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## Monopoly unions, corporatism and optimal structure of labour taxation

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# BANK OF FINLAND DISCUSSION PAPERS

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17/94

Erkki Koskela — Jouko Vilmunen

Research Department  
19.8.1994

## Monopoly Unions, Corporatism and Optimal Structure of Labour Taxation

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# Monopoly Unions, Corporatism and Optimal Structure of Labour Taxation

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## Abstract

According to the conventional theory of competitive labour markets formal incidence of income and payroll taxes is irrelevant in the sense that it does not matter in terms of welfare effects which side the tax is levied on. In this paper this issue is re-examined under imperfectly competitive labour markets by using monopoly union model of wage and a employment determination adjusted for corporatism as the vehicle for analysis. The irrelevance of the structure of labour taxation holds under equal tax bases if there is no uncertainty. Trade unions create a distortion in the labour market by setting the wage rate too high a level; with only one distortion it does not matter which instrument – income or payroll taxation – is used to eliminate that. In the first best case unions should be subsidized and the more so the higher is the degree of corporatism. The structure of labour taxation matters even under certainty if tax bases are unequal and there is some degree of corporatism. Finally, if tax bases are equal, there is idiosyncratic stochastic component in the wage rate and unions are risk-averse, it is desirable to use both income and payroll taxation; trade unions create a distortion and risk is inefficiently allocated so that one needs two instruments to deal with the two inefficiencies. Given the positive income tax it is desirable to introduce a subsidy to employers. Roughly, the income tax serves as social insurance to decrease risk associated with the wage rate and the payroll subsidy is assigned to deal with labour market distortion. Under full corporatism the tax structure is irrelevant even under uncertainty.

## Tiivistelmä

Tavanomaisen kilpaileviin työmarkkinoihin perustuvan teorian mukaan on samantekevää kummalta osapuolelta – työntekijöiltä tai työnantajilta – SOTU-maksut peritään. Pitääkö tämä käsitys paikkaansa epätäydellisesti kilpailevilla työmarkkinoilla, joilla AY-liike asettaa palkat tai niistä neuvotellaan? Paperissa käytetään ns. monopoliliittomallia palkkojen ja työllisyyden määräytymiselle ja osoitetaan, että irrelevanssitulos pätee mikäli veropohjat ovat yhtäsuuria eikä epävarmuutta esiinny. AY-liike aiheuttaa vääristymän asettamalla palkan liian korkealle; hyvinvoinnin kannalta on samantekevää, käytetäänkö työntekijöiltä vai työnantajilta perittyjä SOTU-maksuja vääristymän korjaamiseen. SOTU-maksun työntekijöille pitäisi olla tuen sosiaalisen ylijäämän maksimoimiseksi ja sitä suuremman mitä korporatistisempia liitot ovat. Verorakenteella on varmuuden vallitessa merkitystä hyvinvoinnin kannalta jos liitot ovat korporatistisia ja veropohjat eri suuria. Jos palkkaan liittyy epävarmuutta ja liitot ovat riskiä kaih-tavia, niin irrelevanssitulos ei enää päde vaikka veropohjat ovat yhtäsuuria; on haluttavaa ottaa käyttöön SOTU-maksut sekä työntekijöille että työnantajille. Liitot aiheuttavat vääristymän työmarkkinoille ja riskijako on yhteiskunnan kan-nalta tehoton. Optimaalinen politiikka on verottaa työntekijöitä ja tukea työnan-tajia; karkeasti ottaen edellinen toimii vakuutuksena ja jälkimmäinen korjaa pal-kanasetannasta johtuvaa työmarkkinoiden vääristymää.

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# 1 Introduction

Labour is typically taxed from both sides of the market. Employees pay income taxes, while payroll taxes are levied on employers. According to the conventional theory of tax incidence the formal incidence of income and payroll taxes should be irrelevant in the sense that it should matter neither in terms of behavioral effects nor in terms of welfare effects which side the tax is levied on. Indeed, many empirical studies of wage formation treat income and payroll taxes symmetrically (see, e.g. Layard and Nickell and Jackman (1991)). There are at least two worries about this "lesson" of the theory of tax incidence under perfectly competitive labour markets with instantaneous market clearing. First, contrary to the theoretical prediction, income taxes and payroll taxes seem to have different effects on wages in practice (see e.g. Lockwood and Manning (1993), Holm and Honkapohja and Koskela (1994)). While this may be due to the problems in measuring tax variables in the correct way, the theory may also be wrong. Second, many parts of labour markets, particularly in Europe, are not regarded as being perfectly competitive with market clearing. Trade unions exercising their market power set wages above market clearing levels, which leads to inefficient allocation of resources in the sense that labour is used too little.

Finally, there is the issue of corporatism. It has been argued that in "corporatist economies", which feature centralized labour markets, taxes on labour will be less distortionary when labour supply is determined collectively rather than individually (see Summers et al. (1993)). Essentially, the argument is that global, encompassing unions recognize that there is a perception of the link between taxes paid and benefits received. This internalization of the government budget constraint tends to lead to less distortionary taxes. Does this feature of corporatism have any implications for how income and payroll taxes work and for how the structure of labour taxation should be designed by the benevolent dictator? There has been much research during the last fifteen years or so on the relationship between corporatism and macroeconomic performance (see e.g. Calmfors and Driffill (1988)), but almost nothing about the relationship between taxation and corporatism (Summers et al. (1993) being an exception).

All in all, it seems to be well justified to reconsider the issue of formal incidence of income and payroll taxation in the labour markets. The purpose of the paper is to do that by using the so-called monopoly union model of wage and employment determination as the vehicle for analysis. In the monopoly-union model the trade union fixes the wage and conditional on this firms set employment unilaterally. Income and payroll taxes are levied on union members and firms respectively. This is the simplest trade union model which allows for labour market imperfections. The analysis is potentially interesting in terms of two viewpoints: (i) to understand why income and payroll taxes may have different behavioural effects and thereby different incidence in contrast to conventional wisdom but in conformity with some empirical evidence and (ii) to reopen the question of how the structure of labour taxation should be designed. In this paper maximization of social welfare is interpreted either in the first-best sense of maximizing social surplus or in the second-best sense of



maximizing trade union utility subject to the government tax revenue requirement.

To anticipate results it turns out that one can show the irrelevance of the structure of labour taxation – in the sense that it does not matter from the welfare point of view whether government collects taxes via income taxation levied on trade union members or via payroll taxation levied on firms – even with imperfectly competitive labour markets when tax bases are equal and there is no uncertainty. The argument goes as follows. Trade unions create a distortion for the labour market by setting wage rate to a too high level. When there is only one distortion, it does not matter which instrument – either income taxation or payroll taxation – is used to eliminate that in accordance with the Tinbergen-Theil theory of economic policy. The optimal policy in the first-best case is to subsidize unions, and the more so the higher is the degree of corporatism measured by the perceived connection between taxes paid and benefits received. Subsidizing trade unions has the effect of decreasing wages and increasing employment towards the level of efficient amount of employment. If the corporatism increases the income tax becomes less distortionary and tax revenue considerations less important. The structure of labour taxation matters even under certainty if tax bases are unequal e.g. due to a tax exemptions provided that there is some degree of corporatism. This is roughly because under corporatism a rise in payroll taxation induces benefits and thereby decreases distortion by lowering the wage rate.

Are there any circumstances when the structure of labour taxation matters from the welfare point of view under equal tax bases? There are. If the wage rate remains stochastic after the trade union has set the wage rate, then the structure of labour taxation matters from the welfare point of view if trade unions are risk-averse and risk is idiosyncratic. The stochasticity of the wage rate may due to various reasons. The nominal wages may be imperfectly indexed to the price level and/or income transfers may be stochastic. The welfare maximizing government uses both income and payroll taxation. The Tinbergen-Theil recipe is still applicable; trade unions distort labour markets and risk is inefficiently allocated so that one needs two instruments to deal with two inefficiencies. The income tax serves as social insurance to decrease risk associated with the wage rate and the payroll subsidy is assigned to deal with labour market distortion.

The paper is organized as follows. The theoretical framework under certainty is laid out in section 2 and the issues of tax structure as well as the question of whether one should have taxes or subsidies are analyzed. Section 3 deals with the tax structure in the presence of uncertainty. Finally, there are some concluding remarks.

## 2 Monopoly unions, corporatism and labour taxation under certainty

### 2.1 Theoretical framework

To keep the model simple, we use the monopoly union model as the vehicle for analysis and let the trade union fix the wage rate and assume that firms set employment unilaterally.<sup>1</sup> Employment is determined by maximizing  $\Pi = f(L) - w(1+s)L$  in terms of labour  $L$ , where  $w$  is the wage rate and  $s$  is the payroll tax rate. In what follows the partial derivatives are denoted by primes for functions with one argument and by subscripts for functions with many arguments. With strictly concave revenue function ( $f' > 0$ ,  $f'' < 0$ ) this gives labour demand  $L = L(w(1+s))$  with  $L' > 0$ . The revenue function summarizes the technology of the firm and the demand function for the product jointly. If the technology is of the form  $g(L) = L^\alpha$ ,  $0 < \alpha < 1$ , and the demand function of the constant elasticity type  $D = Bp^{-e}$  with  $e > 1$ , then  $f(L) = pD = L^{\alpha(1-1/e)}A^{1/e}$ . The revenue function is concave because  $f' > 0$  and  $f'' < 0$ . Here we assume for simplicity that the producer price is fixed and normalized at unity. This simplification has no bearing on the issues to be dealt. This gives the labour demand function with constant elasticity

$$L = \left( \frac{\alpha}{w(1+s)} \right)^\delta \quad (1)$$

where  $\delta = 1/(1-\alpha) > 1$  denotes the gross wage elasticity of labour demand.

To make the exposition simpler assume that the utility function of the trade union is of the linear form

$$U = (w(\psi + ta) - b)L \quad (2)$$

where

$$\psi = 1 - t + (s+t)Ag \quad (3)$$

and where  $t$  = the constant income tax rate levied on employees,  $a$  = the level of tax exemption,  $s$  = the payroll tax rate levied on firms and  $b$  = the valuation

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<sup>1</sup> In the recent literature three approaches have dominated the debate on trade union behaviour, namely the monopoly union, "right-to-manage" and efficient bargain models. Though the "right-to-manage" model looks more realistic than the monopoly union model, its comparative statics is qualitatively similar to that of the monopoly union model. Thus the monopoly union model might be preferred on the grounds of Occam's Razor. These models have been criticized for the inefficiency of equilibrium. In the efficient bargain model firms are off their labour demand curve. Oswald (1993), however, presents several theoretical and empirical arguments against this view. See also Koskela and Vilmunen (1994) for some further discussion.

of leisure or outside option. This formulation of the trade union's objective function assumes that the trade union can be a global union in the sense that it perceives a connection between taxes paid and the benefits received. We model the extent of corporatism through a variable  $g$ , the degree of encompassment. Thus higher  $g$  means greater perception of the link between taxes paid and benefits received.  $A$  is the parameter which describes the valuation of benefits. In what follows it is assumed that  $A + a < 1$ .<sup>2</sup> In the case of a local union – usually analyzed in the trade union literature – the degree of encompassment ( $= g$ ) is zero.

The monopoly union chooses the wage rate so as to maximize (2) subject to the labour demand constraint  $\Pi_L = 0$ . This gives for a corporatist union

$$w = \left( \frac{b}{\psi + ta} \right) \left( \frac{\delta}{\delta - 1} \right) \quad (4)$$

One can show that  $w_t = (1 - Ag - a)w\Psi^{-1} > 0$  and  $w_s = -Agw\Psi^{-1} < 0$ . A rise in the income tax rate always increases the wage rate, while the effect of the payroll tax rate is sensitive to the nature of the trade union. In the case of non-local trade union a rise in the payroll rate is anticipated to induce higher benefits, which tends to reduce the wage rate. For the local trade union with constant wage elasticity of labour demand the payroll tax has no effect on the wage rate set by the trade union since the trade union does not perceive tax revenues to come back as benefits. One should note also that  $w_g = -w(s+t)\Psi^{-1} < 0$  so that a rise in corporatism decreases the wage rate and increases employment, *ceteris paribus*.<sup>3</sup>

Substituting the RHS of (4) for  $w$  in the utility function of the trade union and in the profit function of firms gives the indirect utility function of the trade union and the indirect profit functions of firms  $\Pi^*(t,s)$  respectively. Using the envelope theorem yields

---

<sup>2</sup> Roughly this means that the union does not get more in benefits than it pays in taxes.

<sup>3</sup> This wage-moderating and distortion-decreasing effect of corporatism have been recently stressed in a slightly different context by Summers and Gruber and Vergara (1993). As for other comparative statics, it is easy to see that  $w_b = wb^{-1} > 0$  and  $w_\delta = -w(\delta-1)^{-1} < 0$ . An outside option has a positive, while the wage elasticity of labour demand a negative effect on the wage rate.

$$\begin{aligned}
\text{(i)} \quad U_t^* &= -wL(1 - Ag - a) > 0 \\
\text{(ii)} \quad U_s^* &= wL((Ag - (\psi + ta)(1 + s))^{-1}) = U_t^* + wL((1 - \psi(1 + s))^{-1}) < 0 \\
\text{(iii)} \quad \Pi_t^* &= -wL(1 + s) \left( \frac{w_t}{w} \right) < 0 \\
\text{(iv)} \quad \Pi_s^* &= -wL \left( 1 + (1 + s) \left( \frac{w_s}{w} \right) \right) = \Pi_t^* - wL \left( 1 - (1 + s) \left( \left( \frac{w_t}{w} \right) - \left( \frac{w_s}{w} \right) \right) \right) < 0
\end{aligned} \tag{5}$$

For non-local unions a rise in the income tax rate decreases both the maximum utility of the trade union and the maximum profits of firms and the same happens in the case of a rise in the payroll tax rate. In the case of the payroll tax rate the mechanism is slightly more complicated; in contrast with the income tax the payroll tax affects labour demand directly as well. For local unions the signs, though not the magnitudes, of the tax variables are the same.

Finally, the tax revenues of the government are

$$T^* = (s + t(1 - a))wL \tag{6}$$

where  $T^*$  indicates that tax revenues are evaluated at the trade union and firm optimum values of the wage rate and employment. Due to the tax exemption parameter  $a$  associated with the income tax, the tax bases for the income tax and the payroll tax are not identical. The tax revenue effects of the income tax rate  $t$  and the payroll tax rate  $s$  can be obtained by differentiating  $T^*$  and taking into account that both the wage rate and employment depend on the respective taxes. This gives for a corporatist union

$$\begin{aligned}
\text{(i)} \quad T_t^* &= wL \left( 1 + (s + t(1 - a)) \left( (1 - \delta) \left( \frac{w_t}{w} \right) \right) - a \right) \\
\text{(ii)} \quad T_s^* &= wL \left( 1 + (s + t(1 - a)) \left( \left( \frac{w_s}{w} \right) (1 - \delta) - \delta(1 + s)^{-1} \right) \right) = \\
&\quad T_t^* - (s + t)wL((1 - \delta)\psi^1 + \delta(1 + s)^{-1})
\end{aligned} \tag{7}$$

The corresponding expressions for local unions can be obtained by observing  $w_t = w(1 - a)/\Psi > 0$  and  $w_s = 0$ ; expressions are qualitatively similar, though different in magnitudes.

## 2.2 Tax structure, corporatism and tax base

Before analyzing the structure of labour taxation from welfare point of view one has to fix the criterium of social welfare. There are at least two possibilities. First, one can consider policies from the first-best point of view of maximizing social surplus, which is the sum of the trade union's utility, the firms' profit and government tax revenues. This criterium has been criticized as potentially unsuitable for a policy recommendation since tax rates and government tax revenues may be negative in some cases. This criticism suggests that one should consider policies in terms of maximizing welfare of private agents subject to the government tax revenue constraint. This is now the usual approach in the public finance literature. In the paper we analyze the tax structure both without and with government tax revenue requirement (see e.g. Laffont and Tirole (1993) for extensive discussion about these issues).

The first-best problem for the social planner is to choose tax rates  $t$  and  $s$  so as to maximize the social surplus

$$S = U^* + \Pi^* + (1-g)T^* \quad (8)$$

where we have taken into account that the trade union perceives a connection between the taxes paid and the benefits received via the degree of encompassment parameter  $g$ . In terms of the payroll tax rate  $s$  one gets

$$\begin{aligned} S_s = 0 &= U_s^* + \Pi_s^* + (1-g)T_s^* \\ &\Leftrightarrow Ag - (\psi + ta)(1+s)^{-1} - \\ &\quad (1+s)Ag\psi^{-1} + (1-g)[(1-(s+t(1-a)))(Ag(1-\delta)\psi^{-1} + \delta(1+s)^{-1})] = 0 \end{aligned} \quad (9)$$

which defines the optimal  $s$ . Analogously, the optimal  $t$  is defined by

$$\begin{aligned} S_t = 0 &\Leftrightarrow S_s + wL((\psi + ta)(1+s)^{-1} - (1-a) + 1 - (1+s)(1-a)\psi^{-1} + \\ &\quad (1-g)((s+t(1-a))((1-\delta)(1-a)\psi^{-1} + \delta(1+s)^{-1}) - a)) = 0 \end{aligned} \quad (10)$$

In order to see whether the structure of taxation matters we proceed as follows: First,  $S_s = 0$  is solved for  $s$  at  $t = 0$ , which gives  $s = s^*$  at  $t = 0$ . The derivative of the social surplus with respect to the income tax is evaluated at  $s = s^*$  and  $t = 0$ . If this derivative is zero, then the income tax is not needed after the payroll tax has been set to the optimum level. And vice versa, if  $S_s = 0$  at  $s = 0$  and  $t = t^*$ , where  $t^*$  refers to the optimal income tax, then the payroll tax is not needed after the income tax has been set to the optimum level. If these conditions hold, the structure of labour taxation is irrelevant. It can be shown

**Proposition 1:** (i) Under certainty the structure of labour taxation does not matter from the welfare point of view either in the case of local or in the case of corporatist unions in the first-best or in the second-best sense if tax bases for

income and payroll taxes are equal; given the optimal use of either the income tax rate or the payroll tax rate, the other is unnecessary. (ii) if tax bases are unequal e.g. due to tax exemption, then it is desirable generally to use both instruments provided that there is some degree of corporatism.<sup>4</sup>

Proof: Evaluating  $S_s$  at  $t = 0$  gives

$$S_{s|_{t=0}}=0 \Leftrightarrow (1-Ag)\left(1+\frac{1+s}{\psi}-(1-g)\frac{s(1-\delta)}{\psi}\right)=(1-g) \quad (11)$$

which defines  $s = s^*$  at  $t = 0$ . One has now to evaluate  $S_t$  at  $s = s^*$  and  $t = 0$ . To this end, we have

$$\begin{aligned} S_{t|_{t=0,s=s^*}} &= -wL\left\{(1-Ag-a)\left(1+\frac{(1+s)}{\psi}-(1-g)\frac{s(1+\delta)}{\psi}\right)-(1-g)(1-a)\right\} \\ &= -wL\left\{\frac{(1-g)}{(1-Ag)}(1-Ag-a)-(1-g)(1-a)\right\} \quad (\text{by(11)}) \\ &= \frac{-wL(1-g)}{(1-Ag)}\{1-Ag-a-(1-Ag)(1-a)\} \\ &= \frac{wL(1-g)aAg}{(1-Ag)} \geq 0 \quad \text{as } a, A, g \geq 0 \end{aligned} \quad (12)$$

To proceed the other way round, first observe that

$$S_{t|_{s=0}}=0 \Leftrightarrow (1-Ag-a)\left\{1+\frac{1}{\psi}-(1-g)t(1-\delta)\frac{(1-a)}{\psi}\right\}=(1-g)(1-a) \quad (13)$$

and

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<sup>4</sup> But one should notice that corporatism cannot be too high for the feasible solution. As  $g$  approaches one, either the trade union or the firm maximization problem has no interior solution. This means that one has to be careful with the feasibility of the local first-order conditions as is known from the optimal taxation and principal-agent literature (see e.g. Kreps (1990), p. 604-608, for a clear exposition of the issue).

$$\begin{aligned}
S_{s|_{t=t^*,s=0}} &= wL \left\{ Ag - (\psi + ta) - \left( 1 - \frac{Ag}{\psi} \right) + (1-g) \left( 1 - t(1-a) \left( \frac{Ag(1-\delta)}{\psi} + \delta \right) \right) \right\} \\
&= wL \left\{ -(1-Ag)(1-t) \left( 1 + \frac{1}{\psi} - (1-g)t(1-\delta) \frac{(1-a)}{\psi} \right) + (1-g)(1-t(1-a)) - ta \right\} \quad (14) \\
&= wL \left\{ \frac{-(1-Ag)(1-t)(1-g)(1-a)}{1-Ag-a} + (1-g)(1-t(1-a)) - ta \right\} \\
&= \frac{-agwL}{(1-Ag-a)} (A(1-g) + t(1-A-a))
\end{aligned}$$

which depends on the sign of  $t$ . Optimal  $t$  (as  $s=0$ ) is

$$t^* = \frac{1 + g(1-2A) - a}{(1-Ag-a) \left[ g(1-A) + (1-\delta)(1-g) + \frac{a\delta}{1-g} \right] - a(1-a)(1-g)} \quad (15)$$

According to (14)

$$S_{s|_{t=t^*,s=0}} = 0 \Leftrightarrow t_1 = \frac{-A(1-g)}{1-A-a}$$

which is not generically compatible with  $t^*$  in (15).  $\square$

Under certainty and equal tax bases one can follow the Tinberger-Theil recipe; one needs only one instrument to correct distortion due to the wage setting of the monopoly union. From the welfare point of view it does not matter whether the corrective taxes are levied on the trade union or on the firms.<sup>5</sup> The structure of labour taxation matters under unequal tax bases provided that there is some degree of corporatism. This is roughly because under corporatism e.g. a rise in payroll taxation includes benefits and thereby decreases distortion by lowering the wage rate.

### 2.3 Equal tax bases: subsidies or taxes?

The irrelevance of the structure of labour taxation under certainty and equal tax bases is not sensitive to the degree of corporatism provided that feasibility conditions, which guarantee interior solutions, hold. In what follows we develop the formula for the optimal income tax and assume that  $a = 0$ . The equation

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<sup>5</sup> The first-best welfare maximizing policy recommendations can be criticized for the neglect of tax revenue requirement. In the case of certainty it can be shown, however, that the irrelevance proposition holds also in the case of maximizing the welfare of trade union subject to the government budget constraint. In the case of one tax and the government tax revenue requirement one cannot freely choose the taxes. A full set of results is available from the authors upon request.

(10), which defines the optimal  $t^*$ , can be shown to lead to the following solution when  $s = 0$ .

$$t^* = \frac{(1+g(1-2A))}{((1-Ag)(g(1-A)+(1-\delta)(1-g)))} = \frac{1+g(1-2A)}{(1-Ag)[(1-\delta)+g(\delta-A)]} < 0 \quad (16)$$

for all  $g, A$  when  $Ag < 1$ .  $t^*=0$  only if  $g = -1/(1-2A)$ ,  $A \neq -1/2$ . This is not, however, feasible for  $g \in [0,1)$  since  $A < 1/2 \Rightarrow -1/(1-2A) < 0$  and  $A > 1/2 \Rightarrow 1/(2A-1) > 1$ . Thus  $t^* < 0$  under partial corporatism as  $g \in [0,1)$ . Moreover, one gets from the expression (17) that

$$t_g^* = \frac{(1-A)[(1-\delta)+g(\delta-A)] - (1-Ag)(\delta-A)(1+g(1-2A))}{[(1-Ag)((1-\delta)+g(\delta-A))]^2} < 0 \quad (17)$$

so that a rise in the degree of corporatism leads to a higher subsidy. As the corporatism rises, wage rate falls, which lessens the need to subsidize the unions in order to correct the distortion due to the wage setting. On the other hand, tax revenue considerations  $(1-g)T^*$  matter less and less as  $g$  increases. The latter effect dominates the former in the social surplus so that the subsidy goes up. In the case of local trade union  $g = 0$  and (16) simplifies into

$$t^* = \frac{1}{(1-\delta)} < 0 \quad \text{as } g=0 \quad (18)$$

Thus we have

Corollary 1: (a) in the case of local unions the first-best optimal income tax is negative and depends positively on the elasticity of labour demand.<sup>6</sup> (b) the higher is the degree of corporatism the lower the first-best optimal income subsidy is.

The proper way to correct the distortion due to the wage setting of the local monopoly union is to levy a subsidy either on the monopoly union or on the firms. Via both ways one can get a better allocation and increase employment. As the corporatism increases, two things happen. First, in addition to the wage elasticity of labour demand valuation of benefits starts to matter for a corporatist union; the trade union sees partially through the veil of government budget constraint so that taxes are less distortionary. On the other

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<sup>6</sup> This subsidizing result is not new; it was originally presented in a general equilibrium context by Guesnerie and Laffont (1978) and it has been recently elaborated in a macroeconomic context by Agell and Dillen (1994).



hand, tax revenue considerations become less important from the point of view of the social welfare.<sup>7</sup>

### 3 Optimal structure of labour taxation under uncertainty and equal tax bases

#### 3.1 Modelling uncertainty

It has been shown that under certainty it does not matter from the welfare point of view whether government levies taxes on employees or on firms if the tax bases are equal. Let us now proceed to allow for uncertainty and explore its implications for the tax structure.<sup>8</sup> The framework developed in section 2 is modified in the following respects: First, in the light of the results of section 2 the tax bases for the income tax and for the payroll tax are assumed to be identical, which leads to a slight reformulation of the government's tax revenue function. Second, it is assumed that the wage rate contains a stochastic, idiosyncratic component. This means that its expected value is assumed to be zero but it can have positive or negative realizations. Third, under uncertainty one has to specify attitudes towards risk-taking. It is assumed that trade unions are risk averse. In order to attain tractability and transparent exposition it is assumed that the idiosyncratic component of the wage rate is normally distributed with zero mean and constant variance so that  $\tilde{a} \sim N(0, \sigma^2)$  and that the utility function of the trade union is non-linear in terms of the differential between the post-tax wage rate income and option value income and can be described by the exponential utility function. Under these assumptions the expected utility of the monopoly trade union can be written in mean-variance terms as follows

$$EU = E(-e^{-\rho(w\Psi - b)L} \cdot e^{-\rho(1-t)\tilde{a}L}) = -e^x \quad (19)$$

where  $E$  denotes the expectations operator,  $x = -\rho(w\Psi - b)L + (1/2)\rho^2(1-t)^2L^2\sigma_a^2$  and  $\rho = -u''((w+\tilde{a})(1-t))/u'((w+\tilde{a})(1-t))$  = the (constant) Arrow-Pratt measure of absolute risk-aversion (see, e.g. Hirschleifer and Riley (1992) for details). Hence maximizing  $EU$  amounts to minimizing

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<sup>7</sup> The corresponding expression can be developed for the case when  $t = 0$  and the payroll tax is used to correct the distortion by using the equation (9). In the general case, however, this leads to a second-order equation for  $s$  with two roots. It can be shown, that the solution which guarantees the feasibility conditions, is the payroll subsidy. In the case of the local union, the nonlinearity vanishes and one gets  $s^* = -1/\delta < 0$  for the optimal payroll tax as  $g = 0$ . The economic intuition is the following: subsidizing the employers increases employment and thereby decreases the distortion due to the wage setting of the unions. A full set of results is available from the authors upon request.

<sup>8</sup> Oswald (1982) was the first who studied the effects of various kinds of uncertainties on the behaviour of a monopoly union and concluded that the model's comparative static predictions are not changed by the introduction of uncertainty.

$$K = -(w\psi - b)L + \frac{1}{2}\rho^2(1-t)^2L^2\sigma_a^2 \quad (20)$$

with respect to  $w$ . The behaviour of firms is similar to the one presented in section 2 in all details. The first-order condition for the maximization of the expected utility in terms of  $w$  and subject to the demand for labour constraint (1) can be written as

$$K_w = 0 \Leftrightarrow w\psi(1-\delta) + b\delta + \rho\delta(1-t)^2L\sigma_a^2 = 0 \quad (21)$$

The second-order condition can be expressed as

$$K_{ww} = \frac{[w\psi(1-\delta) - \delta^2\rho(1-t)^2\sigma_a^2]}{w} < 0 \quad (22)$$

Given (22) the first-order condition 21 implicitly defines the expected utility maximizing wage rate as a function of tax parameters and variance of transfer parameter  $a$  so that  $w = w^*(s, t, \sigma_a^2)$ . It is straightforward to show that

$$w_{\sigma_a^2}^* = \frac{-K_{w\sigma_a^2}}{K_{ww}} > 0 \quad (23)$$

$$w_s^* = -\frac{K_{ws}}{K_{ww}} = \underbrace{\frac{-wAg(1-\delta)}{K_{ww}}}_{-} - \underbrace{\frac{\delta\sigma_a^2}{(1+s)}w_{\sigma_a^2}^*}_{-} < 0 \quad (24)$$

$$w_t^* = -\frac{K_{wt}}{K_{ww}} = \underbrace{\frac{w(1-Ag)(1-\delta)}{K_{ww}}}_{+} - \underbrace{\frac{2\sigma_a^2}{(1-t)}w_{\sigma_a^2}^*}_{-} = ? \quad (25)$$

According to (23) a rise in the uncertainty about transfers worsens the trade-off between wage rate and employment by making the given wage rate less valuable. Hence the risk-averse trade union requires higher wage rate as a compensation. According to the expressions (24) and (25) the total effect of the tax rates can be decomposed into the "certainty effect" (the first RHS terms) and the "uncertainty effects" (the second RHS terms) (see Caballero (1991) for a similar decomposition in a different context). The total effect of the payroll tax is negative. On the one hand, a rise in the payroll tax tends to decrease the wage rate for non-local union or to remain it unchanged for local union due to the "certainty effect". On the other hand, a rise in the payroll tax decreases net income uncertainty by decreasing employment so that the wage rate also

decreases via this "uncertainty effect" regardless of whether trade union are global or local. So if the trade union is local, the payroll tax affects negatively even with constant labour demand elasticity. Finally, the effect of the income tax rate remains ambiguous a priori. This is due to the conflicting "certainty" and "uncertainty" effects. The former tends to increase the wage rate, while the latter to decrease it.

In the welfare analysis we need to know how the maximum expected utility is changed when the tax parameters change. Using the envelope theorem yields

$$EU_t^* = -e^x \cdot \rho L [w(1-Ag) - \rho(1-t)L\sigma_a^2] \quad (26)$$

and

$$EU_s^* = e^x \rho w L \left[ Ag - \frac{\psi}{1+s} \right] \quad (27)$$

where  $EU^*$  denotes the expected indirect utility  $EU^*(t,s)$ . The government tax revenue function is the same than in section 2. Since the transfer component  $a$  is stochastic with zero mean we have the following government tax revenue function

$$\hat{T} = (s+t)wL \quad (28)$$

Comparative statics of tax revenues with respect to the tax rates has been derived in section 2.<sup>9</sup>

The maximization of social surplus in the first-best sense can be criticized for its neglect of government tax revenue requirement. Therefore, in what follows we take the public finance point of view of maximizing social welfare subject to the government tax revenue requirement. We postulate the second-best problem so as to maximize the expected utility of the trade union subject to the government tax revenue requirement  $T^0 = (1-g)\hat{T}$ .<sup>10</sup>

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<sup>9</sup> We have supposed that the transfer component is independently and identically distributed across individual members of the trade union. Thus there is no aggregate risk, risk is fully idiosyncratic. If the risk is aggregative, then the government tax revenue functions is stochastic and in one way or another private agents must ultimately bear all the risk whether through random taxes, random government expenditures or random government deficits. See Varian (1980) for further discussion and Gordon (1985) for a general equilibrium analysis of risk-shifting issues in the context of corporate taxation.

<sup>10</sup> In what follows we thus neglect for simplicity the treatment of profits though they are positive under the assumptions made. This means that there is 100 % profit taxation, but tax revenues obtained thereby have no effects either on the trade union or on the tax revenue requirement associated with the labour taxation. See Munk (1980) for an analysis of the implication of 100 % or less than 100 % profit taxation in the theory of optimal taxation.

### 3.2 Optimal structure of labour taxation under idiosyncratic risk

The second-best problem for the social planner is to choose  $s$  and  $t$  so as to maximize the Lagrangian  $\Omega = EU^* - \lambda(G - T^*)$  where  $T^* = (1-g)(s+t)wL$ . This gives

$$\Omega_s = e^* \rho w L \left[ Ag - \frac{\psi}{1+s} \right] + \lambda(1-g)wL \left[ 1 + (s+t) \left( (1-\delta) \frac{w_s}{w} - \frac{\delta}{1+s} \right) \right] = 0 \quad (29)$$

and

$$\Omega_t = -e^* \rho L [w(1-Ag) - \rho(1-t)L\sigma_a^2] + \lambda(1-g)wL \left[ 1 + (s+t)(1-\delta) \frac{w_t}{w} \right] = 0 \quad (30)$$

where  $\lambda > 0$  because of the binding budget constraint and where the expressions (26), (27), (7i) and (7ii) with  $a = 0$  have been utilized. The equations (29) and (30) define implicitly the optimal payroll and income tax rates. It can be shown

**Proposition 2:** If under equal tax bases the trade unions are risk averse and there is idiosyncratic uncertainty about a component of wage rate, the structure of labour taxation matters from the second-best welfare point of view. In particular, given the optimal income tax rate for members of the trade unions welfare can be increased at the margin by introducing a payroll subsidy for employers.

Proof: For simplicity we assume that  $g = 0$ <sup>11</sup> and ask first the question: if  $s$  is set at the optimum, is there a need for  $t$ ? The optimal  $s$  for  $g = t = 0$  is given from (29) by

$$\frac{-e^* \rho}{(1+s)} + \lambda \left[ 1 + s \left( \frac{w_s}{w} (1-\delta) - \frac{\delta}{1+s} \right) \right] = 0 \quad (31)$$

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<sup>11</sup> Under uncertainty with risk aversion the structure of labour taxation matters under  $g > 0$  as well provided that corporatism, measured by  $g$ , is "not too high".

$$\frac{e^* \rho}{1+s} - \lambda \left[ 1 + s \left( (1-\delta) \frac{\frac{\delta^2 \rho L \sigma_a^2}{(1+s)}}{w(1-\delta) - \delta^2 \rho L \sigma_a^2} - \frac{\lambda}{1+s} \right) \right] = 0 \quad (31')$$

This can be transformed into the following form

$$(\rho e^* - \lambda) = s \frac{w(1-\delta)^2}{w(1-\delta) - \delta^2 \rho L \sigma_a^2} \quad (32)$$

which defines optimal  $s = s^*$  at  $g = t = 0$ . Next, one has to evaluate  $\Omega_t$  at  $g = t = 0$  as  $s = s^*$ . (31) gives

$$\Omega_{t|_{g=0=t, s=s^*}} = -e^* \rho L [w - \rho L \sigma_a^2] + \lambda w L \left[ 1 + s(1-\delta) \frac{w(1-\delta) + 2\delta \rho L \sigma_a^2}{w(1-\delta) - \delta^2 \rho L \sigma_a^2} \right] \quad (33)$$

$\Leftrightarrow$

$$\begin{aligned} & -wL \left[ \rho e^* - \lambda \left( 1 + s \frac{w(1-\delta)^2}{w(1-\delta) - \delta^2 \rho L \sigma_a^2} \right) \right] + \\ & \rho^2 L^2 e^* \sigma_a^2 + \lambda w L s (1-\delta) \frac{2\delta \rho L \sigma_a^2}{w(1-\delta) - \delta^2 \rho L \sigma_a^2} = 0 \end{aligned} \quad (34)$$

The first term is zero from (31') so that we have

$$\text{sgn} \Omega_{t|_{g=0=t, s=s^*}} = \text{sgn} \left\{ \rho L^2 \sigma_a^2 \left[ \rho e^* + s(1-\delta) \frac{2\delta \lambda w}{w(1-\delta) - \delta^2 \rho L \sigma_a^2} \right] \right\} \quad (35)$$

Now  $\Omega_{\lambda} = 0$  implies that  $s > 0$  ( $T^0 > 0$ ) so that  $\Omega_{t|_{g=0=t, s=s^*}} > 0$  under uncertainty and risk aversion ( $\sigma_a^2, \rho > 0$ ). The other way round, one gets from (30)

$$\begin{aligned} \Omega_{t|_{g=s=0}} = 0 & \Leftrightarrow \\ & -e^* \rho L (w - \rho(1-t)L\sigma_a^2) + \lambda w L \left[ 1 + t(1-\delta) \frac{w(1-\delta) + 2\delta \rho L(1-t)\sigma_a^2}{w(1-\delta)(1-t) - \delta^2 \rho(1-t)^2 L \sigma_a^2} \right] = 0 \end{aligned} \quad (36)$$

Given  $t = t^*$ , the expression (29) can be modified into

$$\begin{aligned}
\Omega_s|_{g \rightarrow 0, t=t^*} &= -e^* \rho w L (1-t) \\
&+ \lambda w L \left[ 1 + t \left( (1-\delta) \frac{\delta^2 \rho (1-t)^2 L \sigma_a^2}{w(1-\delta)(1-t) - \delta^2 \rho (1-t)^2 L \sigma_a^2} - \delta \right) \right] \\
&= -w L (1-t) \left[ \rho e^* - \lambda \left( 1 + t(1-\delta) \frac{w(1-\delta)}{w(1-\delta)(1-t) - \delta^2 \rho (1-t)^2 L \sigma_a^2} \right) \right] \\
&= - \left( \rho^2 L^2 e^* \sigma_a^2 + \lambda w L \frac{t 2 \delta \rho (1-t) \sigma_a^2 (1-\delta)}{w(1-\delta)(1-t) - \delta^2 \rho (1-t)^2 L \sigma_a^2} \right) (1-t)
\end{aligned} \tag{37}$$

by (36). The expression (37) can be transformed into

$$\text{sgn} \Omega_s|_{g \rightarrow 0, t=t^*} = -\text{sgn} \left\{ \rho L^2 \sigma_a^2 \left( \rho e^* + \lambda w \frac{t 2 \delta (1-\delta)}{w(1-\delta) - \delta^2 \rho (1-t) L \sigma_a^2} \right) (1-t) \right\} \tag{38}$$

Now  $\Omega_\lambda = 0$  implies that  $t > 0$  ( $T^0 > 0$ ) so that  $\Omega_s|_{g \rightarrow 0, t=t^*} < 0$  if  $t < 1$  when there is uncertainty and risk aversion ( $\sigma_a^2, \rho \geq 0$ ). On the other hand  $\Omega_t = 0$  is incompatible with  $t = 1$ . In fact  $\lim \Omega_t \rightarrow -\infty$  so that  $t^* < 1$ . Finally,  $t \rightarrow 1$ . (29) implies

$$\lim_{g \rightarrow 1} \Omega_s|_{t=0} = e^* \rho w L \left( A - \frac{1+sA}{1+2} \right) < 0 \quad \text{as } s \neq -1 \tag{39}$$

so that there is no tax structure under full corporatism.  $\square$

Thus under idiosyncratic uncertainty the structure of labour taxation matters, when trade unions are risk averse. Under these circumstances, employment is too low and risk-sharing is not efficiently allocated. A rise in the income tax decreases risk and thus makes risk-sharing better, while the role of the payroll subsidy is to correct disformation due to the wage setting of the trade union. It is not optimal for incentive reasons to eliminate all the risk by setting  $t = 1$ .<sup>12</sup>

<sup>12</sup> This result can be regarded as a variant of the diversification theorem by Brainard (1969). Brainard showed that under certain type of uncertainty the policy maker should use all available instruments at his disposal rather than just one to meet his objective. The reason is that by diversifying in this way, the associated risks can be reduced.

## 4 Concluding remarks

According to the conventional theory of competitive labour markets the formal incidence of income and payroll taxes is irrelevant in the sense that it does not matter in terms of the welfare effects which side the tax is levied on. In this paper this issue has been re-examined under imperfectly competitive labour markets by using the monopoly union model of wage and employment determination adjusted for corporatism as the vehicle for analysis. It has been shown that the irrelevance of the structure of labour taxation holds under equal tax bases and certainty even when labour markets are imperfectly competitive. Trade unions create a distortion in the labour market by setting wage rate to a too high level; with only one distortion it does not matter which instrument – income or payroll taxation – is used to eliminate that. Optimal policy in the first best sense is to subsidize unions, and the more so the higher is the degree of corporatism measured by the perceived connection between taxes paid and benefits received. The structure of labour taxation matters even under certainty if tax bases are unequal e.g. due to a tax exemption provided that there is some degree of corporatism. This is roughly because under corporatism a rise in payroll taxation induces benefits and thereby decreases distortion by lowering the wage rate.

The structure of labour taxation matters if there is idiosyncratic uncertainty about a component of wage and trade unions are risk averse. Under these circumstances it is desirable to use both income and payroll taxation. Trade unions create a distortion and risk is inefficiently allocated so that one needs to instruments to deal with two inefficiencies. Given the positive income tax it is desirable to introduce a subsidy to employers. Roughly, the income tax serves as social insurance to decrease risk associated with the wage rate and the payroll subsidy is assigned to deal with labour market distortion. Under full corporatism the tax structure is irrelevant even under uncertainty.

There are areas for further research. First, the framework should be extended to deal with issues of open economies, where factors of production show various degrees of mobility and where wages affect the country's terms of trade (see Rama (1994) for a preliminary analysis of some of the issues). Second, the framework could be used to study the employment effects of the compensated change in the structure of labour taxation, which will keep the government tax revenue unchanged.

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