Taxes, Employment, and Social Welfare Services: An Analysis of International Spillover Effects*

Yoshihiko Fukushima†

Abstract

The paper presents a theoretical analysis of the macroeconomic effects of the labour tax reduction in a two-country general equilibrium framework. Both labour and goods markets are imperfectly competitive. Wages are determined by monopoly unions. A change in the labour tax rate in one country gives rise to international spillover effects on the other country. The model formally identifies and analyses spillover effects via both the terms of trade and capital reallocation. A reduction in the labour tax rate in the domestic economy leads to a reduction in wage costs for employers in the private sector. As a result, private-sector employment is increased in the domestic economy. A spillover effect via the terms of trade tends to increase employment in the foreign country, whereas an effect via capital reallocation works in the opposite direction. The former effect, however, dominates the latter and thus employment tends to increase in the foreign country. Policy coordination leads to a lower tax rate, higher private-sector employment, and a smaller supply of social welfare services.

Keywords: Tax, employment, international spillover, social welfare, coordination
JEL classification: E61, F16, F21, F42, H55, J38, J51, I38

1 Introduction

High persistent unemployment rates in the European welfare states have been attributed to high real labour costs, which may, to a large extent, be explained by high labour taxes financing a generous welfare state (see e.g. Nickell and Layard, 1999; Calmfors and Holmlund, 2000 ; and Daveri and Tabellini, 2000). As a consequence, many proposals on how to reduce unemployment have focused on the need for welfare state reform and tax cuts. This paper analyses how a reduction in the labour tax is likely to affect employment, both domestically and abroad. The main focus will be on international spillover effects and the extent to which the amount of tax cuts and the macroeconomic outcomes will depend on whether labour taxation is coordinated among countries.

When one country reduces its tax on labour, this implies an increase in after-tax wages for workers, which may reduce wage costs for employers and encourage job creation. The country becomes more competitive and gains market shares from other countries. But employers in other countries may also benefit by relocating their business to that country, leading to increased job creation in that country and job destruction in other countries. As a result, there is an increase in the output of the country where wages decline and a decrease in other countries. Such a re-allocation of jobs can be regarded as a cost

* I am grateful for many useful suggestions by Lars Calmfors, Jonas Agell, Torsten Persson, and Hans Wijkander, and to participants in seminars at Stockholm University.

† Nagoya University of Commerce and Business Administration, 4–4 Sagamine Komenogi-cho Nisshin-shi Aichi 470–0193 Japan, E-mail: flipfuku@nucba.ac.jp

imposed by one country on others and it represents a negative spillover effect. A labour tax reduction may be regarded as unfair competition or *social dumping*.

However, if a labour tax reduction in one country increases its employment, there may also be positive spillover effects on other countries. An increase in employment in one country leads to higher output and a decline in its relative price of domestically produced goods. Thus, consumers in other countries can consume those products at a lower price. Moreover, an increase in the national income of that country also creates an increase in demand for products from other countries, which also tends to increase their output and employment. These are positive spillovers that tend to offset the negative effects of cutting wage costs in one country.

One strand of the literature focusing on international spillover effects of policies has been concerned with capital mobility. Most studies have examined the relationship between spillover effects of fiscal policies and capital mobility. (Wilson, 1986, 1999; Wildasin, 1988; Bucovetsky, 1991; Janeba, 1995; L pez et al., 1998; and S rensen, 2000). These studies concentrate on how changes in capital income taxes and public expenditure affect social welfare. Most of these studies conclude that the capital income tax will be inefficiently low, and that social welfare tends to fall under tax competition. Among the few models dealing with labour market equilibrium and capital mobility, Gabszewicz and Ypersele (1996) have analysed how the determination of the minimum wage by a median voter is affected by capital mobility in a two-country framework. They conclude that capital mobility always drives down the politically optimal minimum wage, when compared to the optimal minimum wage under autarky.

Another strand of literature has examined international spillover effects through the terms of trade. Most studies have examined the spillover effects of fiscal policies (Turnovsky, 1988; Devereux,1991; Levine and Brociner, 1994; Andersen and S rensen, 1995; Jensen, 1996; and Dixion and Santoni, 1997) and most of these conclude that uncoordinated policies lead to an overexpansion of government expenditure or/and too high tax rates. Holmlund and Kolm (1999) have investigated the spillover effects of employment policies, such as changes in the payroll tax and unemployment benefits, through the real exchange rate. Their numerical simulation suggests the gains from coordinated tax policies to be very small.

In this paper, I develop a framework that is used for an analysis of international spillover effects of labour tax reduction through both the terms of trade and capital mobility. With respect to capital, I examine two polar cases. The first case assumes the capital stock of each firm to be fixed while the second case instead assumes capital to be mobile between all firms, irrespective of whether these are domestic or foreign. In today's international world, these would seem to be the relevant cases, the first corresponding to the short-run and the second to the long-run scenario.[1)] I study how decisions on reform are influenced by whether they are coordinated between countries or taken in an uncoordinated way. When policy coordination is discussed in the European Union, considerable attention has been paid to monetary and fiscal polices, and much less to structural policies, such as reforms of labour taxation and labour market regulations (see e.g. Calmfors, 2002). Although my discussion formally only applies to one specific type of reform of labour taxation, the results can be expected to generalize to a wider class of labour market reforms working in the direction of reducing real wage costs (Saint-Paul, 1996; Calmfors, 2001).

Section 2 sets out the theoretical framework for a two-country model with imperfectly competitive labour and product markets. It analyses how a reduction in the labour tax rate influences the home and foreign economies when capital is immobile among firms in the country and also internationally. I also discuss the welfare implications of coordination. In Section 3, I

1) The "intermediate" traditional case of domestic capital mobility and international immobility no longer seems to be relevant for the OECD countries, as earlier capital controls have been abolished and a true international capital market now seems to exist. At present, it can hardly be claimed that it must be easier to re-allocate capital nationally than internationally.

analyse the case when capital is perfectly mobile among firms in the country and also internationally. A comparison between the uncoordinated and the coordinated equilibrium is also made in this section. Section 4 concludes.

2 The immobile capital case

2.1 The model

There are two countries in the model which use the same currency, i.e., they are members of a monetary union (like the EMU). All goods produced in both countries are tradable and the price of each good is the same in both countries.

Firms in both countries act as monopolistic competitors. Thus, the number of firms in each country also gives the number of goods produced in the country. I assume each country to have the same number of firms, and the total number of firms in the world to be exogenously given as F. Hence, there are $F/2$ firms in each country and each firm produces output with labour and capital. Labour is immobile between countries, wages are determined by monopoly unions and unemployment arises as an equilibrium phenomenon.

The total population in each country is the same and is exogenously given as M. There are five "groups' in each economy: (1) employed workers in the private sector; (2) employed workers in the public sector; (3) unemployed workers in the private sector; (4) unemployment in the public sector; and (5) capitalists. I let N_{i_p}, N_{i_g}, U_{i_p}, U_{i_g}, and $\widetilde{K}_i$ denote the total number of individuals in each group described above in country i ($i = 1,2$), respectively. I assume the private-sector and the public-sector labour markets to be entirely separated, so that there are no labour flows between the two sectors. The total number of workers in each sector is exogenously given as M_{i_p} and M_{i_g}, respectively. The total population in country i (M) is equal to $N_{i_p} + N_{i_g} + U_{i_p} + U_{i_g} + \widetilde{K}_i$. $\widetilde{K}_i$ is assumed to be exogenously given and thus, so is the total number of workers, i. e. $N_{i_p} + N_{i_g} + U_{i_p} + U_{i_g}$.

I assume that each capitalist owns one unit of capital. When capital is immobile, $\widetilde{K}_i$ also represents the total amount of capital used in production in country i. The total amount of capital in the world ($\widetilde{K}$) is assumed to be constant and there is no possibility for capital accumulation in the model, i.e. $\widetilde{K} = \widetilde{K}_1 + \widetilde{K}_2$.

2.1.1 Households

The individual's utility is additively separable and depends on: (1) consumption of private goods; (2) consumption of a "home-produced' good, which could either be regarded as leisure or a non-marketable good; and (3) consumption of social welfare services, which can be considered as a collective good. The production of the home good is so time-consuming that it can only be done if an individual is unemployed. Employed workers and capitalists obtain money income and use it for consumption of private goods. If an individual is unemployed, he has no money income and he consumes (enjoys) his own home production. I also assume that all individuals in the two countries have the same preference functions.

The utility function for the jth unemployed worker in country i ($u_{u_i}^j$) is given by

$$u_i^j = z + G_i \qquad (1)$$

z is home production, which is constant and the same for all unemployed workers in both countries. G_i is aggregate social welfare services provided by the government in country i.

The jth employed individual in country i ($u_{n_i}^j$) maximises the following utility function:

$$u_{n_i}^j = F^{\frac{1}{1-\theta}} C_i^j + G_i, \qquad (2)$$

where

$$C_i^j = \left(\sum_{h=1}^{\frac{F}{2}} \left(c_{1_h}^j\right)^{\frac{\theta-1}{\theta}} + \sum_{h=\frac{F}{2}}^{F} \left(c_{2_h}^j\right)^{\frac{\theta-1}{\theta}} \right)^{\frac{\theta}{\theta-1}}. \quad (3)$$

$c_{i_h}^j$ denotes the jth individual's consumption of the hth good produced in country i and θ is the elasticity of substitution in consumption. θ is assumed to be greater than unity, i.e. $\theta > 1$. As can be seen from (3), there is no distinction between home and foreign produced goods regarding the elasticity of substitution: all varieties enter symmetrically into the aggregate CES index (C_i^j). It is sometimes assumed that the elasticity of substitution is higher among domestic varieties than between domestic and foreign goods, but no important results hinge on this. I assume the same elasticity between all goods, to simplify the analysis[2)].

Let p_{i_h} denote the nominal price of good h in country i. The budget constraint for a non-unemployed individual is given by

$$\sum_{h=1}^{\frac{F}{2}} p_{1_h} c_{1_h}^j + \sum_{h=\frac{F}{2}}^{F} p_{2_h} c_{2_h}^j = I^j, \quad (4)$$

where I^j is the nominal after-tax income for each individual.

Maximising (2) w.r.t. $c_{i_h}^j$ subject to (4) gives the individual demand function for good h as

$$c_{i_h}^j = \left(\frac{1}{F}\right)\left(\frac{p_{i_h}}{P_c}\right)^{-\theta}\left(\frac{I^j}{P_c}\right), \quad (5)$$

where

$$P_c = \left(\frac{1}{F}\right)^{\frac{1}{1-\theta}} \left[\sum_{h=1}^{\frac{F}{2}} p_{1_h}^{1-\theta} + \sum_{h=\frac{F}{2}}^{F} p_{2_h}^{1-\theta} \right]^{\frac{1}{1-\theta}}. \quad (6)$$

P_c is the consumer price index, which will be the same for both countries due to the assumption of identical preferences and a common currency.

Substituting (5) into (2), the indirect utility function for the jth non-unemployed individual in country i ($v_{n_i}^j$) can be written:

$$v_{n_i}^j = \frac{I^j}{P_c} + G_i, \quad (7)$$

Equation (5) represents the jth individual's demand for the hth good. The demand depends on the real price of the good and the real income. Defining the world nominal income as I^w, the aggregate demand for good h can be expressed as

$$C_{i_h} = \left(\frac{1}{F}\right)\left(\frac{p_{i_h}}{P_c}\right)^{-\theta}\left(\frac{I^w}{P_c}\right). \quad (8)$$

2) This assumption is quite common in the recent literature of open-economy macroeconomic analysis (see e.g. Obstfeld and Rogoff, 1996, 2000; Obstfeld, 1999, 2001; Corsetti and Pesenti, 2001; and Lane, 2001).

where p_{i_h}/P_c is the real price of good h in terms of the consumer price index.

2.1.2 Firms

Each firm in country i has a Cobb-Douglas production function:

$$y_{i_h}=A_i n_{i_h}^{\alpha} k_{i_h}^{1-\alpha}, \tag{9}$$

where $0<\alpha<1$. y_{i_h}, n_{i_h}, and k_{i_h} are the output, labour and capital of the hth firm in country i, respectively, while A_i represents productivity.

Wages are determined by monopoly unions. The firms adjust employment to maximise profits, taking wages as given. The profit of the hth firm in country i (π_{i_h}) can be written as

$$\pi_{i_h}= p_{i_h}y_{i_h}- w_{i_h}n_{i_h}- r_{i_h}k_{i_h}, \tag{10}$$

where w_{i_h} is the nominal wage and r_{i_h} the nominal rental price of capital of the hth firm in country i, respectively. Since firms act as monopolistic competitors, they take the aggregate demand function into account when maximising their profits. Since $C_{i_h}= y_{i_h}$, I have from (8) that the profit of the hth firm in terms of the consumer price index can be written as

$$\frac{\pi_{i_h}}{P_c}=\left[\left(\frac{1}{F}\right)\left(\frac{I^w}{P_c}\right)\right]^{\frac{1}{\theta}} y_{i_h}^{\frac{\theta-1}{\theta}}-\frac{w_{i_h}}{P_c}n_{i_h}-\frac{r_{i_h}}{P_c}k_{i_h}. \tag{11}$$

Each firm is assumed to be very small and thus, has no influence on the world real income (I^w/P_c). However, when the capital stock is given, each firm takes the total cost of capital for production ($r_{i_h}k_{i_h}$) as given. Employment is chosen to maximise (11). The first-order condition gives

$$w_{i_{c_w}}=\left(\frac{\theta-1}{\theta}\right)\left[\left(\frac{1}{F}\right)\left(\frac{I^w}{P_c}\right)\right]^{\frac{1}{\theta}}\alpha A_i^{\frac{\theta-1}{\theta}} n_{i_h}^{-\frac{\theta-\alpha(\theta-1)}{\theta}} k_{i_h}^{\frac{(\theta-1)(1-\alpha)}{\theta}}, \tag{12}$$

where $w_{i_{c_w}}= w_{i_h}/P_c$ is the real consumption wage in country i.

Since $C_{i_h}= y_{i_h}$, it follows from (8) and (9) that

$$\left[\left(\frac{1}{F}\right)\left(\frac{I^w}{P_c}\right)\right]^{\frac{1}{\theta}}=\left(\frac{p_{i_h}}{P_c}\right)\left(A_i n_{i_h}^{\alpha} k_{i_h}^{1-\alpha}\right)^{\frac{1}{\theta}}. \tag{13}$$

Plugging (13) into (12) gives

$$w_{i_{c_w}}=\left(\frac{\theta-1}{\theta}\right)\alpha A_i \frac{p_{i_h}}{P_c} n_{i_h}^{-(1-\alpha)} k_{i_h}^{1-\alpha}. \tag{14}$$

I shall assume that there are firm-specific unions so that one union is associated with each firm. Unions maximise the expected utility of a representative worker who is employed with probability n_{i_h}/m_{i_h}, where m_{i_h} is membership in the union of the hth firm in country i, and unemployed with probability $1-(n_{i_h}/m_{i_h})$. From (1) and (7), the union utility function in the hth firm of country i (Ω_{i_h}) is:

$$\Omega_{i_h}=\frac{n_{i_h}}{m_{i_h}}(1-\tau_i) w_{i_{c_w}}+\left(1-\frac{n_{i_h}}{m_{i_h}}\right)z, \tag{15}$$

where τ_i is the income tax in country i. The real wage ($w_{i_{h_i}}$) is determined so as to maximise (15). Taking (12) into account, the first-order condition can be written as

$$(1-\tau_i)\, w_{i_{c_h}} = \Phi^{im}_{i_h} z, \tag{16}$$

where $\Phi^{im}_{i_h} = \theta/[\alpha(\theta-1)] > 1$ represents a mark-up over the utility level (the value of home production) for unemployed workers (z). (The "im" superscript is used to represent the case when capital is immobile, when this is helpful for comparison with the analysis in Section 3.) $\Phi^{im}_{i_h}$ only depends on non-firm and non-country specific parameters and thus, $\Phi^{im}_{i_h}$ has the same value for all firms in both countries, i.e., $\Phi^{im}_{i_h} = \Phi^{im}$. As z is constant in the model and the same for all firms, the after-tax real wage is also constant and the same for all firms in my model. Thus, a rise in the tax rate implies an increase in the wage costs for all employers.[3)]

The assumption that all labour unions within the country are identical means that $p_{i_h} = P_i$, $w_{i_{c_h}} = w_{i_c}$, $n_{i_h} = n_i$, and $k_{i_h} = k$ in equilibrium. It follows from (14) and (16) that the employment in each firm of country i is

$$n_i = \left[\left(\frac{\theta-1}{\theta}\right)\alpha A_i^{\frac{\theta-1}{\theta}}\left(\frac{1-\tau_i}{\Phi^{imz}}\right)\left(\frac{P_i}{P_c}\right)\right]^{\frac{1}{1-\alpha}} k_i. \tag{17}$$

The above relationship shows employment to be negatively related to the home production of the unemployed (z). Since a rise in z means an increase in the alternative utility for workers when becoming unemployed, the real wage tends to increase and thus, employment tends to decrease.

Aggregate employment in the private sector (N_{i_p}) and aggregate capital (K_i) used in production in country i can be written as $N_{i_p} = (F/2)n_i$ and $K_i = (F/2)k_i$. Since $K_i = \widetilde{K}_i$ when capital is immobile, it follows from (17) that aggregate employment in the private sector of country i can be expressed as

$$N_{i_p} = \left[\alpha A_i^{\frac{\theta-1}{\theta}}\left(\frac{\theta-1}{\theta}\right)\left(\frac{1-\tau_i}{\Phi^{im}z}\right)\right]^{\frac{1}{1-\alpha}}\left(\frac{P_i}{P_c}\right)^{\frac{1}{1-\alpha}}\widetilde{K}_i. \tag{18}$$

Moreover, because the production function of each firm is homogeneous of degree one, the aggregate output in country i (Y_i) can be written as

$$Y_i = A_i N_{i_p}^{\alpha} K_i^{1-\alpha}. \tag{19}$$

2.1.3 Government

Social welfare services (G_i) are produced in the public sector by the following technology:

$$G_i = N_{i_g}, \tag{20}$$

where N_{i_g} is employment in the public sector. As can be seen from (20), one unit of labour produces one unit of social welfare service and thus, the wage in the public sector also represents the unit cost of social welfare services.

I assume that the government sets the real wage in the public sector (w_{i_g}) as a mark-up over the utility from being unemployed (the value of home production), so that the after-tax real wage for workers is

3) A problem that I do not analyse is that in which, in the absence of binding wage contracts, unions renege on wage contracts after firms have made decisions on employment and investment. This has been analysed by Grout (1984), Van Der Ploeg (1987), Devereux and Lockwood (1991), and Cripps (1997). I assume that unions can credibly commit to these contracts.

$$(1-\tau_i)w_{i_g}=\kappa_i z, \tag{21}$$

where $\kappa_i > 1$. I thus assume the utility from working in the public sector to be greater than the utility from being unemployed. Otherwise, no one would work in the public sector.

Taxes are used to finance the production cost of social welfare services. The budget constraint of country i in real terms can be written:

$$\tau_i(w_{i_c}N_{i_p}+ w_{i_g}N_{i_g})=w_{i_g}G_i. \tag{22}$$

The LHS in (22) is tax revenues and the RHS is the expenditure on social welfare services. Equation (22) shows that the total amount of social welfare services is increased when tax revenues increase. Since it holds that $\Phi_{i_h}=\Phi_i$ in a symmetric equilibrium, it follows from (16), (21), (22) that the total amount of social welfare services can be written as

$$G_i=\left(\frac{\tau_i}{1-\tau_i}\right)\left(\frac{\Phi_i}{\kappa_i}\right)N_{i_p}. \tag{23}$$

2.1.4 Equilibrium conditions

Since all firms within the country are identical, it follows from (8) that the aggregate demand function for the good produced in country i can be written as[4)]

$$C_i=\sum_{h=1}^{\frac{F}{2}}C_{i_h}=\frac{1}{2}\left(\frac{P_i}{P_c}\right)^{-\theta}\left(\frac{I^w}{P_c}\right).$$

From the above relationship, therefore

$$\frac{C_1}{C_2}=P^{-\theta}, \tag{24}$$

where P is the relative price between goods produced in country 1 and goods produced in country 2 (the real exchange rate), i.e. $P = P_1/P_2$. In this model, P also represents the terms of trade. Equation (24) shows the consumption ratio to be a function of the relative price of goods produced in the two countries and thus, it is independent of the level of income.

According to the market-clearing condition for good i, i.e. $C_i = Y_i$, equation (24) can be expressed as

$$P=\left(\frac{Y_1}{Y_2}\right)^{-\frac{1}{\theta}}. \tag{25}$$

If the relative output in country 1 increases (decreases), P falls (rises). In equilibrium, a rise in the relative output must be matched by an increase in demand for the product and thus, the price must decrease.

2.1.5 Equilibrium

The complete model is now given by equations (16), (18), (19), (20), (21), (23) and (25).[5)] The core variables, i.e. employment in the private sector (N_{i_p}) and the total amount of social welfare services (G_i), are determined by (18) and (23).

4) Blanchard and Kiyotaki (1987) have done a similar aggregation.

5) Note that (16), (18), (20), (21), and (23) represent two equations each.

As can be seen from (18) and (23), N_{i_p} and G_i are affected by the relative price, given by (19) and (25). The other endogenous variables, i.e. w_{i_c}, N_{i_g}, and w_{i_g}, are derived from (16), (20), and (21). The exogenous variables determined by the government are the tax rate (τ_i) and the mark-up factor in the public sector (κ_i). The other exogenous variables are the utility of the unemployed (z) as well as the technical and 'scale' parameters, α, θ, ρ, A_i, F, $\widetilde{K}$, $\widetilde{K}_i$, and M.

2.2 Comparative statics

In this section, I shall analyse how a change in the tax rate in one country influences the domestic and the foreign economies. More precisely, I shall investigate the comparative statics in terms of a change in τ_1, decided by the government in country 1.

By total differentiation of (18), (19), (23), and (25) w.r.t. τ_1, I obtain

$$\frac{dN_{1_p}}{d\tau_1}=-\frac{N_{1_p}}{(1-\alpha)(1-\tau_1)}\left(\frac{1}{1+\left(\frac{1}{1-\alpha}\right)\left(\frac{\alpha}{\theta}\right)}\right)\left[1-\frac{\Upsilon_1\left(\frac{1}{1-\alpha}\right)\left(\frac{\alpha}{\theta}\right)}{1+\left(\frac{1}{1-\alpha}\right)\left(\frac{\alpha}{\theta}\right)}\right]<0, \tag{26}$$

$$\frac{dN_{2_p}}{d\tau_1}=-\frac{N_{2_p}}{(1-\alpha)(1-\tau_1)}\left(\frac{1}{1+\left(\frac{1}{1-\alpha}\right)\left(\frac{\alpha}{\theta}\right)}\right)\Upsilon_2\left(\frac{1}{1-\alpha}\right)\left(\frac{\alpha}{\theta}\right)<0, \tag{27}$$

$$\frac{dP}{d\tau_1}=\left(\frac{P}{1-\tau_1}\right)\left[\frac{\left(\frac{1}{1-\alpha}\right)\left(\frac{\alpha}{\theta}\right)}{1+\left(\frac{1}{1-\alpha}\right)\left(\frac{\alpha}{\theta}\right)}\right]>0, \tag{28}$$

$$\frac{dG_1}{d\tau_1}=\left(\frac{N_{1_p}\left(\frac{\Phi^{im}}{\kappa_1}\right)}{(1-\alpha)(1-\tau_1)^2}\right)\left[\frac{\left(1+\Upsilon_2\left(\frac{1}{1-\alpha}\right)\left(\frac{\alpha}{\theta}\right)\right)(1-\alpha-\tau_1)+\Upsilon_1\left(\frac{\alpha}{\theta}\right)}{1+\left(\frac{1}{1-\alpha}\right)\left(\frac{\alpha}{\theta}\right)}\right]\lesseqgtr 0, \tag{29}$$

$$\frac{dG_2}{d\tau_1}=-\left(\frac{N_{2_p}\left(\frac{\Phi^{im}}{\kappa_2}\right)}{(1-\alpha)(1-\tau_1)}\right)\left(\frac{\tau_2}{1-\tau_2}\right)\left[\frac{\Upsilon_2\left(\frac{1}{1-\alpha}\right)\left(\frac{\alpha}{\theta}\right)}{1+\left(\frac{1}{1-\alpha}\right)\left(\frac{\alpha}{\theta}\right)}\right]<0, \tag{30}$$

where $\Upsilon_1=P^{\theta-1}/(1+P^{\theta-1})$ and $\Upsilon_2=1/(1+P^{\theta-1})$.

As can be seen from (26), employment in the private sector in country 1 is increased when the tax rate decreases. The first term in the brackets of the RHS in (26) represents the direct effect of a change in the tax rate, which tends to increase employment when t_1 is decreased, for the following reason. As can be seen from (16), a fall in the tax rate implies a reduction in the real wage in my model. Thus, employment in the private sector tends to increase. The second term in the brackets of the RHS in (26) is the effect via the terms of trade, which tends to decrease employment in the private sector when τ_1 decreases, since, according to (28), P is reduced by a fall in τ_1. As a reduction in P implies a decrease in the real price of good 1, i.e. $\partial(P_1/P_c)/\partial P<0$, the effect on employment in the private sector via the terms of trade tends to decrease its employment when τ_1 decreases. However, the negative sign of (26) shows the direct effect via the tax rate to dominate the indirect effect via the terms of trade.

Employment in the private sector in country 2 is only affected via the terms of trade. Equation (27) shows that a reduction in τ_1 tends to increase employment in the private sector in country 2. When the tax rate in one country is reduced, there is an international spillover raising the terms of trade, which tends to increase employment in the private sector in the other country. This is because a fall in the tax rate in country 1 tends to expand its production in the private sector and the quantity of the product produced in country 1 becomes relatively abundant in the world. As a consequence, the price of the good produced in country 2 becomes relatively higher, which induces an increase in labour demand in the private sector in country 2.

The fact that the relative price (P) is decreased by a reduction in τ_1 implies that, according to (25), there is a larger increase in the aggregate output of private goods in country 1 than in country 2, i.e. $(dY_1/d\tau_1)/Y_1 > (dY_2/d\tau_2)/Y_2$.

Equation (29) shows that the effect of a change in τ_1 on the supply of social welfare services in country 1 is, in general, ambiguous. As I explained in Section 2.2.3, the supply of social welfare services is increased when tax revenues increase. On the one hand, it follows from (22) that a fall in the tax rate reduces the real wage. This tends to decrease tax revenues. On the other hand, the negative sign of (26) implies that employment is increased by a reduction in the tax rate. This tends to increase tax revenues. The sign of (29) shows that the net effect on the supply of social welfare services is unclear. However, as can be seen from (29), the supply of social welfare services in country 1 is increased when τ_1 is not sufficiently large, i.e., $\tau_1 < 1-\alpha$.

In country 2, a rise in τ_1 has no impact on the real wage and increases the number of tax payers (the employed in the private sector). Thus, tax revenues are decreased and the supply of social welfare services is reduced.

2.3 Uncoordinated versus coordinated policies

In this section, I shall analyse how decisions on tax rate reduction are affected by whether reform decisions are coordinated between the two countries. First, I shall discuss the case when the decisions concerning the reform are taken in an uncoordinated way. More precisely, I shall analyse the case where one country sets the tax rate (τ_i) so as to maximise the social welfare of the political majority, taking the level of the tax rate in the other country as given. This is a Nash equilibrium. Second, I shall investigate the case when decisions are coordinated between countries. A comparison between the uncoordinated and the coordinated equilibrium is also made in the section.

2.3.1 Uncoordinated reform decisions

I assume that the workers in the private sector form a political majority and that they elect a government maximising their welfare. The objective function for the government is the expected utility of workers in the private sector of the country. More precisely, the objective function in country i can be written as

$$Q_i = \frac{1}{M_{i_p}}\left(\sum_{j=1}^{N_{i_p}} v_{n_i}^j + \sum_{j=1}^{U_{1_p}} u_{u_i}^j\right), \tag{31}$$

where $v_{n_i}^j$ is the utility for the jth employed worker and u_{u_i} for the unemployed in the private sector of country i. Since all employed and all unemployed workers in the private sector are identical, it follows from (1), (7) and (31) that the expected utility of workers in country i can be written:

$$Q_i = (1-\tau_i) w_{i_c} \frac{N_{i_p}}{M_{i_p}} + z\frac{U_{1_p}}{M_{i_p}} + G_i. \tag{32}$$

The government in country 1 chooses the level of the tax rate (τ_1) so that the expected utility of workers in the private sector is maximised, i.e., $\partial Q_1/\partial\tau_1 = 0$, taking τ_2 as given. It follows from (16), (21), (26) and (32) that the differentiation of Q_1 w.r.t. τ_1 is

$$\frac{\partial Q_1^{im}}{\partial \tau_1} = \frac{N_1}{(1-\alpha)(1-\tau_1)^2}\left[\frac{\left(\frac{\Phi^{im}}{\kappa_1}\right)\left[\left(1+\left(\frac{1}{1-\alpha}\right)\Upsilon_2\left(\frac{\alpha}{\theta}\right)\right)(1-\alpha-\tau_1)+\Upsilon_1\left(\frac{\alpha}{\theta}\right)\right]-\frac{z(\Phi^{im-1})}{M_{1_p}}\left[1+\left(\frac{1}{1-\alpha}\right)\Upsilon_2\left(\frac{\alpha}{\theta}\right)\right](1-\tau_1)}{1+\left(\frac{1}{1-\alpha}\right)\left(\frac{\alpha}{\theta}\right)}\right]. \tag{33}$$

The condition that $\partial Q_1^{im}/\partial\tau_1=0$, represents the reaction function for country 1 in this case. The slope of the reaction function has an ambiguous sign, i.e., $d\tau_1/d\tau_2=[\partial^2 Q_1^{im}/(\partial\tau_1\partial\tau_2)]/(\partial^2 Q_1^{im}/\partial\tau_1^2)\lessgtr 0$. A similar condition holds for country 2.

I assume the uncoordinated equilibrium to be unique. A sufficient condition for the reaction curves to only intersect once in a symmetric equilibrium is that

$$\left|\frac{d\tau_1}{d\tau_2}\right|=\left|\frac{\dfrac{\partial^2 Q_1^{im}}{\partial\tau_1\partial\tau_2}}{\dfrac{\partial^2 Q_1^{im}}{\partial\tau_1^2}}\right|<1. \tag{34}$$

This is also a condition for "dynamic stability'' in the Nash game, where the government of each country decides its level of τ_i, taking the actions of the other government as given.

The optimal level of the tax rate in country 1 ($\tau_{1_N}^{im*}$) is given by[6)]

$$\tau_{1_N}^{im*}=\frac{(1-\alpha)\left(\dfrac{\Phi^{im}}{\kappa_1}\right)-\dfrac{z(\Phi^{im}-1)}{M_{1_p}}+\dfrac{\Upsilon_1\left(\dfrac{\alpha}{\theta}\right)\left(\dfrac{\Phi^{im}}{\kappa_1}\right)}{1+\Upsilon_2\left(\dfrac{1}{1-\alpha}\right)\left(\dfrac{\alpha}{\theta}\right)}}{\dfrac{\Phi^{im}}{\kappa_1}-\dfrac{z(\Phi^{im}-1)}{M_{1_p}}}. \tag{35}$$

2.3.2 Coordinated reform decisions

In this section, I shall analyse the effect of coordinated decisions on tax rate reduction. In a coordinated regime, the governments in the two countries cooperatively decide on the level of the tax rate. More precisely, I assume that the governments in the two countries maximise their joint objective function: $S^{im}=Q_1^{im}+Q_2^{im}$. The optimal conditions w.r.t. τ_i are given by

$$\frac{\partial S^{im}}{\partial\tau_i}=\frac{\partial Q_1^{im}}{\partial\tau_i}+\frac{\partial Q_2^{im}}{\partial\tau_i}=0. \tag{36}$$

From (16), (21), (27), and (32), differentiation of Q_2^{im} w.r.t. τ_1 gives

$$\frac{\partial Q_2^{im}}{\partial\tau_1}=-\left(\frac{N_{2_p}}{(1-\alpha)^2(1-\tau_1)}\right)\Upsilon_2\left(\frac{\alpha}{\theta}\right)\left[\frac{\left(\dfrac{\tau_2}{1-\tau_2}\right)\left(\dfrac{\Phi^{im}}{\kappa_2}\right)+\dfrac{z(\Phi^{im}-1)}{M_{2_p}}}{1+\left(\dfrac{1}{1-\alpha}\right)\left(\dfrac{\alpha}{\theta}\right)}\right]<0. \tag{37}$$

Equation (37) shows the expected utility of workers in the private sector of country 2 to always be increased by a reduction in τ_1 for the following reason. As explained in Section 2.2, employment in the private sector in country 2 is increased by a decrease in τ_1. Since the total number of workers in this sector is constant, an increase in employment here implies a reduction in unemployment. Moreover, the after-tax real income for employed workers is not affected by a change in τ_1, and it is greater than the home production of unemployed workers. As a consequence, the expected income of workers in the private sector and tax revenues are both increased. A rise in the expected income of workers implies a higher expected utility from consumption. An increase in tax revenues means a larger supply of social welfare services and thus a higher utility from social welfare services.

From (33) and (37), differentiation of S^{im} w.r.t. τ_1 in a symmetric equilibrium, where $N_{1_p}=N_{2_p}=N_C^{im}$, $M_{1_p}=M_{2_p}=M_p$,

6) The reasonable values of parameters ensure that $\Phi^{im}/\kappa_1-z(\Phi^{im}-1)/M_{1_p}>0$.

$\kappa_1=\kappa_2=\kappa$, and $Y_1=Y_2$, gives

$$\frac{\partial S}{\partial \tau_1}=ac N_C^{im}(1-\alpha)(1-\tau_C^{im})^2\left[\frac{\left[\frac{z(\Phi^{im}-1)}{M_p}-\left(\frac{\Phi^{im}}{\kappa}\right)\right]\left[1+\left(\frac{1}{1-\alpha}\right)\left(\frac{\alpha}{\theta}\right)\right]\tau_C^{im}-\left[\frac{z(\Phi^{im}-1)}{M_p}-(1-\alpha)\left(\frac{\Phi^{im}}{\kappa}\right)\right]\left[1+\left(\frac{1}{1-\alpha}\right)\left(\frac{\alpha}{\theta}\right)\right]}{1+\left(\frac{1}{1-\alpha}\right)\left(\frac{\alpha}{\theta}\right)}\right]. \tag{38}$$

The optimal level of the tax rate in the coordinated regime, which satisfies the condition that $\partial S/\partial \tau_1=0$, is defined as

$$\tau_C^{im*}=\frac{(1-\alpha)\left(\frac{\Phi^{im}}{\kappa}\right)-\frac{z(\Phi^{im}-1)}{M_p}}{\frac{\Phi^{im}}{\kappa}-\frac{z(\Phi^{im}-1)}{M_p}}. \tag{39}$$

2.3.3 Uncoordinated versus coordinated equilibria

I shall compare the level of the tax rate in the uncoordinated regime with that in the coordinated regime. For this purpose, I evaluate $\partial S/\partial \tau_1$ at the uncoordinated level of the tax rate, $\tau_1=\tau_2=\tau_N^{im}$. From (33), (35), (36) and (37), I have

$$\left.\frac{\partial S}{\partial \tau_1}\right|_{\tau_1=\tau_2=\tau_N^{im}}=\left.\frac{\partial Q_2^{im}}{\partial \tau_1}\right|_{\tau_1=\tau_2=\tau_N^{im}}<0.$$

Moreover, from (33), (36), and (37), I can derive that it globally holds that $\partial^2 S/\partial \tau_1^2+\partial^2 S/(\partial \tau_1 \partial \tau_2)<0$ in a symmetric equilibrium.[7)] Since this inequality is always fulfilled, the optimal level of the tax rate is smaller in the coordinated than in the uncoordinated regime. More precisely, in a symmetric equilibrium, it follows from (35) and (39) that

$$\tau_N^{im*}-\tau_C^{im*}=\frac{\frac{1}{2}\left(\frac{\alpha}{\theta}\right)\left(\frac{\Phi^{im}}{\kappa}\right)}{\left(\frac{\Phi^{im}}{\kappa}-\frac{z(\Phi^{im}-1)}{M_p}\right)\left[1+\frac{1}{2}\left(\frac{1}{1-\alpha}\right)\left(\frac{\alpha}{\theta}\right)\right]}>0. \tag{40}$$

Coordination leads to a lower tax rate and thus a lower wage in my model, since a reduction in the labour tax in one country increases the relative price of the goods produced in the other country. This represents a positive spillover effect, which is taken into account under coordination.

3 The mobile capital case

I turn now to the case where capital is perfectly mobile among firms in the country, and also mobile between countries. There is no doubt that cross-border capital mobility is increasing in today's international world. International capital markets allow capital owners of different countries to reallocate their capital to maximise their revenues and minimise various risks. Thus, the case when capital is perfectly mobile among firms both domestically and internationally is more relevant than the immobile capital case. This section analyses this possibility.

3.1 The capital market

When capital is mobile, each firm chooses capital to maximise its profit. Maximising (11) w.r.t. k_{ih} gives

7) The details of the calculations are available on request.

$$\frac{r_{i_h}}{P_c}=\left(\frac{\theta-1}{\theta}\right)\left[\left(\frac{1}{F}\right)\left(\frac{I^w}{P_c}\right)\right]^{\frac{1}{\theta}}(1-\alpha)A_i^{\frac{\theta-1}{\theta}}n_{i_h}^{\frac{\alpha(\theta-1)}{\theta}}k_{i_h}^{-1+\frac{(\theta-1)(1-\alpha)}{\theta}}.$$

Since all firms within the country are identical, I have $r_{i_h}=r_i$, $n_{i_h}=n_i$ and $k_{i_h}=k_i$. The first-order condition can be expressed as

$$r_{i_c}=\left(\frac{\theta-1}{\theta}\right)\left[\left(\frac{1}{F}\right)\left(\frac{I^w}{P_c}\right)\right]^{\frac{1}{\theta}}(1-\alpha)A_i^{\frac{\theta-1}{\theta}}n_i^{\frac{\alpha(\theta-1)}{\theta}}k_i^{-1+\frac{(\theta-1)(1-\alpha)}{\theta}}. \tag{41}$$

where $r_{i_c}=r_i/P_c$ is the real rental price of capital in terms of the consumer price index.

I assume the total amount of capital in the world ($\tilde{K}$) to be constant and thus, it can be written as

$$\tilde{K}=\tilde{K_1}+\tilde{K_2}=K_1+K_2=\frac{F}{2}(k_1+k_2), \tag{42}$$

where $\tilde{K_i}$ is the total capital owned by capitalists in country i and K_i is the capital used in the production of good i.

Capital is assumed to be perfectly mobile between these countries. The capital allocation is assumed to be determined in a such way as to equalise the returns of capital in the two countries, i.e. $r_{1_c}=r_{2_c}=r_c$. From (14), (16), and (41), the condition $r_{1_c}=r_{2_c}$ is equivalent to

$$A_1^{-(\theta-1)}w_{1_c}^{\alpha(\theta-1)}\left[\left(\frac{1}{F}\right)\left(\frac{I^w}{P_c}\right)\right]^{-\frac{\alpha(\theta-1)}{\theta}}k_1=A_2^{-(\theta-1)}w_{2_c}^{\alpha(\theta-1)}\left[\left(\frac{1}{F}\right)\left(\frac{I^w}{P_c}\right)\right]^{-\frac{\alpha(\theta-1)}{\theta}}k_2. \tag{43}$$

Taking (42) into account, rearranging (43) gives

$$K_1=\frac{1}{\left(\frac{A_2}{A_1}\right)^{\theta-1}\left(\frac{w_{1_c}}{w_{2_c}}\right)^{\alpha(\theta-1)}+1}\tilde{K}, \tag{44}$$

$$K_2=\frac{1}{\left(\frac{A_2}{A_1}\right)^{-(\theta-1)}\left(\frac{w_{1_c}}{w_{2_c}}\right)^{-\alpha(\theta-1)}+1}\tilde{K}, \tag{45}$$

Equations (44) and (45) show that K_1 and K_2 are functions of the relative wage between the two countries, i.e., (w_{1_c}/w_{2_c}). When the wage in country 1 increases relative to the wage in country 2, capital used in the production in country 1 (K_1) tends to decrease, because the return to capital tends to become lower in country 1 than in country 2. Since the total amount of capital in the world is constant, a reduction in K_1 implies an increase in K_2, which can be seen from (45).

Moreover, it follows from (13) and (43) that

$$P=\left(\frac{A_2}{A_1}\right)\left(\frac{w_{1_c}}{w_{2_c}}\right)^{\alpha}. \tag{46}$$

The relative price can be expressed as a function of the relative wage (w_{1_c}/w_{2_c}) between the countries.

Substituting (46) into (44) and (45), I have

$$K_1=\frac{1}{P^{\theta-1}+1}\tilde{K}, \tag{47}$$

$$K_2=\frac{1}{P^{-(\theta-1)}+1}\tilde{K}. \tag{48}$$

When capital is perfectly mobile, the union in the hth firm of country i takes (12) and (41) into account, and chooses the real wage to maximise (15). This gives rise to a similar mark-up equation as (16), but the mark-up of the hth firm in country i ($\Phi_{i_h}^m$)

is now

$$\Phi_{i_h}^m = 1 + \frac{1}{\alpha(\theta - 1)}. \tag{49}$$

The superscript "m" represents the case when capital is perfectly mobile. As before, $\Phi_{i_h}^m$ is constant and only depends on non-firm and non-country specific parameters. Thus, $\Phi_{i_h}^m$ has the same value for all firms in both countries, i.e., $\Phi_{i_h}^m = \Phi^m$.

Since Φ^{im} is equal to $\theta/[\alpha(\theta - 1)]$ and Φ^m is equal to $1 + 1/\alpha(\theta - 1)$, I have

$$\Phi^{im} - \Phi^m = \frac{1-\alpha}{\alpha} > 0.$$

The above relationships show the wage mark-up to be lower when capital is mobile, since labour demand becomes more elastic. When capital is mobile, a rise in the wage in one country implies not only that labour demand falls with a given capital stock. In addition, the rental price of capital in that country tends to fall, resulting in a fall in the capital stock, so as to restore the equality of returns to capital in the two countries. As a result, employment falls more when capital is mobile.

It follows from (14) and (49) that aggregate employment in the private sector in country i can be expressed as

$$N_{i_p} = \left[\alpha A_i^{\frac{\theta-1}{\theta}} \left(\frac{\theta-1}{\theta}\right)\left(\frac{1-\tau_i}{\Phi^m z}\right)\right]^{\frac{1}{1-\alpha}} \left(\frac{P_i}{P_c}\right)^{\frac{1}{1-\alpha}} K_i. \tag{50}$$

3.2 Comparative statics

In this section, as before, I shall analyse the macroeconomic effects of a change in τ_1, decided by the government in country i.

By total differentiation of (23), (44), (45), (46), and (50) w.r.t. τ_1, I obtain

$$\frac{\partial K_1}{\partial \tau_1} = -K\left(\frac{1}{1-\tau_1}\right)\alpha(\theta-1)\Upsilon_1, < 0, \tag{51}$$

$$\frac{\partial K_2}{\partial \tau_1} = K_2\left(\frac{1}{1-\tau_1}\right)\alpha(\theta-1)\Upsilon_2 > 0, \tag{52}$$

$$\frac{dN_{1_p}}{d\tau_1} = -N_{1_p}\left(\frac{1}{1-\alpha}\right)\left(\frac{1}{1-\tau_1}\right)[1-\alpha\Upsilon_1\Theta] < 0, \tag{53}$$

$$\frac{dN_{2_p}}{d\tau_1} = -N_{2_p}\left(\frac{1}{1-\alpha}\right)\left(\frac{1}{1-\tau_1}\right)\alpha\Upsilon_2\Theta \leq 0, \tag{54}$$

$$\frac{dP}{d\tau_1} = \alpha p\left(\frac{1}{1-\tau_1}\right) > 0, \tag{55}$$

$$\frac{dG_1}{d\tau_1} = N_{i_p}\left(\frac{1}{1-\alpha}\right)\frac{\left(\frac{\Phi^m}{\kappa_1}\right)}{(1-\tau_1)^2}(\alpha-\tau_1)(1+\alpha\Upsilon_1\Theta) \lesseqgtr 0, \tag{56}$$

$$\frac{dG_2}{d\tau_1} = N_{2_p}\left(\frac{1}{1-\alpha}\right)\left(\frac{\tau_2\left(\frac{\Phi^m}{\kappa_2}\right)}{(1-\tau_1)(1-\tau_2)}\right)\alpha\Upsilon_2\Theta \geq 0, \tag{57}$$

where $\Theta = 1 - (\theta - 1)(1 - \alpha) > 0$. Together with the assumption that $\theta > 1$, I have

$$1 < \theta < \frac{2-\alpha}{1-\alpha}.$$

It follows from (51) that capital in country 1 is increased by a reduction in τ_1. A fall in τ_1 decreases the real wage in country 1

and has no impact on the real wage in country 2. This implies that employment in the private sector in country 1 increases relative to employment in the private sector in country 2. As a consequence, the return to capital becomes larger in country 1. This induces capital flight from country 2 to country 1, as shown by the negative sign of (51) and the positive sign of (52).

Equation (53) shows that a reduction in τ_1 increases employment in the private sector in country 1. The first term in the brackets of the RHS in (53) represents the direct effect via the fall in the real wage induced by the tax rate, which tends to increase employment. The second term in the brackets is the effects via the terms of trade and capital reallocation. On the one hand, as I explained, a reduction in τ_1 increases the capital in country 1, which tends to increase its employment. On the other hand, it follows from (55) that the terms of trade for country 1 are worsened by a reduction in τ_1, which tends to decrease employment in the private sector. According to $\Theta > 0$, the sign of the second term in the brackets in (53) is non-negative, which shows that the effect via capital allocation does not dominate the effect via the terms of trade. Moreover, equation (53) shows that the direct effect of a change in τ_1 dominates the induced effects, i.e., the effect via the international spillover effects.

It follows from (54) that a reduction in the tax rate in one country does not decrease employment in the private sector of the other country. On the one hand, as can be seen from (52), capital in country 2 is decreased by a reduction in τ_1 and thus, its employment in the private sector tends to decrease. On the other hand, according to (55), the terms of trade for country 2 are improved by a reduction in τ_1, which tends to increase employment in the private sector. However, since the effect via capital mobility does not dominate the effect via the terms of trade, employment in country 2 is not decreased.

If the tax rate is not sufficiently high, i.e., if $\alpha > \tau_1$, it follows from (56) that the supply of social welfare services in country 1 is decreased by a reduction in τ_1, for the same reason as before. A reduction in τ_1 decreases the real wage of employed workers and increases the number of tax payers (those employed in the private sector) in country 1. Tax revenues are decreased when $\alpha > \tau_1$ and thus the supply of social welfare services in country 1 is reduced.

In country 2, tax revenues are affected only via the number of tax payers. Therefore the supply of social welfare services is not decreased because a reduction in τ_1 does not decrease employment in the private sector of country 2, which can be seen from (54) and (57).

3.3 Uncoordinated versus coordinated policies

In this section, I shall compare the labour tax reduction decisions in an uncoordinated equilibrium (Nash equilibrium) and a coordinated equilibrium.

3.3.1 Uncoordinated reform decisions

As before, the government in country 1 is assumed to choose τ_1 so as to maximise the expected utility of workers in the private sector, i.e. $\partial Q_1^m / \partial \tau_1 = 0$. The first-order condition is derived from (16), (21), (32), and (53):

$$\frac{\partial Q_1^m}{\partial \tau_1} = \left(\frac{1}{1-\alpha}\right)\left(\frac{N_{1_p}}{(1-\tau_1)^2}\right)\left[(1-\alpha)\left(\frac{\Phi^m}{\kappa_1}\right) - (1-\tau_1)\left[\left(\frac{\Phi^m}{\kappa_1}\right) + \frac{z(\Phi^m - 1)}{M_{1_p}}\right](1-\alpha\Upsilon_1\Theta)\right] = 0. \tag{58}$$

The superscripts "m" represent the case when capital is mobile between the countries. The condition that $\partial Q_1^m / \partial \tau_1 = 0$ represents the reaction function for country 1 when capital is mobile between the countries. A similar condition holds for country 2. As before, the sign of the slope of the reaction function is ambiguous.

The optimal level of the tax rate ($\tau_{1_N}^{im*}$) is given by

$$\tau_{N}^{im*}=1-\frac{(1-\alpha)\left(\frac{\Phi^{m}}{\kappa_{1}}\right)}{\left[\frac{z(\Phi^{m}-1)}{M_{1_{p}}}+\left(\frac{\Phi^{m}}{\kappa_{1}}\right)\right](1-\alpha\Upsilon_{1}\Theta)}. \tag{59}$$

3.3.2 Coordinated reform decisions

As before, in a coordinated regime, the governments in the two countries maximise their joint objective function : $S^{m}=Q_{1}^{m}+Q_{2}^{m}$. From (16), (21), (32), and (54), differentiation of Q_{2} w.r.t. τ_{1} gives

$$\frac{\partial Q_{2}^{m}}{\partial\tau_{1}}=-\left(\frac{1}{1-\alpha}\right)\left(\frac{N_{2_{p}}}{1-\tau_{1}}\right)\left[\left(\frac{\tau_{2}}{1-\tau_{2}}\right)\left(\frac{\Phi^{m}}{\kappa_{2}}\right)+\frac{z(\Phi^{m}-1)}{M_{2_{p}}}\right]\alpha\Upsilon_{2}\Theta<0. \tag{60}$$

From (58) and (60), $\partial S/\partial\tau_{1}$ in a symmetric equilibrium, where $\tau_{1}=\tau_{2}=\tau_{C}^{m}$, $\kappa_{1}=\kappa_{2}=\kappa$, $N_{1_{p}}=N_{2_{p}}=N_{C}^{m}$, $M_{1_{p}}=M_{2_{p}}=M_{p}$, and $\Upsilon_{1}=\Upsilon_{2}$, can be expressed as

$$\frac{\partial S^{m}}{\partial\tau_{1}}=\left(\frac{1}{1-\alpha}\right)\left(\frac{N_{1}}{(1-\tau_{C}^{m})^{2}}\right)\left[(1-\alpha)\left(\frac{\Phi^{m}}{\kappa}\right)-\left(\frac{z(\Phi^{m}-1)}{M_{p}}+\left(\frac{\Phi^{m}}{\kappa}\right)\left(1-\frac{1}{2}\alpha\Theta\right)\right)(1-\tau_{1})\right]=0. \tag{61}$$

Except for the wage mark-up (Φ^{m}), $\partial S/\partial\tau_{1}$ in (61) is the same expression as the relationship (38), which holds when capital is immobile, for the following reason. When social welfare reform decisions are coordinated between the countries, the two countries change their expenditure on social welfare services in the same way in a symmetric equilibrium. Thus, there is no international spillover effect. The optimal level of the tax rate in the mobile capital case is given by

$$\tau_{C}^{m}=1-\frac{\left(1-\alpha+\frac{1}{2}\alpha\Theta\right)\left(\frac{\Phi^{m}}{\kappa}\right)}{\frac{z(\Phi^{m}-1)}{M_{p}}+\left(1-\frac{1}{2}\alpha\Theta\right)\left(\frac{\Phi^{m}}{\kappa}\right)}. \tag{62}$$

3.3.3 Uncoordinated versus coordinated equilibria

In order to compare the uncoordinated optimal level of the tax rate with the coordinated optimal level of the tax rate, I evaluate $\partial S/\partial\tau_{1}$ at the uncoordinated equilibrium level (τ_{N}^{im}). It follows from (36), (58), (59), and (60) that

$$\left.\frac{\partial S}{\partial\tau_{1}}\right|_{\tau_{1}=\tau_{1}=\tau_{N}^{im}}=\left.\frac{\partial Q_{2}^{m}}{\partial\tau_{1}}\right|_{\tau_{1}=\tau_{2}=\tau_{N}^{im}}<0.$$

Furthermore, from (36), (58), and (60), I can derive that it globally holds that $\partial^{2}S/\partial\tau_{1}^{2}+\partial^{2}S/(\partial\tau_{1}\partial\tau_{2})<0$ in a symmetric equilibrium.[8)] Thus it holds that the optimal level of the tax rate is smaller in the coordinated than in the uncoordinated regime. More precisely, in a symmetric equilibrium, it follows from (59) and (62) that

$$\tau_{N}^{m*}-\tau_{C}^{m*}=\frac{\alpha\Theta\left(\frac{\Phi^{m}}{\kappa}\right)\left[\left(\frac{\Phi^{m}}{\kappa}\right)\left(2-\alpha-\frac{1}{2}\alpha\Theta\right)+z(\Phi-1)\left(1-\frac{1}{2}\Theta\right)\alpha\right]}{2\left[\frac{z(\Phi^{m}-1)}{M_{p}}+\left(\frac{\Phi^{m}}{\kappa}\right)\right]\left[\frac{z(\Phi^{m-1})}{M_{p}}+\left(1-\frac{1}{2}\alpha\Theta\right)\left(\frac{\Phi^{m}}{\kappa}\right)\right]\left(1-\alpha\frac{1}{2}\Theta\right)}>0. \tag{63}$$

The difference between τ_{N}^{m*} and τ_{C}^{m*} depends on the international spillover effects via the terms of trade and capital mobility.

8) The details of the calculations are available on request.

As can be seen from (36), (58), and (60), there is a net positive spillover effect. Hence, when taking this into account, policy-makers will never choose a higher level of tax rate in a coordinated than in an uncoordinated equilibrium.

4 Concluding remarks

This paper has analysed how a change in the labour tax affects both the domestic and the foreign economy in a two-country model. A reduction in the labour tax decreases public expenditure and thus, the supply of social welfare services tends to decrease. A fall in the tax rate leads to a reduction in wage costs for employers. As a result, private-sector employment is increased in the domestic economy. The effect on aggregate employment is, in general, ambiguous since employment falls in the public sector.

A reduction in the labour tax in one country gives rise to international spillover effects on the foreign country. First, there is a spillover effect via the terms of trade, which tends to increase employment in the foreign country since a fall in the tax rate in one country tends to increase its private-sector output and thus, reduce the relative price of this output. As a result, the price of the private-sector good produced in the foreign country becomes relatively higher, which induces an increase in labour demand in the foreign country. Second, there is an effect via capital reallocation, which tends to decrease employment in the foreign country, for the following reason. A reduction in the tax rate tends to reduce the wage in the domestic country, which implies that employment in the domestic country increases relative to employment in the foreign country. As a consequence, the return to capital becomes larger in the domestic country and induces capital flight from the foreign to the domestic country. However, the former effect dominates the latter and thus, there is an increase both in employment in the private sector and in aggregate employment in the foreign economy.

Policy coordination leads to a lower tax rate, higher private-sector employment, and a smaller supply of social welfare services than non-coordination, since policy-makers under coordination take into account that there is a positive net spillover to the other countries from reducing the labour tax.

References

[1] Andersen and So rensen, 1995, Unemployment and Fiscal Policy in an Economic and Monetary Union, *European Journal of Political Economy* 11.

[2] Barr, N., 1992, Economic Theory and the Welfare State: A Survey and Interpretation, *Journal of Economic Literature* 30.

[3] Blanchard, O. J. and S. Fischer, 1989, *Lectures on Macroeconomics* (The MIT Press).

[4] Blanchard, O. J. and N. Kiyotaki, 1987, Monopolistic Competition and the Effects of Aggregate Demand, *American Economic Review* 77.

[5] Brander, J. A., 1981, Intra-Industry Trade in Identical Commodities, *Journal of International Economics* 11.

[6] Bucovetsky, S., 1991, Asymmetric Tax Competition, *Journal of Urban Economics* 30.

[7] Calmfors, L., 2001, Unemployment, Labour Market Reform, and Monetary Union, *Journal of Labor Economics* 19.

[8] Calmfors, L., 2002, Macroeconomic Policy Coordination in the EU: How Far Should It Go?, *Swedish Economic Policy Review* 9.

[9] Calmfors, L. and B. Holmlund, 2000, Unemployment and Economic Growth: A Partial Survey, *Swedish Economic Policy Review* 7.

[10] Calmfors Commission, 1997, *EMU — A Swedish Perspective*, (Kluwer Academic Publishers).

[11] Corsetti, G. and P. Pesenti, 2001, Welfare and Macroeconomic Interdependence, *Quarterly Journal of Economics* CXVI.

[12] Cripps, M. W., 1997, Bargaining and the Timing of Investment, *International Economic Review* 38.

[13] Daveri, F. and G. Tabellini, 2000, Unemployment, Growth, and Taxation in Industrial Countries, *Economic Policy* 15.

[14] Devereux, M. B., 1991, The Terms of Trade and the International Coordination of Fiscal Policy, *Economic Inquiry* XXIX.

[15] Devereux, M. B. and B. Lockwood, 1991, Trade Unions, Non-Binding Wage Agreements, and Capital Accumulation, *European Economic Review* 35.

[16] Dixion, H. D. and M. Santoni, 1997, Fiscal Policy Coordination with Demand Spillovers and Unionised Labour Markets, *Economic Journal*

107.

[17] Ellis, C. J., and J. Fender, 1987, Bargaining and Wage Resistance in an Open Macroeconomic Model, *Economic Journal* 97.

[18] Erikson, C. L., and S. Kuruvilla, 1994, Labor Costs and the Social Dumping Debate in the European Union, *Industrial and Labor Relations Review* 48.

[19] Fukushima, Y., 2003, *Essays on Employment Policies*, *Dissertations in Economics*, 2003:1, Stockholm University.

[20] Gabszewicz, J. and T. van Ypersele, 1996, Social Protection and Political Competition, *Journal of Public Economics* 61.

[21] Grout, P., 1984, Investment and Wages in the Absence of Binding Contracts: A Nash Bargaining Approach, *Econometrica* 52.

[22] Hamermesh, D., 1993, *Labor Demand* (Princeton University Press).

[23] Holmlund, B. and A.-S. Kolm, 1999, Economic Integration, Imperfect Competition, and International Policy Spillovers, Mimeo.

[24] Janeba, E., 1995, Corporate Income Tax Competition, Double Taxation Treaties, and Foreign Direct Investment, *Journal of Public Economics* 56.

[25] Jensen, H., 1996, The Advantage of International Fiscal Cooperation under Alternative Monetary Regimes, *European Journal of Political Economy* 12.

[26] Lane, P. R., 2001, The New Open Economy Macroeconomics: A Survey, *Journal of International Economics* 54.

[27] Layard, R., S. Nickell and R. Jackman, 1991, *Unemployment* (Oxford University Press).

[28] Levine, P. and A. Brociner, 1994, Fiscal Policy Coordination and EMU — A Dynamic Game Approach, *Journal of Economic Dynamics and Control* 18.

[29] Lindbeck, A., 1993, *Unemployment and Macroeconomics* (The MIT Press).

[30] L' pez, S., M. Marchand and P. Pestieau, 1998, A Simple Two-Country Model of Redistributive Capital Income Taxation, *Finanzarchiv* 55.

[31] Manning, A., 1991, The Determinants of Wage Pressure: Some Implications of a Dynamic Model, *Economica* 58.

[32] Nickell, S. and R. Layard, 1999, Labour Market Institutions and Economic Performance, *Handbook of Labor Economics*, Ch. 46 (North-Holland).

[33] Obstfeld, M., 1999, New Directions for Stochastic Open Economy Models, NBER Working Paper no. 7313.

[34] Obstfeld, M., 2001, International Macroeconomics: Beyond the Mundel-Fleming Model, NBER Working Paper no. 8369.

[35] Obstfeld, M. and K. Rogoff, 1996, *Foundation of International Macroeconomics* (The MIT Press).

[36] Obstfeld, M. and K. Rogoff, 2000, The Six Major Puzzles in International Macroeconomics: Is there a common cause?, NBER Working Paper no. 7777.

[37] OECD, 2000, *Reforms for an Ageing Society*, Paris.

[38] Ohyama, M. and Y. Fukushima, 1995, Endogenous Dualistic Structure, Marshallian Externalities, and Industrialization, in: W. Chang and S. Katayama, eds., *Imperfect Competition in International Trade* (Kluwer Academic Publishers).

[39] Oswald, A. J., 1982, The Microeconomic Theory of the Trade Union, *Economic Journal* 92.

[40] Pissarides, C. A., 1997, The Need for Labour-Market Flexibility in a European Economic and Monetary Union, *Swedish Economic Policy Review* 4.

[41] Saint-Paul, G., 1996, Exploring the Political Economy of Labour Market Institutions, *Economic Policy* 23.

[42] S rensen, P. B., 2000, The Case for International Co-ordination Reconsidered, *Economic Policy* 31.

[43] Turnovsky, S., 1988, The Gain from Fiscal Coordination in the Two Commodity Real Trade Model, *Journal of International Economics* 25.

[44] Van Der Ploeg, R., 1987, Trade Unions Investment and Unemployment: An Non-Cooperative Approach, *European Economic Review* 31.

[45] Venables, A. J., 1985, Trade and Trade Policy with Imperfect Competition : The Case of Identical Products and Free Entry, *Journal of International Economics* 19.

[46] Weitzman, M. L., 1987, Steady State Unemployment under Profit Sharing, *Economic Journal* 97.

[47] Wildasin, D. E., 1988, Nash Equilibria in Models of Fiscal Competition, *Journal of Public Economics* 35.

[48] Wilson, J. D., 1986, A Theory of Interregional Tax Competition, *Journal of Urban Economics* 19.

[49] Wilson, J. D., 1999, Theories of Tax Competition, *National Tax Journal* 52.