CESifo *Working Paper Series*

TAX COMPETITION AND INTERNATIONAL PUBLIC GOODS

Kjetil Bjorvatn
Guttorm Schjelderup*

Working Paper No. 390

December 2000

CESifo
Center for Economic Studies & Ifo Institute for Economic Research
Poschingerstr. 5
81679 Munich
Germany
Phone: +49 (89) 9224-1410/1425
Fax: +49 (89) 9224-1409
http://www.CESifo.de

* We are indebted to Wolfgang Eggert, Kåre Petter Hagen, Andreas Haufler, Michael Keen, Mats Persson, Christian Riis, Agnar Sandmo, and Fred Schroyen for useful comments. The usual disclaimer applies. This paper is forthcoming in *International Tax and Public Finance.*

CESifo *Working Paper No. 390*
December 2000

TAX COMPETITION AND INTERNATIONAL PUBLIC GOODS

Abstract

A well known result in the tax competition literature is that tax rates are set too low in the Nash equilibrium to finance an efficient level of public consumption goods. In this model we introduce international spillovers in public goods provision and show that such spillovers reduce, and in the limiting case of perfect spillovers, eliminate tax competition. There is, however, always underprovision of the public good in equilibrium, since larger spillovers increase the problem of free riding. In an extension to the model, we demonstrate that congestion costs may result in overprovision of the public good.

Keywords: Tax competition for capital, international public goods

JEL Classification: H2, H4, H7

Kjetil Bjorvatn
Norwegian School of Economics and Business Administration
Helleveien 30
5045 Bergen
Norway
email: Kjetil.Bjorvatn@nhh.no

Guttorm Schjelderup
Norwegian School of Economics and Business Administration
Helleveien 30
5045 Bergen
Norway
email: Guttorm.Schjelderup@nhh.no

1 Introduction

One of the main results in the tax competition literature is that tax rates are set too low in the Nash equilibrium to finance an efficient level of publicly provided consumption goods.[1] In the standard tax competition model the publicly provided good either takes on the character of a private good or a local public good. We change this setup by allowing locally provided public consumption goods to have spillovers across jurisdictions. If we think carefully, many types of public expenditure may have significant spillover effects. For instance, a reduction in national CO2-emissions may improve the international environment, publicly sponsored R&D efforts may benefit other countries through the transfer of technologies and ideas; a reduction in unemployment at home through expansive fiscal policies may reduce unemployment abroad by increasing the demand for foreign goods, etc.

Modifying the standard tax competition model by allowing for spillover effects introduces a second source of undersupply, namely that of free riding. Intuitively one might therefore expect the problem of undersupply to be aggravated. In this paper, however, we show that adding international spillovers from locally provided public goods reduces, and in the limiting case of perfect international spillovers, eliminates the detrimental effects of tax competition. On the other hand, larger spillovers increase the strength of the free riding problem, so that the decentralized solution is necessarily characterized by undersupply of public goods.

With international spillovers in public goods provision, our model is closely related to the literature on private provision of public goods, see for instance Warr (1983), Kemp (1984), Bergstrom et al. (1986), and Ihori

[1] See e.g., Zodrow and Mieszkowski (1986) and Keen and Marchand (1997).

(1992). Relative to these models, the main novelty of the present contribution is the introduction of a mobile tax base. Thus, our model represents a merger of the tax competiton and "private provision" literature. For a discussion of how our results relate to these two literatures, see Section 3 in this article.

The paper is also related to the literature on optimal taxation in open ecnomies, see Sandmo and Wildasin (1999) for a recent contribution. While they study optimal policies from the viewpoint of a single jurisdiction, taking the policies of other jurisdictions as given, the present article focuses on equilibrium policies resulting from competition between several jurisdictions.

In an extension to the model, we introduce "congestion" costs. In this case, for a given level of public expenditure, the amount of the public good available to the consumers in a country depends negatively on the number of firms in that country. If the public good is the quality of the environment, we can think of congestion as the result of pollution associated with firms' operations. Naturally, congestion reduces the incentives of attracting foreign investment, and therefore reduces tax competition. In fact, if congestion costs are sufficiently serious, and the environmental problem largely a national one, there may be oversupply of the public good in equilibrium.

The paper is organized as follows. Section 2 presents the basic model, starting with the derivation of the Pareto optimal provision of the public good, and then describing the non-cooperative solution. Section 3 contains a discussion of the results, relating them to the findings of the existing literature. Section 4 extends the basic model by introducing congestion costs. Section 5 concludes.

2 The Model

We use a tax competition model adapted from Wildasin (1988) and Konrad and Schjelderup (1999). The model consists of N identical jurisdictions, which for convenience we shall generally refer to as countries. Each country has a capital endowment k. The total amount of capital in the world is therefore

$$K = Nk \tag{1}$$

Income generated in country i is denoted by y_i, which is a function of capital employed (k_i) in that country

$$y_i = f(k_i), \tag{2}$$

where $f'(k_i) > 0$, $f''(k_i) < 0$. There is perfect international capital mobility. In equilibrium, therefore, the after tax return to capital is equalized across countries

$$f'(k_i) - t_i = \rho \tag{3}$$

for all $i \in \{1, ..., N\}$, where ρ is the after tax return to capital and t_i is the tax rate per unit of capital in country i. Income can be spent on a private good (x_i), a public good (g_i), and remuneration to foreign capital $\rho(k_i - k)$, where $(k_i - k)$ is the difference between capital stock and capital endowment in country i. The marginal rate of transformation between the two goods is unity, so that the budget constraint for each country is defined by

$$y_i = x_i + g_i + \rho\left(k_i - k\right), \tag{4}$$

and for the public sector by

$$t_i k_i = g_i. \tag{5}$$

The present paper opens up for the possibility of consumers deriving utility not only from public goods supplied at home, but also from those supplied abroad. The utility of the representative household in country i is given by

$$U_i = \left(x_i, G_i\right), \tag{6}$$

which is assumed to have all the standard properties, thus satisfying the Inada-conditions. Define public good consumption in country i as

$$G_i = g_i + \beta \sum_{j \neq i} g_j, \tag{7}$$

where $\beta \in [0, 1]$ measures the degree to which public goods supplied "abroad" adds to the consumption of those supplied "at home", i.e., the strength of international spillovers in national public goods provision. For $\beta = 0$, there are no spillovers and the public good is purely national, while for $\beta = 1$, there are perfect spillovers and the public good is purely international.

We can think of G_i as the quality of the environment in country i, in which case β measures the degree to which environmental problems are global. If β is high, spending on equipment that reduces the emission of toxic waste in country j, will have a significant, positive impact on the environment also in country i. The public good in this case could be the quality of the air, or the atmosphere, which is affected by international emissions. If β is low, environmental problems are more local, and spending on the environmental good in one country will have only limited impact on the environmental quality in other countries. The public good can here be exemplified by the quality of fresh-water, which may primarily be affected by emissions from local industry and agriculture.

2.1 Pareto optimal provision of public goods

The condition for Pareto-optimal provision of the international public good can be found by maximizing $\sum U_i$ with respect to G_i. Define the marginal rate of substitution for the representative individual in country i (MRS_i) as $(\partial U_i/\partial G_i) / (\partial U_i/\partial x_i)$. Using our assumption that the marginal rate of transformation is unity, we get

$$MRS_i = \frac{1}{1+(N-1)\beta}, \tag{8}$$

which is a modified version of the Samuelson rule. The right hand side of (8) is the slope of the consumption possibility frontier in the internationally coordinated case: A one-unit increase in G_i requires that all countries give up $1/(1+(N-1)\beta)$ units of the private good x_i. Of course, in the case of perfect spillovers, $\beta = 1$ and (8) can be stated as the familiar Samuelson condition $N(MRS_i) = 1$. For illustrative purposes, consider the case of log-linear utility

$$U_i = x_i + b \ln G_i. \tag{9}$$

In this case, (8) reduces to

$$t^{PO} = \frac{b}{k} \tag{10}$$

This condition can be interpreted as saying that each country should contribute an amount b to the public good.[2] Figure 1 illustrates the Pareto-optima for different values of β: point a for the case of $\beta = 1/2$; point b for $\beta = 1$.[3] The consumption possibility frontier for the case of $\beta = 1/2$ is given by C_a, and for the case of $\beta = 1$ by C_b. The utility functions tangent to these frontiers are given by U_a and U_b.

Figure 1 shows that the increase in β expands the consumption possibility frontier from C_a to C_b. By raising the effective supply of the public good, a larger spillover intensity increases utility and reduces MRS_i at Pareto-optimum.

2.2 Non-cooperative provision of public goods

Let the strategic variable be the capital tax rate t_i, and assume that countries make their decisions simultaneously, taking the other countries' tax rates as given.[4] Maximizing (6) with respect to t_i, the first order condition is given by

$$\frac{\partial U_i}{\partial t_i} = \frac{\partial U}{\partial x_i}\frac{\partial x_i}{\partial t_i} + \frac{\partial U}{\partial G_i}\frac{\partial G_i}{\partial t_i} = 0. \tag{11}$$

[2]The reason why t^{PO} is independent of β and N in the quasi-linear case is the following: The reduction in the marginal rate of transformation in consumption following an increase in β and/or N is matched by an equal reduction in MRS_i (as increased spillovers raise the effective supply of the public good).

[3]Figure 1 and Figure 2 are based on $b = 1$, $y_i(k) = 2$, and $N = 2$.

[4]An alternative approach would be to let the level of public expenditure be the strategic variable. As shown by Wildasin (1988), tax equilibria in tax rates and public goods do not in general coincide.

Figure 1: Pareto-optimum and spillover-intensity

Using (5) in (4) and (7), the following comparative static results can be derived

$$\frac{\partial x_i}{\partial t_i} = -f'(k_i)\,\varepsilon_i \frac{\partial k_i}{\partial t_i} + k \frac{\partial \rho}{\partial t_i} \tag{12}$$

and

$$\frac{\partial G_i}{\partial t_i} = k_i (1 + \xi_i) + \beta \sum_{j \neq i} k_j \xi_{i,j}, \tag{13}$$

where

$$\varepsilon_i \equiv \frac{\partial f'(k_i)}{\partial k_i} \frac{k_i}{f'(k_i)}, \quad \xi_i \equiv \frac{\partial k_i}{\partial t_i} \frac{t_i}{k_i}, \quad \xi_{i,j} \equiv \frac{\partial k_j}{\partial t_i} \frac{t_i}{k_j}. \tag{14}$$

Using (12) and (13), (11) can be expressed as

$$MRS_i = \frac{f_i' \varepsilon_i \frac{\partial k_i}{\partial t_i} - k \frac{\partial \rho}{\partial t_i}}{k_i \left(1 + \xi_i\right) + \beta \sum_{j \neq i} k_j \xi_{j,i}}, \tag{15}$$

which implicitely defines the Nash-equilibrium tax rates.[5] The right hand side of (15) is the slope of the consumption possibility frontier as perceived by country i, taking into consideration the effect of taxes on the mobile tax base, given the other countries' tax rates.

In the following, we shall focus on the standard case of identical countries.[6] In the Nash equilibrium with identical countries, tax rates will be the same ($t_i = t_j = t$) and capital will not move between countries $(k_i = k_j = k)$. Hence, in the following we omit the country specific subscripts in the elasticity terms defined by (14). Using (3), in the symmetric equilibrium, we have,

$$\frac{\partial k_i}{\partial t_i} = \frac{k}{f'(k)\,\varepsilon} \frac{(N-1)}{N}, \tag{16}$$

$$\frac{\partial k_j}{\partial t_i} = -\frac{k}{f'(k)\,\varepsilon} \frac{1}{N}, \tag{17}$$

$$\frac{\partial \rho}{\partial t_i} = -\frac{1}{N}, \tag{18}$$

[5] Existence of equilibrium will be assumed. For a discussion of the issue of existence of Nash-equilibria in tax competition models, see Mintz and Tulkens (1986).

[6] It is well known in the tax competition literature that in this case taxes are too low and the public good underprovided in the Nash equilibrium (Zodrow and Miezskowski (1986); Wildasin (1988); Bucovetsky and Wilson (1991)). Fuest and Huber (1999) demonstrate that the undertaxation result may not hold in a situation with imperfect labor markets. For tax competition models with asymmetric countries see e.g. Bucovetsky (1991), Wilson (1991), and Haufler and Wooton (1999).

where in the derivation of $(\partial k_j / \partial t_i)$ we also used the fact that $(\partial k_i / \partial k_j) = -1/(N-1)$, calculated from (3). Substituting (16), (17), and (18) into (15), the symmetric Nash-equilibrium is:

$$MRS = \frac{1}{1 + \frac{N-1}{N}\xi (1-\beta)} \tag{19}$$

Since $\xi < 0$, the right hand side of (19) is greater than that of (8) for $N > 1$, implying that the equilibrium supply of public goods, and therefore the equilibrium tax rate, is lower than in the Pareto-optimum.

If $\beta = 0$, public provison of g_i does not affect utility in other countries, and (19) reduces to the standard underprovision result in the tax competition literature.[7] For $\beta = 1$ the tax competition distortion is eliminated. Now, (19) describes the standard free-riding result from the private provision literature, see Warr (1983). Hence we have the following proposition.

Proposition 1 *With perfect international spillovers from locally supplied public goods, there is no incentive for tax competition.*

The intuition is straightforward. With full spillovers from local public goods, the potential gain of attracting capital is exactly offset by the loss from an international reduction in the supply of public goods. Although this means that the incentive to compete for capital is eliminated, there is still undersupply of the public good in the Nash equilibrium due to free riding. Again, let us illustrate using the quasi-linear preferences defined in (9). In

[7] Note that equation (10.1) in Wildasin (1988) is based on an assumption of 100 percent foreign ownership of capital, and therefore differs slightly from the corresponding equation (19) here. Note also that equation (7) in Konrad and Schjelderup (1999) is derived from a quasilinear utility function, and for that reason differs slightly from equation (19) here.

this case, the tax rate in Nash-equilibrium is given by

$$t^* = \frac{b}{k\left[1+D\right]}, \tag{20}$$

where

$$D \equiv \beta\left[N-1\right] + (1-\beta)\left[\frac{N-1}{N}\frac{b}{|f''|\,k^2}\right]. \tag{21}$$

The distortion (D), relative to the Pareto optimal tax rate given by (10), is a weighted average of the free riding effect (first term) and the tax competition effect (second term). Figure 2 illustrates the Nash equilibrium for $\beta = 1/2$ (point b) and compares it with the associated Pareto optimum (point a) reproduced from Figure 1.[8]

An increase in β in this case reduces the undersupply of public goods if the following condition holds

$$\frac{\partial D}{\partial \beta} = (N-1)\left(1 - \frac{b}{|f''|\,k^2 N}\right) < 0 \quad \Leftrightarrow \frac{b}{|f''|\,Nk^2} > 1. \tag{22}$$

Thus the more serious is the tax competition problem relative to the free-riding problem, the more likely it is that an increase in β improves efficiency. In particular, the distortion from tax competition relative to free riding is more fierce; (i) the larger is b (i.e., strong preferences for the public good makes it important to increase the country's tax base); (ii) the smaller are $|f''|$ and k (i.e., high productivity of capital increases the profitability of attracting capital), and; (iii) the smaller is N.

Note that while both terms in (21) increase with N, tax competition (the second term) increases at a lower rate than free riding (the first term).

[8] The Figure is based on $y_i = \ln k_i$.

Figure 2: Nash-equilibrium and Pareto-optimum

Intuitively, since tax competition applies only if domestic and foreign public goods are not perfect substitutes, i.e., $\beta < 1$, there is a willingness to pay for domestically provided public goods. This fact reduces the downward pressure on t_i as N goes up.

3 Discussion

Proposition 1 is related to a literature which demonstrates that labor mobility may improve Pareto efficiency. Burbidge and Myers (1994) show that labor mobility reduces tax competition, and Wellisch (1995) demonstrates that it reduces international environmental problems. In our model, public goods spillovers play much the same role as migration in the two former articles referred to above: International migration and international spillovers represent links between countries which tend to equalize international welfare. Through these links, any policy which reduces the welfare of other countries, such as tax competition and weaker environmental protection, at least partly backfires on the country initiating the policy, thereby reducing the incentives to carry out such policies in the first place.

Proposition 1 can also be seen as a special case of the neutrality result in the literature on the private provision of public goods, the seminal contribution being Warr (1983), and for an application to international economics, see Kemp (1984). The neutrality result states that under certain circumstances, redistribution of income between a group of agents contributing to a public good is completely neutral, affecting neither the aggregate supply of the public good nor the welfare of the agents. The reason is that transfers of income in equilibrium are perfectly offset by changes in the voluntary provision of the public good. In such an environment, it is also clear that agents will not be interested in undertaking costly forms of redistribution, such as tax competition.

4 Extension

In the basic version of the model presented above, we studied various degrees of international spillovers, i.e., various degrees of international rivalry in public goods. Within each country, however, we assumed that the public good was entirely non-rival. In this extension we modify this assumption, and introduce congestion in the use of the public good: An increase in the number of firms in a country, i.e., an increase in k_i, crowds out the amount of the public good available for consumers, for any given level of g_i. Thinking of the public good as the quality of the environment, this extension can be interpreted as the situation where firms pollute the local environment. Let $c(k_i)$ represent the congestion cost in terms of reduced availability of the public good in country i, where $c' > 0$. The modified version of (7), taking into account congestion, can be stated as

$$G_{ci} = g_i - c(k_i) + \beta \sum_{j \neq i} (g_j - c(k_j)) . \tag{23}$$

The Pareto optimality condition is defined as in (8), but with the marginal rate of substitution now defined as $MRS_c = (\partial U_i / \partial G_{ci}) / (\partial U_i / \partial x_i)$. Since $G_{ci} < G_i$, the Pareto-optimal level of public goods supply is greater in the congestion case than in the benchmark case. The reason is simply that the reduction in the level of the public goods available to the consumers at least partly should be offset by an increase in public good supply. The symmetric Nash-equilibrium in the congestion case is characterized by

$$MRS_c = \frac{1}{1 + \frac{N-1}{N} \xi_c (1 - \beta)} \tag{24}$$

where

$$\xi_c \equiv \frac{\partial k}{\partial t} \frac{(t - c'(k))}{k} .$$

Note that ξ_c may well be positive, which is true for $t < c'(k)$. For $\beta > 0$, an increase in the marginal congestion cost reduces $|\xi_c|$ and thereby increases the slope of the perceived consumption possibility frontier. Indeed, in this scenario, there may be oversupply of the public good in Nash-equilibrium.

This is the case if the right hand side of (24) is smaller that of (8), which is true if $\xi_c > N\beta/(1-\beta)$.

The reason why there may be oversupply in equilibrium, is that when environmental problems are primarily local, i.e., β is low, countries have an incentive to increase tax rates in order to induce some of its polluting firms to leave the country and pollute elsewhere. This effect, the congestion effect, obviously modifies the tax competition effect.[9] If the congestion effect is sufficiently strong, overtaxation and thereby oversupply of the local public good may result.

Oversupply is less likely to take place when international spillovers in public goods provision are large. The reason is simply that with large international spillovers, domestic welfare is affected by the total international amount of pollution, and not so much by whether the polluting firms are located at home or abroad. Hence, there is less incentive to tax local capital in order to move polluting activity out of the country.

5 Conclusion

This paper demonstrates that international spillovers from public goods reduce tax competition. In fact, in the case of purely international public goods, there will be no tax competition at all. Underprovision of public goods will however prevail due to the free-rider problem. We also investigate the effect of congestion in the model, which may be interpreted as an endogenization of pollution, and find that this effect tends to modify the extent of tax competition in the model. If the congestion effect is sufficiently strong, the result may in fact be overprovision of the public good in equilibrium.

[9] A similar result can be found in Markusen et al. (1995), which considers the case of purely local pollution.

Let us conclude with two suggestions for further research. First, it would be interesting to investigate implications of various types of asymmetries, such as asymmetry in county size, asymmetry in spillovers between countries, etc. Second, it could be of interest to investigate the case where the public good, rather than the tax rate, is the strategic variable.

References

Bergstrom, T., L. Blume, and H. Varian. (1986). "On the private provision of public goods." *Journal of Public Economics* 29, 25-49.

Bucovetsky, S., and J. Wilson. (1991). "Tax competition with two tax instruments." *Regional Science and Urban Economics 21, 333-350.*

Burbidge, J.B., and G.M. Myers. (1994). "Population mobility and capital tax competition." *Regional Science and Urban Economics* 24, 441-459.

Fuest, C., and B. Huber. (1999). "Tax coordination and unemployment." *International Tax and Public Finance* 6, 7-26.

Haufler, A., and I. Wooton. (1999). "Country size and tax competition for foreign investment." *Journal of Public Economics* 71, 121-139.

Ihori, T. (1992). "Impure public goods and transfers in a three-agent model." *Journal of Public Economics* 48, 385-401.

Keen, M., and M. Marchand. (1997). "Fiscal competition and the pattern of public spending." *Journal of Public Economics* 66, 33-53.

Kemp, M.C. (1984). "A note of the theory of international transfer." *Economics Letters* 14, 259-262.

Konrad, K., and G. Schjelderup. (1999). "Fortress building in global tax competition." *Journal of Urban Economics* 46, 156-167.

Markusen, J., E.R. Morey, and N. Olewiler. (1995). "Competition in regional environmental policies when plant locations are endogenous." *Journal of Public Economics* 56, 55-77.

Mintz, J., and H. Tulkens. (1996). "Commodity tax competition between member states of a federation: Equilibrium and efficiency." *Journal of Public Economics* 29, 133-172.

Sandmo, A., and D.E. Wildasin. (1999). "Taxation, migration, and pollution." *International Tax and Public Finance* 6, 39-59.

Warr, P. (1983). "The private provision of a public good is independent of the distribution of income." *Economics Letters* 13, 207-211.

Wellisch, D. (1995). "Can household mobility solve basic environmental problems?" *International Tax and Public Finance* 2, 245-260.

Wildasin, D.E. (1988). "Nash equilibria in models of fiscal competition." *Journal of Public Economics* 35, 229-240.

Wilson, J.D. (1991). "Tax competition with interregional differences in factor endowments." *Regional Science and Urban Economics* 21, 423-451.

Zodrow, G., and P. Mieszkowski. (1986). "Pigou, Tiebout, property taxation and the underprovision of local public goods." *Journal of Urban Economics* 19, 356-370.