical answers to the question of the impact of higher indexation. Due to a negative effect on the workers' contribution to unemployment insurance caused by potentially lower wages, a raise in the contribution tax rate might be necessary resulting in an increase of labor costs, thus potentially offsetting the positive employment effect of a higher indexation. In order to gain some insight, we have evaluated the direction of a change of the endogenous variables by using a set of parameters which have been prominently applied in labor market research. In the case of competitive labor markets, union bargaining and search frictions, the higher indexation equilibrium is still associated with a higher employment level. In the case of the search unemployment model, the higher employment equilibrium can even be sustained although the firms pay higher wages. In search equilib-

[5] The derivation of this result is available from the authors upon request.

[6] Note that the similarity in outcomes of the union and the search model is not surprising as the bargaining mechanism is the same.

rium with higher employment, firms face a higher probability to fill a vacancy and hence reduced vacancy costs. In conclusion, our results suggest that we should be careful to draw firm policy conclusions from studies which treat the UI benefits as exogenous and that we should carefully distinguish among different institutional features of the labor market.

8 Appendix

8.1 Competitive labor markets

The calculation is carried out for three different parameter combinations. In all three cases, the replacement ratio was set at $b/nw = 0.6$, the indexation coefficient at $\vartheta = 0.4$ (the parameter choices are broadly motivated by the German system) and, following Pissarides (1998) in his short-run argument, $A = k = D = 1$. Concerning the exogenous employment probability p and utility of consumption exponent β, we calculate three cases: (i) $p = 0.9$, $\beta = 0.7$, (ii) $p = 0.9$, $\beta = 0.5$, and, (iii) $p = 0.7$, $\beta = 0.5$. The signs of the derivatives are shown in the table 1 below.

Table 1: Comparative statics for competitive labor markets

case	partial/general	$\frac{\partial n}{\partial \vartheta}$	$\frac{\partial w}{\partial \vartheta}$	$\frac{\partial E(u_t)}{\partial \vartheta}$	$\frac{\partial \tau}{\partial \vartheta}$
(i)	partial	+	-	-	
(i)	general	+	-	+	-
(ii)	partial	+	-	+	
(ii)	general	+	≈ 0	+	≈ 0
(iii)	partial	+	-	+	
(iii)	general	+	-	+	-

Note that for all numerical calculations, a Cobb-Douglas production function is used, i.e. we make the implicit assumption that $\sigma = 1$.

8.2 Union wage bargaining

The example which we compute for the case of decentralized union bargaining also presupposes a Cobb-Douglas production function, i.e. $\sigma = 1$. The capital coefficient is set equal to $\alpha = 0.3$. We assume equal bargaining strength for the firm and the union, i.e. $\delta = 0.5$. Unemployment insurance characteristics are the same as for the competitive case, except that the replacement ratio is now b/w rather than b/nw (labor supply is normalized to one). We calculate the equilibrium for different degrees of risk aversion in the union utility function: (i) Motivated by the estimation of Carruth/Oswald (1985), we set the risk aversion parameter at $\gamma = 0.8$, which corresponds to an employment approximately equal to $N \approx 0.7$. (ii) For comparison, the case of a risk-neutral firm is also calculated, i.e. with $\gamma = 0$. In this case, equilibrium employment is about 10 percentage points lower. However, the results are qualitatively the same which can be seen from table 2.

Table 2: Comparative statics for decentralized union wage bargaining

case	partial/general	$\frac{\partial N}{\partial \vartheta}$	$\frac{\partial w}{\partial \vartheta}$	$\frac{\partial V_i}{\partial \vartheta}$	$\frac{\partial \pi_i}{\partial \vartheta}$	$\frac{\partial W}{\partial \vartheta}$	$\frac{\partial \tau}{\partial \vartheta}$
(i)	partial	+	-	-	+	+	
(i)	general	+	-	+	+	+	-
(ii)	partial	+	-	-	+	+	
(ii)	general	+	-	+	+	+	-

8.3 Search unemployment

For the numerical examples, unemployment insurance is again assumed to have a replacement ratio of 0.6 and an indexation coefficient of 0.4. Periods correspond to years. Following Pissarides (1998), the separation rate s amounts to 0.2 while $\mu = 3.3$. We consider two cases with low and high unemployment, (i) $N = 0.7$ and (ii) $N = 0.9$, respectively. Vacancy costs c are calibrated in order to guarantee the chosen level of employment ($c = 0.45$ and $c = 0.52$ in case (i) and (ii), respectively). The matching parameter is set at $\eta = 0.5$ in accordance with empirical studies of British data by Pissarides (1986) and US data by Blanchard/Diamond (1989), respectively. The annual real interest rate is set equal to $r = 0.05$ (results are qualitatively the same for $r = 0.10$). Employer and worker have equal bargaining strength (i.e. $\beta = 0.5$). Again, results do not vary much over employment levels (compare table 3).

Table 3: Comparative statics for search unemployment

case	partial/general	$\frac{\partial N}{\partial \vartheta}$	$\frac{\partial w}{\partial \vartheta}$	$\frac{\partial \theta}{\partial \vartheta}$	$\frac{\partial W}{\partial \vartheta}$	$\frac{\partial \tau}{\partial \vartheta}$
(i)	partial	+	-	+	+	
(i)	general	+	+	+	+	-
(ii)	partial	+	-	+	+	
(ii)	general	+	+	+	+	-

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