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Abstract

We model a two sector economy with unionized labor markets and competitive product markets, where workers and unions care about their relative wages, and show that the presence of a relative wage concern could help generation a positive relationship between tax progressivity and wage pressure.

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1 Introduction

Changes in labor tax progressivity, holding average labor taxes constant, can affect wage pressure and unemployment. The empirical evidence on this relationship is mixed. Lockwood and Manning [1993], Malcomson and Sartor [1984] and Holmlund and Kolm [1995] find a negative relationship. Newell and Symons [1993], Brunello, Parisi and Sonedda [2002] and Lockwood et al. [2000] find a positive relationship between tax progressivity and either unemployment or pretax wages.

In the literature, the impact of tax progressivity on pretax wages is usually decomposed into a *wage moderation effect* and a *labor supply effect.* The wage moderation effect occurs because, when the marginal tax rate increases, the price in terms of foregone employment of a higher take - home pay goes up. This allows the union to buy more employment through wage moderation, because a given fall in the pre-tax wage leads to a smaller change in the after tax wage. The labor supply effect can generate higher wage pressure when an increase in tax progressivity reduces the supply of working hours, because the income effect is dominated by the substitution effect. If the wage moderation effect prevails over the labor supply effect, higher labor tax progressivity reduces pretax wages and unemployment.

In this paper, we add to the wage moderation and labor supply effects another mechanism, *the relative wage effect*, and show how it influences the relationship between tax progressivity and the pretax wage in unionized labor markets. Briefly put, when individuals and unions care about relative wages and an increase in tax progressivity reduces the own wage via the wage moderation effect, this reduction translates into lower relative wages, which can only be avoided by increasing wage pressure.

2 The Model

Consider a closed economy characterized by two sectors and composed of three economic agents: households, unions and firms. Skilled workers are employed in one sector (the skilled sector) and unskilled workers work in the other sector (the unskilled sector). Each sector is fully unionized and for simplicity we assume that both unions have monopoly power over wage setting. The labor force is constant and individuals earn only wage income. Hours of work are fixed, so there is no labor supply effect by assumption.

This economy is populated by a fixed number of identical competitive firms, indexed by j. Their technology is described by the following production function:

$$Y_{ji} = \alpha_i L_{ji}^{\sigma_i} \tag{1}$$

where $i = u, s$ stands for "unskilled" and "skilled" respectively and α_i is a productivity parameter. By assumption $\alpha_u < \alpha_s$ and both σ_u and σ_s are lower than 1.

In both sectors the labor input L_{ji} is homogeneous and hours of work are fixed and normalized to 1. Therefore, provided that the goods market is competitive, labor demand can be obtained by inverting the first order condition of the profit function:

$$L_{ji} = N_{ji}(w_{ji}) = \left[\frac{w_{ji}}{\alpha_i \sigma_i}\right]^{\frac{1}{\sigma_i - 1}} \tag{2}$$

Risk neutral skilled and unskilled individuals care about their consumption and their relative position in the distribution of income. They have homothetic preferences described by a utility function, separable over consumption and the wage differential between their own wage and the wage of the other group.

The utility function is linear in both arguments and takes the following form:

$$U^{i,m} = c_i + a_i \left[w_i (1 - t_i) - w_k (w_i) (1 - t_k)\right] \tag{3}$$

where $k \neq i = u, s$; $m = e\,(employed)$, $un\,(unemployed)$; c_i denotes consumption, the term $[w_i(1-t_i) - w_k\,(w_i)\,(1-t_k)]$ is the wage differential and $t_i = t_u, t_s$ denotes the average personal income tax rate of unskilled and skilled workers respectively. Finally a_i is a parameter that measures the marginal utility of the wage differential[1]. Since each agent internalizes the effect of changes in the own wage on the other wage, the term $w_k\,(w_i)$ in the utility function captures the conjecture on how the other wage is expected to respond. We assume that the conjectural variation $\frac{dw_k}{dw_i}$ is equal to a positive constant $\varphi_i > 0$.

There is no saving and households face the following budget constraint:

$$\omega_i^m = c_i^m \tag{4}$$

where

$$\omega^m = \begin{cases} w_i - T(w_i, z) & if \quad employed \\ b_i \quad if & unemployed \end{cases}$$

with $w_i - T(w_i, z)$ as the income net of taxes and b_i as unemployment benefits, which are determined by some political-economy mechanism outside the model and are not taxable by assumption. As in Lockwood and Manning (1993), $T(w_i, z)$ is for personal labor income taxes and z is a vector of parameters (marginal tax rates, tax brackets...) which takes into account any non-linearities in the tax system.

Each sector is characterized by the presence of a monopolistic union which sets the sectorial wage by taking into account the effects of its own decision on the other sector wage. Following Dowrick [1989], we interpret the parameter $0 < \varphi_i < 1$ as a measure of the degree of centralization in the wage setting process. When $\varphi = 0$ ($\varphi = 1$) wage determination is fully decentralized (fully centralized). Since the output price index is normalized to unity, setting nominal (pretax) wages is equivalent to setting real wages. Unions are unable to affect fiscal policy decisions and their aim is to maximize the expected utility of members subject to (2). The union optimization problem is:

[1] We believe that the introduction of the wage differential in the utility function cannot be considered as arbitrary since fairness or envy motives truly affect behaviour. See Fehr and Schimdt [1999], who refer to a more general context than the labor market.

$$\max_{w_i} N_i\left(w_i\right)\left[U_i^e - U_i^{un}\right] \tag{5}$$

Following Lockwood and Manning (1993), we express (5) in logs and define the first order condition ψ as:

$$\psi_i = 0 = \frac{\frac{\partial N_i(w_i)}{\partial w_i}}{N_i\left(w_i\right)} + \frac{\frac{\partial\left[U_i^e - U_i^{un}\right]}{\partial w_i}}{\left[U_i^e - U_i^{un}\right]} \tag{6}$$

where $\frac{\partial\left[U_i^e - U_i^{un}\right]}{\partial w_i} = \frac{\partial\left[U_i^e - U_i^{un}\right]}{\partial w_i} + \frac{\partial\left[U_i^e - U_i^{un}\right]}{\partial wj}\frac{\partial w_j}{\partial w_i}$. We can use (3) and rewrite (6) as

$$\psi_i = \left\{ \begin{matrix} w_u - \frac{b_u}{1-t_u} M_u = 0 \quad if \quad i=u \\ w_s - \frac{b_s}{1-t_s} M_s = 0 \quad if \quad i=s \end{matrix} \right. \tag{7}$$

with M_i as the union markup in sector i, defined as

$$M_i = \left\{ \begin{matrix} \left[(1+a_u)(\nu_u(\sigma_u - 1)+1) - \frac{(1-t_s)}{(1-t_u)}(\sigma_u - 1)a_u\nu_s\varphi_s - \frac{a_u}{RW}\right]^{-1} \quad if \quad i=u \\ \left[(1+a_s)(\nu_s(\sigma_s - 1)+1) - \frac{(1-t_u)}{(1-t_s)}(\sigma_s - 1)a_s\nu_u\varphi_u - a_s RW\right]^{-1} \quad if \quad i=s \end{matrix} \right.$$

In the above expression ν is the coefficient of residual income progression $\left(\nu_i = \frac{1-\tau_i}{1-t_i}\right)$; the marginal tax rate τ_i is equal to $\frac{\partial T(w_i)}{\partial w_i}$ and RW is the relative post tax wage $\frac{w_u(1-t_u)}{w_s(1-t_s)}$.

Sectorial wages in the two reaction functions defined by (7) are increasing functions of unemployment benefits and of the union markup. We can decompose this markup into three components. The first term, $((1+a_i)(\nu_i(\sigma_i - 1)+1))$, is the well know wage moderation effect; the second term, $\left(\frac{(1-t_k)}{(1-t_i)}(\sigma_i - 1)a_i\nu_k\varphi_k\right)$, is generated by the presence of conjectural variations, and we define the last term as the relative wage concern. The markup is increasing in the first term, decreasing in the second term and either decreasing (M_u) or increasing (M_s) in the relative wage. An equilibrium of this game requires that each union achieve positive utility. This condition is guaranteed if each sectorial wage is higher than unemployment benefits. The second order conditions of the optimization problem (5) are met if $(1+a_i)(1-\tau_i) > a_k(1-\tau_k)\varphi_k$, which surely holds when a and τ are not too different.

3 Analysis

In this section we study how changes in the labor tax parameters affect equilibrium skilled and unskilled pre-tax wages. In order to do so, it is convenient to re-write (7) in implicit form as follows

$$\psi_u = \psi_u(w_u, w_s(w_u), \nu_u, \nu_s, X_u) = 0 \tag{8}$$

$$\psi_s = \psi_s(w_u(w_s), w_s, \nu_s, \nu_u, X_s) = 0 \tag{9}$$

where $X_i \in (a_i, \sigma_i, b_i, t_i)$. Total differentiation of (8) and (9) and the application of Cramer's rule allows us to establish the following

Remark 1 *Given the average tax rate and with fixed hours, an increase in tax progressivity v_i has both a wage moderation effect and a relative wage effect, with an ambiguous overall effect on the determination of wage w_i.*

Proof.

$$\frac{dw_i}{d\nu_i} = -\frac{\left[\frac{\partial\psi_i}{\partial\nu_i}\frac{\partial\psi_k}{\partial w_k} + \frac{\partial\psi_i}{\partial\nu_i}\frac{\partial\psi_k}{\partial w_k}\frac{\partial w_i}{\partial w_k}\right] - \left[\frac{\partial\psi_k}{\partial\nu_i}\frac{\partial\psi_i}{\partial w_k} + \frac{\partial\psi_k}{\partial\nu_i}\frac{\partial\psi_i}{\partial w_i}\frac{\partial w_i}{\partial w_k}\right]}{|J|} \gtreqless 0 \tag{10}$$

where $\frac{\partial\psi_k}{\partial w_k} < 0$; $\frac{\partial\psi_i}{\partial\nu_i} > 0$; $\frac{\partial\psi_i}{\partial w_i} < 0$; $\frac{\partial w_i}{\partial w_k} > 0$; $\frac{\partial\psi_i}{\partial w_k} > 0$; $\frac{\partial\psi_k}{\partial w_i} > 0$; $\frac{\partial\psi_k}{\partial\nu_i} < 0$

See the Appendix for details. ■

As usual, the sign of (10) depends on the numerator since the sign of the denominator corresponds to the sign of the determinant of the Jacobian matrix J, which must be positive to guarantee the stability of the system. Following Padilla, Bentolila and Dolado [1996], we distinguish between a direct effect (shift of the reaction curve), captured by the terms in the former bracket in the numerator, and a strategic effect (movement along the reaction curve), represented by the terms in the latter bracket.

The relative wage effect on the reaction curve associated to the i sector workers is captured by the second term in the first bracket in the numerator. In the absence of this effect and of the strategic effect, given by the first term in the second bracket, the sign of the derivative is positive, which suggests that an increase in tax progressivity should reduce the pretax wage in sector i. This is the well known wage moderation effect. The presence of a relative wage concern combined with a certain degree of centralization in the wage determination process adds to this the relative wage effect. On the one hand, the union in the i sector, aware of the fact that a decline in the own wage induced by higher tax progressivity in its sector will reduce its relative wage, reacts by increasing wage pressure. On the other hand, the union in sector k realizes that the union in sector i could avoid the (expected) reduction in its relative wage by bargaining for a higher wage (or by going for lower wage moderation). In order to prevent the deterioration of its own relative wage, the union in the k sector will also react by increasing its own wage pressure. These effects are amplified by the strategic complementarity between the two wages and generate an increase in wage pressure. Therefore, the wage moderation and the relative wage effect have opposite influences on the wage determination. The overall effect is ambiguous and depends on the parameters of the model.

Remark 2 *Given the average tax rate and with fixed hours, the effect of an increase in tax progressivity ν_k on the i sector wage is ambiguous.*

Proof.

$$\frac{dw_i}{d\nu_k} = -\frac{\left[\frac{\partial\psi_i}{\partial\nu_k}\frac{\partial\psi_k}{\partial w_k} + \frac{\partial\psi_i}{\partial\nu_k}\frac{\partial\psi_k}{\partial w_i}\frac{\partial w_i}{\partial w_k}\right] - \left[\frac{\partial\psi_k}{\partial\nu_k}\frac{\partial\psi_i}{\partial w_k} + \frac{\partial\psi_k}{\partial\nu_k}\frac{\partial\psi_i}{\partial w_i}\frac{\partial w_i}{\partial w_k}\right]}{|J|} \gtreqless 0 \tag{11}$$

where $\frac{\partial\psi_k}{\partial w_k} < 0$; $\frac{\partial\psi_i}{\partial\nu_k} < 0$; $\frac{\partial\psi_k}{\partial w_i} > 0$; $\frac{\partial w_i}{\partial w_k} > 0$; $\frac{\partial\psi_k}{\partial\nu_k} > 0$; $\frac{\partial\psi_i}{\partial w_k} > 0$; $\frac{\partial\psi_i}{\partial w_i} < 0$.

See the Appendix for details. ■

In the absence of a relative wage concern, an increase in tax progressivity in the k sector ν_k has no impact on the i sector wage. When wages are strategic complements and conjectural variations are introduced, the presence of a relative wage effect implies that the wage moderation effect on the k sector wage spills over to the i sectorial wage, with uncertain overall effects.

The effect of changing tax progressivity (e.g. a ceteris paribus variation of ν_i or ν_k) on the determination of the two sectorial wages works in the same direction but is asymmetric in size. Finally, consider a general rise in the degree of tax progressivity (e.g. $\nu_{i=u}$ and $\nu_{k=s}$ increase by the same amount). The sign of this effect is clear since the *wage moderation effect* triggers *the relative wage effect*. The size of the effect, however, is asymmetric and depends on the values of the underlying parameters. In particular, the relative pretax wage $\left(\frac{w_u}{w_s}\right)$ increases if the direct effect (shift of the reaction curve) is lower than strategic effect (movement along the reaction curve)[2].

To summarize, our simple model suggests that, in unionized labor markets where unions care about the wage differential and make conjectures about the effects of changes in their own wages on the other wages, changes in tax progressivity have ambiguous effects on wage pressure. There are two important mechanisms at work: a) a union wage moderation effect; b) a relative wage effect. To these we should also add the hours supply effect, that was not included in the model for the sake of simplicity. While the former effect reduces wage pressure in the presence of an increase in tax progressivity, the other two effects increase it.

Our results are robust to different model specifications. If we rule out conjectural variations and consider instead a framework where employers determine employment in either sector and the two unions are completely collusive, an increase in tax progressivity raises (reduces) the unskilled wage w_u if and only if $a_u > 1 + a_s$ $(a_u < 1 + a_s)$. Furthermore, the ambiguous effect on wage determination could also be obtained in a simple Bertrand-Nash game under the assumption that skilled and unskilled wages bear equal marginal and average tax rates (e.g when tax brackets are quite large).

[2] Since by assumption $w_u < w_s$, the unskilled wage reaction curve is flatter tha the skilled wage curve.

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4 Appendix

Remark 1:

The explicit form of the total differential $\frac{dw_i}{d\nu_i}$ can be decomposed in a relative wage (RW) and wage moderation (WM) effect. These effects are:

$$a_k\phi_i\frac{a_i}{w_i}\left[1+a_k-a_kRW-\frac{b_k}{w_k\left(1-t_k\right)}\right]\left[\nu_i\left(1+a_i\right)-a_i\nu_k\phi_k\frac{1-t_k}{\left(1-t_i\right)}\right] \qquad \text{(RW)}$$

$$+\left(1+a_i\right)\left[1+a_i-a_iRW^{-1}(1-t_i)^2)-\frac{b_i}{w_i\left(1-t_i\right)}\right]\left[\left(1-t_k\right)a_i\frac{b_i}{\left(-1+t_i\right)^2w_i}\right]$$

$$\left[(\frac{a_k}{w_k}\frac{1-t_i}{1-t_k})*\left(\left(\nu_k*\left(1+a_k\right)\right)-\left(a_k\nu_i\phi_i*\left(1-t_i\right)/\left(1-t_k\right)\right)\right)\right]$$

$$\left(1+a_i\right)\left[\frac{a_k}{w_k}RW+\frac{b_k}{w_k^2\left(1-t_k\right)}\right] \qquad \text{(WM)}$$

$$\left[1+a_i-a_iRW^{-1}-\frac{b_i}{w_i\left(1-t_i\right)}\right]\left[\nu_k\left(1+a_k\right)-a_k\nu_i\phi_i\frac{1-t_i}{\left(1-t_k\right)}\right]$$

$$+\frac{a_k}{1-t_i}\frac{\phi_i}{1-t_k}\left(\left(\nu_i\left(1+a_i\right)\right)-\left(a_i\nu_k\phi_k(1-t_k)\,/\left(1-t_i\right)\right)\right)$$

$$\left(\frac{a_iRW}{w_i}+\frac{b_i}{w_i^2\left(1-t_i\right)}\right)\left[\left(1-t_k\right)a_i\frac{b_i}{\left(1-t_i\right)w_i}\right]$$

$$\left[1+a_k-a_kRW-\frac{b_k}{w_k\left(1-t_k\right)}\right]$$

Whether or not the relative wage effect dominates the wage moderation strictly depends on the values of the underlying parameters, on the relative wage RW and on the two sectorial wages.

Remark 2:

The explicit form of the total differential $\frac{dw_i}{d\nu_i}$ can be decomposed in a relative wage (RW) and wage moderation (WM) effect. These effects are:

$$[1+a_k]\,\frac{a_i RW^{-1}}{w_k}\left[1+a_k-a_k RW-\frac{b_k}{w_k\,(1-t_k)}\right] \tag{RW}$$
$$\left[\nu_i\,(1+a_i)-a_i\nu_k\phi_k\frac{1-t_k}{(1-t_i)}\right]+a_i\frac{1-t_k}{1-t_i}\phi_i$$
$$\left[1+a_i-a_i RW^{-1}(1-t_i)^2-\frac{b_i}{w_i\,(1-t_i)}\right]\left[(1-t_k)\,a_i\frac{b_i}{(-1+t_i)^2\,w_i}\right]$$
$$\left[(\frac{a_k}{w_k}\frac{1-t_i}{1-t_k})\,((\nu_k*(1+a_k))-(a_k\nu_i\phi_i*(1-t_i)\,/(1-t_k)))\right]$$

$$a_i\phi_k\quad\left[\frac{a_k w_i}{w_k}+\frac{b_k\,(1-t_k)}{w_k^2\,(1-t_k)\,(1-t_i)}\right]\left[1+a_i-a_i RW^{-1}-\frac{b_i}{w_i\,(1-t_i)}\right]$$
$$\left[\nu_k\,(1+a_k)-a_k\nu_i\phi_i\frac{1-t_i}{(1-t_k)}\right]+[1+a_k]*\left[1+a_k-a_k RW-\frac{b_k}{w_k\,(1-t_k)}\right]$$
$$((\nu_i\,(1+a_i))-(a_i\nu_k\phi_k(1-t_k)\,/1-t_i)) \tag{WM}$$
$$\left(\frac{a_i RW}{w_i}+\frac{b_i}{w_i^2\,(1-t_i)}\right)*\left[(1-t_k)\,a_i\frac{b_i}{(1-t_i)\,w_i}\right]$$