Buffer funding of unemployment insurance: wage and employment effects

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Abstract

This chapter examines the financing of unemployment insurance (UI) and its effects on wage levels and employment when labour markets are unionized and the revenues of the firms are stochastic. Unemployment benefits are partly financed by the union with the UI contributions of its employed members and therefore the union runs a UI fund. First we assume that the fund operates on a pay-as-you-go financing principle and show that stochasticity causes procyclical employment fluctuations. Then we allow the union to collect a buffer fund to stabilize the cost of unemployment over business cycles. The main focus of this chapter is on the effects of buffer funding on the union's wage decisions and thereby on employment. We show that if wages are flexible, buffer funding stabilizes the economy by decreasing employment fluctuations. If wages are rigid, the result holds only if the UI payment is imposed on employers. When the wages are rigid and the UI payment is imposed on the employees, buffer funding does not directly affect employment fluctuations, but it can increase the union's wage demand and thereby decrease employment.

JEL-codes: J32, J51, J58

1 Introduction

In the standard trade union models, it is usually assumed that the unemployment benefits the unemployed members receive are provided and financed by the government. It is also assumed that the government finances the benefits from its general tax revenue and that the wage decisions of a single union do not affect the general tax level. In the standard models, there is thus no link between the union's wage decisions and unemployment expenses.

In the so-called Ghent countries the link exists. Several papers by Holmlund and Lundborg (1988, 1989, 1999) examine how different UI financing systems affect union wage demands and employment. They assume that the unemployment insurance system is organized through trade union affiliated funds. This system, called the Ghent system, is practiced in Finland and Sweden, where the funds are also heavily subsidized by the state. Holmlund and Lundborg study the effects of different financing systems in a static monopoly union model. They have modified the union model by assuming that the union finances part of the benefits of its unemployed members. They show, for example, that a higher lump-sum state grant to the funds increases employment, but that a higher marginal subsidy has an ambiguous effect on employment. Holmlund and Lundborg, and also Holmlund (2001), claim but do not show that a higher marginal subsidy, that is, a higher experience rating, leads to wage moderation and thus to higher employment.

We also study the effects of the unemployment insurance financing system on wage levels and employment in labour markets where the wage is set by a monopoly union. We assume that the unemployment insurance system is organized by the union. The union finances unemployment benefits from employees' UI contributions, for which it maintains a UI fund. We show, for example, that a higher experience rating almost always moderates the union's wage demand. A higher marginal subsidy increases this wage demand only if the wage elasticity of the labour demand in very low. The well-known result from labour taxation literature is that in the standard trade union models the composition of wage and payroll tax does not affect the wage-bargaining outcome if the employer and employees have the same tax bases (Koskela and Schöb, 1999). We show that when the tax is a decision variable of the union the result does not necessarily hold.

We are particularly interested in the effect of *buffer funding* on union wage demands and on employment. Buffer funding was introduced at Finland in the end of the 1990s. Following the deep recession earlier in the decade Filnand's unemployment financing system was reformed, and buffer funding was part of that reform. A buffer is created by collecting UI payments set at a level higher than the current state of the economy would require. In a recession, part of the benefits can then be paid from the buffer. The upper limit of the buffer is an amount that corresponds to expenses of 3.6 per cent unemployment (about 0.5 billion euros). The UI fund can show a deficit of an equal amount in a recession.

The goal of the new system was to stabilize the unemployment expenses and to smooth out fluctuations in the cost of labour over business cycles. It is obvious that buffer funding stabilizes labour costs and employment but what it does to union wage demands is less obvious. Does buffer funding have an effect on unions' wage decisions? When the financing reform and buffer funding were designed there was very little discussion about the possible effects of buffer funding on wages and thereby on employment. Labour market organizations emphasized the stabilizing effects. However, if buffer funding increases a union's wage demand then this would imply not only that employment fluctuates less but also that employment fluctuates on a lower level.

No research exists on the effects of buffer funding on wage-bargaining outcomes. In this study, we examine how it affects the union wage demand in a simple two-period monopoly union model. In the first period the union can, or must, collect a positive buffer for the UI fund, which it can use in the second period to pay part of the second period unemployment expenses. First we assume that wages are flexible. It turns out that buffer funding decreases employment and net wage fluctuations when wages are flexible. When wages are rigid, buffer funding smooths out employment fluctuations only when the insurance payment is levied on the employer. We also show that when wages are rigid buffer funding can increase the union's wage demand and the effect is stronger the worse is the economic state in the second period. We also examine how buffer funding affects the union's utility. We assume that the union collects the buffer on the government's order but it turns out that in some cases the buffer increases the union's total utility.

The chapter is organized as follows. In Section 2 we present a static model where the union finances a part of the unemployment benefits of its unemployed members. In Section 3 we examine a two-period model and assume that wages are flexible. In the first period of the model the union has to augment the UI fund a positive buffer that it can use in the second period. In Section 4 we examine the effects of wage rigidity on the results of Section 3. Section 5 concludes.

2 Benchmark model

Our benchmark model is based on the standard monopoly union model (see, for example, Oswald 1982) which represents labour markets between one union and one firm. The model assumes that all workers the firm can employ are unionized and the union has a monopoly in the labour market, in the sense that it can determine the wage level. However, the firm has a right to manage: given the wage level set by the union, it can decide how many workers to employ.

We assume the union has M members, some of whom are employed and some of whom are unemployed. The employed members are paid wage w, set by the union, and the unemployed members receive a fixed unemployment benefit b. In the standard monopoly union model, financing of the unemployment benefits is exogenous when the underlying assumption usually is that the government finances the benefits with its general tax revenue and the union's wage decision does not affect the general tax level. We modify the standard model by assuming that a share α of the benefits is financed by the union and a share $1-\alpha$ is financed by the government. We can then interpret the parameter α as the degree of experience rating.

The union finances the benefits by imposing a UI contribution on its employed members and consequently maintains UI fund. Employees contribute share τ of their gross wage to the fund and the union pays the benefits of its unemployed members. When L denotes employment, the income of the fund equals τwL and the expenditure $\alpha(M-L)b$. When the fund operates on a pay-as-you-go principle the union adjusts the level of the contribution such that every period the income equals the expenditure. Later we allow the union to save contributions, in which case the UI fund can have a positive buffer.

In this study, we assume that the UI contribution is imposed only on employees because it makes the derivation of the results slightly easier. The assumption is also justified in the case of a monopoly union . If we had assumed wage bargaining between the union and the firm, the contribution could be also imposed on the employer and an object of bargaining.

We keep the assumptions that the government finances its share of the unemployment expenses with its general tax revenue and that the union's wage decision does not affect the general tax level, but change the standard model by adding uncertainty to it. We assume that the firm's revenues are subject to a demand or a technological shock θ. The course of events in the benchmark model is the following: the shock occurs and both the union and the firm observe the shock; the union sets the wage and the UI contribution; the firm decides employment given w and τ.

2.1 The equilibrium

We solve the modified monopoly union model by backwards induction and start from the firm's problem. Given the wage decision of the union, the firm chooses employment such that the choice maximizes profits. When we normalize the price level to one and assume fixed capital the firm's profit is then given by

$$\pi = \theta f(L) - wL, \tag{1}$$

where $f(\cdot)$ denotes an increasing and concave production function and θ a technological shock. We assume a Cobb Douglas production function

$$f(L) = \frac{L^{\xi}}{\xi}, \tag{2}$$

where $0 < \xi < 1$. We examine neither the case where the shock the economy faces drives the firm into bankruptcy nor the case where there is excess demand of labour in the economy. Therefore the shock $\theta \in [\underline{\theta}, \overline{\theta}]$, such that $\underline{\theta}, \overline{\theta} > 0$, $\underline{\theta} < \overline{\theta}$, and $\pi \geq 0$ and $L \leq M$ with all $\theta \in [\underline{\theta}, \overline{\theta}]$. We can now write the firm's profit function as

$$\pi = \theta \frac{L^{\xi}}{\xi} - wL. \tag{3}$$

From the firm's maximization problem, $\max_L \pi$, we can solve the labour demand function

$$L = L(w) = \left(\frac{\theta}{w}\right)^{\frac{1}{1-\xi}}. \tag{4}$$

In the case of a Cobb Douglas production function the wage elasticity of labour demand is constant and given by $\eta = \frac{1}{1-\xi} > 1$. We can write the labour demand function in the elasticity form when

$$L(w) = \left(\frac{\theta}{w}\right)^{\eta}. \tag{5}$$

The union has M homogenous, risk-averse members. We assume that the objective function of the monopoly union is

$$V(w, \tau, L) = L\left[u(\widehat{w}) - u(b)\right], \tag{6}$$

where $u(\cdot)$ is an increasing and concave utility function of a union member and $\widehat{w} = w(1-\tau)$ the net wage. Two constraints restrict the union's wage and UI contribution decisions: the labour demand function (5) and the budget constraint

$$\tau w L - \alpha(M - L)b = 0. \tag{7}$$

From the budget constraint (7) we can solve the UI contribution $\tau = \tau(w)$ and show that $\tau' > 0$; the contribution increases when the union raises its wage demand.

The union's maximization problem can now be written as

$$\max_{w,\tau} V(w, \tau, L) \tag{8}$$

subject to

$$\begin{aligned} L &= L(w) && (9) \\ \tau &= \tau(w). && (10) \end{aligned}$$

When we substitute (9) and (10) for L and τ in the objective function we can write the first-order condition of the maximization problem as

$$L'(w)\left[u(\widehat{w}) - u(b)\right] + L(w)u'(\widehat{w})\widehat{w}_w = 0. \tag{11}$$

At the optimum, the union equates the marginal gain from a wage increase with the marginal loss. The first term in equation (11) is the marginal loss: a change in employment multiplied by the utility loss when moving from the set of employed to the set of unemployed. The second term is the marginal gain: an increase in the utility of the employed multiplied by employment multiplied by the change in the net wage.

We can write (11) in the form

$$\eta\left[1 - \frac{u(b)}{u(\widehat{w})}\right] = \frac{u'(\widehat{w})\widehat{w}}{u(\widehat{w})}\gamma(w), \tag{12}$$

where $\eta = -\frac{L'(w)w}{L(w)}$ is the wage elasticity of the labour demand and $\gamma(w) = \frac{\widehat{w}_w w}{\widehat{w}}$ is the gross wage elasticity of the net wage. When τ is fixed, $\gamma(w) = 1$. Now the elasticity $\gamma(w) < 1$ because a rise in the gross wage increases unemployment and thereby the UI contribution rises also, which decreases the net wage. If we assume that the union members have a *CRRA* utility function $u(x) = \frac{x^{1-\rho}}{1-\rho}$ we can write the union's pricing equation as

$$\widehat{w} = w(1-\tau) = \left[1 + \frac{\gamma(w)(\rho - 1)}{\eta}\right]^{\frac{1}{\rho-1}} b. \tag{13}$$

We must leave the solution in implicit form, because, on the assumptions made, we cannot solve the union's wage demand in closed form.

2.2 Properties of the equilibrium

If we assume in the standard model that the firm has a Cobb Douglas production function we get the following pricing equation:

$$w = \left[1 + \frac{(\rho - 1)}{\eta}\right]^{\frac{1}{\rho-1}} b. \tag{14}$$

When we compare the pricing equation (14) to equation (13) we notice that the union's participation in the financing of the unemployment benefits decreases the net wage of its employed members. It is easy to show that when the wage elasticity of the labour demand is not too high the gross wage decreases also.[2] Let us denote the employment and unemployment rates by e and u, that is, $e = \frac{L}{M}$ and $u = \frac{M-L}{M}$. We can show the following:

Proposition 1 *If the wage elasticity of the labour demand $\eta > \rho\gamma\frac{u}{e}$ then the optimal wage demand of the union, w^*, decreases when the union's share of the unemployment expenses, α, increases.*

Proof. In Appendix A. ■

Parameter $\gamma(w) < 1$ and in realistic cases also $\frac{u}{e} < 1$. Therefore the proposition surely holds if $\rho < 1$ but can also hold when $\rho > 1$.

A well-known result of labour taxation theory says that in the standard trade union models the composition of wage and payroll tax does not affect the wage-bargaining outcome if the employer and employees have the same tax bases (Koskela and Schöb, 1999). It turns out that when the tax, or the UI contribution, is the union's decision variable the result does not necessarily hold. The effect of the tax then depends on

[2] Note that the set-up here slightly differs from the set-up in Chapter 2. In Chapter 2 we assumed that UI contributions are exogenous and a non-proportional insurance premium is endogenous.

how the employees' net wage and the employer's labour cost react to changes in the gross wage.

In Appendix B we derive the union's pricing equation when the UI payment is imposed on the firm. Then $\widehat{w} = w$ and $\gamma(w) = 1$ and the pricing equation becomes

$$w = \left[1 + \frac{(\rho - 1)}{\eta\kappa}\right]^{\frac{1}{\rho-1}} b, \tag{15}$$

where $\kappa = \frac{\overline{w}_w w}{\overline{w}} > 1$ is the gross wage elasticity of the labour cost $\overline{w} = w(1+\tau)$. The elasticity κ is higher than one because an increase in the gross wage raises the firm's UI contribution which implies that the labour cost increases by more than the full amount of the wage increase.

When we compare equation (13) to equation (15) we notice that, with same UI contribution level, the net wage is higher (lower) when the UI contribution is imposed on the employees than when on the employer, if $\gamma(w)\kappa > 1$ ($\gamma(w)\kappa < 1$). When $\gamma(w)\kappa = 1$ the net wages are equal in both cases. Let us suppose, for example, that $\gamma(w) = 0.8$ when a five per cent increase in the gross wage causes only a four per cent rise in the net wage. Both models lead to same net wage if $\kappa = 1.25$. If the gross wage elasticity is larger (smaller) than 1.25, the net wage is higher (lower) when the UI contribution is imposed on the employees than when on the employer.

When the UI contribution is imposed on employees the labour cost is $w = \left[1 + \frac{\gamma(w)(\rho-1)}{\eta}\right]^{\frac{1}{\rho-1}} \frac{b}{(1-\tau)}$, and when it is imposed on the employer $w(1+\tau) = \left[1 + \frac{(\rho-1)}{\eta\kappa}\right]^{\frac{1}{\rho-1}} b(1+\tau)$. It is easy to see that if $\gamma(w)\kappa \geq 1$ the labour cost is higher and employment lower when the UI contribution is from the employees than when it is from the employer (again with same contribution level). If $\gamma(w)\kappa < 1$ the labour cost can be higher, equal or lower and employment lower, equal or higher when the UI contribution is from employees than when it is from the employer. We combine the results in the following proposition:

Proposition 2 *When the gross wage elasticity of the net wage ($\gamma(w)$) is larger than the inverse of the gross wage elasticity of the labour cost ($\frac{1}{\kappa}$), the net wage and labour* *cost are higher when the UI contribution is imposed on employees than when it is imposed on the firm. When they are equal, the net wages are equal in both cases but the labour cost is higher when the UI contribution is imposed on the employees than when on the employer. When $\gamma(w) < \frac{1}{\kappa}$ the net wage is lower but labour cost can be higher, equal or lower when the UI contribution is imposed on employees than when it is imposed on the firm.*

Finally we prove a result we will need in the next section. The result states that the union decreases its wage demand when the state of the economy improves. The result is not very intuitive. In the trade union models where the financing of the unemployment benefits is exogenous, an improvement in the economic state leads to a rise in wages. In our model the union also must take into account the effect an improvement has on the UI contribution. During a boom the firm demands more labour and employment rises. A fall in unemployment leads to a decrease in the UI contribution which gives room to wage moderation.

Proposition 3 *The optimal wage demand of the union, w^*, decreases when θ increases.*

Proof. In Appendix C. ■

3 Two-period model with flexible wages

This chapter focuses on unemployment insurance buffer funding and on its influence on the union's wage decisions and consequently on employment. By buffer funding, we mean that the union saves part of the income of its UI fund and uses it for future unemployment expenses. We examine the effects of buffer funding in the simplest possible dynamic environment: a two-period model. We therefore assume that the modified monopoly union game we presented in the previous section is played twice. First we assume the fund operates on the pay-as-you-go principle where the union adjusts its UI contribution according to the economic state. It turns out that employment then fluctuates procyclically. Then we change the financing principle, assuming that in the first period the union must collect a positive buffer for the UI fund, and examine the effect of this on employment fluctuations. Our basic assumption is that to stabilize the economy the government orders the union to collect the buffer and decides what size the buffer should be. In section 3.2, however, we also study under what circumstances the buffer increases the total utility of the union.

The course of events in both periods is now the same as in the one-period model. That is, in both periods, first the shock occurs and both the union and the firm observe the shock. The union sets its wage demand and the UI contribution, and then the firm decides employment. In other words, here we assume that the union can react to the shock by changing both its wage demand and the UI contribution. In Section 4 we examine the effects of wage rigidity when the union has to fix its wage demand at the beginning of period one and cannot change it after the realization of the second period shock.

3.1 The equilibrium

Let us first assume that the UI fund operates on the pay-as-you-go principle. We denote the wage, the UI contribution, employment, and the value of the shock in period i by w_i, τ_i, L_i, and θ_i, $i = 1, 2$. For simplicity we assume that the shock can take only two values. The shock can either be “good”, when $\theta_i = \theta^g$, or “bad”, when $\theta_i = \theta^b$, $\quad \theta^g > \theta^b$. The probability of a good shock is known by both the union and the firm and $P(\theta_i = \theta^g) = \psi$ when $P(\theta_i = \theta^b) = 1 - \psi$.

From the firm’s period i maximization problem we now get the labour demand in period i

$$L_i(w_i) = \left(\frac{\theta_i}{w_i}\right)^{\eta}, \qquad i = 1, 2. \tag{16}$$

The pay-as-you-go principle implies that the period i budget constraint of the union is

$$\tau_i w_i L_i - \alpha(M - L_i)b = 0, \qquad i = 1, 2. \tag{17}$$

The union's two-period maximization problem is now

$$\max_{(w_1,w_2,\tau_1,\tau_2)} L_1 \left[u(\widehat{w}_1) - u(b)\right] + \beta L_2 \left[u(\widehat{w}_2) - u(b)\right] \tag{18}$$

subject to

$$L_i = L_i(w_i), \qquad i = 1, 2 \tag{19}$$

$$\tau_i w_i L_i - \alpha(M - L_i)b = 0, \qquad i = 1, 2, \tag{20}$$

where $\beta = \frac{1}{1+r^d}$ is the union's discount factor and r^d the discount rate.

In the case of pay-as-you-go financing the only difference between the periods is the possible change in the value of the shock. We assumed that the shock occurs before the union gives its wage demand which implies that in both periods the union can react to the shock with its wage and contribution decisions. Clearly, if the value of the shock does not change between the periods neither does the union's wage demand nor the firm's employment decision. If the value of the shock changes, based on Proposition 3, we can conclude that if the economy is worse (better) in the first period than in the second period then the union demands a higher (lower) wage in the first period than in the second period.

Next we assume that in the first period the union saves a part of the UI contributions, that is, it collects a buffer a, $a > 0$, for its UI fund. In the second period the union can then cover some of the unemployment expenses with the buffer and its interest income. We do not consider private saving because our focus is on the implications of buffer funding for the union's wage decisions. We therefore assume that the union has easier access to credit markets than its members have. Including private saving would complicate the model considerably. It is difficult to include private saving in the standard trade union models because in both periods of a two-period model it is completely random which of the members are employed and which are unemployed, for example.[3]

In the case of buffer funding the union maximizes (18) subject to the first and second period labour demand constraints (19) and the following two budget constraints:

$$\tau_1 w_1 L_1 - \alpha(M - L_1)b - a = 0, \quad (21)$$

$$\tau_2 w_2 L_2 - \alpha(M - L_2)b + (1 + r)a = 0, \quad (22)$$

where r denotes the interest rate. Let w_1^* and w_2^*, and L_1^* and L_2^* denote the optimal first and second period wage demand and employment. In the two-period model economy can be in four possible states. We can show that if the economic state does not change, the union's wage demand increases in the period when it collects the buffer and decreases in the period when it uses the buffer. That is, in a non-stochastic world the wages are higher and employment is lower in the period the buffer is collected than in the period it is used. Buffer funding then causes wage and employment fluctuations.

Proposition 4 *Let θ be fixed. Then the union demands a higher wage in the period it collects the buffer fund than in the period it uses it, that is, if $\theta_1 = \theta_2$ then $w_1^* > w_2^*$ which implies that $L_1^* < L_2^*$.*

Proof. In Appendix D. ∎

In the most unrealistic situation the economy is in recession in the first period when the buffer is formed and is in a boom in the second period when the buffer is used. When the fund operates on the pay-as-you-go principle ($a = 0$) the union demands a higher wage during a recession than during a boom in the second period

[3]Private saving and unemployment insurance is examined in an interesting paper by Hassler and Mora (1999). Hassler and Mora begin with an observation that unemployment benefits are higher and turnover between unemployment and employment is lower in Europe than in the U.S.. They explain that when turnover is high, saving and borrowing can replace unemployment insurance but when turnover is low, that is, when unemployment is more persistent, generous unemployment benefits become more valuable and the political system more easily supports them.

(Proposition 3). Employment is affected by both the union's wage demand and the shock. Due to the influence of the shock, labour demand and thereby employment is lower during a recession than during a boom, and changes in the union's wage demand increase the difference between the first and second period employment. When $a > 0$ the union increases the first period and decreases the second period wage demand. Hence the buffer in this case further increases fluctuations in the union's wage demand and thereby in employment.

Let us next assume the state of the economy is good when the buffer is collected and bad when it is used. This case represents the situation the buffer is built for: it is collected during a boom to cover part of increased unemployment expenses during a recession. When the fund operates on the pay-as-you-go principle ($a = 0$) the union demands a higher wage during a recession than during a boom and the variations in the union's wage demand increase employment fluctuations. When $a > 0$ the union increases its first and decreases its second period wage demand. Wages then fluctuate less, which levels out employment fluctuations. Buffer funding in this case stabilizes the economy.

Figure 1 shows how the buffer fund and the size of the second period shock affect differences in the first and second period gross and net wage, and employment. The figure is drawn such that when the value of the second period shock is two there is no uncertainty, $\theta_1 = \theta_2$. In Figure 1 (a) we can see that the larger the buffer fund collected in the first period is, the more the gross wage varies between the periods. On the other hand, a larger buffer decreases fluctuations in the net wage and in employment, as shown in Figure 1 (b) and 1 (c). In Figure 1 (c) we have also drawn the plane where employment fluctuations are zero. From the intersectional line of the two planes we get the size of the buffer that completely levels out the fluctuations in employment. Figure 1 (c) shows that the lower the value is of the second period shock, the larger must be the buffer to level out employment fluctuations.

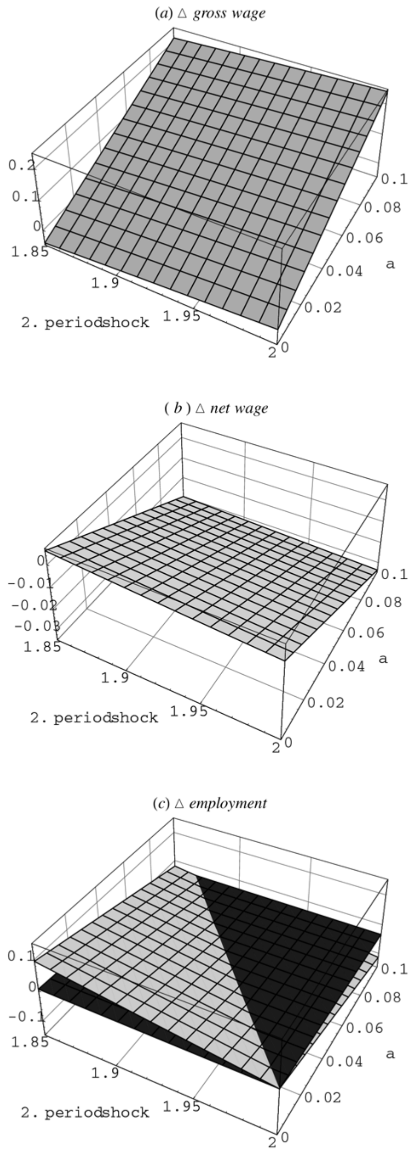

Figure 1: *The relationship between the value of the second period shock,* θ_2*, the size of the buffer, a, and the difference between the first and the second period (a) optimal gross wage, (b) optimal net wage, and (c) employment. (Parameter values:* $\alpha = 0.4$*, b=1, M=1,* $\rho = 0.9$*,* $\eta = 1.1$*, r=0.05.)*

3.2 The union's utility

We assumed that the union collects the buffer at the government's demand. Would the union do it voluntarily in some cases? In other words, is it possible that in some circumstances the union could benefit from a buffer? Labour demand and thereby unemployment expenses are stochastic and the union in our model cannot insure itself against labour demand variation. Therefore, in some cases it could benefit the union to use the buffer for self-insurance.

Next we study under what conditions a positive buffer increases the total utility of the union. Let V now denote the maximum value function of the two-period model. By the envelope theorem

$$\begin{aligned} V_a &= (V_1)_a + \beta(V_2)_a && (23)\\ &= -L_1 u(\widehat{w}_1)(\widehat{w}_1)_a - \beta L_2 u'(\widehat{w}_2)(\widehat{w}_2)_a && (24)\\ &= -u'(\widehat{w}_1) + \beta(1+r)u'(\widehat{w}_2). && (25)\end{aligned}$$

We want to know under on what conditions $V_a > 0$. The inequality $V_a > 0$ holds if

$$-u'(\widehat{w}_1) + \beta(1+r)u'(\widehat{w}_2) > 0. \tag{26}$$

We can write (26) in the form

$$\frac{u'(\widehat{w}_1)}{\beta u'(\widehat{w}_2)} < 1 + r. \tag{27}$$

Equation (27) states that the buffer increases the total utility of the union if the marginal rate of substitution between net wage in two periods is smaller than the interest factor.[4] With a CRRA utility function the inequality (27) becomes

$$\frac{\widehat{w}_2}{\widehat{w}_1} > \left(\frac{1+r}{1+r^d}\right)^{1/\rho}. \tag{28}$$

Let us assume that the economy is in a boom in the first period when the buffer is collected and in a recession in the second period when the buffer is used. In Figure

[4] Note that result and equation (27) are closely connected with union employed members' optimal intertemporal allocation of consumption (see, for example, Deaton 1992).

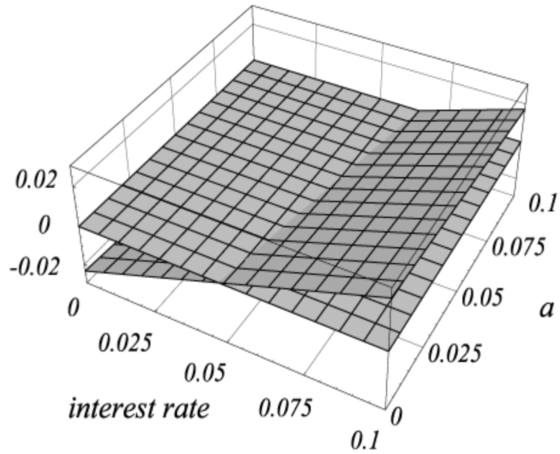

Figure 2: *The relationship between the value of the interest rate, r, the size of the buffer, a, and the derivative of the value function with respect to the buffer, V_a, when wages are flexible. (Parameter values:* $\alpha = 0.4$, *b=1, M=1,* $\rho = 0.9$, $\eta = 1.1$, *r^d=0.05.)*

2 we have drawn V_a with different values of the interest rate r and the buffer a. We have also drawn in figure a plane where $V_a = 0$. We can see that the larger the buffer is, the higher is the interes rate required to increase the utility of the union.

4 Two-period model with rigid wages

In the previous section we assumed that the union was able to react to the shocks the economy faces by changing its wage demand. We derived the result that the union increases its wage demand in the period it collects the buffer and decreases it in the period it uses the buffer. In practice, due to the labour market agreements, nominal wages adjust more slowly than employment to a new economic situation. Next we examine how wage rigidity affects the results of the previous section. Therefore we assume that at the beginning of the two-period game the union sets the wage for both periods. The union makes its wage decision after the first period shock has been realized and cannot change it during the second period. Following the wage decision, the union sets the first period UI contribution and the firm chooses the first period employment. Then the second period shock occurs, the union sets the second period UI contribution and the firm chooses the second period employment. We keep the assumptions that the union finances the unemployment benefits with the UI contributions of its employed members and that in the first period the union collects a buffer a and in the second period uses it.

4.1 The equilibrium

When the wage is the same in both periods the only factor that changes the firm's employment decision is the value of the shock. The labour demand function in period i is now

$$L_i(w) = \left(\frac{\theta_i}{w}\right)^\eta, \qquad i = 1, 2. \tag{29}$$

The union chooses its wage demand for the two periods, in a situation where it knows the first period economic state but is uncertain about that of the second period. The union then maximizes its expected utility

$$\begin{aligned} EV &= V_1 + \beta EV_2 = \\ & V_1 + \beta\left(\psi V_g + (1-\psi)V_b\right), \end{aligned} \tag{30}$$

where V_g and V_b denote union's utility when the second period state of the economy is good and when it is bad. The union's maximization problem now is

$$\max_{w,\tau_1,\tau_2^g,\tau_2^b} V_1 + \beta\left(\psi V_g + (1-\psi)V_b\right) \tag{31}$$

subject to

$$L_1 = \left(\frac{\theta_1}{w}\right)^\eta \tag{32}$$

$$L_g = \left(\frac{\theta_g}{w}\right)^\eta \tag{33}$$

$$L_b = \left(\frac{\theta_b}{w}\right)^\eta \tag{34}$$

$$\tau_1 = \frac{\alpha(M - L_1)b + a}{wL_1}, \tag{35}$$

$$\tau_g = \frac{\alpha(M - L_g)b - (1+r)a}{wL_2^g}, \tag{36}$$

$$\tau_b = \frac{\alpha(M - L_b)b - (1+r)a}{wL_b}, \tag{37}$$

where τ_1, τ_g, and τ_b denote the first period, the second period good state, and the second period bad state UI contribution. The first-order condition is now

$$\begin{aligned} & L_1'(w)\left(u(\widehat{w}_1) - u(b)\right) + L_1(w)u'(\widehat{w}_1)\widehat{w}_1' + \\ & \beta\psi\left[L_g'(w)\left(u(\widehat{w}_g) - u(b)\right) + L_g(w)u'(\widehat{w}_g)\widehat{w}_g'\right] + \\ & \beta(1-\psi)\left[L_b'(w)\left(u(\widehat{w}_b) - u(b)\right) + L_b(w)u'(\widehat{w}_b)\widehat{w}_b'\right] \\ = \; & 0. \end{aligned} \tag{38}$$

Equation (38) can be written as

$$\begin{aligned} & L_1(w)u(\widehat{w}_1)\left[\frac{L_1'(w)w}{L_1(w)}\left(1 - \frac{u(b)}{u(\widehat{w}_1)}\right) + \frac{u'(\widehat{w}_1)\widehat{w}_1}{u(\widehat{w}_1)}\frac{\widehat{w}_1'w}{\widehat{w}_1}\right] + \\ & \beta\psi L_g(w)u(\widehat{w}_g)\left[\frac{L_g'(w)w}{L_g(w)}\left(1 - \frac{u(b)}{u(\widehat{w}_g)}\right) + \frac{u'(\widehat{w}_g)\widehat{w}_g}{u(\widehat{w}_g)}\frac{\widehat{w}_g'w}{\widehat{w}_g}\right] + \\ & \beta(1-\psi)L_b(w)u(\widehat{w}_b)\left[\frac{L_b'(w)w}{L_b(w)}\left(1 - \frac{u(b)}{u(\widehat{w}_b)}\right) + \frac{u'(\widehat{w}_b)\widehat{w}_b}{u(\widehat{w}_b)}\frac{\widehat{w}_b'w}{\widehat{w}_b}\right] \\ = \; & 0 \end{aligned} \tag{39}$$

which can be further simplified to

$$\begin{aligned} & \theta_1^\eta(1-\tau_1)^{1-\rho}\left[-\eta\left(1 - \left(\frac{b}{\widehat{w}_1}\right)^{1-\rho}\right) + (1-\rho)\gamma_1\right] + \\ & \beta\psi\theta_g^\eta(1-\tau_g)^{1-\rho}\left[-\eta\left(1 - \left(\frac{b}{\widehat{w}_g}\right)^{1-\rho}\right) + (1-\rho)\gamma_g\right] + \\ & \beta(1-\psi)\theta_b^\eta(1-\tau_b)^{1-\rho}\left[-\eta\left(1 - \left(\frac{b}{\widehat{w}_b}\right)^{1-\rho}\right) + (1-\rho)\gamma_b\right] \\ = \; & 0. \end{aligned} \tag{40}$$

From equation (40) we get a pricing equation that resembles the pricing equation

(14) we solved from the one-period model. We get

$$w = \left[\frac{p}{z} + \frac{x(\rho-1)}{z\eta}\right]^{\frac{1}{\rho-1}} b, \tag{41}$$

where the terms

$$\begin{aligned} p &= \theta_1^\eta(1-\tau_1)^{1-\rho} + \beta\left(\psi\theta_g^\eta(1-\tau_g)^{1-\rho} + (1-\psi)\theta_b^\eta(1-\tau_b)^{1-\rho}\right), & (42)\\ x &= \theta_1^\eta(1-\tau_1)^{1-\rho}\gamma_1 + \beta\left(\psi\theta_g^\eta(1-\tau_g)^{1-\rho}\gamma_g + (1-\psi)\theta_b^\eta(1-\tau_b)^{1-\rho}\gamma_b\right), & (43)\\ z &= \theta_1^\eta + \beta\left(\psi\theta_g^\eta + (1-\psi)\theta_b^\eta\right). & (44) \end{aligned}$$

Note that if the value of the shock θ is the same in both periods and there is no buffer $\tau_1 = \tau_g = \tau_b = \tau$ and $\gamma_1 = \gamma_g = \gamma_b = \gamma$. Then the pricing equation (41) becomes the same we obtained from the one-period model, that is, $w = \left[(1-\tau)^{1-\rho} + \frac{(1-\tau)^{1-\rho}\gamma(\rho-1)}{\eta}\right]^{\frac{1}{\rho-1}} b$.

Two things now affect the union's wage demand: uncertainty and the buffer. Let us first suppose that there is no buffer, that is, $a = 0$ and $\theta_1 = \theta_g > \theta_b$. If the realization of the second period shock is bad, the union then must increase the UI contribution that put a wage raise pressure on the union's wage decision at the beginning of the first period. This wage pressure increases the fixed wage. A positive buffer, $a > 0$, has two effects: the union must increase the first period UI contribution but can decrease the second period contributions. A rise in τ_1 causes wage raise pressure and a fall in τ_g and τ_b wage cut pressure. A fall in τ_b also reduces the wage raise pressure caused by the second period bad shock. The first period effect can dominate the second period effect, as depicted in Figure 3. Figure 3 shows how the size of the buffer and the value of the second period bad shock affect the gross and net wage. In both of the figures we have assumed that the state of the economy is good in the first period when the buffer is formed. The probability that the shock is good in the second period is fixed but the value of the bad shock changes. Then a decrease in the value of the second period bad shock implies an increase in uncertainty. When $\theta_b = 2$ there is no uncertainty; the value of the shock is the same in both periods and in both economic states.

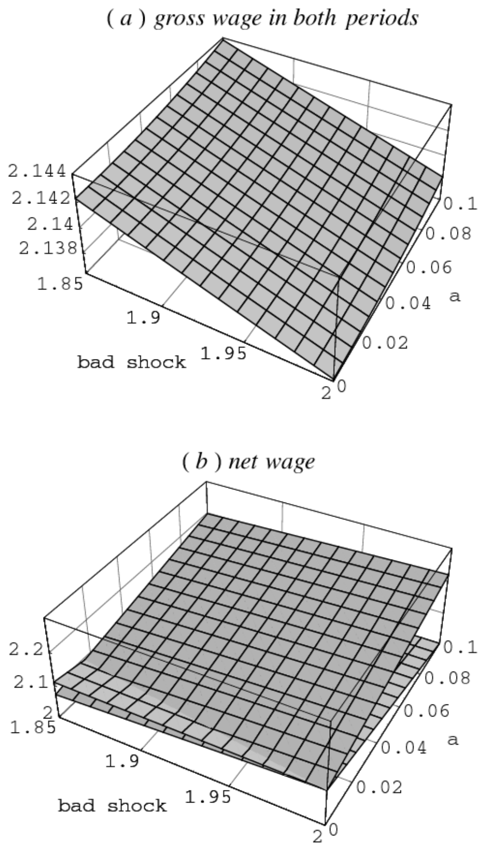

Figure 3: *The relationship between the value of the second period bad shock, the size of the buffer, a, and (a) the optimal gross wage, and (b) the first and second period optimal net wage. (Parameter values: b=1, m=1,* $\rho = 0.9$, $\eta = 1.1$, *r=0.05.)*

In Figure 3 (a) we see that when $a = 0$ and uncertainty increases, that is, when the value of the second period bad shock decreases, the union raises the wage demand it gives at the beginning of the first period. We can also see that when there is no uncertainty the union raises its wage demand with the the size of the buffer. Uncertainty and buffer funding together make the union wage demand higher the worse the second period bad shock is and the larger the buffer is. In Figure 3 (b) the descending plane represents the first period net wage and the ascending plane the second period net wage. Figure shows that, given the value of the second period bad shock, the difference in net wages increases when the size of the buffer rises; the buffer in this case increases fluctuations in the net wage. Figure 3 (b) also shows that the lower the value is of a bad shock, the larger must be the buffer to damp down fluctuations in the net wage. When the wage is rigid and the unemployment insurance payment is imposed on the employees the buffer does not affect the fluctuations in employment. We have seen that the buffer can increase the gross wage and thereby decrease employment but it has no effect on the differences between the first and second period employment.

4.2 The union's utility

Next we examine how a positive buffer affects the union's utility when the wage is rigid and the insurance payment is levied on the employees. Let V denote the maximum value function of the two-period model. Now we can write V_a in the following form:

$$
\begin{aligned}
V_a &= (V_1)_a + \beta E(V_2)_a && (45)\\
&= -L_1 u'(\widehat{w}_1)(\widehat{w}_1)_a && (46)\\
&\quad -\beta\left(\psi L_2 u'(\widehat{w}_g)(\widehat{w}_g)_a + (1-\psi)L_2 u'(\widehat{w}_b))(w_b)_a\right) \\
&= -u'(\widehat{w}_1) + \beta(1+r)\left(\psi u'(\widehat{w}_g) + (1-\psi)u'(\widehat{w}_b)\right), && (47)
\end{aligned}
$$

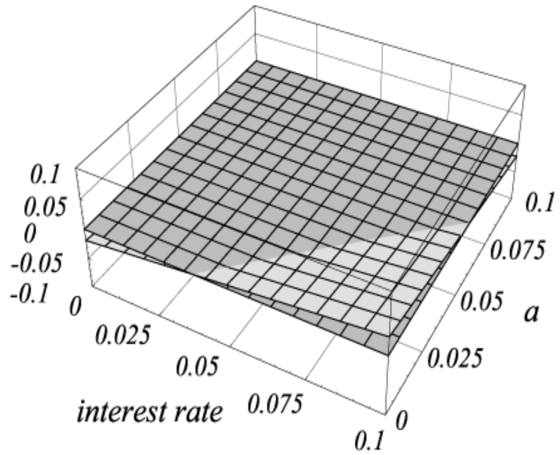

Figure 4: *The relationship between the value of the interest rate, r, the size of the buffer, a, and the derivative of the value function with respect to the buffer,* V_a, *when wages are rigid. (Parameter values: b=1, m=1,* $\rho = 0.9$, $\eta = 1.1$, r^d*=0.05.)*

where we again used the envelope theorem. We try to find out on what conditions $V_a > 0$. The inequality holds if

$$\frac{1+r}{1+r^d}\left(\psi u'(\widehat{w}_g) + (1-\psi)u'(\widehat{w}_b)\right) > u'(\widehat{w}_1), \tag{48}$$

where r^d denotes the union members' discount rate. We can also write (48) in the form

$$\frac{u'(\widehat{w}_1)}{\beta E u'(\widehat{w}_2)} < 1 + r. \tag{49}$$

The buffer now increases the total utility of the union if the marginal rate of substitution between net wage in the first period and expected net wage in the second period is smaller than the interest factor.

In Figure 4 we have again drawn V_a and the plane where $V_a = 0$. Let us first assume that $\tau_1 > \tau_b > \tau_g$. Then $\widehat{w}_1 < \widehat{w}_b < \widehat{w}_g$ which implies that $u'(\widehat{w}_1) > u'(\widehat{w}_b) > u'(\widehat{w}_g)$. Then the inequality (49) can only hold if $r^d << r$. The buffer can increase the total utility of the union if the union's discount rate is very small. When $r^d \geq r$ the total effect of the buffer is always negative for the union. Let us next assume that $\tau_b \geq \tau_1 > \tau_g$ when the net wage is higher or equal in the first period compared with the second period. The inequality $\widehat{w}_b \leq \widehat{w}_1 < \widehat{w}_g$ implies that $u'(\widehat{w}_b) \geq u'(\widehat{w}_1) > u'(\widehat{w}_g)$. Then the inequality (48) can also hold with higher values of the discount rate r^d, that is, with lower values of the discount factor β. Then it is possible that the inequality (48) can hold even when $r^d \geq r$.

We have drawn Figure 4 with the same parameter values we used in Figure 2. The only difference is in the values of the second period shock. In Figure 4 the expected value of the second period shock equals the value of the second period shock we used in Figure 2. When we compare figures (2) and (4) we can see that wage rigidity decreases union's opportunities to benefit from the buffer.

5 Conclusions and future research

We have examined buffer funding of unemployment insurance in a modified monopoly union framework assuming that the union finances a part of the unemployment benefits of its unemployed members. The union finances the benefits with UI contributions it imposed on employees and invests the contributions in the UI fund it maintains. The chapter has focused on the implications of buffer funding with respect to wage levels and employment.

When buffer funding was proposed in Finland, it was argued that it would smooth out labour cost variation and thereby stabilize employment. Our study shows that this statement holds true when wages are flexible. However, when wages are rigid and the UI contribution is imposed on employees, the buffer can increase the union's wage demand and thereby affect the employment level but it has no direct effect on employment fluctuations. The worse the economic state is, which the union is prepared for with buffer funding, the stronger the levelling effect becomes.

This study is our first attempt to examine the implications of buffer funding and the model we have used has the usual shortcomings of two-period models. Therefore our next goal is to examine buffer funding in a truly dynamic environment, where we can also allow for, for example, the union's borrowing, that is, a negative buffer, and correlated shocks.

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A Proof of Proposition 1

The maximization problem of the union is

$$\max_{w,\tau} V = L\left(u(w(1-\tau)) - u(b)\right) \tag{50}$$

subject to

$$\begin{aligned} L &= L(w) && (51)\\ \tau &= \tau(w) = \frac{\alpha(M-L)b}{wL}. && (52) \end{aligned}$$

To prove that the union's participation in the financing of the UI benefits decreases its wage demand we show that the optimal w decreases when α, the union's share of the unemployment expenses, increases.

In the proofs we use Topkis' theory of monotone comparative static (see Topkis 1978, 1998). The objective function of the union, V, is continuous and differentiable. Let us denote a parameter by x. According to Topkis' monotonicity theorem, if we can prove, for example that $V_{wx} < 0$, we can conclude that when x increases then optimal w decreases. Now

$$V_{\alpha} = L(w)u'(\widehat{w})\widehat{w}_{\alpha} = -u'(\widehat{w})(M - L(w))b \tag{53}$$

and

$$V_{\alpha w} = -u''(\widehat{w})\widehat{w}_w(M - L(w))b + u'(\widehat{w})L'(w)b \tag{54}$$

We denote the wage elasticity of the labour demand by $\eta = -\frac{L'(w)w}{L(w)}$, the elasticity of the net wage with respect to the gross wage by $\gamma = \frac{\widehat{w}_w w}{\widehat{w}}$ and the ratio of unemployment to employment by $\varepsilon = \frac{M-L(w)}{L(w)}$. When the union members have a CRRA utility function $u(x) = \frac{x^{1-\rho}}{1-\rho}$ the measure of the relative risk aversion is $\rho = -\frac{u''(\widehat{w})\widehat{w}}{u'(\widehat{w})}$. The condition $V_{w\alpha} < 0$ now holds if

$$-\frac{bu'(\widehat{w})L(w)}{w}(\eta - \rho\gamma\varepsilon) < 0. \tag{55}$$

The first term is negative, therefore the inequality holds if

$$\eta - \rho\gamma\varepsilon \;>\; 0 \Rightarrow \tag{56}$$

$$\eta \;>\; \rho\gamma\varepsilon. \tag{57}$$

With realistic parameter values the left side of the condition, $\rho\gamma\varepsilon$, is less than one and the condition holds.

B Proof of Proposition 2

When the UI payment is imposed on the employer the firm's profit is

$$\pi = \theta f(L) - \overline{w}L, \tag{58}$$

where $\overline{w} = w(1+\tau)$ denotes the labour cost. From the firm's maximization problem, $\max_L \pi$, we can solve the labour demand function

$$L(w) = \left(\frac{\theta}{\overline{w}}\right)^{\eta}. \tag{59}$$

The union's objective function is

$$V(w, \tau, L) = L\left[u(w) - u(b)\right] \tag{60}$$

and the budget constraint is

$$\tau w L - \alpha(M - L)b = 0. \tag{61}$$

From the budget constraint we can again solve the UI contribution $\tau = \tau(w)$ and show that $\tau' > 0$.

The union's maximization problem is now

$$\max_{w,\tau} V(w, \tau, L) \tag{62}$$

subject to

$$\begin{aligned} L &= L(\overline{w}) \\ \tau &= \tau(w). \end{aligned}$$

The first-order condition of the maximization problem is now

$$L'(\overline{w})\overline{w}_w\left[u(w) - u(b)\right] + L(\overline{w})u'(w) = 0. \tag{63}$$

We can write

$$\eta\kappa\left[1 - \frac{u(b)}{u(w)}\right] + (1-\rho) = 0,$$

where $\frac{L'(\overline{w})\overline{w}}{L(\overline{w})} = \eta$ is the labour cost elasticity of the labour demand and $\frac{\overline{w}_w w}{\overline{w}} = \kappa > 1$ the gross wage elasticity of the labour cost. The union's pricing equation now becomes

$$w = \left[1 + \frac{(\rho-1)}{\eta\kappa}\right]^{\frac{1}{\rho-1}} b.$$

C Proof of Proposition 3

The maximization problem of the union is

$$\max_{w,\tau} V = L\left(u(w(1-\tau)) - u(b)\right) \tag{64}$$

subject to

$$\begin{aligned} L &= L(w) & (65)\\ \tau &= \tau(w) = \frac{\alpha(M-L)b}{wL}. & (66) \end{aligned}$$

We must show that the optimal w decreases when the value of θ, the technological shock, increases.

Now

$$V_\theta = L_\theta\left(u(\widehat{w}) - u(b)\right) + Lu'(\widehat{w})\widehat{w}_\theta = \frac{\eta}{\theta}\left[L(w)\left(u(\widehat{w}) - u(b)\right) + \alpha Mbu'(\widehat{w})\right] \tag{67}$$

and

$$V_{\theta w} = \frac{\eta}{\theta}\alpha Mbu''(\widehat{w})\widehat{w}_w < 0. \tag{68}$$

D Proof of Proposition 4

First we notice than the maximization problem of the union consists of two optimization problems: the first period problem and the second period problem. The only difference between the periods is in the budget constraints. In the first period the union collects a positive buffer a. Compared with the one-period model, the fund increases from 0 to positive a. In the second period the buffer is used, that is, the union "collects a negative fund" a. First we show that a positive buffer increases the union's first period wage demand. We must show that $(V_1)_{wa} > 0$ where V_1 is the union's first period utility function. First we solve

$$(V_1)_a = -L(w)u'(\widehat{w})\widehat{w}_a = -u'(\widehat{w}).$$

Then

$$(V_1)_{wa} = -u''(\widehat{w})\widehat{w}_w > 0.$$

If we want to show that a positive buffer decreases the union's second period wage demand, we must show that in the second period problem $(V_2)_{wa} < 0$. We get

$$(1 + r)u''(\widehat{w})\widehat{w}_w < 0. \tag{69}$$