Economics Letters 64 (1999) 343–349

economics letters

Does the composition of wage and payroll taxes matter under Nash bargaining?

Erkki Koskela[a,*], Ronnie Schöb[b]

[a]Department of Economics, University of Helsinki, P.O. Box 54, Unioninkatu 37, FIN-00014 Helsinki, Finland
[b]Center for Economic Studies, University of Munich, Schackstrasse 4, D-80539 Munich, Germany

Received 10 August 1998; accepted 9 April 1999

Abstract

Using the Nash bargaining approach to wage negotiations this paper shows that conventional wisdom, according to which the total tax wedge is the sum of wage and payroll taxes, is valid for equal tax bases, e.g. when the tax exemption takes the form of a tax credit. However, the equivalence result ceases to hold when the tax bases are unequal due to tax allowances. In this case a revenue-neutral restructuring of labour taxes towards a narrower tax base decreases the gross wage and is thus good for employment.

Keywords: Tax wedge; Payroll tax; Wage tax; Wage bargaining; Non-equivalence

JEL classification: H20; J51

1. Introduction

According to conventional wisdom it does not matter who *de jure* pays the tax on labour. Gross nominal wages are the same regardless of whether the employer pays a payroll tax or the employee pays a wage tax. Layard et al. (1991, pp. 209–210) use this conjecture in their empirical study of non-competitive labour markets. They argue that the total tax wedge, which is the sum of the wage and payroll taxes, is sufficient to specify the distortion of wage formation caused by labour taxation. In theoretical studies on tax incidence and wage formation no distinction is usually made between wage and payroll taxes, though there is some empirical evidence which suggests that the two types of labour taxes might have different effects on wage formation (see, e.g., Lockwood and Manning, 1993; Holm et al., 1994).

*Corresponding author. Tel.: +358-9-191-8894; fax: +358-9-191-8877.
E-mail address: erkki.koskela@helsinki.fi (E. Koskela)

0165-1765/99/$ – see front matter
PII: S0165-1765(99)00102-0

This paper shows within a 'right-to-manage' wage bargaining model that if the government grants a personal tax allowance to workers, which is deductible from taxable income, payroll taxes and wage taxes differ in their impact on the gross wage rate and thereby on employment. In the presence of a personal tax allowance, the wage tax turns out to have a smaller tax base than the payroll tax. Hence any revenue-neutral increase in the wage tax must be higher than the associated fall in the payroll tax. This increases the marginal tax rate while leaving the average tax rate constant. As the recent literature on tax progression has pointed out, an increase in the tax progression leads to a fall in gross wages and boosts employment because the trade union's benefit from wage increases becomes less. By contrast, if the government grants a personal tax credit, which is deductible from the tax payments, both labour taxes turn out to be equivalent as the tax bases and, therefore, tax progression, remain the same.

Section 2 develops the Nash bargaining approach to describe wage negotiation with the relevant comparative statics, while Section 3 studies the impact of a revenue-neutral restructuring of labour taxation and presents the main results. Section 4 provides the economic interpretation for these results.

2. The Nash bargaining model of wage negotiation

We consider a single firm which produces good Y with capital K and labour L as inputs. The technology is linear-homogenous, the elasticity of substitution σ is assumed to be constant. We assume imperfect competition in the goods market, i.e. each single firm faces a downward sloping demand curve which is assumed to be iso-elastic, $Y = D(p) = p^{-\varepsilon}$, with p denoting the output price and $\varepsilon \equiv -(\partial D/\partial p)\cdot(p/D)$ the output demand elasticity. To guarantee a profit maximum the output demand elasticity must exceed unity. Profits are given by

$$\pi = pY - \tilde{w}L - rK,$$

whereby the firm considers the interest rate r and the wage rate $\tilde{w}$ as given. The wage $\tilde{w}$ paid by firms may consist of the nominal wage w, actually paid to the employee, and a payroll tax t_p, i.e. $\tilde{w} = (1 + t_p)w$.

The trade union operates at the firm level and its objective is to maximize the income of its N members. Each worker supplies one unit of labour if employed, or zero labour if unemployed. In the former case the worker receives a wage income (net of the payroll tax) w. Each worker has to pay a wage tax t_w on the wage income minus a personal tax allowance a. In addition, the worker might be eligible to a tax credit c which she can deduct from her total tax payment. Unemployed workers are entitled to unemployment benefits b. The objective function of the trade union can then be written as

$$V^* = (w(1 - t_w) + t_w a + c)L + b(N - L).$$

We use the 'right-to-manage' approach so that w is determined in a bargaining process between the trade union and the firm and the firm unilaterally determines employment. The fall-back position of the trade union is given by $V^0 = bN$, i.e. all members receive their reservation wage which is equal to the unemployment benefit. The fall-back position for the firm is given by zero profits, i.e. $\pi^0 = 0$. The Nash bargaining maximand can then be written as

$$\Omega = (V^* - V^0)^\beta \pi^{1-\beta},$$

with β representing the bargaining power of the trade union. Using $V \equiv V^* - V^0$, the first-order condition with respect to nominal wage is

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

where variables with subscripts refer to partial derivatives (e.g., $V_w = \partial V/\partial w$). For the comparative statics of the wage tax t_w and the payroll tax t_p, we make use of the explicit form of the first-order condition, which can be written as

$$\Omega_w = (w(1-t_w) + t_w a + c - b)[\beta\eta_{L,\tilde{w}} + (1-\beta)s(1-\varepsilon)] + w(1-t_w)\beta = 0. \quad (1)$$

In Eq. (1), s denotes the share of labour cost in total cost, $s \equiv \tilde{w}L/cY$, with $c = c(\tilde{w},r)$ denoting the (constant) marginal cost, and $\eta_{L,\tilde{w}}$ the wage elasticity of labour demand, which can be derived analogously to the case of perfect competition (cf. Allen, 1938):

$$\eta_{L,\tilde{w}} \equiv \frac{L_{\tilde{w}}\tilde{w}}{L} = -\sigma + s(\sigma - \varepsilon).$$

The second-order condition is given by

$$\Omega_{ww} = y + xz < 0,$$

with $y = (1-t_w)[\beta(1+\eta_{L,\tilde{w}}) + (1-\beta)s(1-\varepsilon)]$, $z = [\beta(\sigma-\varepsilon) + (1-\beta)(1-\varepsilon)]s_{\tilde{w}}(1+t_p)$ and $x = w(1-t_w) + t_w a + c - b$, where we have taken into account the effect changes in the negotiated wage rate have on the cost share of labour s. The comparative statics of the net-of-tax wage with respect to the wage tax rate t_w and the payroll tax rate t_p follows straightforwardly from implicit differentiation of Eq. (1). Expressing the comparative statics results in elasticity forms, we obtain

$$\omega_{t_w} \equiv \frac{w_{t_w}(1-t_w)}{w} = (y+xz)^{-1}\left[y - \frac{a}{w}(y-\beta)\right], \quad (2)$$

$$\omega_{t_p} \equiv \frac{w_{t_p}(1+t_p)}{w} = -(y+xz)^{-1}xz. \quad (3)$$

The personal tax allowance a moderates a wage increase due to an increase in the wage tax rate, but does not have a direct effect on the change of the negotiated wage if the payroll tax rate changes. By contrast, the tax credit c has no direct effect in either Eq. (2) or Eq. (3). Note that the sign of z depends on the complementarity relationship of factors and on the elasticity of substitution. If factors are price complements, i.e. $\sigma - \varepsilon < 0$, we have $\text{sign}(z) = \text{sign}(1-\sigma)$.[1]

[1]This can be seen from differentiating the cost share of labour: $s_w = s_{\tilde{w}}(1+t_p) = (s/w)(1-s)(1-\sigma)$.

3. Variations in the structure of labour taxes

In order to analyze the impact a revenue-neutral change in the structure of labour taxation has on the gross wage and thereby on employment, we have to formulate the government budget constraint

$$G = [(t_w + t_p)w - t_w a - c]L - b(N - L). \tag{4}$$

The condition for a revenue-neutral change in tax progression is given by

$$dG = 0 = G_{t_w} dt_w + G_{t_p} dt_p \Leftrightarrow dt_w = -G_{t_w}^{-1} G_{t_p} dt_p.$$

For the Laffer curve being upward-sloping, i.e. $G_{t_p}, G_{t_w} > 0$, we can now develop the formula for the gross wage effect of a revenue-neutral tax reform. The total differential of the gross wage $\tilde{w} = w(1 + t_w)$ with respect to t_w and t_p can be written as $d\tilde{w} = w dt_p + (1 + t_p)(w_{t_p} dt_p + w_{t_w} dt_w)$. Utilizing the definitions for elasticities from Eqs. (2) and (3) we end up with

$$d\tilde{w} = w\left[(1 + \omega_{t_p})dt_p + \frac{(1 + t_p)}{(1 - t_w)}\omega_{t_w} dt_w\right]. \tag{5}$$

Finally, by substituting the revenue-neutrality condition for dt_w in Eq. (4) we can derive the impact a revenue-neutral restructuring of labour taxation has on the gross wage:

$$\left.\frac{d\tilde{w}}{dt_w}\right|_{dG=0} = G_{t_p}^{-1} w\left[-G_{t_w}(1 + \omega_{t_p}) + G_{t_p}\frac{(1 + t_p)}{(1 - t_w)}\omega_{t_w}\right]. \tag{6}$$

In order to evaluate Eq. (6) we need to develop explicit formulas for the marginal tax revenues which account for the direct and indirect effects of taxes via the negotiated wage rate and employment. It is shown in Appendix A that

$$G_{t_w} = wL\left[1 - \frac{a}{w} + \frac{\psi}{(1 - t_w)}\omega_{t_w}\right] \tag{7}$$

and

$$G_{t_p} = wL\left[1 + \frac{\psi}{(1 + t_p)}\omega_{t_p} + \frac{\psi - (t_w + t_p)}{(1 + t_p)}\right], \tag{8}$$

where $\psi \equiv t_w + t_p + (t_w + t_p + (b - t_w a - c)/w)\eta_{L,\tilde{w}}$. The expression in parentheses in Eq. (6), which determines the sign of the change of the gross wage rate, can now be calculated by using Eqs. (2), (3), (7) and (8):

$$-G_{t_w}(1 + \omega_{t_p}) + G_{t_p}\frac{(1 + t_p)}{(1 - t_w)}\omega_{t_w} = -(1 + \omega_{t_p})\left(1 - \frac{a}{w}\right) + \omega_{t_w}. \tag{9}$$

As Eqs. (2) and (3) imply that $\omega_{t_w} = (1 + \omega_{t_p}) - (y + xz)^{-1}a(y - \beta)w^{-1}$, substituting this value for ω_{t_w} in Eq. (9) yields after some further manipulations

$$-G_{t_w}(1+\omega_{t_p}) + G_{t_p}\frac{(1+t_p)}{(1-t_w)}\omega_{t_w} = (y+xz)^{-1}\frac{a\beta}{w}\left\{\begin{matrix}<\\=\end{matrix}\right\}0 \Leftrightarrow a\left\{\begin{matrix}>\\=\end{matrix}\right\}0 \quad (10)$$

Condition (10) in combination with Eq. (6) shows that if the personal tax allowance a granted to workers is positive, a shift of labour taxes towards wage taxes reduces the gross wage rate and boosts employment. As the wage tax is levied on the tax base $(w - a)$ while the payroll tax is levied on the wage rate w, this can be summarized as follows.

Non-equivalence result. Under Nash bargaining a revenue-neutral tax reform which reduces the payroll tax rate and increases the wage tax rate will decrease the gross wage rate and boosts employment if the employee's tax base is narrower than the employer's tax base.

If the tax allowance a is zero, a revenue-neutral restructuring will have no effect on gross wages so that the structure of labour taxation becomes irrelevant. This result holds irrespective of the value the tax credit c takes. In the absence of a personal tax exemption, tax bases are equal. Hence, this result can be summarized as follows.

Equivalence result. Under Nash bargaining a revenue-neutral tax reform affects neither the gross wage rate nor employment when the tax bases are equal, as is the case when the tax exemption takes the form of a tax credit.[2]

4. Interpretation of the results

Whether payroll taxes and wage taxes are equivalent or not turns out to depend on whether a change in the structure of labour taxation affects tax progression. Restructuring labour taxation may change tax progression for two reasons. First, if the income changes as a result of the tax reform, the actual tax progression will change for any given tax schedule. Second, as the tax rate changes, the tax schedule may change for any given income. The recent literature on tax progression (cf., e.g., Koskela and Vilmunen, 1996) has pointed out that if the tax progression increases at a given level of income, gross wages will fall and employment will boost because the trade union's benefit from wage increases become less. Hence, by looking at the question of whether the incentives for the trade union have changed due to a change in the structure of labour taxation, we have to see whether the reform has changed the tax schedule.

An appropriate and intuitive way to define tax progression is to look at the average tax rate progression, which is given by the difference between the marginal tax rate t^m and the average tax rate t^a

$$\mathrm{ARP} = t^m - t^a.$$

The tax system is progressive if ARP is positive, and tax progression is increased if the difference

[2] Holm and Koskela (1996) proved the non-equivalence and the equivalence result under the more restrictive assumption of a monopoly trade union and for the special case of a constant wage elasticity of labor demand. They do not, however, make the important distinction between tax allowance and tax credit.

increases (at a given income level; cf. Lambert, 1989, p. 159). Defining the tax wedge for a worker with respect to the gross wage rate, the marginal tax wedge is given by $t^{m} \equiv (t_w + t_p)/(1 + t_p)$ and the average tax wedge by $t^{a} \equiv t^{m} - (t_w a + c)/\tilde{w}$. Hence, we have

$$\mathrm{ARP} = t^{m} - t^{a} = \frac{t_w a + c}{\tilde{w}}.$$

If there is no personal tax allowance, $a = 0$, Eq. (6) shows that the gross wage $\tilde{w}$ does not change and the average tax rate progression is independent of the tax rates t_w and t_p. If, however, the government grants some personal tax allowances, i.e. $a > 0$, the tax progression increases as a result of a revenue-neutral shift towards higher wage taxes:

$$\left.\frac{\mathrm{dARP}}{\mathrm{d}t_w}\right|_{\mathrm{d}G=0} = \frac{a}{\tilde{w}}\left[1 - \frac{t_w}{\tilde{w}}\frac{\mathrm{d}\tilde{w}}{\mathrm{d}t_w}\Big|_{\mathrm{d}G=0}\right] > 0.$$

As the wage tax has a smaller tax base than the payroll tax, the increase in the wage tax must be higher than the fall in the payroll tax which increases the marginal tax rate for a given average tax rate. It is therefore the effect a change in the structure of labour taxation has on the progressivity of the tax schedule which drives our result. As tax progression is good for employment in unionized labour markets a shift away from payroll taxes towards wage taxes moderates gross wages and alleviates unemployment.

Acknowledgements

The first author is indebted to the Research Unit on Economic Structures and Growth (RUESG) for financial support and the CES in Munich for its great hospitality. We are grateful to an anonymous referee for helpful comments.

Appendix A. Derivation of Eqs. (7) and (8)

Differentiating the government budget constraint (4) with respect to t_w yields

$$\begin{aligned} G_{t_w} &= (w - a)L + (t_w + t_p)Lw_{t_w} + (t_w(w - a) - c + b + t_p w)L_{\tilde{w}}(1 + t_p)w_{t_w} \\ &= wL\left[1 - \frac{a}{w} + \frac{1}{1 - t_w}\left(t_w + t_p + \left(t_w + t_p + \frac{b - t_w a - c}{w}\right)\eta_{L,\tilde{w}}\right)\omega_{t_w}\right], \end{aligned} \tag{A.1}$$

which gives Eq. (7). Analogously, the differentiation with respect to t_p gives

$$\begin{aligned} G_{t_p} &= wL + (t_w + t_p)Lw_{t_p} + (t_w(w - a) - c + b + t_p w)L_{\tilde{w}}w + (t_w(w - a) + t_p w)L_{\tilde{w}}(1 + t_p)w_{t_p} \\ &= wL\left[1 + \frac{1}{1 + t_p}\left(t_w + t_p + \left(t_w + t_p + \frac{b - t_w a - c}{w}\right)\eta_{L,\tilde{w}}(1 + \omega_{t_p})\right)\right], \end{aligned} \tag{A.2}$$

which is Eq. (8) of the text.

References

Allen, R.G.D., 1938. Mathematical Analysis for Economists, Macmillan, London.

Holm, P., Honkapohja, S., Koskela, E., 1994. A monopoly union model of wage determination with capital and taxes: an empirical application to the Finnish manufacturing. European Economic Review 38, 285–303.

Holm, P., Koskela, E., 1996. Tax progression, structure of labour taxation and employment. Finanzarchiv 53, 28–46.

Koskela, E., Vilmunen, V., 1996. Tax progression is good for employment in popular models of trade union behaviour. Labour Economics 3, 65–80.

Lambert, P.J., 1989. The Distribution and Redistribution of Income. A Mathematical Analysis, Basil Blackwell, Cambridge, MA.

Layard, R., Nickell, S., Jackman, R., 1991. Unemployment: Macroeconomic Performance and the Labour Market, Oxford University Press, Oxford.

Lockwood, B., Manning, A., 1993. Wage setting and the tax system. Journal of Public Economics 52, 1–29.