Efficient Taxation, Wage Bargaining and Policy Coordination*

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Abstract

This paper concerns optimal nonlinear taxation under right-to-manage wage formation, and we assume that the fall-back profit facing firms during wage bargaining depends on the profit they can obtain if moving production abroad. The purpose is to study how policy coordination among countries can be used to increase the welfare level in comparison with an uncoordinated equilibrium. We consider coordinated policy reforms with respect to the marginal taxation of labor income, the unemployment benefit and the provision of a public good.

Keywords: Optimal taxation, policy coordination, union wage setting

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1 Introduction

Capital is highly mobile across countries, implying that independent national governments may adjust their public policies in order to compete for mobile capital. This idea has inspired a considerable amount of research on tax competition[1]. A central message is that tax competition gives rise to a suboptimal resource allocation from society's point of view. One possible outcome is undertaxation of capital in an uncoordinated equilibrium which may, in turn, give rise to underprovision of public goods[2]. Therefore, to solve this resource allocation problem, some degree of policy coordination may become necessary.

The threat of capital flight also influences the labor market: it can be used by firms during bargaining as a tool to moderate wage claims. This idea follows from the observation that the bargained wage rate is, in general, a decreasing function of the 'fall-back' profit facing the firm, i.e. the profit level that can be obtained in case no agreement is reached. In an open economy, the fall-back profit (or outside opportunity) is likely to be the profit that the firm can obtain if moving production abroad. The resulting interaction among countries is also important for public policy; the policy undertaken by the government in any country gives rise to external effects in other countries because it influences the outcome of wage bargaining. Therefore, if each national government treats the private and public decision variables of other countries as exogenous, the uncoordinated equilibrium is likely to be inefficient. To our knowledge, it has not been recognized in previous studies on optimal taxation that wage formation in any country may impose external

[1] For an overview, see Wilson (1999).

[2] Two early references are Zodrow and Mieszkowski (1986) and Wilson (1986).

effects on other countries.

This paper relates to the literature on optimal nonlinear taxation of labor income under imperfect competition in the labor market[3]. We extend the analytical framework of previous studies primarily by considering a multi-country economy, where the countries interact via the system of wage formation in the way described above. The purpose is to study how reforms designed to impose some degree of policy coordination among countries can be used to increase the welfare in comparison with an uncoordinated equilibrium. We shall distinguish between two different versions of the model: one in which each national labor market is characterized by imperfect competition, and the other where only part of the countries have imperfectly competitive labor markets. In real world market economies, the degree of competition in the labor market differs substantially between countries, implying that the 'outside options' facing firms in any country may differ accordingly. In addi-

[3]There are relatively few previous studies on efficient nonlinear taxation under imperfect competition in the labor market. Fuest and Huber (1997) consider the implications of wage bargaining between unions and firms for optimal labor income taxation in an economy where the hours of work per employee are fixed. One of their contributions is to relate the degree of progression of the labor income tax to the structure of wage bargaining. Aronsson and Sjögren (2002a) analyze optimal taxation and provision of public goods in the context of the mixed tax problem, where the set of policy instruments contains a nonlinear income tax and linear commodity taxes. Their main contribution is to derive policy rules for the tax instruments and the public good under union wage setting. Finally, Aronsson and Sjögren (2002b) relate the optimal degree of tax progression in a unionized economy to the choice of hours of work. They show how the optimal degree of tax progression depends on whether the employed individuals choose their hours of work themselves conditional on the wage rate, or whether the union chooses the hours of work per employee.

tion, since the results, to a large extent, depend on which regime is chosen, it is interesting to make this distinction also from a theoretical point of view. Throughout the paper, we assume that imperfect competition in the labor market is a result of the influence of unions on wage formation.

To be able to focus on the relationship between taxation and imperfect competition in the labor market, we follow Fuest and Huber (1997) and Aronsson and Sjögren (2002b) by abstracting from asymmetric information and other motives for tax progression at the national level that also apply under perfect competition. Instead, the motives for tax progression at the national and global levels discussed here are due to imperfect competition in the labor market. This simplification makes the analytical framework much more convenient than it would otherwise have been, although the mechanisms we wish to highlight are valid also in a more complex framework.

The contribution of the paper is to focus on the relationship between wage bargaining and the possible gains from policy coordination. We consider three aspects of public policy; (i) the marginal taxation of labor income, (ii) the level of unemployment benefits and (iii) the level of a public good. The basic question is whether these policy instruments are chosen to be too high or too low in a noncooperative equilibrium, where all countries (or, equivalently, jurisdictions in a federation) choose their policies in isolation. This also provides the basis for analyzing policy reforms designed to impose some degree of coordination among countries.

The outline of the paper is as follows. In section 2, we present the basic model. Section 3 concerns the optimal tax structure and expenditures in an uncoordinated equilibrium. In Section 4, we consider policy coordination in case the individual countries are identical, meaning that all of them are characterized by imperfect competition in the labor market, whereas Section 5 considers policy coordination in case some of the countries are perfectly competitive market economies. Section 6 summarizes the results.

2 The Model

Consider an economy with J identical countries (or jurisdictions). Each country is characterized by a competitive goods market, in which identical firms produce a homogenous good. The output price is determined on the world market and is exogenous to each individual country. To simplify the notations, we normalize the number of firms in each country to one. The production function facing the representative firm in each country is given by $f(L)$, where L is total employment measured as the hours of work per employee, l, times the number of employed persons, n. The production function satisfies the standard conditions $f_L > 0$ and $f_{LL} < 0$. The objective of the firm is to choose employment in order to maximize the profit, which is given by $\pi = f(L) - wL$, where w is the wage rate. Since the output price is exogenous, it has been set equal to one. Profit maximization defines a labor demand function, $L(w)$, and a profit function, $\pi(w)$, which are decreasing in w.

There are three types of consumers; employed workers, unemployed workers and firm-owners. The consumers have identical preferences defined by the utility function $u(c, z, g)$, where c is a private good, z leisure and g a public good. Leisure is, in turn, defined by $z = H - l$, where H is a time endowment. We assume that $u(\cdot)$ is increasing in each argument and strictly quasiconcave. Although the three types of consumers have identical preferences, to be able to distinguish between them we will use u^e, u^u and u^p to denote the utility of an employed worker, an unemployed worker and the firm-owner, respectively.

The number of firm-owners will be normalized to one for notational convenience. To simplify the analysis, we assume that the firm-owner does not work, meaning that his/her consumption is given by $c^p = \pi(1-s)$, where s is the profit income tax rate[4]. As a consequence, the utility of the firm-owner becomes $u^p(\pi(1-s), H, g)$.

There are m workers in the labor force, among which n are employed and $m-n$ unemployed. An unemployed worker receives a net of tax unemployment benefit, b, in which case his/her utility becomes $u^u(b, H, g)$. An employed worker, on the other hand, faces the budget constraint $c^e = wl - T(wl)$, where $T(wl)$ is the labor income tax. The tax function is continuously differentiable, and the marginal and average tax rates are defined as $t_m = \partial T(\cdot)/\partial[wl]$ and $t_a = T(\cdot)/wl$, respectively. The first order condition for the hours of work is written

$$u_c^e w(1-t_m) - u_z^e = 0 \tag{1}$$

which is standard and needs no further interpretation.

[4]The profit income tax is levied on the firm-owner. An alternative would be to introduce a corporate tax. The only difference between these two taxes in terms of the model is that a corporate tax affects the wage rate, which is determined by bargaining between unions and firms (see below), whereas the profit income tax does not. We have chosen to use the profit income tax instead of the corporate tax, since the profit income tax does not influence any behavior in terms of the model. This makes it easier to focus explicitly on the role of labor income taxation as a means to improve the resource allocation under imperfect competition in the labor market.

The labor market is characterized by the influence of unions on wage formation. We assume that all workers are union members. In addition, wage formation is local in the sense that each union treats the policy instruments of the government as exogenous[5]. Given these characteristics, the number of unions is not important. In what follows, we normalize the number of unions to one. The union acts in accordance with the expected utility framework, and its objective function is given by

$$U = \frac{n}{m} u^e \left(wl - T\left(wl\right), H - l, g \right) + \left(1 - \frac{n}{m} \right) u^u \left(b, H, g \right) \tag{2}$$

The wage rate is determined by bargaining between the union and the firm. As such, the wage formation part of the model will be described by the 'right-to-manage' framework[6]. If no contract is signed, the union members become unemployed and obtain the fall-back utility, u^u, which is exogenous to the union by the assumption of local wage formation above, whereas the firm has the option to move abroad (or outside the jurisdiction) in case no agreement is reached. If the firm moves abroad, it receives the profit $\pi^0 \left(w^0\right)$, where w^0 is the foreign wage rate. Moving production abroad is associated with a cost, q, meaning that the fall-back profit becomes $\bar{\pi} = \pi^0 \left(w^0\right) - q$. By defining $\Phi = U - u^u$ and $\Psi = \pi - \bar{\pi}$, respectively, to be the rents from bargaining, the outcome of the bargain will be the wage rate that maximizes the Nash product

$$\Omega = \Phi^{\alpha} \Psi^{1-\alpha} \tag{3}$$

[5]Although bargaining systems differ across countries, Calmfors (1993) argues that there has been a tendency towards more decentralized wage formation.

[6]See Oswald (1985).

subject to the labor demand, $n = L(w)/l$, where α is the relative bargaining power of the union. By assuming that the wage rate is decided upon conditional on l, the first order condition can be written[7]

$$\Omega_w = [\alpha\Psi U_w + (1-\alpha)\Phi\pi_w]\Phi^{\alpha-1}\Psi^{-\alpha} = 0 \tag{4}$$

where $U_w = L_w(u^e - u^u)/lm + L(1-t_m)u_c^e/m$ and $\pi_w = -L$. We assume that the second order sufficient condition, $\Omega_{ww} < 0$, is fulfilled. Note finally that equation (4) implies $U_w > 0$.

3 The Uncoordinated Optimal Tax Problem

In previous studies on optimal taxation and provision of public goods under imperfect competition in the labor market, such as Fuest and Huber (1997), Aronsson et al. (2002) and Aronsson and Sjögren (2002b), the authors assume a Utilitarian social welfare function (or an extension thereof). We will follow their approach and assume that the social welfare function is of the Utilitarian type;

$$W = nu^e(c^e, H-l, g) + (m-n)u^u(b, H, g) + u^p(\pi^n, H, g) \tag{5}$$

The set of policy instruments facing each national government consists of the parameters of the labor income tax function, $T(\cdot)$, the profit income tax

[7]Other possible specifications would be to assume that the union recognizes how the hours of work chosen by its members respond to a change in the wage rate, or that the union and the firm also bargain over the hours of work. We will not consider these possible extensions here. The optimal degree of tax progression at the national level in case the hours of work per employee are chosen by a monopoly union is discussed by Aronsson and Sjögren (2002b).

rate, s, the public good, g, and the unemployment income, b. Note that by choosing the parameters of $T(\cdot)$, the government can induce any desired combination of c^e and l, meaning that (c^e, l) and the parameters of $T(\cdot)$ constitute two equivalent sets of policy instruments. As it turns out, it is more convenient to use c^e and l instead of the parameters of the tax function as decision variables of the government.

To simplify the analysis, we assume that the utility of being employed exceeds the utility of being unemployed, i.e. $u^e > u^u$, at the optimal tax policy, meaning that we do not have to impose such a constraint on the optimization problem. The government maximizes the social welfare function subject to equations (1), (4) and the labor demand, which together represent the private decision variables, as well as subject to its budget constraint. Since the government chooses $T(\cdot)$ via c^e and l, it will be convenient to rewrite equation (4) by eliminating the term $(1 - t_m)$ in the expression for U_w. By using equation (1), we can rewrite U_w as

$$U_w = \frac{L_w}{lm}\left[u^e\left(c^e, H - l, g\right) - u^u\left(b, H, g\right)\right] + \frac{L}{wm}u_z^e\left(c^e, H - l, g\right) \tag{6}$$

Substituting equation (6) into equation (4), we obtain a modified first order condition for the wage rate, $\tilde{\Omega}_w = 0$. As such, the equilibrium wage rate is defined as an implicit function of some of the decision variables facing the government; c^e, l, g and b, as well as of the relative bargaining power of the union and the fall-back profit of the firm. This 'reduced form' wage equation is written

$$w = w\left(c^e, l, g, b, \alpha, \bar{\pi}\right) \tag{7}$$

To be able to carry out the comparative statics analysis below, and in accordance with the assumption that the union obeys the second order sufficient condition for a maximum, we assume that $\tilde{\Omega}_{ww} < 0$.

Turning to the budget constraint facing the government, the tax revenues, $nT(\cdot) + s\pi$, will be used to finance the public good, g, and unemployment benefits, $(m-n)b$. By using the private budget constraint, $c^e = wl - T(wl)$, and that the number of employed persons is given by $n = L(w)/l$, the government's budget constraint can be written as

$$s\pi(w) + [b + wl - c^e]\frac{L(w)}{l} - bm - g = 0 \tag{8}$$

The Lagrangean is given by

$$\mathfrak{L} = \frac{L(w)}{l}u^e(c^e, H-l, g) + \left[m - \frac{L(w)}{l}\right]u^u(b, H, g)$$

$$+u^p(\pi^n, H, g) + \mu\left[s\pi(w) + (b + wl - c^e)\frac{L(w)}{l} - bm - g\right]$$

where $w = w(c^e, l, g, b, \alpha, \bar{\pi})$ is given by equation (7) and μ is the Lagrange multiplier associated with the budget constraint. The first order conditions become

$$\frac{\partial \mathfrak{L}}{\partial g} = nu_g^e + (m-n)u_g^u + u_g^p - \mu + \frac{\partial W}{\partial w}\frac{\partial w}{\partial g} = 0 \tag{9}$$

$$\frac{\partial \mathfrak{L}}{\partial b} = (m-n)(u_c^u - \mu) + \frac{\partial W}{\partial w}\frac{\partial w}{\partial b} = 0 \tag{10}$$

$$\frac{\partial \mathfrak{L}}{\partial c^e} = n(u_c^e - \mu) + \frac{\partial W}{\partial w}\frac{\partial w}{\partial c^e} = 0 \tag{11}$$

$$\frac{\partial \mathfrak{L}}{\partial l} = \frac{n}{l}[\mu(c^e - b) - (u^e - u^u)] - nu_z^e + \frac{\partial W}{\partial w}\frac{\partial w}{\partial l} = 0 \tag{12}$$

$$\frac{\partial \mathfrak{L}}{\partial s} = \pi(\mu - u_c^p) = 0 \tag{13}$$

where $\partial W/\partial w = \partial \mathfrak{L}/\partial w$, since the social welfare function is equal to the Lagrangean at the optimum. Then, by defining $\varepsilon = L_w w/L < 0$ to be the wage elasticity of the labor demand, we have

$$\frac{\partial W}{\partial w} = \frac{L_w}{l}\left(u^e - u^u\right) - (1-s)\, L u_c^p + \mu L \left[1 - s + \varepsilon\left(t_a + \frac{b}{wl}\right)\right] \tag{14}$$

Equation (14) measures the welfare effects of an increase in the wage rate. The first two terms on the right hand side are negative, since an increase in the wage rate reduces the number of employed persons, $n = L/l$, as well as reduces the consumption possibility of the firm owner. The third term on the right hand side is associated with the effect on the government's budget contraint of an increase in the wage rate. This effect consists of three parts; (i) the increase in the labor income tax base, L, (ii) the loss of revenues from the profit income tax, $-Ls$, and (iii) the loss of labor income tax revenues net of transfer payments due to reduced employment, $L\varepsilon(t_a + b/wl) = L_w(T+b)/l$. Unless the utility gain associated with an increase in the labor income tax base is very large, one would normally expect $\partial W/\partial w < 0$. The intuition for this 'normal case' is straight forward: by reducing the wage rate at the margin, the number of employed persons increases, which also increases the welfare level.

Tax and Expenditure Policies in the Uncoordinated Equilibrium

In the analysis of policy coordination to be carried out below, the uncoordinated equilibrium constitutes the prereform situation. It is, therefore, important to discuss some of the properties of the uncoordinated equilibrium in more detail. In particular, how does union wage setting affect the incentives underlying public policy? The labor income tax structure implicit in the uncoordinated equilibrium is similar to that of a 'one-country' model economy, which is characterized by Aronsson and Sjögren (2002b) in the context of monopoly union wage formation. We shall briefly extend their results to the right-to-manage framework as well as derive some additional results with respect to the tax structure. More specifically, we show that the marginal labor income tax rate is positive, and the tax structure progressive in the sense that $t_m/t_a > 1$[8], if $\partial W/\partial w \leq 0$ and $u_{cz}(c, z, g) \geq 0$. To describe the optimal labor income tax structure, it will be convenient to define a relationship between the marginal labor income tax rate and the average labor income tax rate. In the Appendix, we show that this relationship can be written as follows in the uncoordinated equilibrium;

$$t_m = \left(t_a + \frac{b}{wl}\right)\frac{\mu}{\theta u_c^e} + \frac{(u^e - u^u)}{\theta u_c^e wl} - \frac{\delta\Psi}{\theta\eta u_c^e nw}\frac{\partial W}{\partial w} \tag{15}$$

where

$$\begin{aligned}
\eta &= l^2 m\Phi^{1-\alpha}\Psi^{\alpha}\tilde{\Omega}_{ww} < 0 \\
\delta &= \alpha L_w \left(u^e - u^u\right) - \alpha l^2 L u_{cz}^e + \frac{\alpha l^2 L u_{zz}^e}{w} \\
\theta &= 1 - \frac{l\gamma}{n\eta}\frac{\partial W}{\partial w} \\
\gamma &= \alpha L_w \Psi - (1-\alpha) L^2 < 0
\end{aligned}$$

To understand equation (15), it is important to observe that an increase in the hours of work per employee tends to decrease the number of employed persons. This is so for two reasons: first, there is a direct tradeoff between work hours and employment (since $n = L/l$) and, second, an increase in the

[8] See Musgrave and Musgrave (1984).

hours of work leads to a higher wage rate which, in turn, reduces the number of employed persons. The latter result is derived from the reduced form wage equation, and we show in the Appendix that $\partial w / \partial l > 0$.

Although the two influences of l described above are present in equation (15), they are not easily separated in terms of the tax formula. Except for the influence of the parameter θ, the first two terms on the right hand side reflect the direct tradeoff between the hours of work per employee and the number of employed persons. The first term is a budget effect for the government of an increase in the number of employed persons, since each additional worker who becomes employed gives rise to an increase in the tax revenues net of transfer payments equal to $t_a wl + b$, whereas the second term measures the direct utility gain of being employed instead of unemployed. If $\partial W / \partial w \leq 0$, in which case $\theta > 0$, the first and second terms on the right hand side of equation (15) contribute to increase the marginal labor income tax rate over the average labor income tax rate. Note also that, in the special case where $\partial W / \partial w = 0$, the first and second terms on the right hand side are only associated with the direct effect of l on n, and their influence would imply that the marginal labor income tax rate is positive and the tax structure progressive.

The third term on the right hand side of equation (15), finally, depends on the indirect effect of l on n, which arises via the change in w, as well as on the effect of c^e on w (see the Appendix). If consumption and leisure are weak complements in the sense that $u_{cz}(c, z, g) \geq 0$, and if $\partial W / \partial w < 0$ (> 0), this term works as an incentive to further reduce (increase) the hours of work per employee. The requirement that $u_{cz}(c, z) \geq 0$ means that an increase in private consumption (weakly) increases the marginal utility of leisure, which induces the union to try to increase the wage rate and, therefore, reduce the number of employed persons. In the normal case, where $\partial W/\partial w < 0$, this tendency to increased wage rate is offset by reducing the hours of work per employee via the labor income tax.

Turning to the optimal unemployment benefit, we can derive the following result by differentiating the reduced form wage equation;

$$\frac{\partial w}{\partial b} = \frac{u_c^u \left[\alpha \Psi L_w - (1-\alpha) L^2\right]}{lm\Phi^{1-\alpha}\Psi^{\alpha}\tilde{\Omega}_{ww}} > 0 \tag{16}$$

Equation (16) implies that the wage rate is an increasing function of the unemployment benefit, which is a conventional result in the theory of wage formation. By combining equation (10) and (16), and if $\partial W/\partial w < 0$, it follows that right-to-manage wage formation tends to restrict the unemployment benefit.

Finally, the wage rate may either increase or decrease in response to an increase in the public good. This is seen if we differentiate the reduced form wage equation with respect to g, which gives

$$\frac{\partial w}{\partial g} = -\frac{\alpha \Psi U_{wg} + (1-\alpha)\Phi_g \pi_w}{\Phi^{1-\alpha}\Psi^{\alpha}\tilde{\Omega}_{ww}} \tag{17}$$

where $U_{wg} = [L_w/(lm)][u_g^e - u_g^u] + [L/(wm)]u_{zg}^e$, $\Phi_g = U_g - u_g^u$ and $U_g = [n/m]u_g^e + [1-n/m]u_g^u$. Equation (17) suggests that an increase in the public good can generally affect the wage rate in either direction. The qualitative effect is in a sense related to whether the public good is complementary with, or substitutable for, either private consumption or leisure. For instance, if the public good is complementary with leisure in the sense that $u_{zg}(c, z, g) > 0$, and if this complementarity is strong enough to imply $u_g^e < u_g^u$ at the uncoordinated equilibrium, then $\partial w/\partial g > 0$. The intuition is that the union, in this case, has an incentive to offset the increased demand for leisure associated with a higher g by increasing the wage rate. If, on the other hand, the public good is complementary with private consumption, and leisure is weakly separable from the other goods in terms of the utility function, then $\partial w/\partial g < 0$. By combining equations (9) and (17) we can see that if $\partial W/\partial w < 0$, and if $\partial w/\partial g > 0$ (< 0), the system of wage formation works to reduce (increase) the optimal public good. In the special case where the utility function is additively separable in the public good, $\partial w/\partial g = 0$.

4 Policy Coordination in a Symmetric Equilibrium

Since each national government treats the private and public decision variables of other countries as exogenous, it is clear that the uncoordinated equilibrium is inefficient. A basic question is, therefore, how coordinated fiscal actions can be used to improve the resource allocation. However, 'coordinated fiscal actions' need not necessarily imply attempts to implement the cooperative equilibrium concept. In fact, real world cooperations seldomly (or never) refer to all policies. It is, perhaps, more realistic to assume that countries agree upon smaller projects, the purpose of which are to improve the resource allocation in comparison with a noncooperative regime. The concern of this section is the welfare effects of such projects.

More specifically, and given the set of policy instruments discussed above, is it possible to design coordinated policy reforms such that the welfare increases in all countries? Throughout the analysis in this section, we assume that each national government adjusts its profit income tax to maintain balance of the budget and then consider coordinated changes in the other policy instruments. To begin with, we assume that the countries are identical which means, among other things, that they are all characterized by imperfect competition in the labor market. In the next section, we relax the symmetric equilibrium assumption and, instead, assume that part of the countries are characterized by perfect competition.

Lemma 1 simplifies the analysis below;

Lemma 1: *In the uncoordinated symmetric equilibrium, and if* $\partial W/\partial w < 0$ *(*> 0*), a small coordinated reduction (increase) of the hours of work per employee increases the welfare in all countries.*

Proof. Consider how a coordinated change in the hours of work affects the welfare level in the representative country. A small increase in the 'domestic' hours of work has no first order welfare effect at the national level, since the hours of work per employee are already optimally chosen by each government in isolation. This is so because

$$\frac{\partial W}{\partial l} + \frac{\partial W}{\partial s}\frac{\partial s}{\partial l} = 0$$

at the uncoordinated equilibrium, where $\partial s/\partial l$ measures the adjustment in the profit income tax that is required to maintain budget balance for the government. What then remains is the welfare effect associated with a small increase in the 'foreign' hours of work, l^0. Differentiating the Lagrangian and the reduced form wage equation with respect to l^0 yields

$$\frac{\partial W}{\partial l^0} = \lambda \frac{\partial W}{\partial w}$$

where

$$\lambda = \frac{\partial w}{\partial \bar{\pi}} \frac{\partial \bar{\pi}}{\partial w^0} \frac{\partial w^0}{\partial l^0} > 0$$

Therefore, $sign\, \partial W/\partial l^0 = sign\, \partial W/\partial w$, which establishes Lemma 1. ■

The intuition behind Lemma 1 follows from the wage formation system in the identical economies. A decrease in the foreign hours of work reduces the foreign wage rate. This leads to an increase in the foreign profit level, π^0, and, therefore, to an increase in the fall-back profit $\bar{\pi}$. As a consequence, the domestic wage rate falls.

Is it possible to implement the change in the hours of work analyzed in Lemma 1 by means of tax policy? Consider a coordinated change in the marginal labor income tax rates, which is carried out subject to the constraint that the consumption of the employed workers remains constant. To be able to analyze the consequences of marginal income taxation, it will be convenient to reparameterize the wage equation such that its dependence on the marginal income tax rate becomes explicit. By using equation (4), we can define $w = \omega(c^e, l, g, b, t_m, \alpha, \bar{\pi}) = \phi(c^e, g, b, t_m, \alpha, \bar{\pi})$, where the second equality comes from equation (1) which implicitly defines $l = \varrho(c^e, w, t_m)$. The following result is a direct consequence of Lemma 1;

Proposition 1 *In the uncoordinated symmetric equilibrium, consider a coordinated policy reform such that each country slightly increases (decreases) the marginal labor income tax rate, t_m, with c^e held constant. Then, if (i) $u_{cz}(c, z, g) \geq 0$, (ii) $d[w(1 - t_m)]/dt_m < 0$, and (iii) $\partial W/\partial w < 0$ (> 0), welfare increases in all countries.*

To see this result, consider the first order condition for the hours of work, $u_z^e/u_c^e = w(1 - t_m)$. Suppose that the reform discussed in Proposition 1 decreases the right hand side of this expression via an increase in t_m. Then, if $u_{cz}(c, z, g) \geq 0$, the left hand side will also decrease if the hours of work decrease. The associated welfare effect then follows directly from Lemma 1. Complementarity between private consumption and leisure is needed to assure that the only way to unambiguously decrease the marginal rate of substitution between leisure and private consumption, if c^e is held constant, is to decrease the hours of work, while $d[w(1-t_m)]/dt_m < 0$ rules out that the general equilibrium effect on w (which may go in either direction) is strong enough to fully offset the direct effect of t_m on the marginal wage rate. If the increase in the marginal labor income tax rate discussed in Proposition 1 reduces the gross labor income, wl, it also implies that the marginal labor income tax rate increases relative to the average labor income tax rate. Defining the degree of tax progression by the ratio t_m/t_a, and if $\partial W/\partial w < 0$, it follows that the degree of tax progression is inefficiently low in the uncoordinated equilibrium.

The effect of policy coordination of the unemployment benefit is discussed in Proposition 2;

Proposition 2 *In the uncoordinated symmetric equilibrium, and if* $\partial W/\partial w < 0$ *(*> 0*), a small coordinated reduction (increase) of the unemployment benefit increases the welfare in all countries.*

The proof of Proposition 2 is analogous to the proof of Lemma 1 and is, therefore, omitted. The intuition is again based on the observation that the unemployment benefit is optimally chosen by each national government conditional on $\bar{\pi}$, meaning that a coordinated change in the unemployment benefit will affect each national welfare level via the fall-back profit alone.

Since an increase in the unemployment benefit abroad increases the bargained wage rate abroad, it will decrease the fall-back profit facing the domestic firms. As a consequence, if $\partial W/\partial w < 0$ (> 0), a welfare increase can be achieved by increasing (decreasing) the fall-back profit via a coordinated decrease (increase) in the unemployment benefit.

Turning, finally, to coordination in the provision of public goods, we can derive;

Proposition 3 *Suppose that the countries have reached the uncoordinated symmetric equilibrium prior to any coordination of the fiscal policy. Then, if* $\partial W/\partial w < 0$ *and* $\partial w/\partial g > 0$ (< 0)*, a small coordinated decrease (increase) of the public goods increases the welfare in all countries. If, on the other hand,* $\partial W/\partial w > 0$ *and* $\partial w/\partial g > 0$ (< 0)*, a small coordinated increase (decrease) in the provision of the public goods increases the welfare in all countries.*

Proof. By analogy to the proof of Lemma 1, the welfare effect in any country of policy coordination is given by

$$\frac{\partial W}{\partial g^0} = \rho \frac{\partial w^0}{\partial g^0}\frac{\partial W}{\partial w}$$

where $\rho = (\partial w/\partial \bar{\pi})(\partial \bar{\pi}/\partial w^0) > 0$. Therefore, if $\partial W/\partial w$ and $\partial w^0/\partial g^0$ have the same sign (are of opposite signs), then $\partial W/\partial g^0 > 0$ (< 0). ■

Let us concentrate the interpretation of Proposition 3 to the 'normal case', where $\partial W/\partial w < 0$. Although this assumption simplifies the interpretation, the welfare effect of coordinating the provision of the public goods is, nevertheless, ambiguous. The reason for this ambiguity is, of course, that an increase in the public good may affect the wage rate in either direction.

With reference to section 3, suppose that $u_{zg}(c, z, g) > 0$, and that the complementarity between z and g is strong enough to imply $u_g^e < u_g^u$ at the uncoordinated equilibrium. It follows that $\partial w/\partial g > 0$ and, as a consequence, $\partial W/\partial g^0 < 0$. The intuition is that a coordinated decrease in the provision of the public good increases the fall-back profit in each country which is, in turn, welfare improving by decreasing the wage rate and increasing employment. Similarly, if $u_g^e > u_g^u$ and $u_{cz}(c, z, g)$ is either nonpositive or sufficiently small in absolute value, we will obtain the opposite result in the sense that $\partial w/\partial g < 0$. In this case, a coordinated increase in the provision of public goods increases the fall-back profit for each individual country. As a consequence, it increases the welfare level in each country via a lower wage rate. Finally, if the utility function is additively separable in the public good, a small coordinated increase in the provision of public goods does not affect the welfare level.

5 Unionized and Competitive Economies

The analysis carried out in the previous section is based on the assumption that all countries are identical and characterized by imperfect competition in the labor market. In this section, we allow for one important difference between the countries by assuming that part of them are competitive. Except for the difference in wage formation processes, the countries are identical.

In the competitive economies, all m workers are employed. The labor market equilibrium means that supply equals demand

$$L(w) = ml \tag{18}$$

Equations (1) and (18) describe the equilibrium in the labor market in terms of l and w in the competitive countries. By analogy to the analysis carried out in section 3, the fiscal policy problem in a competitive country will be to choose g, c^e, l and s such as to maximize

$$W^c = m\, u^e(c^e, H - l, g) + u^p(\pi(w)(1 - s), H, g) \tag{19}$$

subject to

$$s\pi(w) + m(wl - c^e) - g = 0 \tag{20}$$

The first order conditions become

$$\frac{\partial \mathfrak{L}}{\partial g} = m u^e_g + u^p_g - \mu = 0 \tag{21}$$

$$\frac{\partial \mathfrak{L}}{\partial c^e} = u^e_c - \mu = 0 \tag{22}$$

$$\frac{\partial \mathfrak{L}}{\partial l} = -m\, u^e_z + \mu m w + \frac{\partial W}{\partial w}\frac{\partial w}{\partial l} \tag{23}$$

$$\frac{\partial \mathfrak{L}}{\partial s} = -u^p_c + \mu = 0 \tag{24}$$

where $\partial w/\partial l$ is determined by equation (18) and $\partial W/\partial w = u^p_c \pi_w(1 - s) + \mu s \pi_w + \mu m l$. Since $\mu = u^p_c$ according to equation (24), and $\pi_w = -L$, it follows that $\partial W/\partial w = 0$. Therefore, equation (23) reduces to read $-u^e_z + u^e_c w = 0$, meaning that the marginal income tax rate is zero. This means that the nondistortionary profit income tax is combined with a positive or negative lump-sum tax levied on the workers.

The wage rate is lower and the profit higher in the competitive countries than in the unionized countries. As a consequence, each unionized economy will only consider the competitive economies as objects for a possible fall-back investment in case the wage bargain fails. Therefore, the fall-back profit of the firm in a unionized economy becomes $\bar{\pi} = \pi^{\diamond}(w^{\diamond}) - q$, where $w^{\diamond}$ is the wage rate in the competitive economies[9]. We can derive;

Proposition 4 *If $\partial W/\partial w < 0$ (> 0) in the unionized economies, a policy reform that increases (decreases) the profit in the competitive economies can be designed such that the welfare increases in the unionized economies, while it leaves the welfare in the competitive economies unchanged.*

As an example, consider a small increase in the hours of work in the competitive economies. By using the profit function, we can derive the change in profit of a competitive economy as follows;

$$\frac{\partial \pi^{\diamond}}{\partial w}\frac{\partial w^{\diamond}}{\partial l} > 0$$

where $\partial w^{\diamond}/\partial l = \partial f_L(l^{\diamond}m)/\partial l < 0$. If the competitive economy adjusts its profit income tax to maintain balance of the budget constraint, the welfare effect becomes

$$\frac{\partial W^{\diamond}}{\partial l} + \frac{\partial W^{\diamond}}{\partial s}\frac{\partial s^{\diamond}}{\partial l} = 0$$

Finally, since $\partial w/\partial \bar{\pi} < 0$ in a unionized economy, its welfare increases (decreases) if $\partial W/\partial w < 0$ (> 0).

To be able to provide an interpretation, consider once again the normal case in the unionized economies where $\partial W/\partial w < 0$. One possible way

[9]Note that a requirement for the uncoordinated equilibrium to exist is that q is large enough to assure that no movements among firms take place as long as the wage rates are agreed upon in the unionized economies.

of increasing the hours of work in the competitive economies is to introduce a small subsidy of labor in combination with the restriction that the consumption should remain constant. If this reform increases the hours of work in the competitive economies, it also increases the welfare in the unionized economies, via the decrease in the wage rate implied by the higher fall-back profit, whereas the first order welfare effect is zero in the competitive economies. The latter implies that an agreement on such a policy reform might be difficult to reach. However, note that the government in each unionized economy is, in principle, willing to pay for this reform. It can do so by slightly increasing the nondistortionary profit income tax and transfer the revenues to the competitive economies.

6 Summary

This paper is related to the literature on optimal nonlinear taxation under imperfect competition in the labor market. The purpose is to analyze the welfare effects of policy reforms designed to introduce coordination among countries, in case the preexisting equilibrium means that each country has chosen its tax and expenditure policies in isolation. The paper is based on the assumption that right-to-manage wage formation causes imperfect competition in the labor market. Another basic assumption is that the countries interact via the wage formation system in the sense that the fall-back profit facing the firms during wage bargaining is the profit they can obtain if moving the production abroad minus a cost associated with such a move.

Under union wage formation, one would normally expect a negative (local) relationship between the wage rate and the welfare level. In this case, and if all countries are characterized by imperfect competition in the labor market, one can show that a symmetric uncoordinated equilibrium means that each country tends to choose too many work hours per employee and an inefficiently high level of the unemployment benefit. The reason is that the national governments treat the fall-back profits as exogenous. A policy reform designed to give a coordinated increase in fall-back profits decreases the wage rate and increases employment in each country. This can be accomplished by a coordinated decrease in the hours of work per employee (via the tax system) and/or a coordinated decrease in the unemployment benefits. Coordinated changes in the provision of public goods, on the other hand, may either increase or decrease the welfare level in each country, since the influence of the public good on the wage rate in each country is ambiguous.

If only part of the countries are characterized by imperfect competition in the labor market, while the other part represents perfectly competitive economies, the incentives for policy coordination are different from those mentioned above. Since the profit is higher under perfect competition than under union wage formation, ceteris paribus, the firms in the unionized economies will only consider the competitive economies as prospects for their fall-back investments in case no agreement is reached with respect to the wage rates. In this case, policy coordination with the purpose of increasing the profit in the competitive economies can be designed such that welfare increases in the unionized economies and remains unaffected in the competitive economies. The argument is, once again, that an increase in fall-back profits reduces the wage rate and increases employment in each unionized economy, whereas a small parametric policy change has no welfare effect in the competitive economies.

7 Appendix

To derive the relationship between the marginal labor income tax rate and the average labor income tax rate, let us substitute equation (11) into equation (12) and then use the private budget constraint, $c^e = wl - T(wl)$, together with the first order condition for the hours of work to obtain

$$t_m = \left(t_a + \frac{b}{wl}\right)\frac{\mu}{u_c^e} + \frac{(u^e - u^u)}{wlu_c^e} - \frac{\beta}{nwu_c^e}\frac{\partial W}{\partial w} \tag{A1}$$

where

$$\beta = w\frac{\partial w}{\partial c^e} + \frac{\partial w}{\partial l} \tag{A2}$$

By differentiating the reduced form wage equation with respect to c^e and l, respectively, we have

$$\frac{\partial w}{\partial c^e} = -\frac{\alpha l^2 m U_{wc^e}\Psi - (1-\alpha)\, L^2 l u_c^e}{l^2 m \Phi^{1-\alpha}\Psi^{\alpha}\tilde{\Omega}_{ww}} \tag{A3}$$

$$\frac{\partial w}{\partial l} = -\frac{\alpha l^2 m U_{wl}\Psi + (1-\alpha)\, L^2[(u^e - u^u) + lu_z^e]}{l^2 m \Phi^{1-\alpha}\Psi^{\alpha}\tilde{\Omega}_{ww}} > 0 \tag{A4}$$

where

$$U_{wc^e} = \frac{L_w}{lm}u_c^e + \frac{L}{wm}u_{cz}^e \tag{A5}$$

$$U_{wl} = -\frac{wL_w\left[(u^e - u^u) + lu_z^e\right] + l^2 L u_{zz}^e}{wl^2 m} > 0 \tag{A6}$$

Equations (A3) and (A4) imply

$$\beta = \frac{\delta\Psi}{\eta} - \frac{wu_c^e l\gamma}{\eta}t_m \tag{A7}$$

By substituting equation (A7) into equation (A1), we obtain equation (15).

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