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Tax Incidence in Union Models

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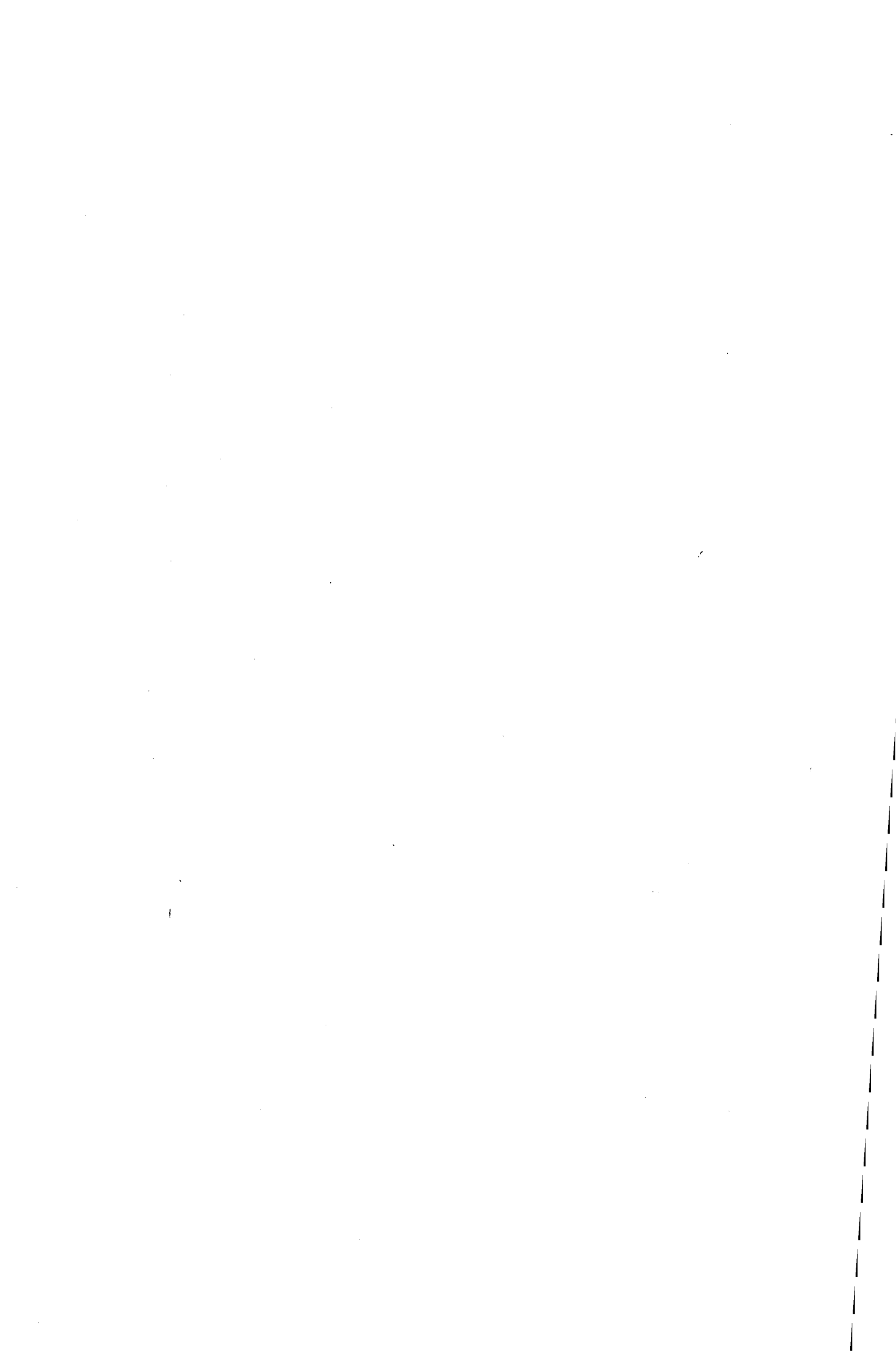
Abstract

This paper considers three union models with alternative specifications of union preferences. We examine the effects of four tax parameters of interest on both wages and employment.

The main results are as follows. The conjecture of irrelevance of de jure incidence appears not to hold in union models. Most of the comparative statics is a priori ambiguous without certain restrictions on either union's objective function or technology. However, given the most plausible conjectures about the decisive elasticities, the results are not sensitive to the theoretical specification applied. Higher progressive income tax unambiguously leads to lower wages. The effect of a higher proportional income tax is analogous to that of a sales tax and is ambiguous without restrictions on the union's objective function but parameter values which can be considered as the most plausible indicate positive wage impact. Generally, the employer's payroll tax as well has an a priori ambiguous effect on wages. Under plausible assumptions about technology, however, a rise in the payroll tax rate tends to decrease wages.

Contents

	Page
Abstract	3
1 Introduction	7
2 The model	9
3 The wage effects	13
3.1 Monopoly union model	13
3.1.1 Utilitarian union	13
3.1.2 Stone-Geary utility function	15
3.1.3 Iso-elastic utility function	16
3.1.4 Summary of the wage effects in the monopoly union model	17
3.2 Right-to-manage model	18
3.2.1 Utilitarian union	19
3.2.2 Stone-Geary utility function	19
3.2.3 Iso-elastic utility function	20
3.2.4 Summary of the wage effect in the right-to-manage model	20
3.3 Efficient contract model	21
3.3.1 Payroll tax, s	22
3.3.2 Proportional income tax, τ	23
3.3.3 Progressive tax, τ_m	23
3.3.4 Summary of the wage effect in the efficient contract model	24
3.4 Summary of the wage effects	25
4 The employment effects	26
4.1 Labour demand curve models	26
4.2 Efficient contract model	26
4.2.1 The slope of the contract curve	27
4.2.1.1 Utilitarian union	27
4.2.1.2 Stone-Geary utility function	28
4.2.1.3 Iso-elastic utility function	28
4.2.2 Summary of the employment effects in the efficient contract model	30
5 Conclusions	32
Appendix	34
References	36



1 Introduction*

Kotlikoff & Summers (1987) survey the literature on tax incidence in a competitive economy with clearing markets. Given the choice of the model and the issue of concern, the results are generally ambiguous without additional restrictions on the precise nature of preferences and technology. The sensitivity of the judgements to a large number of elasticities is stressed. One of the few commonly accepted conclusions concerns the irrelevance of de jure incidence, i.e., that the incidence does not depend on which side of the market the tax is levied. The burden is borne by the side which can not easily adjust. According to Kotlikoff & Summers these principles carry over to much more general contexts and underly the general equilibrium results as well.

In this paper the focus is in unionized labour markets. Two topics are of special interest. First, do the two characteristics of competitive models (the irrelevance of de jure incidence and the sensitivity to various elasticities) hold in the union framework? Second, are the hypotheses on the tax incidence sensitive for the specification of 1) the structure of the bargaining and 2) the union preferences? So far, a thorough analysis on these issues has been missing.¹ As there is no accurate empirical evidence neither on the structure of bargaining nor on the proper description of union preferences, researchers have usually chosen one of the specifications on personal preferences.² To see whether this is essential for the hypotheses concerning the tax incidence, the comparative statics for the commonly used models is derived.³ Earlier contributions where tax incidence has been evaluated in the context of union models are, among others, Hersoug (1983), Holmlund (1989) and more recently Creedy & McDonald (1991) and Andersen & Rasmussen (1992).

We consider a partial equilibrium.⁴ As vast majority of the literature on union models, the analysis is static by nature. According to Kotlikoff & Summers (1987, p. 1050) "static models can provide considerable insight into

¹ According to Farber (1986, p. 1068) "an interesting and important agenda for future research is a careful exploration of exactly how much a priori structure has to be put on objectives and/or the bargaining process in order to learn something useful from bargaining outcomes about both union objectives and the bargaining process."

² According to Pencavel (1985, p. 223) the "agreements in model building have not arisen because of persuasive evidence of the empirical relevance of these modelling assumptions, but because of the theoretical convenience of certain simplifying assumptions and because of their conformity with analogous assumptions in other areas of economics... In view of this, it would seem ill-advised to place much reliance on these models for the purpose of macroeconomic policy evaluation and prescription."

³ Of course, all possible models are not covered by our exercise. Especially, we do not consider models where the unions optimize knowing that part of the tax revenues will be returned to union members as transfers. A complication of this kind would, however, hardly influence comparative statics.

⁴ The general equilibrium case has been analysed by Lockwood (1990).

* This paper has benefitted from useful comments of Erkki Koskela, Bertil Holmlund and Jaakko Kiander. Needless to say, the usual disclaimer applies.

the incidence of taxation in the short run, i.e., before capital stocks have adjusted to changes in after-tax prices. In addition, many of the conclusions of static tax analysis can be directly applied to the case of the long-run dynamic incidence".⁵

⁵ After the first draft of this paper was completed we discovered that Creedy & McDonald (1991) have evaluated similar issues. The aspects covered are, however, different in the two papers. Our analysis of tax parameters is richer. The same holds for the analysis of the employment effects especially in the context of the efficient contract model. The discussion on the indirect tax rate and, more importantly, on the payroll tax is not on the agenda of Creedy & McDonald and, unlike us, they analyse marginal income tax in a context in which an increase in the marginal rate inevitably implies a compensating opposite change in the average rate due to the "revenue neutrality" presumption.

2 The model

As the discussion above indicates, we wish to distinguish the "union-side" from the discussion concerning technology, price setting, endogenous capital formation etc. which are issues common to all literature analysing tax incidence. In order to keep that part of the model simple, we consider a small open economy where (identical) firms take the producer price (normalized to unity, $P=1$) as given by the world market.⁶ Profits are defined as the difference between sales revenues and production costs:

$$\pi_1 = F(N) - W(1+s)N - C \quad (2.1)$$

where W = nominal wage, N = employment, $C = r\mathbf{K}$ = constant production costs with exogenous interest rate (r) and capital stock (\mathbf{K}) which is considered as predetermined. $F(\cdot)$ summarizes the technology, $F' > 0$, $F'' < 0$ and $F(N) = kQ(N)$, where $k = e^{\lambda t}f(\mathbf{K})$, and t captures the technical progress.

The two key elements in the union utility function are the real take-home pay, \hat{W} , and employment:

$$U = U(\hat{W}, N), \quad \text{where } \hat{W} = \frac{W(1-\tau)}{(1+v)} \quad (2.2)$$

and $U_W \geq 0$, $U_N \geq 0$, $U_{WW} \leq 0$, $U_{NN} \leq 0$. Note that consumer price can be written in terms of the indirect tax, v (value added tax, e.g.), since $P_c = P(1+v) = (1+v)$.

We consider four alternative ways to specify union preferences. The first is the utilitarian utility function,

$$U(\hat{W}, N) = N \cdot u(\hat{W}) + (M-N) \cdot u(B), \quad (2.3)$$

where B = the alternative income, e.g., unemployment benefit in real terms, and M = union membership which is given exogenously and we assume $M \geq N$, as usual. It is note-worthy that $U_N > 0$ only holds when $u(\hat{W}) > u(B)$ which also implies that $\hat{W} > B$.

Stone-Geary utility function is

$$U(\hat{W}, N) = (\hat{W}-B)^{1-b} N^b, \quad (2.4)$$

⁶ Tyrväinen (1991) evaluates a bargaining model in which the producer price is endogenized. A downward sloping demand curve of the separable form introduced by Nickell (1978) is applied. The first result is the introduction of a proxy for the demand shift factor. In addition, the extent to which the parties bear the tax is influenced by the shape of the demand curve (see Stiglitz, 1988, pp. 423-425).

where b indicates the relative weight given to employment, $0 \leq b \leq 1$. Again, $U_N > 0$ implies that $\hat{W}-B > 0$.

Iso-elastic, additively separable utility function is the third specification

$$\begin{aligned} U(\hat{W}, N) &= u_0(\hat{W}) + u_1(N) \\ &= \frac{\hat{W}^{1-\delta_0}}{1-\delta_0} + b_1 \frac{N^{1-\delta_1}}{1-\delta_1} \end{aligned} \quad (2.5)$$

where $b_1 \geq 0$ indicates the weight given to employment and $u'_0 > 0$, $u'_1 > 0$, $u''_0 < 0$, $u''_1 < 0$. It is note-worthy that

$$\delta_0 = -\frac{u''_0 \hat{W}}{u'_0} \quad \text{and} \quad \delta_1 = -\frac{u''_1 N}{u'_1} \quad (2.6)$$

have their counterparts in Arrow-Pratt measures of relative risk aversion with regard to wages ($\delta_0 = R_W^c$) and employment ($\delta_1 = R_N^c$).⁷

Obviously, (2.5) is not defined when $\delta_0 = 1$ and/or $\delta_1 = 1$. However, it can be shown that when δ_0 and δ_1 approach unity, we discover as a special case the logarithmic utility function

$$U(\hat{W}, N) = \log \hat{W} + b_1 \log N. \quad (2.7)$$

The outcome of the bargaining game between the firm and the union is commonly specified as the Nash solution where the parties maximize the product of utility increment over the fall-back utilities U_0 and π_0 which refer to a situation where the bargaining breaks down. We assume⁸ that $U_0 = 0$. If the fall-back profit, π_0 , refers to the constant production cost, C , we can write $\pi_1 - \pi_0 = F(N) - W(1+s)N = \pi$.

The standard hypotheses concerning the structure of the bargaining are as follows. In efficient contract model the problem is

$$\max_{W, N} \Lambda = U^\theta \cdot \pi^{1-\theta} \quad (2.8)$$

⁷ Of course, this description – although commonly applied – is not fully accurate since there is no risk in our analysis.

⁸ In Finland which is a highly strike prone economy in international comparison, strike is the relevant alternative for a contract. During a strike, union members usually receive strike allowances which are funded union fees and, hence, endogenous by nature. On the other hand, the union can be defined as a bargaining party which has no income (= union fees) during a strike.

where θ is a measure of the bargaining power of the union, $0 \leq \theta \leq 1$. By imposing the profit maximization condition on (2.8) we have the right-to-manage model

$$\max_W \Omega = U^\theta \cdot \pi^{1-\theta} \quad \text{s.t. } N(\cdot) = \arg \max_N \pi. \quad (2.9)$$

Setting $\theta = 1$ in (2.9) we get the monopoly union model in which the union sets the wage unilaterally:

$$\max_W U \quad \text{s.t. } N(\cdot) = \arg \max_N \pi. \quad (2.10)$$

In the monopoly union model the union power is constantly unity. The two other models will be emphasized under the assumption that the bargaining power of the parties is equal. This allows us to simplify notation by dropping θ 's away in the rest of the paper.⁹

Finally, the tax parameters we are interested in are the following four

- 1) Payroll tax rate (s)
- 2) Indirect tax rate (v)
- 3) Income tax/Proportional (τ)¹⁰
- 4) Income tax/Progressive (τ_m).

As we are dealing with wage and employment effects of four tax factors within three union models with four different preference functions, the total number of these cases is 96. In addition, the questions related to insider dominated unions are evaluated as special cases implying that unions are indifferent as regards employment. In the Stone-Geary function (2.4) -this implies $b = 0$, in the logarithmic function (2.7) and in the iso-elastic function (2.5) $b_1 = 0$. In the utilitarian function (2.3) the role of employment is not dependent on any specific parameter values. These considerations bring the total number of cases to 168.

Attempts to improve the readability of the paper comprise the economizing in reporting. For instance, in all functional forms τ and v enter the analysis in a manner which allows us to write the partial derivatives as

$$W_v = W_\tau \frac{(1-\tau)}{(1+v)} \quad (2.11)$$

and, hence, having derived W_τ^* , we know that $\text{sgn}(W_v^*) = \text{sgn}(W_\tau^*)$. So, it is not necessary to analyse v separately.

⁹ This has no effect for the comparative statics of interest. This can be seen by rescaling θ so that $0 \leq \theta \leq 2$. Equal bargaining power now implies $\theta = 2-\theta = 1$. In a more explicit context, this issue is considered in the Appendix.

¹⁰ In Finland, the household income tax is a combination of a progressive central government income tax and a proportional local government tax.

Finally, a clarifying note on reporting is worth to make. As will be seen below, part of the elasticities show up to be ambiguous without specific assumptions concerning the parameter values related either to union preferences or to the production technology. In so far as the most plausible conjectures concerning union preferences allow us to sign an elasticity of interest, this result is reported in parenthesis in tables 1–4. In so far as the ambiguity is due to technology, this is indicated by square brackets. A question mark indicates that standard conjectures do not suffice to generate unambiguity. This mode of reporting has been chosen to distinguish the sensitivity of the relevant hypotheses related to the union side from that related to the firm side of the model.

3 The wage effects

In this section we derive the comparative statics concerning wage effects of various taxes in the context of the three union models. In section 4, the employment effects will be examined.

3.1 Monopoly union model

In the monopoly union model, the first order condition for optimum (FOC) is $U_w = 0$. The second order condition $U_{ww} < 0$ holds by definition (see (2.2) above). It can be shown that the comparative statics, W_ϕ^* , for $\phi = s, \tau, \tau_m, v$, derives from

$$\text{sgn } W_\phi^* = \text{sgn } U_{w\phi}. \quad (3.1)$$

Below, we give different specifications for U and derive the comparative statics implied.

3.1.1 Utilitarian union

If the union has the utility function (2.3)¹¹ the FOC becomes

$$U_w = N(1-\tau)u'(W(1-\tau)) + \varepsilon \cdot \frac{N(1+s)}{W} \cdot [u(W(1-\tau)) - u(B)] = 0 \quad (3.2)$$

where ε is the wage elasticity of the demand for labour,

$$\varepsilon = \frac{N_w}{N} W = \frac{F''^{-1}}{F'^{-1}} W(1+s) < 0. \quad (3.3)$$

In the present context, one should make a clear difference between the "capital constant" elasticity and the "output constant" elasticity. In union models, the relevant concept is typically the former whereas Hamermesh (1991), for instance, discusses the latter arguing that the "best guess" for its value is -0.3 . With the Cobb–Douglas technology, for instance, the capital constant elasticity reduces to (minus) the inverse of the capital share which is definitely larger than unity in absolute value.

The partial derivative of the FOC (3.2) with respect to the payroll tax, s , is

¹¹ In some countries unemployment benefits are taxed, in some countries not. In the present paper, we assume them not to be considered as taxable income.

$$U_{W_s} = N_s(1-\tau)u' + \frac{1}{W}[u(\hat{W}) - u(B)](\varepsilon N + \varepsilon N_s(1+s) + \varepsilon_s N(1+s)) \quad (3.4)$$

where ε_s is the elasticity of ε with respect to s . The first term in (3.4) is negative. Since $u(\hat{W}) > u(B)$, the sign of U_{W_s} depends on the sign of the final term in the brackets which can be expressed as

$$\varepsilon N + \varepsilon N_s(1+s) + \varepsilon_s N(1+s) = N(\varepsilon(1+\varepsilon) + \varepsilon_s(1+s)). \quad (3.5)$$

Clearly, the sign of (3.5) depends both on the magnitude of ε and the sign and magnitude of ε_s . These depend on the technology and, hence, W_s^* is generally ambiguous. Assuming any of the standard production functions is not sufficient to generate unambiguity.

The relevant partial derivative of the FOC as far as proportional income tax τ is concerned is

$$U_{W\tau} = -u'_0[1 + \varepsilon(1+s) - R_W^c].$$

So, the sufficient condition for $W_\tau^* > 0$ is $R_W^c - \varepsilon(1+s) > 1$ which always holds when $R_W^c \geq 1$ but may hold with considerably lower values as well. If there is no payroll tax in the analysis, $s=0$, the condition implies that the sum of the relative risk aversion and the (absolute value) of the wage elasticity of labour demand must exceed unity (see Andersen & Rasmussen, 1992, e.g.). Introduction of payroll taxes with $1+s > 1$ makes the relevant condition more probable to be met in real life even if ε would be close to zero and R_W^c below unity.

By allowing the income tax rate to depend on the wage level, $\tau(W)$, the problem is

$$\max_w U = N \cdot u(W(1-\tau(W))) + (M-N) \cdot u(B), \quad \text{s.t. } \pi_N = 0.$$

Let us define the rate of progressivity as

$$\tau_m \equiv \frac{\partial \tau}{\tau} / \frac{\partial W}{W} = \frac{\partial \tau}{\partial W} \frac{W}{\tau} = \frac{\tau W}{\tau}$$

which implies that $\tau' \cdot W = \tau \cdot \tau_m$. Now the FOC is

$$U_W = Nu' \cdot (1 - \tau(w)(1+\tau_m)) + N_w(1+s)[u(W(1-\tau(w))) - u(B)] = 0.$$

The relevant partial derivative with regard to progressivity is

$U_{w\tau_m} = -Nu' \cdot \tau(w) < 0$ and consequently $W_{\tau_m}^* < 0$.

3.1.2 Stone-Geary utility function

If the union has the utility function (2.4), the FOC $U_w = 0$ holds when

$$\left[\frac{(1-b)(1-\tau)}{W(1-\tau) - B} + \frac{b(1+s)\varepsilon}{W} \right] = 0.$$

The relevant partial derivative of the FOC with respect to payroll tax, s , is $U_{ws} = \frac{b}{W}(\varepsilon + \varepsilon_s(1+s))$. Obviously, $W_s^* < 0$ whenever $b > 0$ and $\varepsilon_s \leq 0$. By writing ε_s as

$$\varepsilon_s = \frac{F''^{-1}W}{F'^{-1}} \left[1 - \frac{F''^{-1}W(1+s)}{F'^{-1}} \right] + \frac{F''^{-1}W^2(1+s)}{F'^{-1}}$$

it is easy to verify that the precondition for $\varepsilon_s < 0$ is met at least with the Cobb-Douglas, logarithmic and quadratic production function. Since Hamermesh (1991, p. 5) states that "... the estimates based on both micro and aggregate data suggests the Cobb-Douglas function is a satisfactory way of describing aggregate production ..." we believe that $\varepsilon_s \leq 0$ holds in real life implying $W_s^* < 0$ in the present context. If the union is indifferent with regard to employment ($b=0$), i.e. it is insider dominated, then $W_s^* = 0$.

As far as the proportional income tax, τ , is concerned

$$U_{w\tau} = \frac{-(1-b)U}{(\hat{W}-B)} \left[\frac{(1-b)\hat{W}-B}{\hat{W}-B} + b(1+s)\varepsilon \right] \quad (3.6)$$

The term outside the brackets is definitely negative as well as the second term within the brackets. The sign of the first term within the brackets depends on the weight of wages, $1-b$, in the preference function relative to the replacement ratio, B/\hat{W} . If $1-b \leq B/\hat{W}$, then $U_{w\tau} > 0$ and otherwise ambiguous. The closer b is to zero, the more likely $U_{w\tau} < 0$. Especially, when $b=0$ this holds definitely. In light of the empirical results discussed in Pencavel (1985) and Farber (1986), we expect the sufficient condition¹² for $W_{\tau}^* > 0$ to apply in real life.

¹² According to Layard et al. (1991, Table 5, p. 51) in most European countries replacement ratio in 1985 was 50-70 %, in Finland it was 75 %. Because in (3.6) the final term in the brackets is definitely negative, a rough guess is that in the Finnish context the condition for $U_{w\tau} > 0$ is that the weight given to employment, b , is not below .2. Since $1-b$ and b also have the interpretation as indicators of relative risk aversion R_W^c and R_N^c (scaled so that $R_W^c + R_N^c = 1$), the condition for $W_{\tau}^* > 0$ is $(1/4) \cdot R_W^c \leq R_N^c$ for Finland. In countries where the replacement ratio is 60 %, the critical condition could be $(1/3) \cdot R_W^c \leq R_N^c$.

Having reformulated the utility function by allowing income tax to depend on the wage, the relevant partial derivative of the FOC is

$$U_{W\tau_m} = \frac{-(1-b)\tau}{\hat{W}-B} < 0. \text{ Hence, generally, } W_{\tau_m}^* < 0. \quad (3.7)$$

It is note-worthy that in the present context only W_s^* is influenced by the insider domination conjecture.

3.1.3 Iso-elastic utility function

If the union has the additively separable utility function (2.5), the FOC $U_W = 0$ holds when

$$W^{1-\delta_0}(1-\tau)^{1-\delta_0} + b_1 N^{1-\delta_1}(1+s)\varepsilon = 0 \quad (3.8)$$

The relevant term to evaluate when s is considered is

$$U_{Ws} = b_1 N^{1-\delta_1} \left[\left(1 + \frac{N_W W}{N} + \frac{u_1''}{u_1'} N_W W^2 \right) \varepsilon + \varepsilon_s (1+s) \right] \quad (3.9)$$

which can be written as

$$U_{Ws} = b_1 \frac{N^{1-\delta_1}}{W} [(1 + \varepsilon(1 - R_N^c W))\varepsilon + \varepsilon_s(1+s)] \quad (3.9')$$

Obviously, $W_s^* = 0$ if the union is insider dominated and cares not about employment, i.e. when $b_1 = 0$. Otherwise, the sufficient condition for $U_{Ws} < 0$ is that $R_N^c \geq 0$ ¹³ and $\varepsilon_s \leq 0$ which holds for the Cobb-Douglas technology, for instance. In addition, the higher is $R_N^c = \delta_1$, i.e. the more "risk" averse the union is with regard to employment, the more the payroll tax will be shifted backwards to lower wages. Finally, if $\varepsilon_s \leq 0$ and $R_N^c = \delta_1 = 1$, U_{Ws} is negative implying that $W_s^* < 0$ when the utility function is logarithmic.

Let us now turn to analysis of the proportional income tax, τ . The relevant partial derivative of the FOC can be written as

¹³ The necessary condition is that R_N^c is not a large negative number, i.e., the union is not heavily risk loving (!) with respect to employment.

$$U_{W\tau} = -u'_0[1 - R_w^c]. \quad (3.10)$$

Obviously $W_\tau^* \gtrless 0$ if $R_w^c \gtrless 1$.

The case with $R_w^c = 1$ is the logarithmic function. When connected with monopoly union model it indicates $W_\tau^* = 0$ which contradicts empirical evidence. As the case with $R_w^c > 1$ appears to be the most plausible in light of the discussion in Farber (1986), e.g., we expect that $W_\tau^* > 0$.

With progressive income tax the FOC is

$$U_W = u'_0[1 - \tau(W)(1 + \tau_m)] + b_1 \cdot \frac{N(1+s)u'_1}{W} \varepsilon = 0 \quad (3.11)$$

and the relevant partial derivative with respect to τ_m is

$$U_{W\tau_m} = -u'_0\tau(W) < 0, \quad (3.12)$$

and, hence, $W_{\tau_m}^* < 0$. This result also holds in the special cases of logarithmic utility and insider dominated unions.

3.1.4 Summary of the wage effects in the monopoly union model

The results of this section have been summarized in Table 1. As a general notion, disregarding payroll tax the comparative statics is strikingly similar although it usually depends on certain parameter values in the union preference function. The logarithmic utility function generates the only outliers in this set of results.

The second result of interest concerns the opposite effects discovered for proportional and progressive income taxes. Higher progressivity (= marginal tax) tends unambiguously to reduce wages. The intuition is as follows. The union faces a trade-off between the wage gains and employment losses. Steeper progressivity reduces the after tax wage gain due to a wage increment but leaves the employment loss unchanged. Consequently, the union can increase its utility by reducing the wage. When a proportional tax rises this kind of asymmetry does not emerge. The "income effect" dominates and under plausible circumstances it is profitable for the union to choose a higher (pre-tax) wage. These results are not influenced if the union is dominated by insiders.

Under the insider domination conjecture, on the other hand, a change in the level of the payroll tax rate levied on firms has no influence on wages preferred by the monopoly union. Otherwise, the effect of the payroll tax is ambiguous without specification of the technology. However, disregarding the utilitarian preferences the Cobb-Douglas technology, e.g., generates a negative wage effect. Intuitively one would, of course, expect to find a negative effect. This

argument adheres to the fact that the profit maximizing level of employment is reduced by auxiliary labour cost. This is analogic with a leftward shift of the labour demand schedule. In the monopoly union model the equilibrium wage is where the union's indifference curve is tangential to the labour demand curve. So, a downward shift in the labour demand schedule supposedly leads to a lower equilibrium wage.

Table 1. Wage effects in the monopoly union model^{a)}

	The type of the utility function				An insider dominated union as a special case of	
	Utilitarian (U)	Stone-Geary (SG)	Iso-elastic (I)	Logarithmic (L)	(SG),(I)	(L)
$W_{\tau_m}^*$	-	-	-	-	-	-
W_{τ}^*	(+)	(+)	(+)	0	+	0
W_v^*	(+)	(+)	(+)	0	+	0
W_s^*	?	[-]	[-]	[-]	0	0

a) The parentheses indicate that the sign of the coefficient is conditional on some parameter values of the utility function of the union. Square brackets indicate that the sign depends on technology. The most plausible results are in the Table. The question mark indicates that the standard production functions leave the sign ambiguous. The symbols are: s = payroll tax; v = indirect tax; τ = income tax, proportional; τ_m = income tax, marginal.

3.2 Right-to-manage model

In the monopoly union model, the profit maximization condition only influences the outcome indirectly, via employment which enters the utility function of the union. In this section, we consider whether allowing for the direct effect influences the comparative statics. The FOC for the problem defined in (2.9) is

$$\Omega_w = \pi U_w + U \pi_w = \pi U_w - U(1+s)N = 0, \quad (3.13)$$

where U_w is the FOC of the monopoly union model.

The second order condition $\Omega_{ww} = \pi_w U_w + \pi U_{ww} < 0$ clearly holds as $\pi > 0$, $U_{ww} < 0$ and, by the profit maximization condition, $\pi_w = 0$. As before, it can be shown that

$$\text{sgn } W_{\phi}^* = \text{sgn } \Omega_{W\phi}.$$

3.2.1 Utilitarian union

The relevant partial derivative of the FOC with respect to the payroll tax is

$$\Omega_{W_s} = \pi U_{W_s} - U_W W N - U_N(1+\varepsilon). \quad (3.14)$$

The analysis of the monopoly union model in section 3.1.1 showed that U_{W_s} is generally ambiguous. Obviously, this property carries over to the right-to-manage set-up since the second term in (3.14) is negative but the third is either positive or negative depending whether $\varepsilon \gtrless -1$.

The relevant partial derivative with respect to τ is

$$\Omega_{W\tau} = \pi U_{W\tau} - (1+s)N U_{\tau} \quad (3.15)$$

As $U_{\tau} < 0$ and from section 3.1.1 we know that $U_{W\tau} > 0$ under plausible conditions, we see that $\Omega_{W\tau} > 0$ and, hence, $W_{\tau}^* > 0$.

The relevant partial derivative of the FOC with respect to τ_m is

$$\Omega_{W\tau_m} = \pi U_{W\tau_m} - U_W \tau' W < 0 \quad (3.16)$$

because the analysis above indicates that $U_{W\tau_m} < 0$. Hence, $W_{\tau_m}^* < 0$.

3.2.2 Stone-Geary utility function

The relevant partial derivative with respect to s is (3.14) above. The second term is obviously negative but the third term depends on the magnitude of ε . In addition, we saw in section 3.1.2 that U_{W_s} is negative under plausible structure in technology whereas the insider domination conjecture implied a zero effect. In the right-to-manage model, the additional terms in (3.14) imply that W_s^* may be negative also when the sign of U_{W_s} is ambiguous. If unions are insider dominated W_s^* is unambiguously negative.

As far as proportional income tax is concerned, we know from section 3.1.2 that $U_{W\tau} > 0$ under plausible conditions. Since $U_{\tau} < 0$ holds, the partial derivative of the FOC defined in (3.15) is positive, and consequently $W_{\tau}^* > 0$. In fact, the probability of this conjecture to hold has increased as compared to the monopoly union model.

As far as τ_m is concerned, the relevant partial derivative defined in (3.16) is negative since we know from section 3.1.2 that $U_{W\tau_m} < 0$. Hence, $W_{\tau_m}^* < 0$. Again, the effect is stronger than in the monopoly union model.

3.2.3 Iso-elastic utility function

By differentiating the FOC with respect to the payroll tax, s , we get

$$\Omega_{W_s} = \pi U_{W_s} - U_W W N - N \left[\frac{(1-\varepsilon)}{(1-\delta_0)} (W(1-\tau))^{1-\delta_0} + \frac{(1-\delta_1 \varepsilon)}{(1-\delta_1)} b_1 N^{1-\delta_1} \right]. \quad (3.17)$$

From section 3.1.3 we know that U_{W_s} is negative with plausible technology. However, if the union is insider dominated, U_{W_s} was zero. In the right-to-manage context W_s^* is definitely negative when simultaneously $\delta_0 > 1$, $|\varepsilon| > 1$ and $\delta_1 > 1$. We expect these conditions to be met in real life. If the union is insider dominated ($b_1=0$), the unambiguity is not conditional on δ_1 . Note also that since all the other terms in (3.17) are negative, preconditions for W_s^* may be met also with values of δ_0 below unity. With logarithmic preferences implying $\delta_0 = \delta_1 = 1$, the sign of W_s^* is obviously ambiguous.

The partial derivative of the FOC with respect to τ is again as in (3.15). In the present context $U_\tau = -W^{1-\delta_0}(1-\tau)^{-\delta_0} < 0$. From evaluations concerning the monopoly union model we know that $U_{W\tau} > 0$ when $\delta_0 = R_W^c > 1$. Under the same condition $\Omega_{W\tau} > 0$. Due to additional terms in (3.15), the logarithmic utility function (with $\delta_0 = 1$) gives the same result although in the monopoly union model $U_{W\tau}$ was zero when preferences were logarithmic.

Again, to evaluate the progressive tax, τ_m , we redefined U by letting the income tax rate to depend on the wage. The relevant partial derivative is

$$\Omega_{W\tau_m} = \pi U_{W\tau_m} - \tau W^{1-\delta_0}. \quad (3.18)$$

The second term is obviously negative. From (3.12) we know that $U_{W\tau_m} < 0$. So, $\Omega_{W\tau_m} < 0$ and consequently $W_{\tau_m}^* < 0$. It is easy to see that the same result holds in the logarithmic case with $\delta_0 = 1$ although the monopoly union model implied a zero effect.

3.2.4 Summary of the wage effects in the right-to-manage model

In the right-to-manage model, the tax parameters affect via a) union's objective function, b) demand for labour schedule and c) employer's profit function. As compared to the monopoly union model, the novelty is that in the right-to-manage model the profit function influences as a separate term in the Nash product. As can be seen from Table 2, the comparative statics remains almost identical to that introduced in the context of the monopoly union model. Again, we see the difference between the payroll tax which enters via profit function and the rest of the tax parameters which enter via the union preference function. Signing the wage effect of the payroll tax requires specific structure in technology. The rest of results depend on certain elasticities in union preferences but the probability of them to be met has, in fact, increased as

compared to the monopoly model. However, under most plausible conjectures on elasticities concerned, the results are strikingly similar. In the right-to-manage model the logarithmic preference specification is in the same line with the others as well. In addition, unlike in the monopoly union model the results are now more seldom sensitive for the insider domination conjecture with the only exception concerning the payroll tax in the context of Stone-Geary preferences.

Table 2. Wage effects in the right-to-manage model^{a)}

	The utility function				An insider dominated union as a special case of	
	Utilitarian (U)	Stone-Geary (SG)	Iso-elastic (I)	Logarithmic (L)	(SG), (I)	(L)
$W_{\tau_m}^*$	-	-	-	-	-	-
W_{τ}^*	(+)	(+)	(+)	+	(+)	+
W_v^*	(+)	(+)	(+)	+	(+)	+
W_s^*	?	?	[-]	?	[-]	?

^{a)} The parentheses indicate that the sign of the coefficient is conditional on some parameter values of the utility function of the union. Square brackets indicate that the sign depends on technology. The most plausible results are in the Table. The question mark indicates that the standard production functions leave the sign ambiguous. The symbols are: s = payroll tax; v = indirect tax; τ = income tax, proportional; τ_m = income tax, marginal.

3.3 Efficient contract model

A contract is efficient if there is no contract which would imply a higher utility for one of the parties with no reduction in the utility of the other party. Pareto efficient contracts are on the contract curve which consists of points of tangency between an isoprofit curve and the indifference curve of the union. The relevant part of the contract curve is above the labour demand curve where $\pi_N < 0$ which implies $F' < W(1+s)$. So, as compared to the right-to-manage model we relax the profit maximization condition $\pi_N = 0$. As a result, there is no uniform demand for labour condition to substitute into the Nash solution. In this sense, the efficient contract model is much less restricted than the ones discussed so far.

To evaluate the tax incidence we maximize the Lagrangian function

$$\mathcal{L} = U - \lambda[\underline{\pi} - \pi]$$

where $\underline{\pi}$ defines the minimum profit level.

The first order conditions are

$$\mathcal{L}_W = 0 = U_W + \lambda\pi_W$$

$$\mathcal{L}_N = 0 = U_N + \lambda\pi_N$$

$$\mathcal{L}_\lambda = 0 = \pi - \underline{\pi}$$

The second order condition for maximum is fulfilled on non-restricting conditions as can be easily verified.

3.3.1 Payroll tax, s

According to Cramer's rule the sign of the wage effect of payroll tax is

$$\text{sgn}(W_s^*) = \text{sgn}\left[-\mathcal{L}_{WN}\pi_N\pi_s - \mathcal{L}_{Ns}\pi_N\pi_W + \mathcal{L}_{NN}\pi_W\pi_s + \mathcal{L}_{Ws}\pi_N^2\right].$$

First, note that $\mathcal{L}_{NN} = U_{NN} + \lambda\pi_{NN} < 0$, and $\mathcal{L}_{WN} = U_{WN} + \lambda\pi_{WN} = -\lambda(1+s) < 0$. As the terms stemming from the profit function are identical in all cases,¹⁴ we proceed by evaluating $\mathcal{L}_{Ws} = U_{Ws} + \lambda\pi_{Ws}$ and $\mathcal{L}_{Ns} = U_{Ns} + \lambda\pi_{Ns}$.

A profound consequence of relaxing of the profit maximization condition is that the partial derivatives U_{Ws} and U_{Ns} are zeros with all functional forms considered. This is because payroll tax does not enter directly any of the utility functions. So, the analysis of W_s^* is identical with all preference specifications.

Substituting $\pi_{Ws} = -N < 0$ and $\pi_{Ns} = -W < 0$ and rearranging gives

$$\text{sgn}(W_s^*) = -\text{sgn}\left[\lambda W(1+s)\left(1 - \frac{\pi_{NN}N}{\pi_N}\right) - W(1+s)U_{NN}N - \lambda N\pi_N F'\right].$$

The second term is positive and so is the third. The sign of the first term depends on the concavity of the profit function. So, without more structure on technology, W_s^* appears to be ambiguous in the efficient contract model. The more concave the production function is with respect to labour, the less we can expect that the last two terms would dominate and generate a negative wage effect.

On the other hand, the absolute value of $\pi_N < 0$ indicates the magnitude of deviation from the profit maximizing employment. The deviation is presumably larger with upward sloping than downward sloping contract curve. This

¹⁴ That is, $\pi_W = -(1+s)N < 0$, $\pi_s = \pi_W W(1+s)^{-1} = -WN < 0$,
 $\pi_N = F'(N) - W(1+s) < 0$.

counterintuitive result states that W_s^* is more probably negative when the contract curve is upward sloping. In section 4.2.1 it will be shown that the slope is also influenced by the elasticities in various preference functions. The Stone-Geary function implies that W_s^* is more probably negative when the weight given to employment, b , is very large. With the iso-elastic objective function this requires a) that either $R_N^c > 1$ or the union is insider dominated and b) that R_W^c is small. With the logarithmic function the relative weight given to employment, b_1 , must be large as compared to the weight given to wages.

3.3.2 Proportional income tax, τ

As $\pi_\tau = \pi_{W\tau} = \pi_{N\tau} = 0$, we know that

$$\text{sgn } W_\tau^* = \text{sgn} \left[-U_{N\tau} \pi_W \pi_N + U_{W\tau} \pi_N^2 \right].$$

So, we proceed by evaluating $U_{N\tau}$ and $U_{W\tau}$ in the context of the relevant preference functions.

For a utilitarian union as well as with the Stone-Geary function $U_{W\tau} > 0$ and $U_{N\tau} < 0$ implying $W_\tau^* > 0$. In the latter case, if the union is insider dominated, $U_{W\tau} = U_{N\tau} = W_\tau^* = 0$.

With the iso-elastic function $U_{N\tau} = 0$ and $U_{W\tau} > 0$, whenever $R_W^c = \delta_0 > 1$. So, $W_\tau^* > 0$. The logarithmic utility function implies $U_{W\tau} = 0$ and $U_{N\tau} = 0$, and hence, $W_\tau^* = 0$

3.3.3 Progressive tax, τ_m

As before

$$\text{sgn } (W_{\tau_m}^*) = \text{sgn} \left[-U_{N\tau_m} \pi_N \pi_W + U_{W\tau_m} \pi_N^2 \right].$$

Since $U_{N\tau_m} = 0$ in the context of all the utility functions of interest, the signs are according to $U_{W\tau_m}$.

For a utilitarian union

$$U_{W\tau_m} = -N u'(\tau(w)) < 0.$$

With the Stone-Geary function we have

$$U_{W\tau_m} = -(1-b)N^b \tau(w) [W(1-\tau(w)) - B]^{-b} < 0.$$

With iso-elastic function

$$U_{W_{\tau_m}} = -W^{-\delta_0} \tau(w) < 0,$$

which also holds with logarithmic function, i.e. when $\delta_0 = 1$. So, all utility functions imply that $U_{W_{\tau}} < 0$ and, consequently, $W_{\tau_m}^* < 0$. The insider domination conjecture has no influence on the results.

3.3.4 Summary of the wage effects in the efficient contract model

In the efficient bargaining model the profit maximization condition concerning the determination of employment has been relaxed. Hence, the profit function enters the analysis only as a term in the Nash product instead of the two channels discussed in the context of the right-to-manage model. The comparative statics derived in this section can be seen in Table 3. The ambiguity of the wage effect of the payroll tax once again confirms that this effect can not be signed without specific structure assumed on technology. The rest of the results hold for very generally defined, well-behaved profit functions and show that conjectures about wage effects of direct and indirect taxes are very much similar in most cases. As in the context of the monopoly union model, here as well the logarithmic preference function generates zero elasticities as far as proportional income taxes and indirect taxes are concerned. In addition, the insider domination conjecture also matters as far as the Stone-Geary preferences are proposed.

Table 3. **The wage effects in the efficient contract model^{a)}**

	The type of the utility function				An insider dominated union a special case of	
	Utilitarian (U)	Stone-Geary (SG)	Iso-elastic (I)	Logarithmic (L)	(I)	(SG), (L)
$W_{\tau_m}^*$	-	-	-	-	-	-
W_{τ}^*	+	+	+	0	+	0
W_v^*	+	+	+	0	+	0
W_s^*	?	?	?	?	?	?

^{a)} A question mark indicates that the coefficient depends on special technology assumptions. The symbols are: s = payroll tax; v = indirect tax; τ = income tax, proportional; τ_m = income tax, marginal.

3.4 Summary of the wage effects

To summarize the comparative statics concerning the wage effects of taxes, in accordance with results for competitive markets the signs are mostly ambiguous without restrictions on some elasticities. The distinguishing feature appears to be whether the variable enters via the preference function of the union or of the firm. The effect of the payroll tax which enters via the profit function cannot be signed without specific structure in technology. Higher progressivity in income taxes reduce the equilibrium wage level in all models¹⁵ but the effects of the two other tax factors of interest depend on the properties of the union preference functions. Under the most plausible conjectures about the strategic elasticities, the hypotheses are not sensitive to the set-up applied. The decisive elasticities indicate the weight given to employment and/or the concavity of the preference function with respect to employment. The parameter values which we have considered as the most plausible indicate that higher proportional income tax probably leads to higher wages.¹⁶ Higher indirect taxes have the same effect as proportional income taxes. So, we expect an increase in sales tax to push up wages. An "outlier" results with the logarithmic utility function both in context of the monopoly union model and of the efficient contract model. Here, neither the proportional income tax nor the indirect tax influences the nominal wage. In addition, if unions are insider dominated proportional income tax and, accordingly, sales tax have no wage effect in the efficient contract model with Stone-Geary preferences. Under the same condition, changes in payroll taxes have no wage effect in the monopoly union model. In other models the results (indicating ambiguity in general) of the effect of the payroll tax do not depend on this conjecture. Generally, models seem to indicate partial incidence.

The results also imply that empirical discrimination between hypotheses concerning the structure of bargaining is not straightforward. Evidence on union preferences stemming from wage equations will not be easily interpretable either.

¹⁵ The specification with presumed revenue neutrality in Creedy & McDonald (1991) leaves this effect ambiguous.

¹⁶ The conclusion about proportionality in Creedy & McDonald (1991) is exactly the same although they formulate the problem by imposing the revenue neutrality at the outset. As the definition of the post-tax wage, y , is $y = w - (w-a)t$, analysis of the proportional tax collapses to analysis of the threshold factor a and the analysis of progressivity collapses to analysis of t .

4 The employment effects

4.1 Labour demand curve models

The monopoly union model and the right-to-manage model share the property that the firm operates on the downward sloping labour demand curve. For the tax parameters which enter the model via the preference function of the union, i.e. τ , τ_m , v , obviously

$$\text{sgn}(N_\phi^*) = -\text{sgn}(W_\phi^*) \quad (4.1)$$

The employment effects concerned can be directly derived from Tables 1 and 2. As stated in other contexts above, payroll tax which enters via the profit function makes a difference. This holds here as well. If $W_s^* = 0$, the real labour cost increases by the full amount of the labour tax. Real labour cost increases also when $0 > W_s^* > -1$. The effect on the real labour cost is zero only if wages adjust by the full amount of the tax increment, that is, when $W_s^* = -1$. This implies

$$\text{sgn}(N_s^*) = -\text{sgn}(W_s^* + 1) \quad (4.2)$$

Because we could not sign W_s^* without specific assumptions about technology, the general ambiguity of N_s^* follows. In addition, as can be seen from (4.2), unambiguity of W_s^* would not necessarily generate unambiguity of N_s^* . The decisive conjecture here derives from $W_s^* \leq -1$.

4.2 Efficient contract model

In the efficient contract model, the employment effect depends on the slope of the contract curve. It is shown below that the contract curve is upward sloping in the (W, N) space if the utility function of the union is convex enough with regard to wages or the union otherwise pays more attention to employment than to the wage. The presumption that higher labour cost due to tax changes leads to lower employment is consistent only with the downward sloping contract curve. If the contract curve is vertical there is no effect on employment. Below we examine the implications of various specifications on conjectures about the slope of the contract curve. As will be seen, the results seem to challenge the general accuracy of the statement by Brown & Ashenfelter (1986, p. 51) that "efficient contracts lead, if anything, to negligible (or positive) correlations between price and quantity across bargaining pairs..."

4.2.1 The slope of the contract curve

The contract curve is defined by the condition that the slope of the isoprofit curve equals the slope of the indifference curve, that is

$$\frac{\pi_N}{\pi_W} = \frac{U_N}{U_W} \quad (4.3)$$

Substituting π_N and π_W , the slope can be derived from

$$(F' - W(1+s))U_W = -(1+s)NU_N \quad (4.4)$$

by taking the total differential with respect to W and N . If dW/dN is negative, the contract curve is downward sloping and vice versa.

The employment effect of a tax can be expressed in terms of the contract curve, on the one hand, and the wage effect, W_ϕ^* , on the other hand:

$$\text{sgn } N_\phi^* = \begin{cases} \text{sgn} \left(\frac{dW}{dN} \right) \cdot \text{sgn } W_\phi, & \text{for } \phi = v, \tau, \tau_a \\ \text{sgn} \left(\frac{dW}{dN} \right) \cdot \text{sgn} (W_\phi + 1), & \text{for } \phi = s \end{cases}$$

We proceed by analysing dW/dN in the context of alternative preference functions.

4.2.1.1 Utilitarian union

The slope of the contract curve is

$$\frac{dW}{dN} = \frac{F''(1+s)^{-1}}{\frac{u''(\hat{W})}{u'(\hat{W})} \cdot \left[\frac{u(\hat{W}) - u(B)}{u'(\hat{W})} \right]} > 0$$

which indicates an upward sloping contract curve whenever the union is risk averse ($u''/u' > 0$) which we expect to hold. Under this condition, $N_\tau^*, N_v^* > 0$ and $N_{\tau_m}^* < 0$. N_s^* is ambiguous because W_s^* is ambiguous but $N_s^* > 0$ whenever $W_s^* + 1 > 0$. We consider these results implied by the upward sloping contract curve as perverse as will be made clear in section 4.2.2 below.

4.2.1.2 Stone-Geary utility function

In this case (4.4) becomes

$$W - F'(1+s)^{-1} = b(1-b)^{-1}(\hat{W}-B)(1-\tau)^{-1}$$

where $0 < b < 1$. Total differentiation gives us the slope (which is not defined when $b = \frac{1}{2}$),

$$\frac{dW}{dN} = \frac{F''(1+s)^{-1}}{\left(2 - \frac{1}{1-b}\right)} \leq 0 \quad \text{if } 1-b \geq \frac{1}{2}$$

In accordance with argumentation above we consider the case with $1-b > \frac{1}{2}$ as the more plausible (see also the discussion in section 3.1.2). This implies a downward sloping contract curve indicating $N_\tau^* > 0$, $N_v^* < 0$ and $N_{\tau_m}^* > 0$ and $N_s^* < 0$ whenever $W_s^* + 1 > 0$. The contract curve is unambiguously downward sloping with the insider dominated union which indicates that $b=0$. Since under this conjecture $W_\tau^* = W_v^* = 0$ (see Table 3), also $N_\tau^* = N_v^* = 0$.

4.2.1.3 Iso-elastic utility function

Now the slope is defined by

$$\frac{dW}{dN} = \frac{\left(F''(1+s)^{-1} + b_1(1-\delta_1)N^{-\delta_1}W^{\delta_0}(1-\tau)^{\delta_0-1}\right)}{\left(1 - \delta_0\hat{W}^{\delta_0-1}N^{1-\delta_1}\right)} \quad (4.5)$$

The numerator is unambiguously negative if $\delta_1 \geq 1$ or $b_1 = 0$ and otherwise ambiguous. Below, we assume that this precondition holds. If $\delta_0 = \delta_1 = \delta > 1$, the denominator in (4.5) is

$$1 - \delta \left(\frac{N}{\hat{W}}\right)^{1-\delta} = 1 - \delta \left(\frac{U_N}{U_W}\right) \frac{N}{W}. \quad (4.6)$$

Since the definition of the contract curve implies that

$$\frac{U_N}{U_W} = \frac{W(1+s) - F'}{(1+s)N},$$

(4.6) can be written as

$$1 - \delta \left(\frac{W(1+s) - F'}{(1+s)N} \right) \frac{N}{W} = 1 - \delta \left(1 - \frac{F'}{W(1+s)} \right) \quad (4.6')$$

It should be seen that $F'/W(1+s) = X$ is a kind of measure for the deviation from the profit maximization condition, $\pi_N = 0$, which if holds implies that $X = 1$. In general, on the contract curve $F' < W(1+s)$ and, hence, $0 < X < 1$. Note that this implies $(1-X)^{-1} > 1$.

Obviously, when $\delta > 1$, then

$$\frac{dW}{dN} \gtrless 0 \text{ when } \delta \gtrless (1-X)^{-1}. \text{ When } \delta < 1, \text{ the slope is ambiguous.}$$

In addition, it can be seen from (4.6) that the larger is U_N and the smaller is U_W , the more likely the contract curve is upward sloping. This generates a larger deviation from the profit maximizing employment.

Let us now assume that $\delta_0 \neq \delta_1$. The denominator in (4.5) becomes

$$1 - \delta_0 \frac{(\hat{W})^{\delta_0-1}}{N^{\delta_1-1}} = 1 - \delta_0 \left(\frac{U_N}{U_W} \right) \frac{N}{W} \quad (4.7)$$

In analogy with the previous case it can be shown that (4.7) is unambiguously positive when $\delta_0 < (1-X)^{-1}$. On the precondition that $\delta_1 \geq 1$,

$$\frac{dW}{dN} \gtrless 0 \text{ when } \delta_0 \gtrless (1-X)^{-1}.$$

The intuition of this result is as follows. The unambiguity of any conclusion requires that the concavity of the preference function with respect to employment exceeds the value indicated by $R_N^c = 1$. Interestingly, this condition can be replaced by the insider domination conjecture. If in addition to one of the conditions above, the concavity of preferences (= risk aversion) with respect to wages exceeds certain threshold above unity then the contract curve is upward sloping. Although we presume the union to be risk averse, we do not expect the condition concerning the magnitude of the risk aversion concerned to be met in real life. Admittedly, the evidence in favour of a downward sloping contract curve is vague in the present context. This is why we put this result in double parentheses in Table 4. With iso-elastic preferences, the conclusions are not sensitive for the insider domination conjecture.

Because the contract curve (4.5) is not defined when $\delta_0 = \delta_1 = 1$, the logarithmic utility specification is analysed separately. There the slope is

$$\frac{dW}{dN} = \frac{F''}{(1-b_1)(1+s)}$$

which is negative when $0 < b_1 < 1$ and positive if $b_1 > 1$. If $b_1 = 1$ the contract curve is not defined. Again, we expect that $0 < b_1 < 1$ which indicates a downward sloping contract curve implying that $N_{\tau}^* > 0$ because $W_{\tau_m}^* < 0$. Since $W_{\tau}^* = W_{\nu}^* = 0$ with logarithmic preferences $N_{\tau}^* = N_{\nu}^* = 0$ as well. N_s^* is ambiguous but if $W_s^* + 1 > 0$, then $N_s^* < 0$. Under the insider domination conjecture ($b_1=0$) the contract curve is unambiguously downward sloping.

4.2.2 Summary of the employment effects in the efficient contract model

We have evaluated above the slope of the contract curve. As far as the tax effect on employment is concerned, it is opposite to the wage effect when the contract curve is downward sloping. When the contract curve is upward sloping, the wage effect and the employment effect have the same sign. There is no effect on employment if the contract curve is vertical.

The specification of union preferences as also specific parameter values in the functions concerned influence the slope of the contract curve. The utilitarian preference function gives an upward sloping contract curve as the only alternative (whenever the union is risk averse). The other preference specifications more probably generate a downward sloping contract curve. The implications of the most likely conjectures are in Table 4. The ambiguity of the payroll tax effect is a consequence of ambiguity of W_s^* .

The first column in the table 4 introduces the effects on employment in the context of an upward sloping contract curve generated by the utilitarian preference specification. This set-up indicates, for instance, that employment is reduced by a cut in (proportional) income tax which reduces the wage and, hence, leads to a lower labour cost. This conjecture is non-sense and leads us to consider suspiciously any model characterized with an upward sloping contract curve. Interestingly, presuming that the unions are insider dominated the Stone-Geary as well as logarithmic preferences unambiguously generate a downward sloping contract curve.

Table 4.

**Employment effects in the efficient contract model
given the wage effects conjectured in section 3.^{a)}**

	The type of the utility function				Insider dominated union as a special case of	
	Utilitarian (U)	Stone-Geary (SG)	Iso-elastic (I)	Logarithmic (L)	(I)	(L), (SG)
$N_{\tau_m}^*$	-	(+)	((+))	(+)	((+))	+
N_{τ}^*	+	(-)	((-))	0	((-))	0
N_v^*	+	(-)	((-))	0	((-))	0
N_s^*	?	?	?	?	?	?

^{a)} The parentheses indicate that the sign of the coefficient is conditional on some parameter values of the utility function of the union. The most plausible results are in the Table. The question mark indicates that the coefficient depends on technology and that the standard production functions leave the sign ambiguous. The symbols are: s = payroll tax; v = indirect tax; τ = income tax, proportional; τ_m = income tax, marginal.

5 Conclusions

Majority of the literature – both theoretical and empirical – applying union models assume that the union acts as a monopolist. As severe doubts can be casted on this model¹⁷ it is of special importance to qualify whether the conclusions derived are model specific.

As far as taxes are considered, the feare appears not to be well-grounded. The comparative statics concerning wage effects is not sensitive to the theoretical specification of the union preferences or the structure of bargaining.¹⁸ The profound difference concerns the payroll tax which enters the model via the profit function and the other tax factors which enter via the utility function of the union. The former cannot be signed without specific structure in production technology. In many cases, however, presuming a simple Cobb-Douglas technology is sufficient to define an unambiguously negative wage effect of the payroll tax which is intuitively the only plausible conjecture (see the discussion in section 3.1.4). Higher marginal income tax reduces the equilibrium wage level no matter how the union preferences look like. The signs of the other two tax factors go hand in hand and are ambiguous without restrictions on the preference functions. However, parameter values which can be considered as the most plausible lead to qualitatively identical judgements. Higher proportional income tax probably leads to higher wage claimes.¹⁹ Accordingly, we expect an increase in the sales tax to push up wages.

In general, models seem to indicate partial incidence. This statement is especially straightforward in the right-to-manage model (see Table 2). It also appears to be in accordance with common empirical findings. A closer look at the various formulae reveals that the conjecture of irrelevance of de jure incidence does not hold in union models. As there is some overlapping between this paper and some of those referenced at the outset, it is note-worthy that no conflicting results have been expressed in these contributions.

Our analysis indicates that empirical discrimination between hypotheses concerning the structure of bargaining is not easy. Evidence on union preferences stemming from wage equations will not be easily interpretable either. So, we are not likely to learn much about union objectives by estimating wage equations. With employment equations one could possibly have some

¹⁷ See Layard, Nickell & Jackman (1991, p. 96): "The union never gets everything it wants. It bargains. Thus we reject an excessively simple model in common usage – the model of the 'monopoly union'. Under this model the union chooses wages on its own, with no bargaining. Apart from being patently false, this model may give rise to the 'paradox of the shrinking union': as union members leave, existing members jack up wages progressively so that no hiring occurs. The paradox is, however, no paradox, since the premiss is false."

¹⁸ This is in full accordance with the conclusions of Creedy & McDonald (1991).

¹⁹ Tyrväinen (1992) contains empirical results for Finland which are in accordance with the conjecture introduced on the wage effects of proportionality and progressivity in incomes tax.

hope.²⁰ On the other hand, the results are generally so similar that even though our knowledge of union preferences is not fully accurate, this does not unavoidably deteriorate the relevance of empirical applications derived from union models. This is especially so as far as wage equations are concerned.

The monopoly union model and the right-to-manage model share the property that the firms operate on the downward sloping labour demand curve. Hence, tax changes which lead to higher labour costs tend to reduce employment.

In the efficient contract model things are different and the rule-of-thumb of opposite wage and employment effects do not necessarily hold. Technically, this is because the profit maximizing condition has been relaxed and replaced by the pareto optimality condition. These two conditions do not generally coincide although special cases have been discussed in the literature where they do.

As far as the tax effect on employment is concerned, it is opposite to the wage effect when the contract curve is downward sloping. Since in this case the contract curve has a similar shape as the labour demand curve (although the former is located to the right of the latter), the comparative statics is qualitatively identical. When the contract curve is upward sloping, the tax effect on wage and on employment has the same sign. There is no effect on employment if the contract curve is vertical. Both the specification of union preferences as also specific parameter values in these functions influence the slope of the contract curve. The most plausible conjectures on the decisive elasticities indicating how the union values employment, however, tend to generate a contract curve which is downward sloping in the (W,N) space. In this respect, the utilitarian union is an exception which generates an unambiguously upward sloping contract curve whenever the union is risk averse. The upward sloping contract curve generates hypotheses concerning tax effects which can be considered as perverse. For instance, it implies a reduction in employment as a response to a cut in proportional income tax which leads to a lower wage (and to lower labour cost). As a result, we consider this kind of set-up suspiciously.

The final issue to discuss concerns our limitation to partial analysis. In a broader context, a tax shift which leads the union to push up wages weakens the competitive position of the country concerned. Losses in market shares reduce exports and, thereby, growth of output. In most models this leads to lower employment and – sooner or later – to downward adjustment in real wages. In a general equilibrium set-up, this could well neutralize the original wage effect.²¹ Due to nominal rigidities and union resistance the process concerned may be prolonged. It may involve devaluations and become painful because of substantial fluctuation in unemployment and interest rates. To indicate the nature of processes which shifts in the tax rates tend to produce, we consider the kind of analysis presented in this paper to have a role of its own.

²⁰ Accordingly, the test in Alogoskoufis & Manning (1991) which was designed to discriminate between hypotheses concerning the bargaining structure relies on employment equations instead of wage equations.

²¹ The discussion in Layard et al. (1991, p. 31) is a good reference here.

Appendix

A note on asymmetry in the Nash solution

The role of asymmetry in the bargaining game has not been considered formally in the paper. Here, we wish to show that this is no major deficiency.

Asymmetry measured by θ plays a role in the right-to-manage model (2.9) and the efficient contract model (2.8). In the former, employment implied by the predetermined wage level is on the labour demand curve (LDC). In the latter, wage and employment can be found from the contract curve (CC) (see section 4.2). By reconsidering the Nash solutions (2.9) or (2.8) it is easy to see that asymmetry in the bargaining does not influence the amount of utility available for players but it may influence the shares of the parties. As can be seen, θ enters the maximization problem as a third separate element in addition to U and π . So, it has an independent influence on the location of the equilibrium on the labour demand curve or the contract curve.

For a given value of θ , $0 < \theta < 1$, the comparative statics related to the factors which determine U or π are not influenced. Two examples are given below with the asymmetric right-to-manage model. As far as the payroll tax is concerned in the context of the iso-elastic utility function, the partial derivative of interest is

$$\begin{aligned} \Omega_{w_s} &= \theta\pi U_{w_s} - \theta U_w WN \\ &- (1-\theta)N \left[\frac{(1-\varepsilon)}{(1-\delta_0)} (W(1-\tau))^{1-\delta_0} + \frac{(1-\delta_1\varepsilon)}{(1-\delta_1)} b_1 N^{1-\delta_1} \right] \end{aligned} \quad (3.17')$$

The only difference as compared to (3.17) is that each term has been multiplied by a positive constant, either by $0 < \theta < 1$ or $0 < 1-\theta < 1$.

Knoester & van der Windt (1987) applying a bargaining model with ad hoc features, argue that "in countries where worker bargaining power is strongest, only the employees deflator – i.e. consumer prices – is relevant, which implies an insignificant price-difference variable" (pp. 157–159). In light of our model this is misleading. The bulk of the difference between the deflators relevant for employers and employees consists of indirect taxes, v . Since (2.11) implied a uniform relation between W_τ^* and W_v^* , we can evaluate the matter by considering (3.15) in the context of asymmetric bargaining. With the same functional forms as above, the relevant partial derivative is

$$\Omega_{w_\tau} = \theta\pi U_{w_\tau} - (1-\theta)(1+s)NU_\tau. \quad (3.15')$$

Again, (3.15') is a weighted average of the two terms in (3.15). As U_{w_τ} is negative, Ω_{w_τ} does not vanish when θ approaches unity. So, $W_\tau^* < 0$ and analogously $W_v^* < 0$ with all possible values of θ . This covers also the monopoly union model ($\theta = 1$).

How about the effect of changes in θ . It is straightforward to expect increasing union power to push up wage. As the LDC is generally downward sloping, employment decreases in the right-to-manage model, i.e., $\text{sgn}(N_\theta) = -\text{sgn}(W_\theta)$. As far as efficient contracts are concerned, the slope of the CC is decisive. The contract curve can be either upward sloping, downward sloping or vertical and $\text{sgn}(N_\theta) = \pm \text{sgn}(W_\theta)$ or $N_\theta = 0$, respectively.

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