Wage bargaining and employment under different unemployment insurance contribution policies

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Abstract

In this study, we use the basic monopoly union approach of wage and employment determination under stochastic revenue shocks to study unemployment insurance (UI) contributions as policy instruments. Unemployment benefits are financed from UI contributions that the government imposes on firms. The government has three policy alternatives: passive, fixed and active. In the case of the passive policy the contributions are adjusted according to the state of the economy. In the case of the fixed policy the objective of the government is to stabilize labour cost fluctuations and thereby employment, and in the case of the active policy, to directly stabilize employment fluctuations. The effects of the different policies are shown to depend on the size of the elasticity of substitution between the factors of production in the economy. When the elasticity is small the UI contribution varies counter-cyclically (procyclically) when the passive (active) policy is adopted. The fixed and the active policies then stabilize the economy by smoothing out employment fluctuations. When the elasticity is large the passive policy itself works as an automatic stabilizer leading to a low UI contribution and high employment when economic state is bad.

JEL-codes: E61, J51, J58

1 Introduction

In most EU countries, unemployment benefits are at least partly financed by the insurance contributions of employees and employers. In a *pay-as-you-go* financing system the levels of the contributions are periodically adjusted to the state of the economy. Intuition then says that the contributions tend to increase during a recession. Counter-cyclical fluctuations of unemployment insurance (UI) contributions increase the cost of labour in a recession and decrease it in an economic boom. In a pay-as-you-go system, fluctuations in the contributions therefore tend to strengthen business cycles.

When the financing system operates on the pay-as-you-go principle, the goal of the government is simply to satisfy its period wise budget constraint. Could the government have other goals as well? Could the state affect labour markets through its UI contribution policy? Let us suppose that the state wants to decrease employment fluctuations by smoothing out fluctuations in labour costs. This it could achieve by aiming for fixed insurance contributions. Just such a policy alternative emerged during the debate in Finland at the end of the 90s on the reform of unemployment insurance financing. In connection with the reform, the central labour market organizations agreed to create so-called *buffer funds*. The idea of the buffer fund is to set higher-than-needed insurance contributions when the economy is in a boom. The additional UI contribution accrual, forming a buffer, is invested in the UI funds. During a recession the buffer can be used to cover the increased unemployment expenses, and there is less need to increase contributions.[2] Buffer funding, it was argued, would decrease fluctuations in UI contributions and hence stabilize labour costs and thereby employment.

Intuition again says that a fixed contribution smooths out fluctuations in employment to some extent, but could the state go even further with its insurance contribution policy. Let us suppose that the state aims for fixed employment. This goal could

[2]The Finnish system is described more closely in Holm, Kiander, Tossavainen (1999).

be achieved by a system that adjusts the insurance contributions procyclically. Such a system is discussed in Calmfors (2000a) and in Boeri, Brugiavini, Calmfors (2001). Calmfors writes:

> The Finnish system has been devised to smooth fluctuations in wage costs over business cycles. A more ambitious system could instead aim at actually lowering wage costs in deep recessions. This would amount to establishing an ex ante machinery for cuts in money wage costs without having to cut money wages. (Calmfors 2000a)

Our goal is to study the effects different insurance contribution policies have on wage levels and employment when labour markets are unionized and firms face stochastic revenue shocks. Our model is based on the basic monopoly union model examined in Oswald (1985), for example. The monopoly union model represents a labour market relationship between one firm and one union and assumes that the union sets the wage level and the firm decides employment, given the union's wage demand. Employed members of the union are then paid the union wage and unemployed members get a fixed unemployment benefit.

In the basic model, financing of unemployment benefits is exogenous. We assume that the unemployment benefits are financed by employers' UI contributions. The government decides the levels of the insurance contribution. We want to investigate the effects that the different insurance contribution policies have under different economic conditions and therefore we add uncertainty to the basic model. In our model, the firm's revenue is stochastic when, with a certain probability, its revenue is either good or bad. We also add a player to the game, whom we call the government or policy-maker. The role of the government in our model is very simple. We assume that it pays the unemployment benefits and finances them with UI contributions it collects from the employed members of the union and from the firm.

The government has three policy alternatives. When the financing system operates on the pay-as-you-go principle, we call the government's insurance policy a *passive policy.* When the government adjusts the contributions according to a *fixed policy,* its goal is to set the contribution at a level where it does not depend on the state of the economy. The fixed contribution is set so that every period the government's expected budget balances. The third alternative we call an *active policy,* where the goal of the government is to stabilize employment. When the government adopts the active policy it sets a high contribution when economic conditions are good and a low contribution when they are bad.

It turns out that the effects the different policies have on wages and employment depend crucially on the size of the elasticity of substitution between the factors of production in the economy. We get intuitive results when the elasticity is small. When elasticity is small and the government adopts the passive policy, employment and wages fluctuate procyclically and UI contributions counter-cyclically. When the government commits itself to the fixed policy the UI contributions are fixed and employment fluctuates, but less compared with the passive policy. Finally, when the government adopts the active policy employment is fixed and the UI contributions fluctuate procyclically, which also levels out wage fluctuations.

The situation is different if the elasticity of substitution is large. The passive policy then itself works as an automatic stabilizer. When the elasticity is large and the government adopts the passive, policy it sets a high contribution when economic conditions are good and a low contribution when they are bad. A low contribution during a recession decreases the cost of labour and increases employment.

We also study how different policies affect the union's expected utility. We cannot get a closed form solution for the decision variables of the model, but our simulation results indicate that when the elasticity is small the active policy leads to the highest expected utility and when the elasticity is large the passive policy gives the highest expected utility.

The organization of the paper is as follows. In Section 2 we present the model. In Section 3 we determine the equilibrium wage rate and employment. In Section 4 the different policies are examined. The effects of the different policies on the union's utility are examined in Section 5, and Section 6 concludes.

2 The model

Let us assume that the labour market consists of M unionized workers and one representative firm. We can, for example, think that the model represents one sector of the economy where the wage rate is determined by the union. The firm's revenue is subject to a shock and we denote the shock by θ. The shock can either be "good", when $\theta = \theta_g$, or "bad", when $\theta = \theta_b$, and both $\theta_g, \theta_g \in [\underline{\theta}, \overline{\theta}]$, $\underline{\theta} < \overline{\theta}$. We examine neither the case where the firm going bankrupt due to a bad shock nor the case of a good shock causing an excess demand for labour. Therefore the limits $\underline{\theta}$ and $\overline{\theta}$ are determined such that if $\theta < \underline{\theta}$ the firm's profit is below zero, and if $\theta > \overline{\theta}$, there is excess demand for labour in the labour market. The probability of a good shock is $P(\theta = \theta_g) = \psi$ and a bad shock $P(\theta = \theta_b) = 1 - \psi$.

The firm produces the output with two factors of production – labour and capital – and, for simplicity, we assume that capital is fixed, during the period we consider. If the firm employs L workers it gets a revenue

$$\theta f(L, K), \tag{1}$$

where we have normalized the price level to one. We assume that the production function $f(L, K)$ is twice differentiable and satisfies $f_L > 0$, $f_K > 0$, $f_{KK} < 0$, $f_{LL} < 0$, and $f_{LK} > 0$. The wage, w, is not the only labour cost because the firm also has to pay an UI contribution which we denote by τ. The firm's profit is then given by

$$\pi = \theta f(L, K) - w(1 + \tau)L - rK, \tag{2}$$

where r denotes interest rate.

All M workers are members of the same union and we assume they are risk-averse. A well-known result from labour taxation theory states that if the tax bases of employers and employees are equal, the composition of wage and payroll tax does not affect the wage-bargaining outcome in the standard trade union models (Koskela and Schöb, 1999). Therefore we assume, for simplicity, that the government does

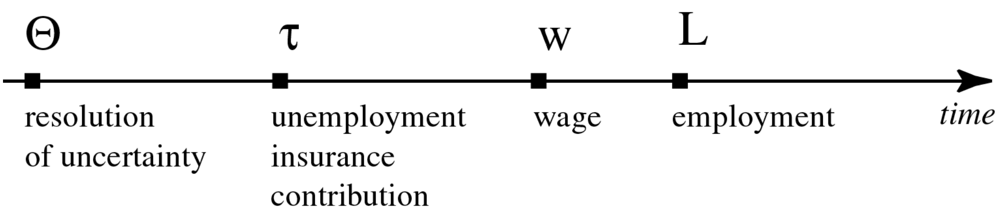

Figure 1: *Time sequence of decisions*

not impose UI contribution on employees. Employed members then get wage w and unemployed members receive a fixed unemployment benefit, b. The government decides the level of the benefit. The union has the utilitarian utility function

$$V(w, L) = Lu(w) + (M - L)u(b), \tag{3}$$

where $u(\cdot)$ denotes an increasing and concave utility function of a union member.

The government finances the unemployment benefits with the UI contributions it imposes on the firm. The government sets the contribution τ such that the following budget constraint is satisfied:

$$\tau wL = (M - L)b. \tag{4}$$

The left side of the equation (4) denotes UI contributions paid by the firm, and the right side unemployment expenses.

The course of events is as follows: First, the shock occurs. We assume that all parties – the government, the union, and the firm – observe the shock. Second, the government adjusts the UI contribution τ. Third, the union sets the wage level, and last, the firm decides on employment. The fact that the shock occurs before contribution, wage, and employment decisions are made is based on the assumption that the business cycle is long enough for the government, the union, and the firm to react to the shock. Figure 1 summarizes the timing of the decisions.

3 The determination of wage and employment

We assume that after the shock has occurred and the government has adjusted the insurance contribution, the union presents its wage demand and the firm then decides how many workers it employs. Given the wage decision of the union, the firm chooses employment that maximizes its profit. We assume that the firm has a CES production function

$$f(L,K) = \left[dL^{-\xi} + (1-d)K^{-\xi}\right]^{-\frac{1}{\xi}}, \tag{5}$$

where $-1 \leq \xi \leq \infty$. The parameter d is related to the share of labour in production; in the limit, as $\xi \to \infty$, d equals the share of labour. We can now write the firm's profit function (2) in the form

$$\pi = \theta\left[dL^{-\xi} + (1-d)K^{-\xi}\right]^{-\frac{1}{\xi}} - w(1+\tau)L - rK. \tag{6}$$

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

$$L = L(\overline{w};\theta) = \left[\left(\frac{d\theta}{\overline{w}}\right)^{\frac{\xi}{1+\xi}} \frac{1}{1-d} - \frac{d}{1-d}\right]^{\frac{1}{\xi}} K, \tag{7}$$

where $\overline{w} = w(1+\tau)$ is the labour cost. In the case of a CES production function the elasticity of substitution in the production is given by $\sigma = \frac{1}{1+\xi}$. We set the fixed capital, without loss of generality, equal to one and write the labour demand function in the elasticity form when

$$L(\overline{w};\theta) = \left[\left(\frac{d\theta}{\overline{w}}\right)^{1-\sigma} \frac{1}{1-d} - \frac{d}{1-d}\right]^{\frac{\sigma}{1-\sigma}}. \tag{8}$$

The union's maximization problem now is

$$\max_w V(w,L) \tag{9}$$

subject to

$$L = L(\overline{w};\theta). \tag{10}$$

The first-order condition of the maximization problem is

$$-\eta(\overline{w})\left[u(w)-u(b)\right]+u'(w)w=0 \tag{11}$$

where $\eta(\overline{w})=-\frac{L_{\overline{w}}\overline{w}}{L}$ is the labour cost elasticity of the labour demand. We can then write (11) in the form

$$\eta(\overline{w})\left(1-\frac{u(b)}{u(w)}\right)=\frac{u'(w)w}{u(w)}. \tag{12}$$

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 in the following form:

$$w=\left(1+\frac{\rho-1}{\eta(\overline{w})}\right)^{\frac{1}{\rho-1}}b. \tag{13}$$

From (13) we can see that the union's optimal wage demand depends on the labour cost elasticity of the labour demand $\eta(\overline{w})$. The labour cost elasticity can be written as

$$\eta=\frac{\sigma}{1-s}, \tag{14}$$

where $s=\frac{\overline{w}L}{\theta f}$ denotes the share of labour in output (see Appendix A). The elasticity η increases when σ rises. In the special case when $\sigma=1$ (Cobb-Douglas production function) the labour cost elasticity of the labour demand is constant and we can solve the union's wage demand in a closed form. The wage level is then independent of the economic state and of the level of the firm's UI contribution τ. When $\sigma\neq 1$, changes in the UI contribution and in the value of the shock affect the union's wage demand through the labour cost elasticity η, and it turns out that the effects depend on whether the factors of production are complements ($\sigma<1$) or substitutes ($\sigma>1$).

We get the union's optimal wage demand $w^*=w(\tau;\theta)$ from the pricing equation (13) and, by substituting w^* for w in (8), optimal employment $L^*=L(\tau,\theta)$ from the labour demand function (8). The impact of the UI contribution on the union's wage demand can be derived by total differentiation of equation (11) when

$$w_\tau=-\frac{(u(w)-u(b))\frac{-\sigma}{(1-s)^2}s_\tau}{V_{ww}}. \tag{15}$$

When $V_{ww} < 0$ the sign of $\frac{dw}{d\tau}$ depends on the sign of $\frac{ds}{d\tau}$. We can show that

$$s_\tau = s_{\overline{w}} w = \frac{s}{1+\tau}(1-\sigma) = \begin{cases} > 0 & when \quad \sigma < 1 \\ = 0 & when \quad \sigma = 1 \\ < 0 & when \quad \sigma > 1. \end{cases} \tag{16}$$

(see Appendix B). When we substitute (16) for s_τ in (15) we get the following result:

Proposition 1 *The total effect of a change in UI contribution τ on wage level depends on the elasticity of substitution as follows:*

$$w_\tau \quad \begin{cases} < 0 & when \quad \sigma < 1 \\ = 0 & when \quad \sigma = 1 \\ > 0 & when \quad \sigma > 1. \end{cases} \tag{17}$$

If the UI contribution increases and the elasticity of substitution is less than one, the share of labour in output increases. A rise in the share of labour causes an increase in the labour cost elasticity of labour demand which puts downwards pressure on the union's wage demand because higher elasticity makes it harder for the union to extract rents. When the elasticity of substitution is less than one, the union decreases its wage demand when the UI contribution increases. When the elasticity of substitution is larger than one, the opposite happens. A rise in τ causes a fall in s which decreases the labour cost elasticity of labour demand. A fall in η makes room for an increase in wages.

We assume that $\eta + \rho > 1$ where ρ denotes the union members' relative risk aversion. We can then show that the UI contribution elasticity of the wage rate, $\omega_\tau = \frac{w_\tau(1+\tau)}{w}$, is always larger than minus one, that is $\omega_\tau > -1$ (see Appendix C). Therefore when the UI contribution increases, the wage rate either decreases, but less than by the full amount of the tax rise (when $\sigma < 1$), or increases (when $\sigma > 1$). A rise in the UI contribution then always increases the labour cost and decreases employment, that is,

$$L_\tau < 0 \quad \forall \quad \sigma. \tag{18}$$

The impact of the shock on the union's wage demand can be derived analogously. From the first-order condition (11) it follows that

$$w_\theta = -\frac{(u(w) - u(b))\frac{-\sigma}{(1-s)^2} s_\theta}{V_{ww}} \tag{19}$$

and we can show that

$$s_\theta = \frac{s}{\theta}(\sigma - 1) = \begin{cases} < 0 & when \quad \sigma < 1 \\ = 0 & when \quad \sigma = 1 \\ > 0 & when \quad \sigma > 1. \end{cases} \tag{20}$$

From equations (19) and (20) we get the following result:

Proposition 2 *The total effect of a change in the value of the shock θ on wage level depends on the elasticity of substitution as follows:*

$$w_\theta \quad \begin{cases} > 0 & when \quad \sigma < 1 \\ = 0 & when \quad \sigma = 1 \\ < 0 & when \quad \sigma > 1. \end{cases} \tag{21}$$

That is, if the elasticity of substitution is less than one, the union increases its wage demand when the economy is in a boom and decreases it in a recession. When the elasticity of substitution is higher than one the opposite happens. We can also show that the shock elasticity of the wage rate, $\omega_\theta = \frac{w_\theta \theta}{w}$, is never larger than one, that is $\omega_\theta < 1$ (see Appendix C). Hence a rise in the value of the shock always increases employment, that is,

$$L_\theta > 0 \quad \forall \quad \sigma. \tag{22}$$

4 Unemployment insurance contribution policies

Next we begin to analyze various UI contribution policies and their effects on the union's wage and the firm's employment decisions. The government in our model finances unemployment benefits with employer's UI contributions and also decides both the level of the unemployment benefit, b, and the level of the UI contribution.

Because our interest is in the effects of different contribution policies, we assume that the level of the unemployment benefit is fixed. The government collects UI contributions and invests them in the UI fund. We assume that the government announces its contribution policy before wage and employment decisions are made and that it cannot afterwards change the policy. We examine the consequences of three different policies: passive, fixed, and active policy. In the case of passive policy the government adjusts the contribution according to the state of the economy. In the case of fixed policy the government aims at labour cost stabilization and in the case of active policy aims directly at employment stabilization.

4.1 Passive policy

In the case of the passive policy the government sets the level of the contribution according to the state of the economy. The passive policy is actually used when the financing system operates on the pay-as-you-go principle. The government sets the contribution such that it can cover the unemployment expenses of every period with the UI contributions it collects from the firm during that period. The government then sets the contribution τ such that the budget constraint

$$\tau w(\tau, \theta) L(\tau, \theta) = (M - L(\tau, \theta))b \tag{23}$$

is satisfied every period. The left side of equation (23) denotes the insurance contributions collected from the firm, and the right side the total unemployment expenses. We can write equation (23) in the form

$$\tau w(\tau, \theta) = \frac{Mb}{L(\tau, \theta)} - b. \tag{24}$$

Let us assume that the firm faces a negative shock that decreases its revenue. A negative shock has a *direct effect* on employment because a fall in revenue decreases labour demand and thereby employment. The shock has also an *indirect effect* through the union's wage demand but its size depends on the elasticity of the substitution. When the value of the shock falls, the union reacts by decreasing its wage demand if the elasticity of the substitution is smaller than one and by increasing it if the elasticity is larger than one. In Figure 2, σ, and thereby also the labour cost elasticity of labour demand, is small when the labour demand curve, drawn in $(L, w)-$ plane, is steep. A negative shock decreases labour demand and the labour demand curve shifts downwards from L_g to L_b'. When σ is small, the labour demand curve also becomes steeper. If the shock had no effect on the wage rate then employment would decrease from L_g^* to L_b''. When $\sigma < 1$ the union, as a consequence of a negative shock, decreases its wage demand. The indirect wage effect therefore reduces the fall in employment, as seen in Figure 2 from L_b'' to L_b'. The opposite happens when $\sigma > 1$. When the labour cost elasticity of labour demand is large the labour demand curve is flat (Figure 3). A negative shock again decreases labour demand. The labour demand curve becomes fatter and shifts downwards from L_g to L_b'. The union reacts to the shock by increasing its wage demand. The indirect wage effect now increases the fall in employment from L_b'' to L_b'. We state this first observation as a proposition.

Proposition 3 *When the firm's revenue is fluctuating, employment and wages fluctuate procyclically if the elasticity of substitution is smaller than one, and employment fluctuates procyclically and wages counter-cyclically if the elasticity of substitution is larger than one. In the former case the wage effect smooths out employment fluctuations and in the latter case it strengthens them.*

How does the government react to the shock when it adopts the passive policy? Intuition suggests that the government increases τ when the economic state gets worse but it turns out that the reaction depends on the size of the elasticity of substitution σ. When σ increases, the labour cost elasticity of labour demand increases and the higher the elasticity the larger is the effect of a change in the labour cost on

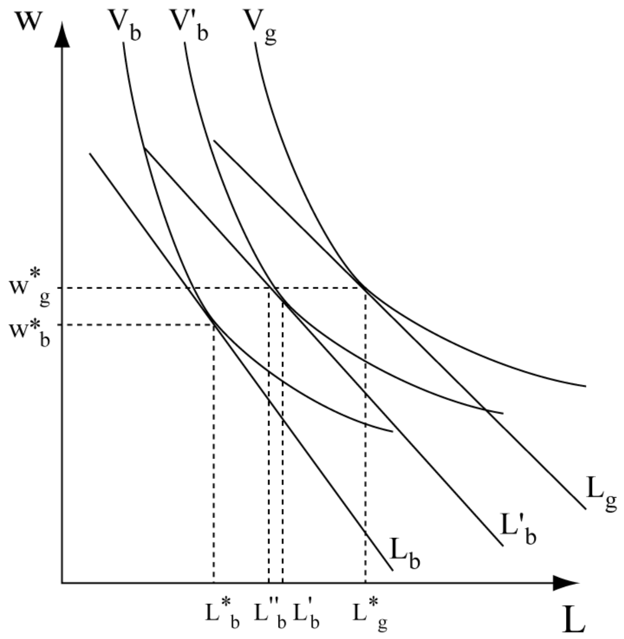

Figure 2: *Labour market equilibrium when* σ *<1*

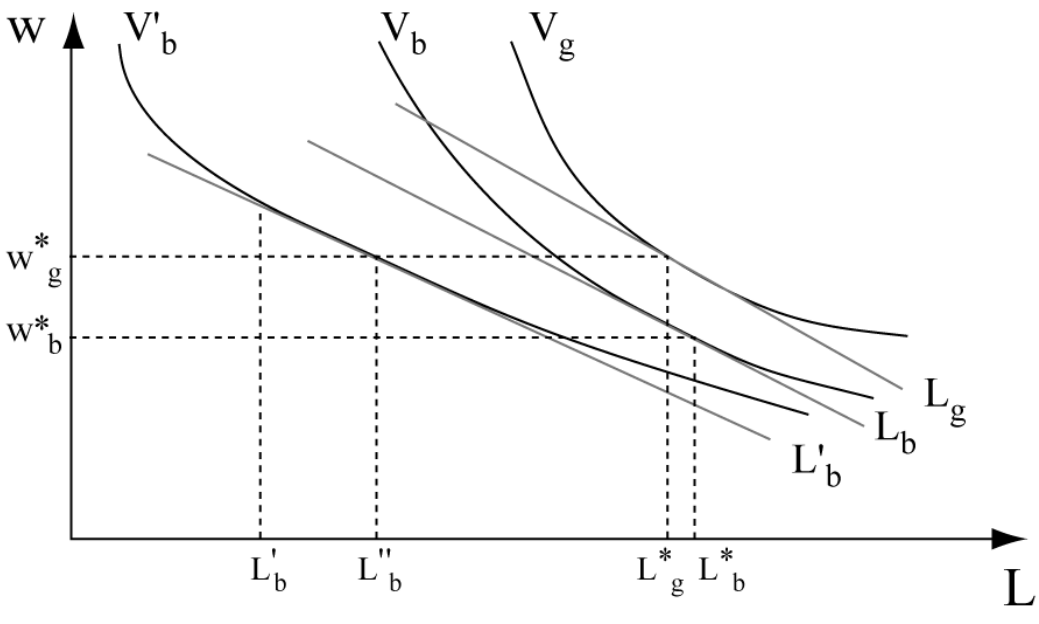

Figure 3: *Labour market equilibrium when* σ *>1*

employment. When employment falls, as a consequence of a negative shock, the right side of equation (24) increases. To balance its budget the government has to choose such action that it either raises employment or increases the left side of (24). A rise in τ always decreases labour demand and employment but its effect on the union's wage demand depends on the size of σ. Let us first suppose that $\sigma < 1$. Employment falls as a consequence of a negative shock but the shift is not large because the union reacts to the shock by decreasing its wage demand. When σ, and thereby also the labour cost elasticity of labour demand, is small the government can increase τ when the state of the economy gets worse. A rise in τ always increases the labour cost and decreases employment but the effect is not large when σ, and thereby η, is small. The union's wage demand decreases but because the labour cost $w(1+\tau)$ increases the left side of equation (24) also increases when τ rises. Figure 2 shows labour demand function shifting downwards from L_b' to L_b and the new equilibrium at (L_g^*, w_g^*).

However, increasing τ is not the only possible government reaction when $\sigma < 1$. When σ and increases, it raises the labour cost elasticity of labour demand and thereby strenthens the effect on employment of a change in the labour cost. The impact of a negative shock on employment also increases because when σ approaches one, disappears the indirect wage effectthat increases employment. After some critical value of the elasticity of substitution, $\sigma \geq \widehat{\sigma}$, a raise of τ has too large an effect on employment and the government chooses to decrease τ when the economic state worsens. A fall in τ decreases the labour cost and thereby the left side of equation (24) but significantly raises employment.

Let us next suppose that $\sigma > 1$ when the labour cost elasticity of labour demand is large. A negative shock directly decreases labour demand and thereby employment and a rise in the union's wage demand strengthens the effect. If the government then increased τ, the union would react by raising its wage demand and that would have a large, decreasing effect on employment. But if the government decreases τ, labour demand increases and the union decreases its wage demand; this has a increasing effect on employment. Therefore, when $\sigma > 1$ the government reacts to a negative shock by decreasing τ. Figure 3 shows labour demand function shifting upwards from L_b' to L_b and the new equilibrium at (L_g^*, w_g^*).

We can conclude that the government reacts to a negative shock by increasing τ when $\sigma < \widehat{\sigma}$ and decreasing it when $\sigma > \widehat{\sigma}$. The size of $\widehat{\sigma}$ depends on the other parameters of the model. Therefore

$$\tau_\theta \quad \begin{cases} \leq 0 & when \quad \sigma < \widehat{\sigma} \\ > 0 & when \quad \sigma > \widehat{\sigma}. \end{cases} \tag{25}$$

We summarize the results in the following proposition:

Proposition 4 *If the government adopts the passive policy and the elasticity of substitution is small ($\sigma < \widehat{\sigma}$) it sets a low insurance contribution when the economic state is good and a high insurance contribution when the economic state is bad. Fluctuations in the contribution level then strengthen employment and wage fluctuations caused bythe stochasticity of the firm's revenue. When the elasticity of substitution is large ($\sigma > \widehat{\sigma}$) the government chooses the opposite action and sets a high insurance contribution when the economy is good and a low insurance contribution when the economy is bad. Employment then fluctuates counter-cyclically. Wages fluctuate counter-cyclically if $\widehat{\sigma} < 1$ and $\widehat{\sigma} < \sigma < 1$ and procyclically, if $\sigma > 1$.*

Given that the elasticity of substitution is small, the passive policy strengthens business cycles because it increases the cost of labour when the economic state is bad and decreases it when it is good. If the elasticity of substitution is large the passive policy starts to work like an automatic stabilizer. The UI contribution and the cost of labour then decrease when the economic state worsens, which boosts employment.

The size of the elasticity of substitution is, of course, an empirical question. Empirical evidence exists which quite strongly suggests that the elasticity of substitution is different from one, but there is no general agreement whether σ is larger or smaller than one. Rowthorn (1999) presents a large set of cross-country estimates of σ and bases his estimates on earlier published estimates of the real wage elasticity of labour demand. Among 52 estimates of σ Rowthorn reports, only ten exceed 0.5 and only three of those exceed one. In a recent study by Ripatti and Vilmunen (2001) the elasticity of substitution in Finland was estimated to be close to 0.5. Duffy and Papageorgiou (2000) provide evidence of σ being statistically significantly above one. They use a panel of 82 countries over a 28-year period from 1960 to 1987 and report estimates of σ of approximately 1.3 to 3.3. Therefore, in terms of empirical evidence, the issue is open.

4.2 Fixed policy

In Finland the unemployment insurance financing system of was reformed at the end of the 90s. Smoothing out fluctuations in insurance contributions was a goal set in connection with the reform when the so-called buffer funds were established. The idea of the buffer fund is to set high insurance contributions when the economic conditions are good for the purpose of creating a surplus. When the economic conditions turn bad, part of the unemployment expenses can be paid from the buffers and there is less need to increase the insurance contributions. Buffer funding decreases fluctuations in the insurance contributions.

Let us next suppose that the government wants to completely level out fluctuations in UI contributions. We call this a fixed policy. The level of the contribution is chosen such that the government's expected budget is in balance. The fixed contribution, $\overline{\tau}$, then satisfies the equation

$$E[\overline{\tau}w(\overline{\tau},\theta)L(\overline{\tau},\theta)-(M-L(\overline{\tau},\theta))b]=0. \tag{26}$$

which implies

$$\begin{aligned}\psi[\overline{\tau}w(\overline{\tau},\theta_g)L(\overline{\tau},\theta_g)-(M-L(\overline{\tau},\theta_g))b]+\\(1-\psi)[\overline{\tau}w(\overline{\tau},\theta_b)L(\overline{\tau},\theta_b)-(M-L(\overline{\tau},\theta_b))b]=0.\end{aligned} \tag{27}$$

We can write equation (27) in the form:

$$\overline{\tau}\left[\psi w_g L_g+(1-\psi)\,w_b L_b\right]=b\left[M-(\psi L_g+(1-\psi)L_b)\right], \tag{28}$$

where the left side is the expected income and the right side expected expenditure of the UI fund.

Next we assume that the government follows the fixed policy, when, regardless of the state of the economy, the UI contribution is fixed. We further assume that the elasticity of substitution is small, that is, $\sigma \leq \widehat{\sigma}$. The fixed contribution, $\overline{\tau}$, is then set such that $\tau_g < \overline{\tau} < \tau_b$ where τ_g and τ_b are the good and bad state contributions when the passive policy is adopted. Hence, in a good economic state the contribution is "too high" and in a bad economic state "too low" compared to the contributions the government sets when it follows the passive policy. During a boom the government collects a surplus to the UI fund and uses it during a recession. The goal, when the government uses fixed contributions, is to smooth out labour cost fluctuations.

The fixed policy also levels out the fluctuations in the union's wage demand. The inequality

$$\tau_g < \overline{\tau} < \tau_b \tag{29}$$

implies that

$$w(\tau_g, \theta_g) < w(\overline{\tau}, \theta_g) < w(\overline{\tau}, \theta_b) < w(\tau_b, \theta_b). \tag{30}$$

When the government uses the fixed policy the wage rate is lower in a good but higher in a bad state of the economy than it is when the government uses the passive policy. Employment fluctuates, but less than in the case of the passive contribution policy. Because the UI contribution is fixed, the employment fluctuations are due to the wage fluctuations and the shocks the economy faces. Inequalities (29), (30) and $\theta_g > \theta_b$ imply that

$$L(\tau_g, \theta_g) > L(\overline{\tau}, \theta_g) > L(\overline{\tau}, \theta_b) > L(\tau_b, \theta_b). \tag{31}$$

The situation is different when $\sigma > \widehat{\sigma}$. When the government follows the passive policy and $\sigma > \widehat{\sigma}$ the UI contribution fluctuates counter-cyclically, being high in a good state and low in a bad state. The passive policy then stabilizes employment fluctuations. The government sets the fixed contribution such that

$$\tau_g > \overline{\tau} > \tau_b. \tag{32}$$

The fixed contribution is then "too low" when the economic state is good and "too high" when the state is bad. Adopting the fixed policy decreases employment fluctuations but in an undesirable way because, compared with the passive policy, employment in a good state increases and in a bad state decreases. Because σ and thereby η is large and the wage effect when $\sigma > 1$ strengthens the impact of a change in the contribution, the fixed policy can make employment fluctuate even procyclically. The following proposition summarizes the results:

Proposition 5 *If the government adopts the fixed policy by setting a fixed insurance contribution in all economic states, with the elasticity of substitution being low ($\sigma \leq \widehat{\sigma}$), wages and employment fluctuate less than with the passive policy. When the elasticity of substitution is large the fixed policy either decreases employment fluctuations or can even make employment fluctuate procyclically.*

4.3 Active policy

The Finnish financing system and buffer funding has not been welcomed with enthusiasm in the economic literature. Lars Calmfors, for example, has criticized the system as being under-ambitious. According to Calmfors (2000a), the goal of a more ambitious system would be to actually decrease labour costs in a bad economy. Next we examine the effects of an ambitious system which aims not at fixed contributions but at fixed employment. We call this an active policy.

Let us again assume that the firm faces a negative shock that decreases its revenue. Labour demand and thereby employment falls. When the government is committed to the active policy it adjusts the UI contributions such that employment is equal in all economic states. We denote the fixed employment by $\overline{L}$ when

$$\overline{L} = \left[\left(\frac{d\theta_g}{\overline{w}_g} \right)^{1-\sigma} \frac{1}{1-d} - \frac{d}{1-d} \right]^{\frac{\sigma}{1-\sigma}} = \left[\left(\frac{d\theta_b}{\overline{w}_b} \right)^{1-\sigma} \frac{1}{1-d} - \frac{d}{1-d} \right]^{\frac{\sigma}{1-\sigma}}. \qquad (33)$$

It is now easy to show that the active policy smooths away variations in the union wage demands. Equation (33) implies that

$$\frac{\overline{w}_g}{\theta_g} = \frac{\overline{w}_b}{\theta_b}, \tag{34}$$

that is, the government adjusts the contribution such that the "effective" labour costs do not depend on the state of the economy. When employment is fixed and equation (34) holds, also the labour cost elasticity of labour demand is fixed (see equation (14)). From the first-order condition of the union's maximisation problem (11) we can see that, when $\eta(\overline{w})$ remains unchanged, the union wage demand is independent of the state of the economy. The union wage demand remains unchanged, because the government neutralizes the effects the shocks have on employment before the union makes its wage desicions.

When w is fixed and $\theta_g > \theta_b$ equation (34) implies that $\tau_g > \tau_b$. To prevent a fall in employment the government must, as a consequence of a negative shock, decrease the UI contribution. Therefore, with all values of σ the UI contribution is higher when the economic state is good than when it is bad.

When σ is low, the active policy is more effective in smoothing out employment and wage fluctuations, compared with the passive and fixed policy. When σ is high, the government, adopting the passive policy, sets a high contribution in a good economic state and a low contribution in a bad state, which implies that employment is lower during a boom than during a recession. When the government adopts the active policy, it, compared with the passive policy, decreases τ_g and increases τ_b, which increases employment in a good stte and decreases it in a bad state.

The active policy levels out employment and wage fluctuations. When σ is low, wages fluctuate procyclically when both the passive and the fixed policies are practiced. Compared with the passive and active policy, the government, adjusting the UI contributions according to the active policy, increases τ_g and decreases τ_b. The wage in a good state decreases and in a bad state increases. Hence, when σ is small, the active policy reduces procyclical wage fluctuations. When σ is large, the active policy increases the wage in a bad state and decreases it in a good state. We summarize the results in the following proposition:

Proposition 6 *If the government adopts the active policy it sets a high insurance contribution when the economy is good and a low insurance contribution when the economy is bad with all values of the elasticity of substitution. Compared with the passive policy, the active policy levels out employment and wage fluctuations with all values of the elasticity of substitution.*

4.4 A numerical example

We cannot solve the decision variables of the model, τ, w, and L, in a closed form and therefore we have calculated a numerical example. In all of the following exercises we assume that the union members have a CRRA utility function, that is, $u(x) = \frac{x^{1-\rho}}{1-\rho}$. The unemployment benefit $b = 1$, the number of the union members $M = 1$, the union members' relative risk aversion $\rho = 1.5$, and the share of labour in the production $d = 0.7$. We have calculated the same example with different values of σ. To make examples comparable, we have set the value of the good shock, θ_g, such that with each σ employment in a good state is approximately 93 per cent. We have then adjusted the value of the bad shock θ_b such that a fall in labour demand decreases employment approximately five percentage points, from 93 per cent to 88 per cent, not taking into account the effect a negative shock has on wage $w(\tau; \theta)$. We assumed that all parties – the government, the union, and the firm – observe the shock and know the probability of a good shock, ψ. Here the probability of a good shock is $\psi = 0.8$.

Table 1 summarizes the results. When $\sigma < 1$ a negative shock decreases the union's wage demand which lessens the effect the shock has on employment. In Table 1 we can see that when $\sigma = 0.2$, wages decrease from 2.583 to 2.480 which reduces the fall in employment from the original five to only 1.24 percentage point. If the government adopts the passive policy it increases the UI contribution from 2.91 to 3.98 per cent, which decreases employment to 91.08 per cent. The fixed and the active policy then stabilize employment fluctuations. A negative shock has similar effects when $\sigma = 0.5$ except that a change in τ has a much larger effect on employment because the labour cost elasticity of labour demand is larger.

Table 1: The relationship between different government UI policies and UI contributions, employment, and wages.

Value of σ	Policy	τ_g (%)	τ_b (%)	L_g (%)	L_b (%)	w_g	w_b
$\sigma = 0.2$	Before adjustment of τ	2.91	2.91	93.00	91.36	2.583	2.480
	Passive	2.91	3.98	93.00	91.08	2.583	2.463
	Fixed	3.11	3.11	92.96	91.31	2.580	2.477
	Active	4.36	−1.90	92.64	92.64	2.559	2.559
$\sigma = 0.5$	Before adjustment of τ	4.55	4.55	93.00	89.80	1.651	1.633
	Passive	4.55	18.88	93.00	76.95	1.651	1.558
	Fixed	6.32	6.32	91.26	88.08	1.641	1.623
	Active	6.96	3.71	90.64	90.64	1.638	1.638
$\sigma = 0.9$	Before adjustment of τ	5.54	5.54	93.00	88.31	1.359	1.357
	Passive	5.54	1.03	93.00	97.44	1.359	1.360
	Fixed	4.82	4.82	94.80	90.03	1.360	1.358
	Active	5.20	3.29	93.86	93.86	1.359	1.359
$\sigma = 1.2$	Before adjustment of τ	5.93	5.93	93.00	87.45	1.268	1.270
	Passive	5.93	3.88	93.00	95.32	1.268	1.267
	Fixed	5.52	5.52	94.59	88.92	1.267	1.270
	Active	5.81	4.32	93.46	93.46	1.268	1.268

When $\sigma = 0.9$, a negative shock still decreases wages which reduces the effect the shock has on employment. The labour cost elasticity is now so large that the government, when it adjusts τ according to the passive policy, cannot increase τ but balances its budget by decreasing the contribution which raises employment. The critical value $\widehat{\sigma}$ is in our case somewhere between 0.5 and 0.9. When $\sigma = 0.9$ the UI contribution, in the case of the passive policy, decreases from 5.54 to 1.03 per cent and employment rises from 93 to more than 97 per cent. If the government now changed to the fixed policy it would have to decrease the good state and increase the bad state contribution, which would increase employment in a good state and decrease it in a bad state employment. Because σ, and thereby η, is large, changes in τ can have substantial effects on employment. The fixed policy could then, compared with the passive policy, make employment fluctuate procyclically, as in our example. A negative shock has similar effects when $\sigma > 1$ except that the shock then increases wages. When $\sigma = 1.2$, the wage effect increases the fall in employment from the original five to 5.25 percentage point.

5 The union's utility

In the last section we examined the effects of the different policies on insurance contribution, wage and employment levels. Next we start to analyze how the policies affect welfare. In choosing among the policies, one criterion the government could use is the policies' possible welfare effects. In our model we have M workers, which are represented by the union. It is therefore natural to use the union's total utility as a measure of welfare in our model economy.

Let us first examine how different policies affect the union's expected utility. With employment $L(\tau, \theta)$ and wage $w(\tau; \theta)$ we can write the expected utility of the union in the following form:

$$\begin{aligned} EV(\tau, \theta) &= \psi \left[L(\tau_g, \theta_g) u(w(\tau_g, \theta_g) + (M - L(\tau_g, \theta_g))\, u(b)) \right] + \\ &\quad (1-\psi) \left[L(\tau_b, \theta_b) u(w(\tau_b, \theta_b)) + (M - L(\tau_b, \theta_b))\, u(b)) \right]. \end{aligned} \tag{35}$$

We can write equation (35) in the form

$$EV(\tau, \theta) = \psi L_g \left(u(w_g) - u(b) \right) + (1-\psi) L_b \left(u(w_b) - u(b) \right) + M u(b). \tag{36}$$

The expected utility of the union depends on the variation of two factors: the employment and utility difference between an employed and an unemployed worker. The union faces a trade-off between employment and the utility difference; for example increasing wages in a good state increases the utility difference but decreases employment.

Table 2: The relationship between different government UI policies and the union's expected utility				
Value of σ	Policy	U_g	U_b	EU
$\sigma = 0.2$	Passive	1.703	1.661	1.694
	Fixed	1.702	1.666	1.694
	Active	1.695	1.695	1.695
$\sigma = 0.9$	Passive	1.264	1.278	1.267
	Fixed	1.270	1.255	1.267
	Active	1.267	1.267	1.267
$\sigma = 1.2$	Passive	1.208	1.213	1.209
	Fixed	1.211	1.200	1.209
	Active	1.209	1.209	1.209

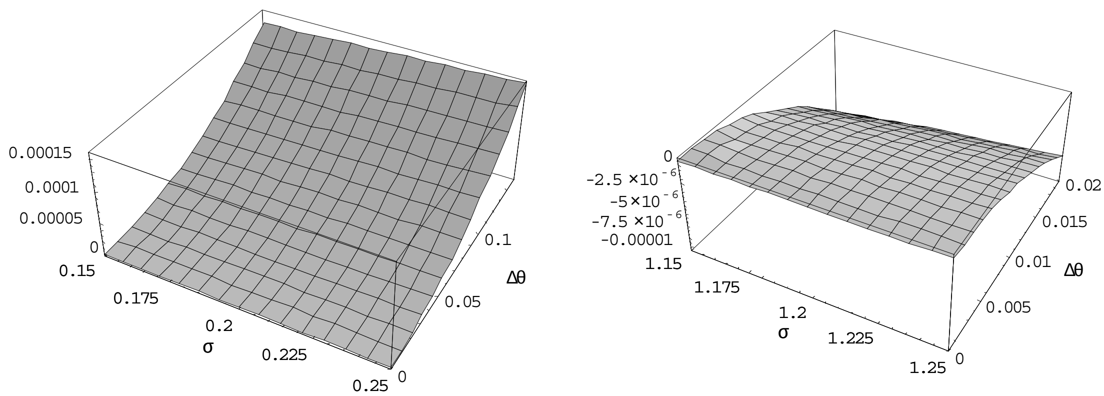

Figure 2: The difference between the union's expected utility in the case of the active and the passive policy.

Table 2 shows how the government's different policies affect the union's utility. We have calculated the figures of the table using the same parameter values as in section 4.4 and in Table 1. On the basis of the table, we can make two observations. First, with all values of σ the active policy levels out not only the fluctuations in employment and in the union's wage demand but also in the union's utility. Second, differences in the expected utilities are very small. However, the differences are too large and too systematic to be rounding errors. In Figure 2 we can see the difference between the union's expected utility in the case of the active policy and the passive policy when σ is small (the left side figure) and when σ is large (the right side figure). $\Delta\theta$ denotes the difference between a good and a bad shock. We can see that when σ is small the difference is positive and increases when $\Delta\theta$ increases. When σ is small the union therefore prefers the active policy; it always gives the union higher expected utility than the passive policy does. The situation differs when σ is large. The difference then is always negative and decreases when $\Delta\theta$ increases. The active policy always gives the union lower expected utility than the passive policy when σ is large.

6 Conclusions

We have studied the effects of different unemployment insurance contribution policies in a economy where labor markets are unionized, the firm's revenue is fluctuating and unemployment insurance is financed with employers' UI contributions. The government, which imposes the contributions on the firms, has three policy alternatives. We call the government's policy 'passive' if it sets the contribution according to the state of the economy. When the government aims at fixed contributions we have a 'fixed' policy, and when it aims at fixed employment we call the policy 'active'. The argument for using of the fixed, and even the active, policy is as follows: When the labour demand and thereby employment is fluctuating, the government, when it uses the passive policy, must increase the employer's UI contribution when the economic state is bad. A rise in the contribution increases the cost of labour and deepens the recession. The government could level out labour costs and employment fluctuations by setting a fixed contribution. Or the government could be even more ambitious and implement an active employment policy by setting the contribution level counter-cyclically. It turns out that the argument is valid only if the elasticity of substitution between the factors of production, and thereby labour cost elasticity of labour demand, is small in the economy. If the elasticity of substitution is large the passive policy itself acts as an automatic stabilizer. The government then sets, when the economic state is bad, a low UI contribution which decreases the cost of labour and boosts bad employment.

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Appendices

A Determinants of labour demand elasticity

The output of the firm is given by the following CES production function:

$$f(L,K)=\left(dL^{\frac{\sigma-1}{\sigma}}+(1-d)K^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}. \tag{37}$$

From the firm's profit maximization we get

$$\overline{w}=w(1+\tau)=\theta f_L. \tag{38}$$

Differentiating the production function, we obtain

$$f_L = d\left(\frac{f}{L}\right)^{\frac{1}{\sigma}} \tag{39}$$

which implies that

$$\overline{w} = \theta d\left(\frac{f}{L}\right)^{\frac{1}{\sigma}}. \tag{40}$$

Differentiating (40) yields

$$\begin{aligned} \frac{d\overline{w}L}{dL\overline{w}} &= \frac{1}{\sigma}\left(\frac{Ldf}{fdL} - 1\right) && (41)\\ &= \frac{1}{\sigma}\left(d\left(\frac{f}{L}\right)^{\frac{1}{\sigma}-1} - 1\right) && (42)\\ &= \frac{1}{\sigma}\left(\frac{\overline{w}L}{\theta f} - 1\right). && (43) \end{aligned}$$

Rearranging (43) we get

$$\eta = \frac{\sigma}{1-s} \tag{44}$$

where $s = \frac{\overline{w}L}{\theta f}$ is the cost share of labour in output.

B The cost share of labour and UI contribution

The share of labour in output

$$s = \frac{\overline{w}L}{\theta f}. \tag{45}$$

Then

$$\begin{aligned} s_\tau &= s_{\overline{w}}w = \frac{Lw}{\theta f} + \frac{\overline{w}L_{\overline{w}}w}{\theta f} - \frac{\overline{w}L}{(\theta f)^2}\theta f_L L_{\overline{w}}w && (46)\\ &= \frac{Lw}{\theta f} + \frac{\overline{w}L_{\overline{w}}w}{\theta f} - \frac{\overline{w}L}{(\theta f)^2}\theta d\left(\frac{f}{L}\right)^{\frac{1}{\sigma}} L_{\overline{w}}w && (47)\\ &= \frac{L\overline{w}}{\theta f}\frac{1}{1+\tau} + \frac{L\overline{w}}{\theta f}\frac{L_{\overline{w}}\overline{w}}{L}\frac{1}{1+\tau} - \left(\frac{\overline{w}L}{\theta f}\right)^2\frac{L_{\overline{w}}\overline{w}}{L}\frac{1}{1+\tau} && (48)\\ &= \frac{s}{1+\tau} - \frac{s}{1+\tau}\eta + \frac{s^2}{1+\tau}\eta && (49)\\ &= \frac{s}{1+\tau}(1-\sigma). && (50) \end{aligned}$$

C Wage rate, UI contribution and revenue shock

In terms of τ we get from the first-order condition

$$w_\tau = -\frac{V_{w\tau}}{V_{ww}} \tag{51}$$

where

$$V_{w\tau} = [u(w) - u(b)] \left(\frac{-\sigma}{(1-s)^2} \right) s_{\overline{w}} w \tag{52}$$

and

$$V_{ww} = [u(w) - u(b)] \left(\frac{-\sigma}{(1-s)^2} \right) s_{\overline{w}}(1+\tau) + u'(w)(1-\eta) + wu''(w). \tag{53}$$

When we substitute (51) for w_τ in equation $\omega_\tau = \frac{w_\tau(1+\tau)}{w}$ we get

$$\omega_\tau = \frac{-[u(w) - u(b)] \left(\frac{-\sigma}{(1-s)^2} \right) s_{\overline{w}}(1+\tau)}{[u(w) - u(b)] \left(\frac{-\sigma}{(1-s)^2} \right) s_{\overline{w}}(1+\tau) + u'(w)(1-\eta) + wu''(w)}. \tag{54}$$

When $\sigma > 1$ $w_\tau > 0$ and ω_τ is positive. We therefore only have to consider the case where $\sigma < 1$ when $s_{\overline{w}} > 0$. From (54) we see that if

$$u'(w)(1-\eta) + wu''(w) < 0 \tag{55}$$

the elasticity $\omega_\tau > -1$. Condition (55) holds when $\eta + \rho > 1$ where ρ denotes union members' relative risk aversion.

In terms of θ we get from the first-order condition

$$w_\theta = -\frac{V_{w\theta}}{V_{ww}} \tag{56}$$

where

$$V_{w\theta} = [u(w) - u(b)] \left(\frac{-\sigma}{(1-s)^2} \right) s_\theta \tag{57}$$

$$V_{ww} = [u(w) - u(b)] \left(\frac{-\sigma}{(1-s)^2} \right) s_{\overline{w}}(1+\tau) + u'(w)(1-\eta) + wu''(w) \tag{58}$$

We can write $s_\theta = \frac{-s_{\overline{w}}\overline{w}}{\theta}$. When we substitute (56) for w_θ in equation $\omega_\theta = \frac{w_\theta \theta}{w}$ we get

$$\omega_\theta = \frac{[u(w) - u(b)] \left(\frac{-\sigma}{(1-s)^2} \right) s_{\overline{w}}(1+\tau)}{[u(w) - u(b)] \left(\frac{-\sigma}{(1-s)^2} \right) s_{\overline{w}}(1+\tau) + u'(w)(1-\eta) + wu''(w)} \tag{59}$$

When $\sigma > 1$ $w_\theta < 0$ and ω_θ is negative. We therefore only have to consider the case where $\sigma < 1$ when $s_{\overline{w}} > 0$. From (59) we see that if

$$u'(w)(1-\eta) + wu''(w) < 0 \tag{60}$$

the elasticity $\omega_\theta < 1$. Condition (60) holds when $\eta + \rho > 1$ where ρ denotes union members' relative risk aversion.