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Essays on the Financing of Unemployment Benefits

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Foreword

The implications of alternative ways of financing unemployment benefits on wage formation and employment is an important, though relatively little researched topic. Marja-Liisa Halko's doctoral dissertation deals with several issues in this area. The first essay uses the "right-to-manage" framework to study the effects of alternative unemployment benefit financing systems on wages and employment. The author shows that, under certain conditions about the wage elasticity of labour demand, a rise in the trade union's share of the unemployment expenses has a wage moderating and thereby employment enhancing effect. In the second essay the author uses a slightly different model to examine the use of unemployment insurance contributions as policy instruments. Halko shows that the impacts of alternative contribution policies on wages and employment depend on the size of elasticity of substitution between labour and capital. In the third essay Halko provides a first analysis of the effects of buffer funding on wage and employment formation in a simple two-period monopoly union model. She shows that the effects of the buffer fund depend on whether wages are flexible or rigid over time. To conclude, this thesis contributes to the emerging literature about the wage and employment effects of alternative ways to finance unemployment benefits.

This study is part of the research agenda carried out by the Research Unit on Economic Structures and Growth (RUESG). The aim of RUESG is to conduct theoretical and empirical research into important issues in the dynamics of the macro economy, game theory and economic organizations, the financial system as well as problems of labour markets, natural resources, taxation and econometrics.

RUESG was established in the beginning of 1995 and it is now one of the Centres of Excellence financed joint by the Academy of Finland, the University of Helsinki, the Yrjö Jahnsson Foundation, Bank of Finland and the Nokia Group. This support is gratefully acknowledged.

Helsinki, March 31, 2003

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Marja-Liisa Halko

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Chapter 1

Introduction

1 Background

The underlying reason for public unemployment insurance (UI) is that it insures risk-averse workers against income fluctuations, assuming that workers do not have access to the credit markets, at least to the same extent than the government. UI, however, has also other than income smoothing effects and during the last two decades plenty of research has been devoted to explore its economic impacts¹. For example, job-search theory has been used to investigate how UI affects the job search behaviour of an unemployed worker, and contract theory to examine the effects of UI on work and employment contracts. The implications of UI on equilibrium wage and thereby on employment are usually explained with help of union-bargaining models. There has also been some research on the normative and welfare questions involved. For example, problems concerning the optimal level or financing of UI has been studied.

In this study we examine how changes in the unemployment insurance financing system affect wage and employment levels in an economy where labour markets are organized and trade unions finance some of the benefits of their unemployed members, either directly by imposing a UI contribution or an insurance premium on employees,

¹For surveys see Holmlund (2002), Holmlund (1998), and Atkinson and Micklewright (1991).

or indirectly when the government imposes the contributions. In the standard trade union models², it is usually assumed that the objective of the union is to maximize either the sum of the utilities of its members or the sum of the expected utilities. In the former case, the utilitarian objective function of a risk-averse union can be written as

$$U(w, L) = Lu(w) + (M - L)u(b), \quad (1)$$

where w is wage, L employment, M the number of union members, and $u(\cdot)$ a utility function of a single union member such that $u'(\cdot) > 0$ and $u''(\cdot) \leq 0$. The term b in equation (1) denotes an outside option of the union members, and can be interpreted as a non-union sector wage or as an unemployment benefit. Regardless of the interpretation, the term b is assumed to be exogenous in standard models. When b denotes unemployment benefit, the assumption is satisfactory only if the unions can neither affect the level of the benefit nor take part in financing the benefits. There is then no link between unemployment expenses and the union's wage decisions.

Finland is one of the so-called Ghent countries,³ in which unemployment insurance (UI) is organized through union-administered but government-subsidized unemployment funds. In these countries the link exists, because unions also finance some of the unemployment benefits of their unemployed members. Changes in the financing system of unemployment insurance can affect union wage decisions and thus employment. The fact that unions in some European countries contribute to unemployment benefits does not make the problem uninteresting. It is commonly believed that the unions moderate their wage demands when they have to take into account how their wage decisions affect the cost of unemployment. An increase in wages decreases em-

²By standard models we mean the monopoly union model (see Dunlop, 1944), the right-to-manage model (see Nickell and Andrews, 1983), and the efficient bargaining model (see MacDonald and Solow, 1981). There is also an extensive literature on trade union objectives and union behaviour; for example, Farber (1986), Oswald (1982, 1985), and Booth (1995).

³The other Ghent countries are Sweden and Belgium, see, for example, Boeri, Brugiavini and Calmfors, 2001.

ployment and raises unemployment expenses, which may check the rise of wages. The Ghent countries' unemployment insurance financing system may therefore have favourable employment effects.

The problem has been previously studied by Holmlund and Lundborg (1988, 1989). The basic set-up in their papers is the same – both consider an industry-wide monopoly union that runs its own unemployment insurance fund and pays the benefits of its unemployed members from the fund. The fund's income is derived from three different sources: the government, employers, and union members. The government finances its part of the unemployment expenses from its general tax revenue. The government can also impose a sector-specific UI contribution on employers. Holmlund and Lundborg consider two alternative UI taxes: a payroll tax and a tax on profits. The third source of income for the fund is insurance premiums paid by the union members. The main differences between the papers are in the objectives of the union and in the determination of the benefit level. Holmlund and Lundborg (1989) assume that the union is risk-neutral and maximizes the sum of the net income of its members; the benefit level is $b = rw$, where r is the replacement ratio. Holmlund and Lundborg (1988), however, assume that the union maximizes the sum of the utilities of its risk-averse members and the benefit level is exogenous. Holmlund and Lundborg show that a rise in the profit tax increases employment in both a risk-neutral and a risk-averse union members. A rise in wage in this case reduces the tax base and decreases employer contributions to the union's UI fund. The union's marginal cost of a rise in wages therefore is increasing in the profit tax which implicates that the union decreases its wage demand when the profit tax increases. A rise in the payroll tax increases employment in the case of a risk-neutral union because of its indirect effect on the benefit level. In the case of a risk-averse union a rise in payroll tax has no effect on employment because a decrease in the wage induced by the tax change keeps the labour cost and consequently employment unchanged.

Holmlund and Lundborg have no difficulties in determining the effects of UI taxes but offer only few results on the effects of subsidy rules and benefits. In the case of a

risk-neutral union they are able to show that a decrease in the government's share of unemployment expenses, that is, an increase in the experience rating, moderates the union's wage demand. The effect of experience rating, however, is ambiguous when risk aversion is added to the model. As well, the effect of a change in the benefit level or in the union membership remains unsolved in Holmlund and Lundborg (1988). The difficulty of the problem partly results from the fact that the union's budget constraint considerably complicates the otherwise simple monopoly union model.

One goal of this study is to extend the work of Holmlund and Lundborg. In Chapter 2 we examine the same question addressed by Holmlund and Lundborg (1988, 1989). We wish to find out how changes in the financing system of unemployment insurance affect union wage demands and thereby employment, when the unions finance a part of the benefits. To obtain the results we use the theory of monotone comparative statics introduced by Topkis (1978, 1998). The theory proves to be very useful in deriving comparative static results when the model we examine has many decision variables and parameters. In Appendix A we briefly review the part of the theory which is relevant for this study.

Other goals of the study are related to the last financial reform of unemployment insurance in Finland. The unemployment insurance financial system in Finland was reformed in the middle of the 1990s after the serious economic recession earlier in the decade. During the recession, the unemployment rate rose from 3 per cent in 1990 to almost 20 per cent in the beginning of 1994 (see Honkapohja and Koskela, 1999). The rapid rise in unemployment caused a large increase in unemployment expenses. This increase in expenses was mainly financed by the state, but also by raising employers' and employees' contributions. In 1990 the employers' average contribution was 0.6 per cent, rising to a high of 5.6 per cent in 1993 (see Figure 1). In 1993 the government imposed UI contributions on employees as well. At its highest, the employees' contribution was 1.87 per cent in both 1994 and 1995. The increase in the contributions raised labour costs and decreased the net income of employees, which made the economic crisis worse. An unexpected change in unemployment expenses

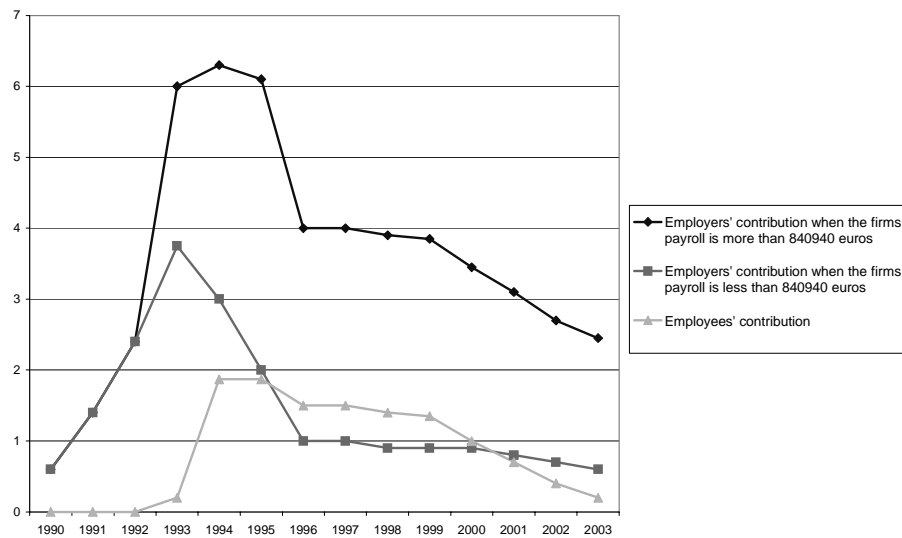


Figure 1: *Unemployment insurance contributions, % (Source: Ministry of Social Affairs and Health)*

also caused an unexpected rise in public expenditure and a need for reform of the financing system. Because our study is based on the system in Finland, we briefly present the main features of the reform. For further details we refer the reader to Asplund, Kettunen (1994), Holm, Mäkinen (1998), and Holm, Kiander and Tossavainen (1999).

The new system of unemployment insurance financing came into full effect at the beginning of 1999. The aim of the new system was to stabilize the financing of unemployment expenses and smooth out fluctuations in UI contributions and thereby in labour cost. Under the new system unemployment benefits are financed by the state, employers and employees. The state's share of the expense is now fixed and corresponds to the basic daily allowance of the earnings-related unemployment benefit. In 2002 the basic daily allowance was 22.75 euros. Both employers and employees pay UI contributions which are invested in the Unemployment Insurance Fund. The Unemployment Insurance Fund directs the payments of the members of private unemployment funds to the private funds which pay the unemployment insurance of their

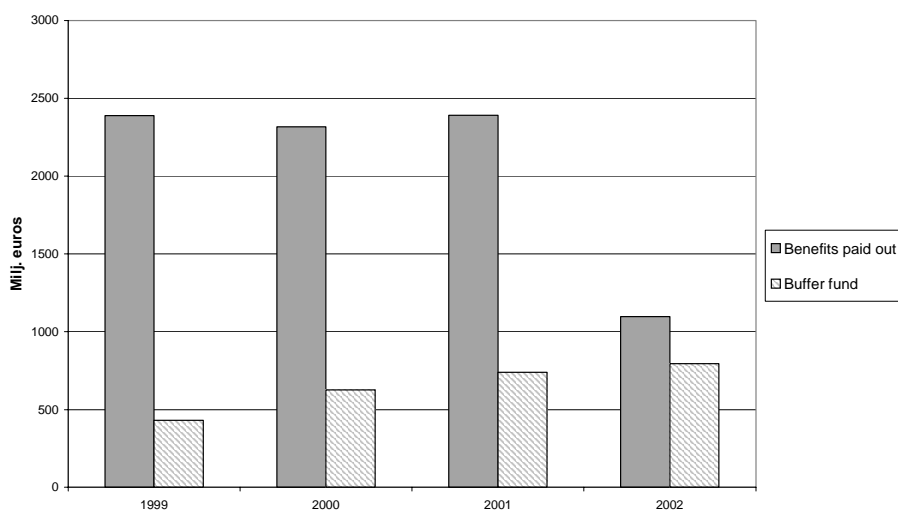


Figure 2: *Unemployment benefits paid out and accrual of the buffer fund (Source: The Unemployment Insurance Fund and the Social Insurance Institute)*

members. The state as well pays its share of the benefits of the members of private funds directly to the private unemployment funds. The other source of income of the private funds is the membership fees. The Unemployment Insurance Fund directs the contributions of the non-members to the Social Insurance Institute which pays the insurance of the non-members.

The labour market organizations administer the Unemployment Insurance Fund. The fund's administrative council consists of 18 members, whom 12 represent employer and 6 employee organizations. The administrative council decides annually what the level of UI contributions will be and the decision must be approved by the Ministry of Social Affairs and Health. The Ministry of Social Affairs and Health also names the members of the council.

The act relating to the financing of unemployment benefits also includes a section dealing with the collection of a buffer fund. It stipulates that the administrative council can decide to collect a buffer fund for the Unemployment Insurance Fund. This is collected by setting UI contributions at a higher level than the state of the

economy would require. The upper limit of the buffer is an amount that corresponds to the yearly expenses of 3.6 per cent unemployment (about 0.5 billion euros). Figure 2 shows that the buffer reached its upper limit in 2000. In a bad economic state the fund can show a deficit of an equal amount. The administrative council also decides when to use the buffer.

Two reasons for forming a buffer fund were emphasized. The first justification was that when buffer funding is possible and a buffer exists, the economy is better prepared for economic disturbances in common currency conditions, in which exchange rate changes are no longer possible. The second rationale was that by means of buffer funding one can decrease fluctuations in employers' and employees' insurance contributions and then smooth out the counter-cyclical changes in the cost of labour. In Chapter 3 of the study we examine the use of UI contributions as a policy instrument and compare three possible government choices. The government can adjust the contributions according to the economic state. Alternatively, the government can, with its policy, either aim at stable labour cost or stable employment. In Chapter 4 we explore in a two period monopoly union model the effects of buffer funding on the union's wage-setting behaviour.

2 Changes in the financing system

In Chapter 2 we examine how changes in the financing system affect wages and employment. The model we study is very close to the model presented in Holmlund and Lundborg (1988). The main difference is that Holmlund and Lundborg assume the union has a monopoly position in the labour market in which case it can unilaterally decide on wages, whereas we assume that wage bargaining takes place between the union and the firm. We extend the basic right-to-manage model by adding a budget constraint to the union and examine how the wage-bargaining outcome reacts to changes in the financing system. We keep the assumption that the benefits are financed with the government's subsidy, employers' UI contributions, and union

members' insurance premiums but we also include the possibility that the government imposes a UI contribution on employees' wages also.

We can extend some of the results of Holmlund and Lundborg to the situation where union and firm bargain over the wage rate. For example, changes in UI contributions have no effect on employment whereas an increase in profit tax raises employment in the case of wage bargaining as well. We can also derive some new results. For example, we show that if the wage elasticity of the labour demand is not very low then a rise in the union's share of the unemployment expenses has a wage-moderating effect. We can also show that a rise in the benefit level increases bargained wages and hence decreases employment.

3 Insurance contributions as a policy instrument

In Chapter 3 we examine the use of unemployment insurance contributions as a policy instrument. We assume that the benefits are financed solely with employers' UI contributions and examine how changes in the government's contribution policy affects wages and employment when the firm's revenue is fluctuating and wages are set by a monopoly union.

The government imposes the insurance contributions and has three contribution policy alternatives: passive, fixed and active. When the government follows the passive policy it adjusts the contributions according to the state of the economy. Under the fixed policy the same contribution is set regardless of the state of the economy. The active policy aims at non-fluctuating employment.

In Chapter 3 we compare the three contribution policies and examine their effects on wage and employment levels and on the expected utility of the union. It turns out that the effects the different policies have on wage and employment decisions depend crucially 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. Both

fixed and active policies then stabilize the economy by smoothing out employment and gross wage fluctuations. When the elasticity is large the passive policy itself works as an automatic stabilizer leading to a low contribution and high employment when the economic state is bad. The expected utility of the union also depends on the elasticity of substitution. When the elasticity is small (large) the expected utility of the union is highest when the government adopts the active (passive) policy.

4 Buffer funding

In Chapter 4 we 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 again assume that the unemployment insurance system is organized by the union, and therefore, that the union runs an unemployment insurance fund. The fund's income consists of employee and/or employer contributions and the government's subsidy. In Chapter 4 our main interest is the effect of buffer funding on union wage demands and on employment. The goal of buffer funding is to stabilize unemployment expenses and reduce fluctuations in the cost of labour over business cycles. It is obvious that buffer funding stabilizes labour costs and employment but it is less obvious what it does to union wage demands.

No research exists on the effects of buffer funding on unions' wage-setting behaviour. In Chapter 4 we examine how buffer funding affects union wage demands in a simple two-period monopoly union model. In the first period the union can, or must, collect a positive buffer for its unemployment insurance fund. In the second period the union can use the buffer to pay a part of the second period unemployment expenses.

First we assume that wages are flexible. It turns out that buffer funding then decreases employment and net wage fluctuations. If wages are rigid the result holds only if the unemployment insurance contribution is imposed on employers. When wages are rigid and the unemployment insurance contribution is imposed on employees, the

buffer does not affect employment fluctuations but can increase the union wage demand and therefore decrease employment. The worse the state of the economy in the second period is, the stronger is the effect.

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A Theory of monotone comparative statics

In this study we use Topkis' theory of monotone comparative statics. We justify the use of the theory by a labour market example. Let us examine the standard

monopoly union model (see, for example, Oswald 1985). Let $f(L)$ denote the firm's increasing and strictly concave production function. The firm chooses employment, L , to maximize its profits $\pi(w, L) = pf(L) - wL$, where p is the price of the firm's output and w the wage rate. For simplicity, we assume that the product price is one. From the firm's profit maximization problem we can derive the labour demand function $L = L(w)$. On grounds of the production function properties we can solve the sign of the first derivative of the labour demand function, $L'(w) < 0$, but not the second derivative.

We assume that the union has a utilitarian utility function

$$U(w, L) = Lu(w) + (M - L)u(b), \quad (2)$$

where $u(\cdot)$ denotes increasing and concave utility function of the union members, M the number of union members, and b exogenous unemployment benefit. The maximization problem of a monopoly union is

$$\max_w Lu(w) + (M - L)u(b) \quad s.t. \quad L = L(w). \quad (3)$$

The first-order condition is

$$U_w = L'(w)(u(w) - u(b)) + L(w)u'(w) = 0. \quad (4)$$

Let $w = w^*$ be the solution of the first order-condition. For comparative static results, the implicit function theorem is normally used. Then we need the second-order condition

$$U_{ww} = L''(w)(u(w) - u(b)) + 2L'(w)u'(w) + L(w)u''(w) < 0. \quad (5)$$

Let us assume that we want to find out how, for example, a rise in benefits affects the union wage demand. From the first-order condition (4) and by the implicit function theorem we get $U_{ww}dw + U_{wb}db = 0$, which implies that $\frac{dw}{db} = -\frac{U_{wb}}{U_{ww}}$. We assume that $U_{ww} < 0$ and conclude that the sign of the U_{wb} gives the sign of $\frac{dw}{db}$. In the second-order condition (5) the last two terms are negative but the sign of the

first term is ambiguous. The problem is the sign of the term L'' , because the second derivative of the labour demand function can be either negative or positive. Therefore, the condition (5) to be satisfied requires some information about the second derivative of the labour demand function. If the labour demand function is concave, i.e. $L'' < 0$ the condition (5) holds. If $L'' > 0$, the sign of the second-order condition is ambiguous and the use of the implicit function theorem is thus questionable.

If the model we examine has several decision variables and parameters the second-order condition becomes even more difficult to verify, and therefore the comparative static results usually rest only on the assumption that the second-order condition holds. We can dispose of that awkward assumption if we use lattice theory to derive comparative statics results. To be able to use that theory the objective function has to meet certain requirements and the parameter space and the action space must have a particular order structure.

Next we briefly list some lattice-theoretic notions and results we will need in this study. More details can be found in Topkis (1978 or 1998). We examine the following general optimization problem: $\max_{x \in S_\tau} f(x; \tau) : X \times T \rightarrow \mathbf{R}$ where the constraint set S_τ and the objective function f depend on the parameter τ . We are especially interested in the case where $X = \mathbf{R}^2$, the parameter vector τ belongs to $\tau = \mathbf{R}_+^n$, and the constraint is of the form $y = g(x; \tau)$ where x and y are the decision variables. We want to know on what conditions the optimal solution to the maximization problem is increasing in the parameter τ .

First we list the conditions the objective function must satisfy.

Definition 1 *A partially ordered set X (\succeq_x) is a lattice if for any $x, y \in X$ there exists a sup (denoted by $x \vee y$) and an inf (denoted by $x \wedge y$) both in X .*

For example, in \mathbf{R}^2 a coordinate-wise \geq is a partial order. With that order any rectangle in \mathbf{R}^2 is a lattice.

Definition 2 *Given a lattice X , S is a sublattice of X if for all $x, y \in S$ $x \vee y \in S$ and $x \wedge y \in S$.*

Note that the sup and the inf are taken with respect to the set X and they must belong to the set S .

Definition 3 Let X be a lattice and $f : X \rightarrow \mathbf{R}$. The function f is supermodular if $\forall x, y \in X \quad f(x \vee y) + f(x \wedge y) \geq f(x) + f(y)$.

The supermodularity of a function means that the function is monotonic in the sense that its value increases more if we increase all its arguments than if we increase just some of them.

Definition 4 Let X and T be partially ordered sets, and $f : X \times T \rightarrow \mathbf{R}$. The function f has increasing differences on $X \times T$ if for all $x_1 \succeq_x x_2$ in X and $\tau_1 \succeq_\tau \tau_2$ in T , we have $f(x_1, \tau_1) - f(x_2, \tau_1) \geq f(x_1, \tau_2) - f(x_2, \tau_2)$.

The definition of increasing differences means that when $x_1 \succeq_x x_2$ the difference $f(x_1, \tau) - f(x_2, \tau)$ is increasing in τ . If $X \times T = \mathbf{R}^2$ supermodularity is equivalent to the property of increasing differences. If $f : \mathbf{R}^n \rightarrow \mathbf{R}$ is twice differentiable then f is supermodular or has increasing differences if $\partial^2 f / \partial x_i \partial x_j \geq 0$ for all $i \neq j$.

Usually the maximization problems in economics are restricted by constraints which are functions of the parameters of the problem. The constraint must be compatible with the optimization problem. The next definition explains when a possible constraint correspondence of the maximization problem increases in the parameter.

Definition 5 Let $L(X)$ be a set of all nonempty sublattices of the set X and T a partially ordered set. A map $S_\tau : T \rightarrow L(X)$ is increasing if $\tau_1 \succeq_\tau \tau_2$ implies that $S_\tau(\tau_1) \succeq_v S_\tau(\tau_2)$, where \succeq_v is Veinott's order on $L(X)$ (for $X, Y \in L(X) \quad X \succeq_v Y$ if for all $x \in X$ and for all $y \in Y \quad x \vee y \in X$ and $x \wedge y \in Y$).

Definition 5 deals with a general constraint correspondence. We are interested in equality constraint of the form $y = g(x; \tau)$. In our case the constraint is increasing in τ if $g_x \geq 0$ and $g_\tau \geq 0$.

We next present Theorem 2.8.1. from Topkis (1998).

Theorem 6 *If X is a lattice, T is a partially ordered set, S_τ is a subset of X for each τ in T , S_τ is increasing in τ on T , $f(x, \tau)$ is supermodular in x on X for each τ in T , and $f(x, \tau)$ has increasing differences in (x, τ) on $X \times T$, then $\arg \max_{x \in S_\tau} f(x, \tau)$ is increasing in τ on $\{\tau : \tau \in T \text{ } \arg \max_{x \in S_\tau} f(x, \tau) \text{ is nonempty}\}$.*

In Topkis' theorem the action set X is any lattice and the parameter space T any partially ordered set. In many optimization problems in economics the action set X is a rectangle in \mathbf{R}_+^n , the parameter space T is a rectangle in \mathbf{R}_+^m and the objective function $f(x; \tau)$ is C^2 . If, in addition, the objective function f is supermodular in x with all τ , i.e. $\frac{\partial^2 f}{\partial x_i \partial x_j} \geq 0 \quad \forall i \neq j$, and has increasing differences in (x, τ) , i.e. $\frac{\partial^2 f}{\partial x_i \partial \tau_j} \geq 0 \quad \forall i = 1, 2, \dots, n$ and $\forall j = 1, 2, \dots, m$, and the constraint correspondence is increasing in τ , then the optimal action is increasing in τ .

When we apply Topkis's theorem to a standard monopoly union model we do not get any new results. The analysis is easier, and more robust, because we do not need the second-order condition.⁴ It suffices to assume that the labour demand function is downwards sloping. After substituting labour demand function L^d for L in the objective function, (2) is a function of one decision variable, w , and two parameters, b and M . A function with only one decision variable is always supermodular. The only constraint $w \geq b$ is ascending in b . The cross partial $\partial^2 U / \partial w \partial b > 0$. By Topkis's theorem we can conclude that the bargained wage w^* is nondecreasing in b . In the case of a standard monopoly union model the second-order condition is possible to calculate and the lattice theory does not give any new results. However, if the model we study has more decision variables and parameters, the second-order condition becomes very difficult to verify. Therefore the condition is usually only assumed to hold, which slightly decreases the credibility of the results.

⁴The theory of monotone comparative statics would allow us to use more general utility functions; for example, continuity is not required. However this extension is beyond the scope of this paper.

Chapter 2

Financing of Unemployment Insurance

Abstract

In conventional trade union models it is assumed that the unemployment benefits of unemployed union members are provided by the government. We examine the case where in a *right-to-manage model* the union finances part of the benefits of its unemployed members and therefore runs an unemployment insurance (UI) fund, to which employed members pay insurance premiums. Part of the fund's income derives from the UI taxes the government imposes on both employees and employers. In this chapter, we show that wages fall and employment rises when the government increases the experience rating or decreases unemployment benefits. A rise in profit tax also increases employment, but changes in UI taxes on payroll or income have no employment effect.

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 hence no link between a union's wage decisions and unemployment expenses.

The link does exist in the Ghent countries. In these countries unemployment insurance (UI) is organized through union-administered but government-subsidized UI

funds. Unions also finance some of the unemployment benefits of their unemployed members. Financing these benefits is therefore not exogenous in the wage bargaining and changes in the means of financing may affect the bargained wage and the employment decisions of firms. The Ghent system is practised in Sweden and Finland¹, for example.

The aim of the study presented in this chapter is to add this link to the standard trade union models, and then examine what effects the various ways of financing unemployment benefits have on wage levels and employment. The link may seem unimportant because it exists only in a few countries. What makes the link interesting is the wage moderation effect it may have. It is commonly believed that when, in wage bargaining, the union must take into account the link between the cost of unemployment and its wage decisions, it is less eager to increase wages. The advantages of the Ghent system are discussed in Boeri, Brugiavini, Calmfors (2001); part II, chapter 5.

The effects of different ways of financing unemployment benefits in the Ghent countries are examined in several papers by Holmlund and Lundborg. The papers most closely related to our work are Holmlund and Lundborg (1988, 1989). In both, the authors assume that unemployment benefits are financed through government subsidy, union members' insurance premiums, and UI taxes levied on firms in the industry. Holmlund and Lundborg consider two alternative UI taxes on firms: a payroll tax and a tax on profits. They examine how changes in government subsidy rules or in UI taxes affect wages and, especially, employment. In both papers the union has a monopoly position in the labour market where it can unilaterally determine wages. The firms decide on employment. The main differences between the papers are that in Holmlund and Lundborg (1989) it is assumed that the replacement ratio is fixed and the union members are risk-neutral, whereas in Holmlund and Lundborg (1988) the unemployment benefit level is fixed and the union members are risk-averse. In the former case, the objective of the union is to maximize its members' net income,

¹More about the Ghent system in Boeri, Brugiavini, Calmfors (2001)

and in the latter case, the union maximizes the total utility of its risk-averse members.

Holmlund and Lundborg show that in the case of risk-neutral union members a rise in the union share of the unemployment expenses has a wage moderating effect. A larger share rises the union's marginal cost of a wage increase because a higher wage lead to lower employment and higher UI taxes. They also show that a rise in the UI tax on the firms payroll decreases the union's wage demand and thereby also the unemployment benefit which increases equilibrium employment. In the case of a risk-averse union members they consider changes in both the union's share of the unemployment expenses and in the benefits but do not get unambiguous results. They show that then the union decreases its wage demand when the government raises the UI tax on employers, but only a rise in the profit tax has employment effects. In the case of a UI tax on payroll, a fall in wages neutralizes the effect a rise in the UI tax has on labour cost and thereby on employment.

The basic set-up in this study is very close to Holmlund and Lundborg's, the main difference being that they assume that the union has a monopoly position in the labour market where the union can unilaterally decide on wages, whereas we assume wage bargaining takes place between the union and the firm. The possibility that the government imposes a UI tax on wages is also included. We can extend some of the results of Holmlund and Lundborg to the situation where the union and the firm bargain over the wage rate, and derive several new results. For example, if the wage elasticity of the labour demand is not very low then a rise in the union's share of the unemployment expenses has a wage-moderating effect. A rise in the benefit level also increases the bargained wage and hence decreases employment.

We also show that union participation in the financing of unemployment changes the effects a proportional income or payroll tax has on wage formation. Labour taxation literature² shows that a higher income tax increases the before-tax wage and thereby raises the total labour cost and decreases employment. the effect of the payroll tax rate depends on the properties of the production function. A higher

²See Koskela, Schöb (1999a, 1999b, 2002) or Koskela (2002).

payroll tax affects the wage formation only if it changes the wage elasticity of labour demand. If the wage elasticity is constant, changes in the payroll tax have no effect on the before-tax wage. These results do not hold when the taxes appear in the union's budget constraint. A higher UI tax on income then has no effect on the before- or after-tax wage because the union can neutralize the influence of a tax change by altering its insurance premium. On the other hand, a higher payroll tax decreases the wage but has no effect on the labour cost and thereby on employment whereas an increase in the profit tax raises employment.

This chapter is organized as follows: Section 2 introduces the model, Section 3 examines how changes in the government subsidy and benefits affect the wage-bargaining outcome and employment, Section 4 considers the effects of UI taxes, and Section 5 concludes.

2 The model

The model we use is a modification of the standard right-to-manage model introduced in Nickell and Andrews (1983). A right-to-manage model is frequently used to represent the wage formation process in a unionized labour market. The basic model applies to labour markets concerning one union and one firm. The union and the firm bargain over the wage level and after the bargaining process the firm can choose how many workers it employs at the agreed wage. The employed union members are paid the agreed wage w and the unemployed members receive a fixed unemployment benefit b . In the basic model both the level and the financing of the unemployment benefits are exogenous.

We adopt the wage and employment formation process of the right-to-manage model but assume that the union pays some of the unemployment benefits of its unemployed members and therefore runs a UI fund. The fund is subsidized by the government which pays a fixed proportion of unemployment expenses, financing this from general tax revenue. The government can also decide to pay a lump-sum grant

to the union's UI fund which it also finances by taxation. We consider wage formation in one sector of the economy, between a single union and a single firm, and we assume that changes in the government's unemployment expenses do not affect the general tax rate. We can then, without loss of generality, assume that income tax is zero.

We also examine the effects of various sector-specific UI taxes. First we assume that the government imposes a UI tax both on wages and on the firm's payroll. Later we also consider the case where the government imposes a tax on the firm's profits instead of applying a UI payroll tax.

We assume that during the period examined the firm can only change one input, labour L , and keeps capital constant. Let $f(L)$ denote the firm's production function which satisfies the usual assumptions that $f_L > 0$ and $f_{LL} < 0$. The wage, w , is not the only cost of labour as firm also pays a UI tax τ^f . The firm's profits are given by

$$\pi(w, L) = Af(L) - w(1 + \tau^f)L, \quad (1)$$

where A is a technology parameter.

The government also imposes a UI tax on employees, which we denote by τ^e . In addition, the employed union members pay an insurance premium z which the union invests in the UI fund. These modifications make the utilitarian utility function of the union

$$U(w, z, L) = Lu(w(1 - \tau^e) - z) + (M - L)u(b), \quad (2)$$

where $u(\cdot)$ is an increasing and concave utility function and M is the number of union members.

Only employed members pay an insurance premium in our model, whereas Holmlund and Lundborg assume that all members do so. Both assumptions can be justified by examples from the real world. In Finland, union members usually are also members of the union's UI fund and pay both a membership fee and an insurance premium. Unions charge unemployed members an equal or lower membership fee and/or premium than employed members and in some unions unemployed members are exempt from the fee or premium. When all union members pay a premium and have the

same utility function, an optimal insurance policy implies that the net incomes of the employed and unemployed are equal. If the employed and unemployed have different utility functions, we have to assume that with income x the slope of the function of the unemployed is smaller than that of the employed. It is difficult to justify both implications – the first because unemployment usually leads to a decrease in net income and the second because it implies that ex ante similar union members are different ex post; the same income gives higher utility when employed than when unemployed. We therefore assume that all union members have the same utility function and only employed members pay an insurance premium.

The unemployment insurance financial system is organized through UI funds run by the unions. In order to analyse the impact that changes in the financial parameters have on the gross wage and thereby on employment, we have to formulate the union's budget constraint. When the firm employs L workers, the outflow from the fund is $(M - L)b$. The inflow consists of UI taxes $(\tau^f + \tau^e)wL$, insurance premiums of employed members zL , and the government's contribution $\alpha'(M - L)b + g_0$. The government pays a fixed proportion α' of the unemployment expenses but may also pay a lump-sum grant g_0 to the union's UI fund. We consider the problem from the union's point of view and therefore we do not determine the government's budget constraint. The government finances its share of the expenses from its tax revenue and we assume that changes in the unemployment cost do not affect the general tax level.

The union's budget constraint becomes

$$(M - L)b = (\tau^f + \tau^e)wL + zL + \alpha'(M - L)b + g_0. \quad (3)$$

When we denote $1 - \alpha'$ by α , equation (3) becomes

$$\alpha(M - L)b = (\tau^f + \tau^e)wL + zL + g_0. \quad (4)$$

When $g_0 = 0$, the parameter α denotes the proportion of the unemployment benefits paid by the employer and employees. We can then interpret α as a degree of experience

rating, the share of unemployment expenses not funded by the government. If we solve the constraint (4) for z it becomes

$$z = z(w, L) = \frac{\alpha Mb - g_0}{L} - \alpha b - (\tau^f + \tau^e)w. \quad (5)$$

The order of the decisions in the model is: the union and firm first bargain over the gross wage given the insurance premium (5) and labour demand, and after the firm decides on employment. We solve the model by backwards induction, starting from the firm's problem. The firm decides on employment by maximizing (1) with respect to L and given the agreed wage w and unemployment insurance tax τ^f . From the first-order condition $f_L(L) - w(1 + \tau^f) = 0$ we can solve the "short-run" labour demand function $L^d = L(\bar{w})$ where labour cost $\bar{w} = w(1 + \tau^f)$. This function satisfies $\frac{dL^d}{d\bar{w}} = \frac{1}{f_{LL}} < 0$. We assume that the firm has a Cobb-Douglas production function

$$f(L) = \frac{L^\xi}{\xi}, \quad (6)$$

where $0 < \xi < 1$. Labour demand function then becomes

$$L^d(\bar{w}) = \left(\frac{A}{\bar{w}}\right)^\eta, \quad (7)$$

where $\eta = \frac{1}{1-\xi}$ denotes the wage elasticity of labour demand. In the case of the Cobb-Douglas production function η is constant and larger than one.

In the right-to-manage model it is assumed that the union and the firm choose the wage level by generalized Nash bargaining. The Nash product

$$\Omega = (U - U^0)^\beta (\pi - \pi^0)^{1-\beta}, \quad (8)$$

where U^0 and π^0 are the utility of the union and the profits of the firm if no agreement is reached. The parameter β can be interpreted to measure the bargaining power of the union. When $\beta = 1$, the union can set the wage unilaterally, a situation analysed in Holmlund and Lundborg (1988). We make the conventional assumptions that $U^0 = Mu(b)$ and $\pi^0 = 0$. After the transformation $V = U - U^0$ the generalized Nash

product can be written

$$\begin{aligned}\Omega &= V^\beta \pi^{1-\beta} \\ &= [L(u(\hat{w}) - u(b))]^\beta [f(L) - \bar{w}L]^{1-\beta},\end{aligned}\tag{9}$$

where $\hat{w} = w(1 - \tau^e) - z$ denotes the net wage of the employed.

When we substitute the labour demand function (7) for L in the union's budget constraint (5) and in the Nash product (9) we can write the Nash bargaining problem as

$$\max_{w,z} \Omega\tag{10}$$

subject to

$$z = z(w).\tag{11}$$

The first-order condition the optimal wage level must satisfy is

$$\Omega_w = \beta \frac{V_w}{V} + (1 - \beta) \frac{\pi_w}{\pi} = 0,\tag{12}$$

where

$$V_w = L_{\bar{w}}^d (1 + \tau^f) (u(\hat{w}) - u(b)) + L^d u'(\hat{w}) \hat{w}_w.\tag{13}$$

If $\beta = 1$ the union has all the bargaining power and the condition (12) becomes $V_w = 0$. When $\beta < 1$ the term V_w must be positive because π_w in (12) is negative. We only consider solutions where $\hat{w} \geq b$,³ which implies that the first term in (13) is negative. Hence the last term in (13) must be positive in order for V_w to be positive. The last term is positive if $\hat{w}_w > 0$. The term \hat{w}_w measures a change in the net wage caused by a change in the gross wage. The derivative is positive when a rise in the gross wage also increases the net wage.

The first-order condition (12) can be written in the form

$$\beta (\eta(u(\hat{w}) - u(b)) - u'(\hat{w}) \hat{w}_w w) + (1 - \beta) (\eta - 1) (u(\hat{w}) - u(b)) = 0\tag{14}$$

³There is no solution where $\hat{w} \geq b$ with all values of α . When the union share of unemployment expenses α increases, the term \hat{w}_w decreases. The higher the union share, the smaller is the effect of a gross wage increase on the net wage. If \hat{w}_w becomes negative, then \hat{w} must be smaller than b in order for the condition $V_w > 0$ to hold.

which implies that

$$\frac{u(b)}{u(\widehat{w})} = 1 - \frac{\beta}{\beta + \eta - 1} \frac{u'(\widehat{w})\widehat{w}}{u(\widehat{w})} \frac{\widehat{w}_w w}{\widehat{w}}. \quad (15)$$

The term $\frac{u'(\widehat{w})\widehat{w}}{u(\widehat{w})}$ measures the effect a change in the net wage has on the utility of an employed union member and the term $\frac{\widehat{w}_w w}{\widehat{w}}$ the effect a change in the gross wage has on the net wage. To simplify the notation we make the following definitions:

Definition 1 Let $\sigma(w)$ be the net wage elasticity of the union members' utility, that is $\sigma(w) = \frac{u'(\widehat{w})\widehat{w}}{u(\widehat{w})}$.

Definition 2 Let $\gamma(w)$ be the gross wage elasticity of the net wage, that is $\gamma(w) = \frac{\widehat{w}_w w}{\widehat{w}}$.

We can now write equation (15) in the form

$$\frac{u(b)}{u(\widehat{w})} = 1 - \frac{\beta\sigma(w)\gamma(w)}{\beta + \eta - 1} = \frac{\beta(1 - \sigma(w)\gamma(w)) + \eta - 1}{\beta + \eta - 1}. \quad (16)$$

Note that if we assume that the financing of the unemployment benefits is exogenous to the union equation (16) becomes

$$\frac{u(b)}{u(\widehat{w})} = 1 - \frac{\beta\sigma(w)}{\beta + \eta - 1} = \frac{\beta(1 - \sigma(w)) + \eta - 1}{\beta + \eta - 1}. \quad (17)$$

3 Effects of the unemployment benefit and government subsidy

Union budget constraint considerably complicates an otherwise simple model and therefore we cannot get closed-form solutions. We can, however, derive some comparative statics results. Next we consider how changes in the unemployment benefit and government subsidy affect the wage-bargaining outcome and employment. First we list the following definitions:

Definition 3 Let e be the employment rate, that is, $e = \frac{L}{M}$ and u the unemployment rate, that is, $u = 1 - e = \frac{M-L}{M}$.

Definition 4 Let κ be the ratio between the utility when unemployed and the utility when employed, that is, $\kappa = \frac{u(b)}{u(\hat{w})}$.

Definition 5 Let ρ be the relative risk aversion of the union members, that is, $\rho = -\frac{u''(\hat{w})\hat{w}}{u'(\hat{w})}$.

The size of the term κ depends on the union members' utility function, but the condition $\hat{w} \geq b$ implies that $\kappa \leq 1$. To clarify the model further, we construct the following numerical example:

Example 6 Let us assume that the union members have a CRRA utility function

$$u(x) = \frac{x^{1-\rho}}{1-\rho}, \quad (18)$$

where $\rho > 0$ and $\rho \neq 1$. The relative risk aversion then equals ρ and the elasticity of the union members' utility with respect to the net wage $\sigma = 1 - \rho$.

The model now has ten parameters, five of which are controlled by the government, that is, parameters α , b , τ^e , τ^f , and g_0 . As a benchmark we assume that the government finances 60 per cent of the unemployment expenses from its general tax revenue, which implies that $\alpha = 0.4$. The unemployed receive a benefit $b = 1$. Both employees and employers pay a one per cent UI tax, that is $\tau^e = \tau^f = 0.01$. To begin with we assume that the government does not pay a lump-sum grant to the UI fund when $g_0 = 0$.

The remaining parameters, that is, β , ρ , m , η , and A are beyond the government's control. In our example the bargaining power of the union $\beta = 0.5$, the relative risk aversion of the union members $\rho = 0.9$, the number of union members $M = 1$, and the wage elasticity of the labour demand $\eta = 1.1$. When we set the value of the technology parameter at $A = 1.75$, the agreed wage $w = 1.99$, the insurance premium $z = 0.025$, and the net wage $\hat{w} = 1.94$. The unemployment rate in our example is 13.9 per cent when employment is 86.1 per cent. The gross replacement ratio $\frac{b}{w} = 0.50$ and the net replacement ratio $\frac{b}{\hat{w}} = 0.52$. Finally, the elasticity of the gross wage with respect to the net wage $\gamma = 0.77$, the ratio of the utility when unemployed to the utility when

employed $\kappa = 0.94$, and the elasticity of the union members' utility with respect to the net wage $\sigma = 1 - \rho = 0.1$.

We first assume that the government considers reducing its subsidy to the union's UI fund, that is, the government considers raising α , the union's share of the unemployment cost. It is commonly believed that in the conventional trade union models an increase in the union's share of the cost of unemployment leads to wage moderation. The intuition is that when the union finances some of this cost, it must take the effects of its wage decisions into account. A wage hike may imply an increase in unemployment costs and in the employee insurance premium.

The two factors that play a crucial role in wage formation are the risk aversion of the union members and the wage elasticity of the labour demand. A wage hike has a smaller effect on union members' utility the more risk-averse the members are and the larger effect on employment the more elastic the labour demand is.

We first examine the monopoly union case when $\beta = 1$. An increase in α makes the union moderate its wage demand if the wage elasticity of labour demand is not too low. To be more specific, when the condition

$$\eta > \rho\gamma\frac{u}{e} \tag{19}$$

holds, the equilibrium wage decreases when α increases. The elasticity of the net wage with respect to the gross wage γ and, in realistic cases, the term $\frac{u}{e}$ as well, is less than one. The product $\rho\gamma\frac{u}{e}$ is then a small number that increases when ρ increases. When the condition does not hold the possible situation is characterized by very low wage elasticity of labour demand and/or very risk-averse union members. In the case of the Cobb-Douglas production function, (19) always holds when $\rho < 1$. Proposition 7 says that a rise in α leads to wage moderation if the wage elasticity of labour demand is not too low. If this wage elasticity is very low, a change in the wage level has only a slight effect on employment. The union then can be less concerned about the effects of its wage decisions on the cost of unemployment. The value of η required for wage

moderation increases when the relative risk aversion of the union members increases. When $\beta = 1$ we can show the following:

Proposition 7 *If $\beta = 1$ and if the wage elasticity of the labour demand $\eta > \rho\gamma\frac{u}{e}$, then the equilibrium wage, w^* , decreases when the union's share of the cost of unemployment, α , increases. A fall in the wage rate increases equilibrium employment L^* .*

Proof. See Appendix A. ■

When $0 < \beta < 1$ the situation is more complicated. The wage moderation condition (19) then becomes

$$\eta > \frac{u}{e-u} \left(\rho\gamma - \frac{\sigma}{1-\kappa} \right). \quad (20)$$

This condition is difficult to interpret. With very low values for relative risk aversion the right side of the inequality (20) can become negative, in which case (20) always holds.

Example 8 *With the parameter values which applied in Example 4 the condition (19) is $\eta > 0.11$ and the condition (20) is $\eta > -0.10$.*

Next we assume that the government wants to raise the level of the unemployment benefit b . In the standard labour union models, where the financing of unemployment expenses is exogenous, a rise in the benefit level leads to a higher wage and lower employment. Holmlund and Lundborg do not get a general result in the case of a monopoly union, but they do show that when the experience rating is complete ($\alpha = 1$) higher benefits have no wage effects. In our model higher benefits imply higher insurance premium which places upwards pressure on the wage level. The result holds both in the case of a monopoly union and wage bargaining; this result not depending on the size of the parameter α . The reason why higher benefits have wage effects in our model, even when the experience rating is complete, is that we assumed only employed members pay an insurance premium whereas in Holmlund and Lundborg's model unemployed members also pay a premium.

Proposition 9 *A rise in the benefit level b leads to an increase in the agreed wage w^* and a decrease in equilibrium employment L^* .*

Proof. See Appendix B. ■

Example 10 *When the benefit level increases 5 per cent, from 1 to 1.05, in Example 4 the gross wage rises from 1.99 to 2.12. The net wage also rises, but less, from 1.94 to 2.03. An increase in the wage level keeps both the gross and net replacement ratios almost unchanged. Employment falls from 86.1 to 80.3 per cent.*

Next we assume that the government considers increasing its lump-sum grant g_0 . Holmlund and Lundborg (1988) show that a monopoly union responds to a rise in g_0 by lowering the wage which then allows for a rise in employment. A lump-sum grant decreases a union's insurance premium, which reduces union wage pressure and makes a fall in the wage level possible. We show that this result also holds when the union and the firm bargain over wages.

Proposition 11 *A rise in the lump-sum grant g_0 leads to a decrease in the agreed wage w^* and an increase in equilibrium employment L^* .*

Proof. See Appendix C. ■

Example 12 *In Example 4 we assumed that the lump-sum grant is zero. Let us suppose that the government contributes a grant $g_0 = 0.03$ to the union's UI fund. With $g_0 = 0.03$, the union is able to finance 3 per cent unemployment. The government's grant decreases the gross wage from 1.99 to 1.97 but has only a negligible effect on the net wage. The effect of the grant on employment is also very small; employment rises from 86.1 to 86.7 per cent.*

The model has an interesting parameter that the government cannot control: the size of the union membership M . In the standard monopoly union model a change in the number of union members does not affect the union wage demand. This is a

natural outcome when the financing at the unemployment benefits is exogenous to the union. When the benefits are partly financed by the union, the membership starts to matter. More members may mean more unemployment within the union and thus higher unemployment costs. We can show that the agreed wage increases when the union membership rises.

Proposition 13 *A rise in the union membership M leads to an increase in the agreed wage w^* and a decrease in employment L^* .*

Proof. See Appendix D. ■

Example 14 *A 5 per cent increase in the union membership in Example 4 raises the gross wage from 1.99 to 2.01 and more than doubles the insurance premium from 0.025 to 0.055. The change has only a marginal effect on employment, lowering it from 86.1 to 84.8 per cent.*

4 Effects of UI taxes

Next we study how different UI taxes affect wages and employment. First, we assume that the government imposes a proportional tax on wages or on the firm's payroll and invests all tax revenues in the union's UI fund. Let us first suppose that the government considers raising the UI tax on employees τ^e . Labour taxation literature⁴ demonstrates that if we add proportional income taxation to the standard right-to-manage model we get a result showing that a higher income tax increases the gross wage. A rise in the income tax rate decreases the difference between the after-tax wage income and the unemployment income which places upwards pressure on the before-tax wage level. It turns out that when the tax appears in the union's budget constraint, a change in the UI tax on employees has no effect on wage formation. A change in τ^e affects neither the gross nor the net wage because the union can neutralize a tax change by changing its insurance premium. The government invests

⁴See Koskela, Schöb (1999a, 1999b, 2002) or Koskela (2002).

all UI tax revenues in the union's UI fund. When the government decides to increase its investment by raising the employee tax, the union reduces its own investment by decreasing the insurance premium. The union compensates for the fall in net wages caused by a tax change with an equal decrease in the insurance premium z . When the gross wage does not change, neither does employment.

Proposition 15 *A rise in the UI tax τ^e on employees has no effect on the agreed wage w^* or equilibrium employment L^* .*

Proof. See Appendix E. ■

Let us next suppose that the government considers raising the payroll tax τ^f . When the union does not have a budget constraint the proportional payroll tax affects wage formation only through the wage elasticity of labour demand. If a change in the payroll tax does not affect the wage elasticity, which is the case when the production function is of Cobb-Douglas type, it has no effect on wage formation (see, for example, Koskela 2002). This result does not hold when the union has a budget constraint. Then, the payroll tax affects wage formation not only through the wage elasticity but also through the gross wage elasticity of the net wage γ . A change in the payroll tax will also affect wage formation when the wage elasticity of the labour demand is constant.

A rise in the payroll tax increases the labour cost $w(1 + \tau^f)$. The effect a tax change has on employment now depends on how it affects the gross wage. If a tax change decreases the gross wage, its effect on the labour cost falls. A rise in the payroll tax decreases the union's insurance premium which decreases the gross wage, but in order to affect employment a payroll tax rise should decrease the gross wage more than the full amount of the tax change. Holmlund and Lundborg (1988) show that in the case of a monopoly union, a fall in the tax rate decreases the union wage demand by exactly the full amount of the tax. A rise in the tax rate then leaves the firm's cost of labour unchanged and thus does not affect employment. The same

result holds in our model. We can show that a rise in the tax rate τ^f decreases wages by exactly the full amount of the tax when the union and the firm bargain over wages.

Proposition 16 *A rise in the employers' UI tax τ^f leads to a decrease in the wage w^* such that $\frac{\partial \ln w}{\partial \ln(1+\tau^f)} = -1$.*

Proof. See Appendix F. ■

Next we assume that instead of imposing UI taxes on employees and employers the government levies a proportional tax τ on the profits of the firm. The firm's total investment in the fund is then $\tau\pi$, where π denotes its profits. A tax on profits does not affect labour demand. A rise in τ decreases the union's insurance premium, which gives rise to wage moderation. On the other hand, when the union makes its wage decisions it must now consider their effect on the firm's profits. When wages rise, profits fall and the firm's investment in the union UI fund decreases. Holmlund and Lundborg show that when the government increases the profit tax, a monopoly union reduces its wage demand. We show that the result also holds when the union and the firm bargain over wages.

Proposition 17 *A rise in the profit tax τ leads to a decrease in wage w^* and an increase in equilibrium employment L^* .*

Proof. See Appendix G. ■

5 Conclusions

We have examined wage setting in a unionized economy in the case where the unions finance part of the unemployment expenses of their unemployed members. We assume that to enable this financing the unions run unemployment insurance funds, having income which includes the insurance premiums of the employed union members. Our model is based on a right-to-manage model in which a union and firm first bargain over wages and, following the bargaining process, the firm can choose how many

workers it employs. We modify the standard model by imposing a budget constraint on the union. Some results from the standard models still hold when the union pays part of the cost of unemployment. For example, an increase in unemployment benefits also raises wages in our modified model. On the other hand, standard models predict that a change in the number of union members does not affect the wage-bargaining outcome. In our model, a rise in the membership decreases wages.

Our main interest has been the effects that various financial methods of unemployment benefits have on the wage-bargaining outcome. In particular, we have attempted to determine how changes in the government subsidy rules, benefits and UI taxes affect employment. We saw that a change in either employee or employer UI tax has no effect on employment. If the government imposes a tax on profits instead, the higher profit tax decreases the agreed wage. We also show that if the wage elasticity of the labour demand is not very low, then an increase in the experience rating – the unemployment expenses not financed by the government – moderates wages. An increase in the government's lump-sum grant to the union UI fund also decreases wages and thereby increases employment.

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A Proof of Proposition 7

In Chapter 2 we examine the following maximization problem:

$$\max_{w,z} \Omega \quad (21)$$

s.t.

$$z = \frac{\alpha Mb - g_0}{L} - \alpha b - (\tau^f + \tau^e)w \quad (22)$$

$$L = L^d(\bar{w}), \quad (23)$$

where

$$\Omega = V^\beta \pi^{1-\beta} = [L(u(w(1 - \tau^e) - z) - u(b))]^\beta [f(L) - w(1 + \tau^f)L]^{1-\beta}. \quad (24)$$

We want to know how optimal wage and employment react to changes in the parameters of the model. The parameters of the model are α , β , τ^e, τ^f , b , g_0 , and M . All proofs are based on Topkis' theory of monotone comparative statics (see Topkis 1978, 1998). First we substitute (23) for L in (22) and in (21) and then we substitute (22) for z in the objective function Ω . Function Ω is continuous and differentiable and a function of only one decision variable, w , which implies that Ω is supermodular with all parameter values. Let us denote a parameter by x . Then to prove that optimal wage increases when x increases, for example, we need to show that Ω has increasing differences in (w, x) . A differentiable function Ω has increasing differences in (w, x) if the cross partial Ω_{wx} is positive. If $\Omega_{wx} > 0$ we can, by Topkis' theorem, conclude that w^* increases when x increases.

We must now show that Ω has decreasing differences in (w, α) which, in the case of a differentiable function Ω , means we must show that $\Omega_{w\alpha} < 0$.

$$\begin{aligned} \Omega_{w\alpha} &= \beta(\beta - 1)V^{\beta-2}V_wV_\alpha\pi^{1-\beta} + \beta V^{\beta-1}V_{w\alpha}\pi^{1-\beta} \\ &\quad + \beta(1 - \beta)V^{\beta-1}V_\alpha\pi^{-\beta}\pi_w \end{aligned} \quad (25)$$

$$= \beta V^{\beta-1}\pi^{1-\beta} \left[(\beta - 1)\frac{V_wV_\alpha}{V} + V_{w\alpha} + (1 - \beta)\frac{V_\alpha\pi_w}{\pi} \right] \quad (26)$$

The first term in (26) is positive. Using the first-order condition the expression in the square brackets becomes $V_{w\alpha} - \frac{V_w V_\alpha}{V}$. We also know that when the bargaining power of the union is less than one, $V_w > 0$ and we can solve

$$V_\alpha = -L^d u'(\hat{w}) z_\alpha = -u'(\hat{w})(M - L^d)b < 0. \quad (27)$$

But without additional assumptions

$$V_{w\alpha} = -u''(\hat{w})\hat{w}_w(M - L^d)b + u'(\hat{w})L^d(1 + \tau^f)b \leq 0. \quad (28)$$

When the measure of relative risk aversion $-\frac{u''(\hat{w})\hat{w}}{u'(\hat{w})} = \rho$, the labour cost elasticity of the labour demand $-\frac{L^d \bar{w}}{L^d} = \eta$, the elasticity of the net wage with respect to the gross wage by $\frac{(\hat{w})_w w}{\hat{w}} = \gamma$, the employment rate $\frac{L}{M} = e$, and the unemployment rate $u = 1 - e$ we can write (28) in the form

$$V_{w\alpha} = -\frac{u'(\hat{w})L^d b}{w} \left[\frac{u''(\hat{w})\hat{w}}{u'(\hat{w})} \frac{(\hat{w})_w w}{\hat{w}} \frac{(1 - \frac{L^d}{M})}{\frac{L^d}{M}} - \frac{L^d \bar{w}}{L^d} \right] \quad (29)$$

$$= -\frac{u'(\hat{w})L^d b}{w} \left[-\rho\gamma \frac{u}{e} + \eta \right]. \quad (30)$$

If

$$\eta > \rho\gamma \frac{u}{e} \quad (31)$$

$V_{w\alpha} < 0$. From (26) we see that if $\beta = 1$ the condition $V_{w\alpha} < 0$ is sufficient for wage moderation. Therefore, if $\beta = 1$ and $\eta > \rho\gamma \frac{u}{e}$ then the optimal wage demand of the union, w^* , decreases when the union's share of the unemployment expenses, α , increases.

Let us next suppose that $0 < \beta < 1$. To show that $\Omega_{w\alpha} < 0$ we must show that

$$V_{w\alpha} - \frac{V_w V_\alpha}{V} < 0. \quad (32)$$

We can write inequality (32) in the form

$$\begin{aligned} & -\frac{u'(\hat{w})L^d b}{w} \left[\frac{u''(\hat{w})\hat{w}}{u'(\hat{w})} \frac{(\hat{w})_w w}{\hat{w}} \frac{(M - L^d)}{L^d} - \frac{L^d \bar{w}}{L^d} \right] \\ & - \frac{u'(\hat{w})L^d b}{w} \left[\frac{L^d \bar{w}}{L^d} \frac{(M - L^d)}{L^d} + \frac{wu'(\hat{w})\hat{w}_w}{u(\hat{w}) - u(b)} \frac{(M - L^d)}{L^d} \right] < 0. \end{aligned} \quad (33)$$

Let $\kappa = \frac{u(b)}{u(\widehat{w})}$ and $\sigma = \frac{u'(\widehat{w})\widehat{w}}{u(\widehat{w})}$. Then we can write $\frac{wu'(\widehat{w})\widehat{w}_w}{u(\widehat{w})-u(b)} = \frac{\frac{u'(\widehat{w})\widehat{w}}{u(\widehat{w})} \frac{\widehat{w}_w w}{\widehat{w}}}{1 - \frac{u(b)}{u(\widehat{w})}} = \frac{\sigma\gamma}{1-\kappa}$ and we can write the condition

$$-\frac{u'(\widehat{w})L^d b}{w} \left[-\rho\gamma \frac{u}{e} + \eta - \eta \frac{u}{e} + \frac{\sigma\gamma}{1-\kappa} \frac{u}{e} \right] < 0. \quad (34)$$

Inequality (34) holds when $\eta > \rho\gamma \frac{u}{e-u} - \frac{\sigma\gamma}{1-\kappa} \frac{u}{e-u}$. Hence if $0 < \beta < 1$ then $\Omega_{w\alpha} < 0$ if $\eta > \rho\gamma \frac{u}{e-u} - \frac{\sigma\gamma}{1-\kappa} \frac{u}{e-u}$. We can then conclude, by Topkis' theorem, that a rise in the union's share of the unemployment expenses leads to a decrease in wages which in turn increases employment.

B Proof of Proposition 9

We must now show that Ω has increasing differences in (w, b) which, in the case of a differentiable function Ω , means we must show that $\Omega_{wb} > 0$. Now

$$\begin{aligned} \Omega_{wb} &= \beta(\beta-1)V^{\beta-2}V_w V_b \pi^{1-\beta} + \beta V^{\beta-1}V_{wb} \pi^{1-\beta} \\ &\quad + \beta(1-\beta)V^{\beta-1}V_b \pi^{-\beta} \pi_w \end{aligned} \quad (35)$$

$$= \beta V^{\beta-1} \pi^{1-\beta} \left[(\beta-1) \frac{V_w V_b}{V} + V_{wb} + (1-\beta) \frac{V_b \pi_w}{\pi} \right]. \quad (36)$$

The first term in (36) is positive. Using the first-order condition the expression in the square brackets becomes $V_{wb} - \frac{V_w V_b}{V}$. To show that $\Omega_{w\alpha} < 0$ we must show that $V_{wb} - \frac{V_w V_b}{V} > 0$. We know that when the bargaining power of the union is less than one, $V_w > 0$. We can solve

$$V_b = -L^d(u'(\widehat{w})z_b + u'(b)) \quad (37)$$

$$= -\alpha(M - L^d)u'(\widehat{w}) - L^d u'(b) < 0 \quad (38)$$

and

$$V_{wb} = -L^d \frac{d}{dw} (1 + \tau^f)(u'(b) - \alpha u'(\widehat{w})) - \alpha(M - L^d)u''(\widehat{w})\widehat{w}_w > 0. \quad (39)$$

Hence $V_{wb} - \frac{V_w V_b}{V} > 0$ and we can conclude, by Topkis' theorem, that a rise in unemployment benefit leads to an increase in wages which reduces employment.

C Proof of Proposition 11

We must now show that Ω has decreasing differences in (w, g_0) which, in the case of a differentiable function Ω , means we must show that $\Omega_{wg_0} < 0$. We get

$$\Omega_{wg_0} = \beta V^{\beta-1} \pi^{1-\beta} \left[(\beta - 1) \frac{V_w V_{g_0}}{V} + (1 - \beta) \frac{V_{g_0} \pi_w}{\pi} + V_{g_0 w} \right]. \quad (40)$$

The first term in (40) is positive. Using the first-order condition the expression in the square brackets becomes $V_{wg_0} - \frac{V_w V_{g_0}}{V}$. To show that $\Omega_{wg_0} < 0$ we must show that $V_{wg_0} - \frac{V_w V_{g_0}}{V} < 0$. When the bargaining power of the union is less than one, $V_w > 0$. We can solve

$$V_{g_0} = -L^d u'(\hat{w}) z_{g_0} = u'(\hat{w}) > 0 \quad (41)$$

and

$$V_{wg_0} = u''(\hat{w}) \hat{w}_w < 0. \quad (42)$$

Hence $V_{wg_0} - \frac{V_w V_{g_0}}{V} < 0$ and we can conclude, by Topkis' theorem, that an increase in the governments's lump-sum grant leads to a decrease in wage level which in turn increases employment.

D Proof of Proposition 13

We must now show that Ω has increasing differences in (w, M) which, in the case of a differentiable function Ω , means we must show that $\Omega_{wM} > 0$. We get

$$\Omega_{wM} = \beta V^{\beta-1} \pi^{1-\beta} \left[(\beta - 1) \frac{V_w V_M}{V} + (1 - \beta) \frac{V_M \pi_w}{\pi} + V_{Mw} \right]. \quad (43)$$

The first term in (43) is positive. Using the first-order condition the expression in the square brackets becomes $V_{wM} - \frac{V_w V_M}{V}$. To show that $\Omega_{wM} > 0$ we must show that $V_{wM} - \frac{V_w V_M}{V} > 0$. When the bargaining power of the union is less than one, $V_w > 0$. We can solve

$$V_M = -L^d u'(\hat{w}) z_M = -u'(\hat{w}) \alpha b < 0 \quad (44)$$

and

$$V_{wM} = -u''(\hat{w}) \hat{w}_w \alpha b > 0. \quad (45)$$

Hence $V_{wM} - \frac{V_w V_M}{V} > 0$ and we can conclude, by Topkis' theorem, that a rise in union membership leads to an increase in wages which in turn reduces employment.

E Proof of Proposition 15

We must show that $\Omega_{w\tau^e} = 0$. We get

$$\Omega_{w\tau^e} = \beta V^{\beta-1} \pi^{1-\beta} \left[(\beta-1) \frac{V_w V_{\tau^e}}{V} + (1-\beta) \frac{V_{\tau^e} \pi_w}{\pi} + V_{\tau^e w} \right]. \quad (46)$$

We can solve

$$V_{\tau^e} = L^d u'(\hat{w})(\hat{w})_{\tau^e} = L^d u'(\hat{w})(-w + w) = 0. \quad (47)$$

Therefore the term in the square brackets is zero which implies that $\Omega_{w\tau^e} = 0$. We can conclude, by Topkis' theorem, that an increase in employees' insurance tax has no effect on wages and employment.

F Proof of Proposition 16

We can assume, without loss of generality, that $g_0 = 0$ and $\tau^e = 0$. When we denote the firm's UI tax by τ the union's maximization problem is as follows:

$$\max_{w,z} V^\beta \pi^{1-\beta} \quad (48)$$

s.t.

$$\alpha(M-L)b = zL + T(\cdot) \quad (49)$$

$$L = L^d(\bar{w}), \quad (50)$$

where $V = L(u(w-z) - u(b))$, $\pi = Af(L) - w(1+\tau)L$ and $T(\cdot) = \tau wL$. The Lagrangian function is

$$\mathcal{L} = V^\beta \pi^{1-\beta} + \lambda [zL^d + T(\cdot) - \alpha(M-L^d)b]. \quad (51)$$

First-order conditions are

$$\mathcal{L}_z = \beta V^{\beta-1} \pi^{1-\beta} V_z + \lambda L^d = 0 \quad (52)$$

$$\mathcal{L}_w = \beta V^{\beta-1} \pi^{1-\beta} V_w + (1-\beta) V^\beta \pi^{-\beta} \pi_w + \lambda \left[(z + \alpha b) L_w^d (1 + \tau) + \frac{\partial T}{\partial w} \right] = 0 \quad (53)$$

$$\mathcal{L}_\lambda = z L^d + T(\cdot) - \alpha (M - L^d) b = 0. \quad (54)$$

Function $T(\cdot) = \tau w L^d$ has the following properties:

$$\frac{\partial T}{\partial w} = \tau L^d + \tau w L_w^d (1 + \tau) = (1 + \tau) [L^d + \tau w L_w^d] - L^d \quad (55)$$

$$\frac{\partial T}{\partial(1 + \tau)} = w L^d + \tau w L_w^d w = w [L^d + \tau w L_w^d] = \frac{w}{1 + \tau} \left(\frac{\partial T}{\partial w} + L^d \right) \quad (56)$$

$$\frac{\partial^2 T}{\partial(1 + \tau) \partial w} = \frac{\partial^2 T}{\partial w \partial(1 + \tau)} = \frac{1}{1 + \tau} \left(\frac{\partial T}{\partial w} + L^d \right) + \frac{w}{1 + \tau} \left[\frac{\partial^2 T}{\partial w^2} + L_w^d (1 + \tau) \right]. \quad (57)$$

We want to know how a change in the UI tax τ affects the wage level, that is, we want to solve $\frac{dw}{d(1+\tau)}$. When we differentiate the first-order conditions (52) - (54) we get the following system:

$$\begin{bmatrix} \mathcal{L}_{zz} & \mathcal{L}_{zw} & N \\ \mathcal{L}_{zw} & \mathcal{L}_{ww} & \mathcal{L}_{\lambda w} \\ L^d & \mathcal{L}_{\lambda w} & 0 \end{bmatrix} \begin{bmatrix} dz \\ dw \\ d\lambda \end{bmatrix} = \begin{bmatrix} -\mathcal{L}_{z\tau} \\ -\mathcal{L}_{w\tau} \\ -\mathcal{L}_{\lambda\tau} \end{bmatrix} d(1 + \tau). \quad (58)$$

Note that in (58) $dx \neq 0$ only when $x = \tau$. We can solve \mathcal{L}_{zz} , \mathcal{L}_{zw} , \mathcal{L}_{ww} and $\mathcal{L}_{\lambda w}$. Next we write $\mathcal{L}_{z\tau}$, $\mathcal{L}_{w\tau}$ and $\mathcal{L}_{\lambda\tau}$ with the help of \mathcal{L}_{zw} , \mathcal{L}_{ww} and $\mathcal{L}_{\lambda w}$. After long and tedious calculations we get

$$\begin{aligned} \mathcal{L}_{z\tau} &= \frac{w}{1 + \tau} [\mathcal{L}_{zw} + \mathcal{L}_{zz}] \\ \mathcal{L}_{w\tau} &= \frac{w}{1 + \tau} [\mathcal{L}_{ww} + \mathcal{L}_{wz}] \\ \mathcal{L}_{\lambda\tau} &= \frac{w}{1 + \tau} [\mathcal{L}_{\lambda w} + L^d]. \end{aligned}$$

We solve $\partial w / \partial(1 + \tau)$ by using Cramer's rule. Let us denote the coefficient matrix of the system (58) by A , its determinant by D , and the ij cofactor of the determinant D by D_{ij} . Now

$$D = -\mathcal{L}_{zw} D_{12} + \mathcal{L}_{ww} D_{22} - \mathcal{L}_{\lambda w} D_{32}. \quad (59)$$

When we substitute vector $\begin{pmatrix} -\mathcal{L}_{z\tau} & -\mathcal{L}_{w\tau} & -\mathcal{L}_{\lambda\tau} \end{pmatrix}$ for the second column of matrix A and denote the determinant of the new matrix by D^2 , we get

$$\begin{aligned}
D^2 &= \left(\frac{w}{1+\tau}\right) [\mathcal{L}_{zw} + \mathcal{L}_{zz}] D_{12} - \left(\frac{w}{1+\tau}\right) [\mathcal{L}_{ww} + \mathcal{L}_{wz}] D_{22} \\
&\quad + \left(\frac{w}{1+\tau}\right) [\mathcal{L}_{\lambda w} + L^d] D_{23} \\
&= -\left(\frac{w}{1+\tau}\right) [-\mathcal{L}_{zw} D_{12} + \mathcal{L}_{ww} D_{22} - \mathcal{L}_{\lambda w} D_{32}] \\
&\quad + \left(\frac{w}{1+\tau}\right) [\mathcal{L}_{zz} D_{12} - \mathcal{L}_{zw} D_{22} + L^d D_{32}].
\end{aligned} \tag{60}$$

Let us denote by D' the determinant of a matrix where we have substituted vector $\begin{pmatrix} -\mathcal{L}_{zz} & -\mathcal{L}_{zw} & -L^d \end{pmatrix}$ for the second column of matrix A . Then $D' = \mathcal{L}_{zz} D_{12} - \mathcal{L}_{zw} D_{22} + L^d D_{32}$. D' must be zero because it is a determinant of a matrix that has two linearly dependent columns. Therefore

$$D^2 = -\left(\frac{w}{1+\tau}\right) D \tag{61}$$

which implies that

$$\frac{\partial w}{\partial(1+\tau)} = \frac{D^2}{D} = -\left(\frac{w}{1+\tau}\right) \frac{D}{D} = -\left(\frac{w}{1+\tau}\right), \tag{62}$$

that is,

$$\frac{\partial \ln w}{\partial \ln(1+\tau)} = -1. \tag{63}$$

G Proof of Proposition 17

We must now show that Ω has decreasing differences in (w, τ) which, in the case of a differentiable function Ω , means we must show that $\Omega_{w\tau} < 0$. We get

$$\Omega_{w\tau} = \beta V^{\beta-1} \pi^{1-\beta} \left[(\beta-1) \frac{V_w V_\tau}{V} + (1-\beta) \frac{V_\tau \pi w}{\pi} + V_{w\tau} \right]. \tag{64}$$

The first term in (40) is positive. Using the first-order condition the expression in the square brackets becomes $V_{w\tau} - \frac{V_w V_\tau}{V}$. To show that $\Omega_{w\tau} < 0$ we must show that

$V_{w\tau} - \frac{V_w V_\tau}{V} < 0$. When the bargaining power of the union is less than one, $V_w > 0$.

We can solve

$$V_\tau = -L^d u'(\hat{w}) z_\tau = u'(\hat{w}) \pi > 0 \quad (65)$$

and

$$V_{w\tau} = u''(\hat{w})(\hat{w})_w \pi + u'(\hat{w}) \pi_w < 0. \quad (66)$$

Hence $V_{w\tau} - \frac{V_w V_\tau}{V} < 0$ which implies that $\Omega_{w\tau} < 0$. We can conclude, by Topkis' theorem, that an increase in the profit tax leads to a decrease in the wage level which in turn increases employment.

Chapter 3

Wage bargaining and employment under different unemployment insurance contribution policies

Abstract

In this chapter, 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.

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.¹ 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 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:

¹The Finnish system is described more closely in Holm, Kiander, Tossavainen (1999).

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 $\theta_g, \theta_b \in [\underline{\theta}, \bar{\theta}]$, $\underline{\theta} < \bar{\theta}$. 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 $\bar{\theta}$ are determined such that if $\theta < \underline{\theta}$ the firm's profit is below zero, and if $\theta > \bar{\theta}$, 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

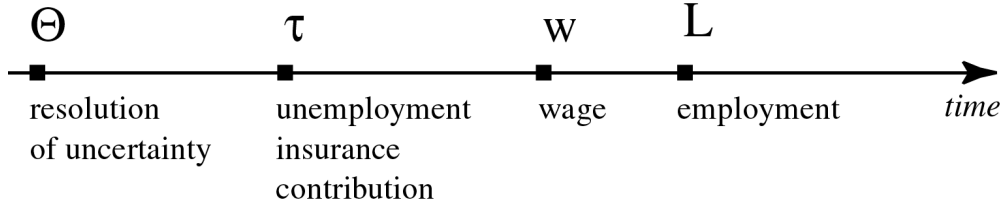


Figure 1: *Time sequence of decisions*

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

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

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:

$$\tau wL = (M - L)b. \quad (4)$$

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

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

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

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

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

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

where $\bar{w} = w(1+\tau)$ 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

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

The union's maximization problem now is

$$\max_w V(w, L) \quad (9)$$

subject to

$$L = L(\bar{w}; \theta). \quad (10)$$

The first-order condition of the maximization problem is

$$-\eta(\bar{w}) [u(w) - u(b)] + u'(w)w = 0 \quad (11)$$

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

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

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:

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

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

$$\eta = \frac{\sigma}{1 - s}, \quad (14)$$

where $s = \frac{\bar{w}L}{\theta f}$ 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

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

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

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

(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:*

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

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,

$$L_\tau < 0 \quad \forall \quad \sigma. \quad (18)$$

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

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

and we can show that

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

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:*

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

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,

$$L_\theta > 0 \quad \forall \quad \sigma. \quad (22)$$

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

$$\tau w(\tau, \theta)L(\tau, \theta) = (M - L(\tau, \theta))b \quad (23)$$

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

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

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

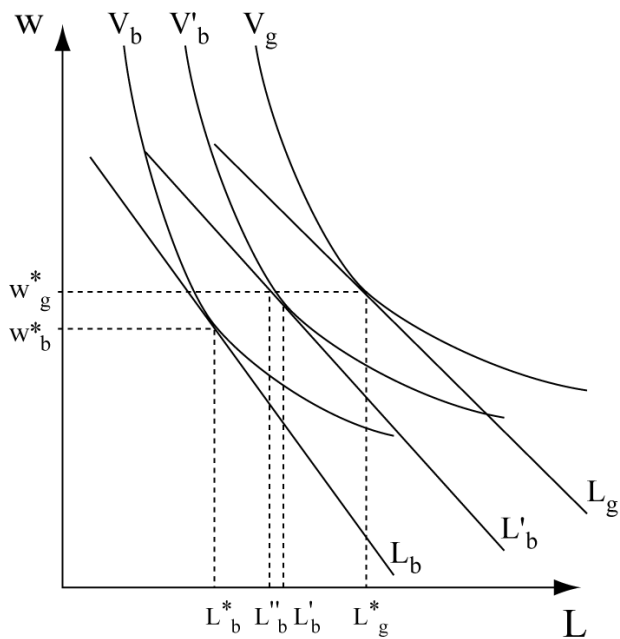


Figure 2: *Labour market equilibrium when $\sigma < 1$*

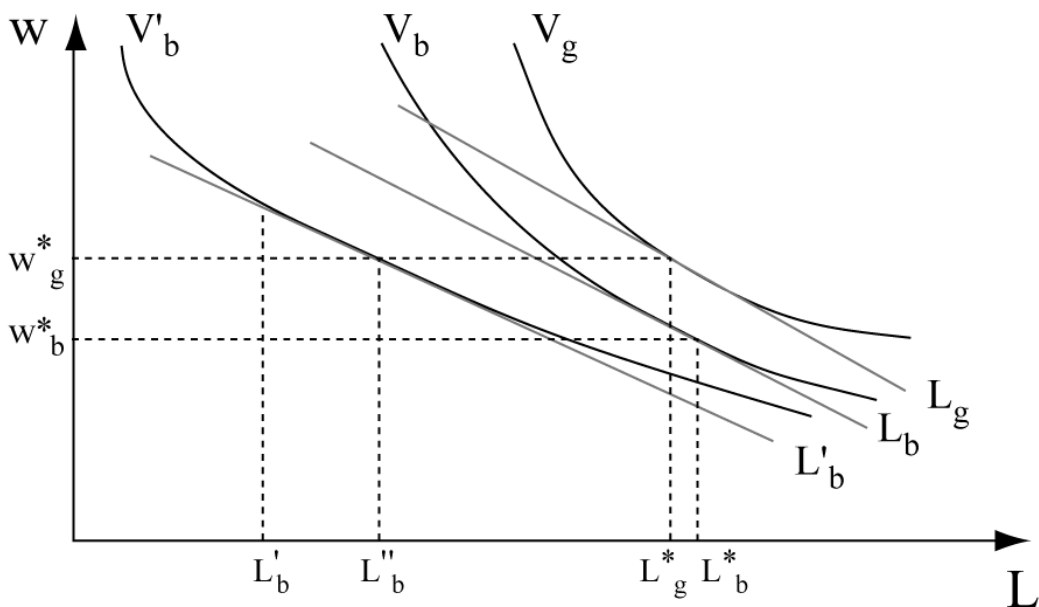


Figure 3: *Labour market equilibrium when $\sigma > 1$*

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 increases, it raises the labour cost elasticity of labour demand and thereby strengthens 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 effect that increases employment. After some critical value of the elasticity of substitution, $\sigma \geq \hat{\sigma}$, 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 $\sigma < \hat{\sigma}$ and decreasing it when $\sigma > \hat{\sigma}$. The size of $\hat{\sigma}$ depends on the other parameters of the model. Therefore

$$\tau_\theta \begin{cases} \leq 0 & \text{when } \sigma < \hat{\sigma} \\ > 0 & \text{when } \sigma > \hat{\sigma}. \end{cases} \quad (25)$$

We summarize the results in the following proposition:

Proposition 4 *If the government adopts the passive policy and the elasticity of substitution is small ($\sigma < \hat{\sigma}$) 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 by the stochasticity of the firm's revenue. When the elasticity of substitution is large ($\sigma > \hat{\sigma}$) 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 $\hat{\sigma} < 1$ and $\hat{\sigma} < \sigma < 1$ 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 Pappageorgiou (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, $\bar{\tau}$, then satisfies the equation

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

which implies

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

We can write equation (27) in the form:

$$\bar{\tau}[\psi w_g L_g + (1 - \psi) w_b L_b] = b[M - (\psi L_g + (1 - \psi)L_b)], \quad (28)$$

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, $\sigma \leq \hat{\sigma}$. The fixed contribution, $\bar{\tau}$, is then set such that $\tau_g < \bar{\tau} < \tau_b$ 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

$$\tau_g < \bar{\tau} < \tau_b \quad (29)$$

implies that

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

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

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

The situation is different when $\sigma > \hat{\sigma}$. When the government follows the passive policy and $\sigma > \hat{\sigma}$ 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

$$\tau_g > \bar{\tau} > \tau_b. \quad (32)$$

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 ($\sigma \leq \hat{\sigma}$), 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 \bar{L} when

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

It is now easy to show that the active policy smooths away variations in the union

wage demands. Equation (33) implies that

$$\frac{\bar{w}_g}{\theta_g} = \frac{\bar{w}_b}{\theta_b}, \quad (34)$$

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 $\eta(\bar{w})$ 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 decisions.

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 state 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.

<i>Table 1: The relationship between different government UI policies and UI contributions, employment, and wages.</i>							
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 $\hat{\sigma}$ 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:

$$EV(\tau, \theta) = \psi [L(\tau_g, \theta_g)u(w(\tau_g, \theta_g)) + (M - L(\tau_g, \theta_g))u(b)] + (1 - \psi) [L(\tau_b, \theta_b)u(w(\tau_b, \theta_b)) + (M - L(\tau_b, \theta_b))u(b)]. \quad (35)$$

We can write equation (35) in the form

$$EV(\tau, \theta) = \psi L_g (u(w_g) - u(b)) + (1 - \psi) L_b (u(w_b) - u(b)) + M u(b). \quad (36)$$

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 ex-

ample increasing wages in a good state increases the utility difference but decreases employment.

<i>Table 2: The relationship between different government UI policies and the union's expected utility</i>				
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

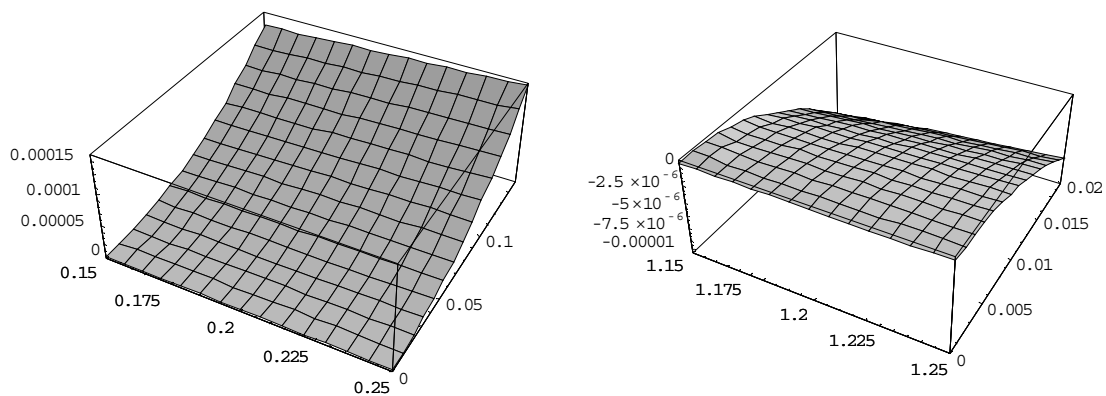


Figure 2: The difference between the union's expected utility in the case of the active and the passive policy.

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:

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

From the firm's profit maximization we get

$$\bar{w} = w(1 + \tau) = \theta f_L. \quad (38)$$

Differentiating the production function, we obtain

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

which implies that

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

Differentiating (40) yields

$$\frac{d\bar{w}L}{dL\bar{w}} = \frac{1}{\sigma} \left(\frac{Ldf}{fdL} - 1 \right) \quad (41)$$

$$= \frac{1}{\sigma} \left(d \left(\frac{f}{L} \right)^{\frac{1}{\sigma}-1} - 1 \right) \quad (42)$$

$$= \frac{1}{\sigma} \left(\frac{\bar{w}L}{\theta f} - 1 \right). \quad (43)$$

Rearranging (43) we get

$$\eta = \frac{\sigma}{1-s} \quad (44)$$

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

B The cost share of labour and UI contribution

The share of labour in output

$$s = \frac{\bar{w}L}{\theta f}. \quad (45)$$

Then

$$s_\tau = s_{\bar{w}w} = \frac{Lw}{\theta f} + \frac{\bar{w}L\bar{w}w}{\theta f} - \frac{\bar{w}L}{(\theta f)^2} \theta f_L L\bar{w}w \quad (46)$$

$$= \frac{Lw}{\theta f} + \frac{\bar{w}L\bar{w}w}{\theta f} - \frac{\bar{w}L}{(\theta f)^2} \theta d \left(\frac{f}{L} \right)^{\frac{1}{\sigma}} L\bar{w}w \quad (47)$$

$$= \frac{L\bar{w}}{\theta f} \frac{1}{1+\tau} + \frac{L\bar{w}}{\theta f} \frac{L\bar{w}\bar{w}}{L} \frac{1}{1+\tau} - \left(\frac{\bar{w}L}{\theta f} \right)^2 \frac{L\bar{w}\bar{w}}{L} \frac{1}{1+\tau} \quad (48)$$

$$= \frac{s}{1+\tau} - \frac{s}{1+\tau} \eta + \frac{s^2}{1+\tau} \eta \quad (49)$$

$$= \frac{s}{1+\tau} (1-\sigma). \quad (50)$$

C Wage rate, UI contribution and revenue shock

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

$$w_\tau = -\frac{V_{w\tau}}{V_{ww}} \quad (51)$$

where

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

and

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

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

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

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

$$u'(w)(1-\eta) + wu''(w) < 0 \quad (55)$$

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

$$w_\theta = -\frac{V_{w\theta}}{V_{ww}} \quad (56)$$

where

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

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

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

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

When $\sigma > 1$ $w_\theta < 0$ and ω_θ is negative. We therefore only have to consider the case where $\sigma < 1$ when $s_{\bar{w}} > 0$. 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.

Chapter 4

Buffer funding of unemployment insurance: wage and employment effects

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.

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 is 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 de-

mands and on employment. Buffer funding was introduced at Finland in the end of the 1990s. Following the deep recession earlier in the decade Finland'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 $\theta \in [\underline{\theta}, \bar{\theta}]$, such that $\underline{\theta}, \bar{\theta} > 0$, $\underline{\theta} < \bar{\theta}$, and $\pi \geq 0$ and $L \leq M$ with all $\theta \in [\underline{\theta}, \bar{\theta}]$. We can now write the firm's profit function as

$$\pi = \theta \frac{L^\xi}{\xi} - wL. \quad (3)$$

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

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

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

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

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

$$V(w, \tau, L) = L [u(\hat{w}) - u(b)], \quad (6)$$

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

$$\tau wL - \alpha(M - L)b = 0. \quad (7)$$

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

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

subject to

$$L = L(w) \tag{9}$$

$$\tau = \tau(w). \tag{10}$$

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

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

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

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

where $\eta = -\frac{L'(w)w}{L(w)}$ is the wage elasticity of the labour demand and $\gamma(w) = \frac{\hat{w}_w w}{\hat{w}}$ 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

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

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:

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

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.¹ 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 $\eta > \rho\gamma_e^u$ 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 how the employees' net wage and the employer's labour cost react to changes in the gross wage.

¹Note 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.

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

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

where $\kappa = \frac{\bar{w}_w w}{w} > 1$ is the gross wage elasticity of the labour cost $\bar{w} = w(1 + \tau)$. 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 $\theta_i = \theta^b$, $\theta^g > \theta^b$. 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

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

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

$$\tau_i w_i L_i - \alpha(M - L_i)b = 0, \quad i = 1, 2. \quad (17)$$

The union’s two-period maximization problem is now

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

subject to

$$L_i = L_i(w_i), \quad i = 1, 2 \quad (19)$$

$$\tau_i w_i L_i - \alpha(M - L_i)b = 0, \quad i = 1, 2, \quad (20)$$

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.²

²Private 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.

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 (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.

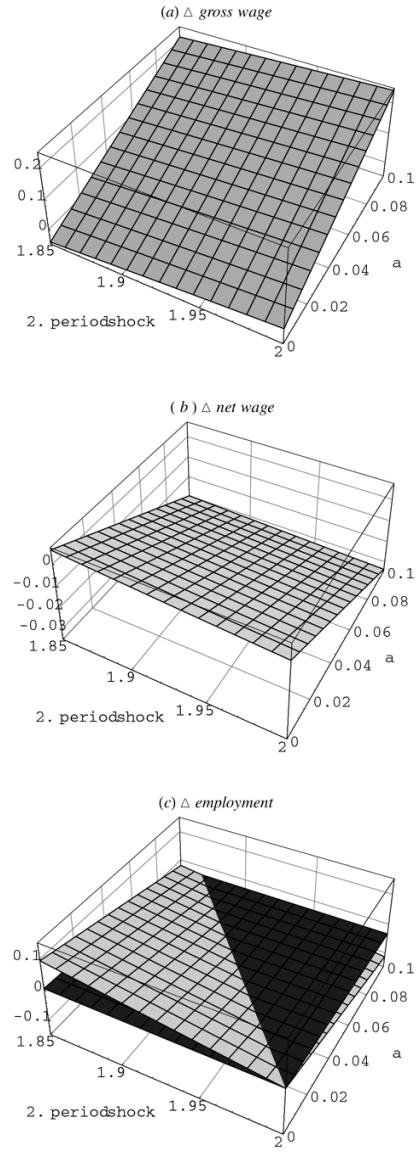


Figure 1: *The relationship between the value of the second period shock, θ_2 , the size of the buffer, a , and the difference between the first and the second period (a) optimal gross wage, (b) optimal net wage, and (c) employment. (Parameter values: $\alpha = 0.4$, $b=1$, $M=1$, $\rho = 0.9$, $\eta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

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.

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

$$V_a = (V_1)_a + \beta(V_2)_a \quad (23)$$

$$= -L_1 u(\hat{w}_1)(\hat{w}_1)_a - \beta L_2 u'(\hat{w}_2)(\hat{w}_2)_a \quad (24)$$

$$= -u'(\hat{w}_1) + \beta(1+r)u'(\hat{w}_2). \quad (25)$$

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

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

We can write (26) in the form

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

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.³ With a CRRA utility function the inequality (27) becomes

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

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 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 interest 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

³Note that result and equation (27) are closely connected with union employed members' optimal intertemporal allocation of consumption (see, for example, Deaton 1992).

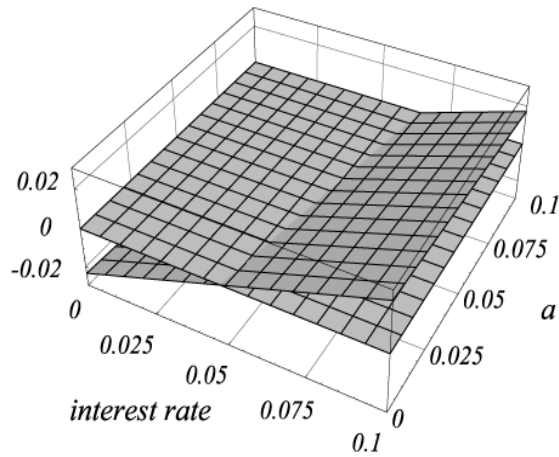


Figure 2: *The relationship between the value of the interest rate, r , the size of the buffer, a , and the derivative of the value function with respect to the buffer, V_a , when wages are flexible. (Parameter values: $\alpha = 0.4$, $b=1$, $M=1$, $\rho = 0.9$, $\eta = 1.1$, $r^d=0.05$.)*

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

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

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

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

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

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

subject to

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

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

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

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

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

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

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

$$L_1'(w) (u(\hat{w}_1) - u(b)) + L_1(w)u'(\hat{w}_1)\hat{w}_1' + \quad (38)$$

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

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

$$p = \theta_1^\eta(1 - \tau_1)^{1-\rho} + \beta \left(\psi\theta_g^\eta(1 - \tau_g)^{1-\rho} + (1 - \psi)\theta_b^\eta(1 - \tau_b)^{1-\rho} \right), \tag{42}$$

$$x = \theta_1^\eta(1 - \tau_1)^{1-\rho}\gamma_1 + \beta \left(\psi\theta_g^\eta(1 - \tau_g)^{1-\rho}\gamma_g + (1 - \psi)\theta_b^\eta(1 - \tau_b)^{1-\rho}\gamma_b \right), \tag{43}$$

$$z = \theta_1^\eta + \beta \left(\psi\theta_g^\eta + (1 - \psi)\theta_b^\eta \right). \tag{44}$$

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.

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

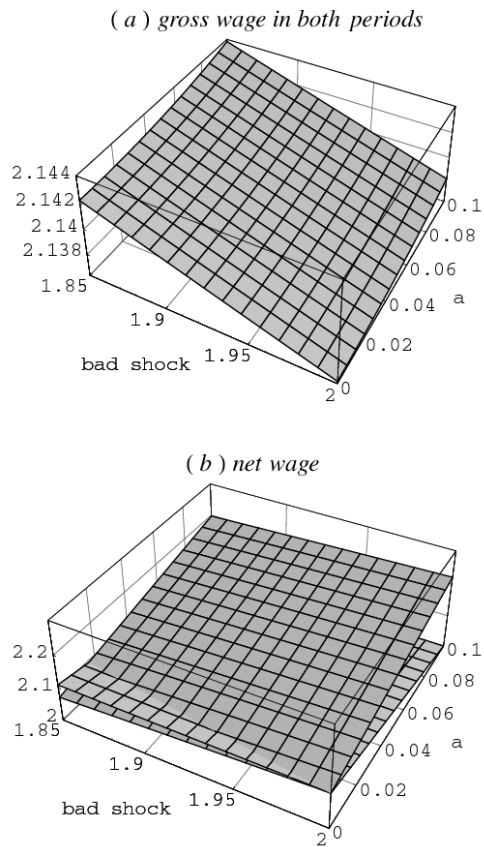


Figure 3: *The relationship between the value of the second period bad shock, the size of the buffer, a , and (a) the optimal gross wage, and (b) the first and second period optimal net wage. (Parameter values: $b=1$, $m=1$, $\rho = 0.9$, $\eta = 1.1$, $r=0.05$.)*

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:

$$V_a = (V_1)_a + \beta E(V_2)_a \quad (45)$$

$$= -L_1 u'(\hat{w}_1)(\hat{w}_1)_a \quad (46)$$

$$-\beta(\psi L_2 u'(\hat{w}_g)(\hat{w}_g)_a + (1 - \psi)L_2 u'(\hat{w}_b)(w_b)_a)$$

$$= -u'(\hat{w}_1) + \beta(1 + r)(\psi u'(\hat{w}_g) + (1 - \psi)u'(\hat{w}_b)), \quad (47)$$

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

$$\frac{1 + r}{1 + r^d}(\psi u'(\hat{w}_g) + (1 - \psi)u'(\hat{w}_b)) > u'(\hat{w}_1), \quad (48)$$

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

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

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.

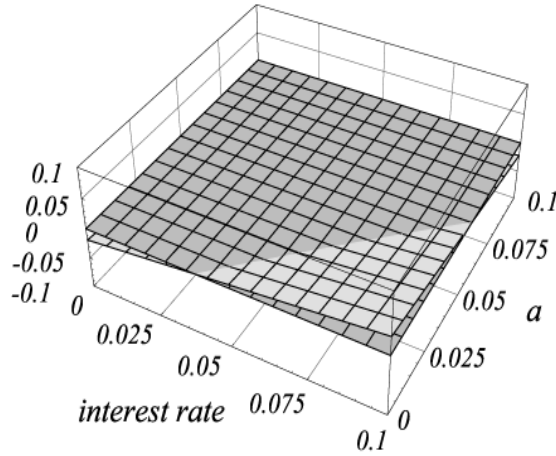


Figure 4: *The relationship between the value of the interest rate, r , the size of the buffer, a , and the derivative of the value function with respect to the buffer, V_a , when wages are rigid. (Parameter values: $b=1$, $m=1$, $\rho = 0.9$, $\eta = 1.1$, $r^d=0.05$.)*

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 $\hat{w}_1 < \hat{w}_b < \hat{w}_g$ which implies that $u'(\hat{w}_1) > u'(\hat{w}_b) > u'(\hat{w}_g)$. Then the inequality (49) can only hold if $r^d \ll r$. 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 $\hat{w}_b \leq \hat{w}_1 < \hat{w}_g$ implies that $u'(\hat{w}_b) \geq u'(\hat{w}_1) > u'(\hat{w}_g)$. 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

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

subject to

$$L = L(w) \quad (51)$$

$$\tau = \tau(w) = \frac{\alpha(M - L)b}{wL}. \quad (52)$$

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

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

and

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

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 $\gamma = \frac{\widehat{w}_w w}{w}$ 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

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

The first term is negative, therefore the inequality holds if

$$\eta - \rho\gamma\varepsilon > 0 \Rightarrow \quad (56)$$

$$\eta > \rho\gamma\varepsilon. \quad (57)$$

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

$$\pi = \theta f(L) - \bar{w}L, \quad (58)$$

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

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

The union's objective function is

$$V(w, \tau, L) = L[u(w) - u(b)] \quad (60)$$

and the budget constraint is

$$\tau wL - \alpha(M - L)b = 0. \quad (61)$$

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

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

subject to

$$L = L(\bar{w})$$

$$\tau = \tau(w).$$

The first-order condition of the maximization problem is now

$$L'(\bar{w})\bar{w}_w [u(w) - u(b)] + L(\bar{w})u'(w) = 0. \quad (63)$$

We can write

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

where $\frac{L'(\bar{w})\bar{w}}{L(\bar{w})} = \eta$ is the labour cost elasticity of the labour demand and $\frac{\bar{w}_w \bar{w}}{\bar{w}} = \kappa > 1$ 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

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

subject to

$$L = L(w) \quad (65)$$

$$\tau = \tau(w) = \frac{\alpha(M - L)b}{wL}. \quad (66)$$

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

Now

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

and

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

D Proof of Proposition 4

First we notice that 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

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

Then

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

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

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

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