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Tax Competition and Determination of the Quality of Public Goods

A.H. Ould Abdessalam and Eric Kamwa

Abstract
In this paper, the authors analyze the behavior of local governments on capital taxation when the financial choices in terms of a public good quality are done by a central planner. More specifically, they ask the question whether a local government has an interest to tax the mobile factor in addition to the tax on representative households or not. The authors show, through a comparison of social welfare given the strategies chosen by the locals governments, that whatever the quality of the public good and its cost is, a local government always has an interest to tax the mobile factor. This leads to a Nash-equilibrium in dominant strategy in their model.

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Keywords Tax competition; public goods; taxation; quality; welfare

Authors
A.H. Ould Abdessalam, ✉ Normandie Univ, France; UNICAEN, CREM, UMR-CNRS 6211. Also, Teaching assistant at Université Paris-Est Créteil, erhaidara@gmail.com
Eric Kamwa, Normandie Univ, France ; UNICAEN, CREM, UMR-CNRS 6211. UFR Sciences Economiques, 19 Rue claude Bloch, F14000 Caen

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1 Introduction

Introduced by Tiébout (1956), the tax competition theory considers an economy with at least two local governments (hereafter, LG) that compete in order to attract the mobile factor (usually, capital) through a system of public spending/taxes. In this competition, LG choose their tax rates without any cooperation. This defines a non-cooperative game which directly affects their budgetary constraints. In this game, each LG chooses the tax rate on capital that maximizes the utility of the representative individual given the tax rates of the other communities. The game ends in the Nash-equilibrium (see Mintz and Tulkens, 1986; Wilson, 1986; Wildasin, 1991, 1988). In most of the cases, this leads to corporate taxation rates below the optimal levels and to an insufficient level of public goods (see Zodrow and Mieszkowski, 1986; Wilson, 1986; Wildasin, 1989). The main matter in the tax competition literature is to know if the fiscal bases (given the induced suboptimal supply of public goods) and the insufficient public spending are interdependent or not. Answers are provided by models in which the vector of strategies (tax rates) are compared to budget choices of the LG.

A somewhat different view of tax competition may come from the introduction of a second factor characterizing the public good. In addition to the amount of the public good, one can specify the level of the quality of the considered public good. The concept of *quality* seems quite understandable but this is not the case. As soon as one tries to define the quality of a service with any degree of accuracy, we become aware that this concept is more complex and requires prerequisites that have nothing mechanical. According to Palmer *et al.* (1991), quality is the production of a better health service combined to satisfaction of a population by taking into account technological constraints, resource constraints and consumers specificities. For Roemer and Montoya-Aguilar (1989), the quality of a public good is measured by the level at which it meets predefined standards.

Various authors have tried to measure the impact of the quality of public service on the location of capital by relying on a dichotomy of this concept: *high quality-low quality*. Jud and Watts (1981) tested and acknowledged a positive correlation between the quality of public service and housing prices. They concluded that, a high quality public services in a LG implies an increase in housing demand and soaring rents. Hoyt and Jensen (2001) showed how the differentiation of the quality of education can improve the differential impacts of tax competition and the consumers' welfare. Gabe and Bell (2004) established that a decrease in taxes associated to a certain level of public services joined to a decreasing quality seems less attractive than a high level of tax coupled with a good quality of public services (see Bénassy-Quéré *et al.*, 2005; Fatica, 2010).

In this paper, our framework is that of the classical approach in the tax competition theory. We follow Roemer and Montoya-Aguilar (1989) in considering the quality of the public good. So, the quality of a public good is measured by the total amount of public funds allocated in order to meet some predetermined standards (maintenance of public parks, roads, property rights, training of manpower, etc.) imposed by a central government. The imposed standards are supposed the same for all the LG. Through a model, we determine the fiscal policy adopted in a LG by comparing the social welfare induced by the fiscal behavior of the local planners given that the public good are required to be supplied at a certain level of quality. We assume that, each local planner have two strategies : he can choose to *tax the capital* (at the maximal rate) or to *not tax the capital*. We show that, if all the LG except one choose to tax the capital, although the capital level is low in this jurisdiction, the social welfare is greater than that obtained when the capital is taxed in this jurisdiction. When a LG decides to not tax the capital when the others do, although the level of capital is higher in this jurisdiction, the social welfare is equal to that obtained when all the LG (this jurisdiction included) choose to not tax. With this, we define a game in which the solution in Nash-equilibrium suggests that every LG should tax the capital. Finally, we find out the level of the quality at the equilibrium.

The rest of the paper is organized as follows: in Section 2, we present our model. The solutions of this model are given in Section 3; also in this section, we determine the equilibrium of the game that we define. Section 4 concludes.

2 The model

We consider a set of M ($M \geq 2$) local governments (C), homogeneous (supposed all the same), each LG is inhabited by a representative resident who is geographically sedentary. The representative resident possesses all the local lands and a fraction of the stock of capital K_i available in the economy. The capital is perfectly mobile between LG with no travel cost. The total capital stock in the economy, $\bar{K} = \sum_{i=1}^{M} K_i$ is assumed to be fixed.

In each LG, a public and a private good are offered to the representative resident. In a given LG i, the representative resident consumes a quantity c_i of the private good and g_i of the public good. We assume in jurisdiction i that the representative resident is very demanding on the quality of the public good that is offered. In order to satisfy this consumer, a central government fixes the standards q to be met by the public good in each of the jurisdictions. These standards define the quality of the public good[1]. Then, it is up to each local government to mobilize financial efforts in order to implement the standards set by the central government. This generates a cost that the local authorities should integrated in the local tax law.

[1] The concept of quality includes all the accompanying measures that follow the provision of a public good. For example, the quality of education can be attached to the qualification of the teaching staff or facilities provided in schools (computers, laboratories, etc).

2.1 Consumer Preferences and production technology

As it is assumed that consumers are very demanding on the quality of the public good that is offered, quality comes as a key parameter in the assessment of their satisfaction. Consumer preferences are represented by a multiplicative utility function of the form

$$U_i(c_i, g_i, q) = c_i g_i q \tag{1}$$

In our frame, we assume that the main production factor in a given locality i is the capital[2] K_i. The public good is assumed productive; this means that, firms also use the public good g_i with the quality q. Then, in jurisdiction i, the production function F_i is assumed log-linear and is defined as follows:

$$F_i(K_i, g_i, q) = \alpha \ln K_i + \beta \ln g_i + \gamma \ln q \tag{2}$$

with $\alpha > 0$, $\beta > 0$ and $\gamma > 0$. The properties of $F_i(K_i, g_i, q)$ are equivalent to those of a Cobb-Douglas function: it is at constant returns to scale and is twice differentiable. $\frac{\delta F_i(K_i,g_i,q)}{\delta K_i} = F_{K_i} > 0$ and $\frac{\delta^2 F_i(K_i,g_i,q)}{\delta K_i^2} = F_{K_i K_i} < 0$. We also assume $\frac{\delta F_i(K_i,g_i,q)}{\delta g_i} = \frac{\delta F_i(K_i,g_i,q)}{\delta q_i} = 0$ to say that firms use the the public good and the quality in fix proportion.

2.2 The provision of the public good and the budgets constrains

After the standards of the local public good are defined by the central government, the unit amount required to implement these standards in each locality is such that $C(q) = q^{\varepsilon}$ with ε the elasticity-cost of the quality. In each locality i, only the tax revenues are used to meet the standards. These tax revenues come from a flat tax levied H_i on households corresponding to a right of residence in the jurisdiction and from the volume of the capital used in the production process taxed at the rate t_i. The local government of jurisdiction i can choose to *not tax the capital* (so, $t_i = 0$) or to *tax the capital* at a maximal rate $t_i = \bar{t}$. When a local planner chooses to not tax the capital, he finances the local public good with quality standards required only by the tax on households $\bar{H}$. The budget constraint in jurisdiction i is then as follows:

$$\begin{cases} g_i = q^{-\varepsilon}\bar{H} & if \;\; t_i = 0 \\ g_i = (\bar{t}\tilde{K}_i + \bar{H})q^{-\varepsilon} & if \;\; t_i = \bar{t} \end{cases} \tag{3}$$

As capital are assumed mobile, they are attracted toward jurisdictions that offer the best return after taxation. At the equilibrium, the net return on capital ρ is the same in all the jurisdictions.

[2] Lands are not considered since we assume no substitution with the other factors.

The objective of a local planner is to maximize the social welfare of its residents in accordance with its budget constraint. This results in the following program:

$$\begin{aligned} & \max U_i(c_i, g_i, q) \\ constrained\ \ to \quad & c_i = F_{K_i}(K_i, g_i, q) - (\rho + t_i)K_i + \rho(\bar{K}/M) - H_i \\ & q^{\varepsilon} g_i = t_i K_i + H_i \end{aligned} \tag{4}$$

The amount $(F_{K_i}(K_i, g_i, q) - (\rho + t_i)K_i)$ corresponds to the land revenue paid by business owners to residents for land use. The value $\rho(\frac{\bar{K}}{M})$ measures the share of return on capital invested by the individual irrespective of his place of residence.

As the capital is assumed to be attracted toward the jurisdiction with the best return after taxes, we need now to know how the tax choices of the local planners can impact the social welfare and what it the equilibrium of our model.

3 Social welfare and tax choices

Since the local planners can choose to *not tax the capital* ($t_i = 0$) or *tax the capital* at $t_i = \bar{t}$), they are all involved in a non cooperative game in order the attract more capital. In this game, all the jurisdictions can have the same policy, or a jurisdiction can choose to not tax the capital while all the others do, or choose to tax while the others do not. To analyze a such game with our model, we first suppose that there is a jurisdiction i that behaves (a)-like all the others jurisdictions $j \neq i$ or (b)-differently of all the other jurisdictions $j \neq i$. These configurations will help us to see the effects on the welfare of the resident of jurisdiction i. We denote by $U_i^{(t_i,t_j)}$, the utility of the representative consumer of jurisdiction i, given t_i and t_j respectively the tax rates in jurisdiction i and in the other jurisdictions j ($i \neq j$). Let us analyze all the possible configurations.

3.1 All the other jurisdictions choose $t_j = 0$

Jurisdiction i behaves like the others

As all the local governments have the same taxation rate $t_i = t_j = 0$ and the same net return in capital $F_{Ki} = F_{K_j} = \rho$, this means that the stock of capital is the same in all jurisdictions: $K_i = K_j = \frac{\bar{K}}{M}$. Thus, it comes that:

$$U_i^{(0,0)} = U_j^{(0,0)} = \bar{H} c_i q^{1-\varepsilon} \tag{5}$$

Jurisdiction i behaves differently

In this case, jurisdiction i chooses $t_i = \bar{t}$ while the others choose $t_j = 0$. The level of capital stock must fit within jurisdiction i for the net return in capital ρ to remain identical in all the other jurisdictions. In jurisdictions i, this net return in capital is equal to $\frac{\alpha}{K_i} - \bar{t}$ and in the others jurisdictions, it is equal to $\frac{\alpha}{K_j}$. At the equilibrium, we have $\frac{\alpha}{K_j} = \frac{\alpha}{K_i} - \bar{t}$.

Except jurisdiction i, all the others have the same amount of capital invested. They will equally share the total stock of capital minus that invested in jurisdiction i. So, in a jurisdiction j, we have $K_j = \frac{\bar{K}-K_i}{M-1}$.

Proposition 1. *Suppose that a local government i decides to tax the capital while all the others do not. By comparison to the case in which this jurisdiction do not tax the capital as the others, it evidences that the capital level $\tilde{K}_i$ will be lower but, there is an improvement in the social welfare of the representative inhabitant: $\tilde{K}_i < \frac{\bar{K}}{M}$ and $U_i^{(\bar{t},0)} > U_i^{(0,0)}$. And $\tilde{K}_i$ is such that*

$$\tilde{K}_i = \frac{M\alpha - \sqrt{\Delta} + \bar{t}\bar{K}}{2\bar{t}} \tag{6}$$

with $\Delta = M^2\alpha^2 + \bar{K}^2\bar{t}^2 - 4\bar{t}\bar{K}\alpha + 2\bar{K}M\bar{t}\alpha$.

Proof. Recall that we have assumed that the capital is attracted toward jurisdictions that offer the best return after taxation. If jurisdiction i tax the capital while the others do not, the lowest return after taxation is recorded in jurisdiction i. So, at the equilibrium, $\tilde{K}_i$ the stock of capital in jurisdiction i will be lower than that we have when no jurisdiction taxes the capital, $\frac{\bar{K}}{M}$. Thus, $\tilde{K}_i < \frac{\bar{K}}{M}$. Let us know compute the value of $\tilde{K}_i$.

As the capital is assumed perfectly mobile, by equalizing the marginal net return at the equilibrium, we have :

$$\begin{aligned}
& \alpha/K_j && = \alpha/K_i - \bar{t} = \rho \\
\Leftrightarrow \quad & \alpha K_i && = \alpha K_j - \bar{t}K_iK_j \\
& && = \alpha\left(\frac{\bar{K}-K_i}{M-1}\right) - \bar{t}K_i\left(\frac{\bar{K}-K_i}{M-1}\right) \\
\Leftrightarrow \quad & \alpha K_i(M-1) && = \alpha(\bar{K}-K_i) - \bar{t}K_i(\bar{K}-K_i) \\
\Leftrightarrow \quad & \bar{t}K_i^2 - K_i(\bar{t}\bar{K}+\alpha M) + \alpha\bar{K} = 0 &&
\end{aligned}$$

We then have a second degree equation. By solving this equation, we retain the lowest solution among the two found :

$$\tilde{K}_i = \left[M\alpha - \sqrt{\Delta} + \bar{t}\bar{K}\right]/2\bar{t} \tag{7}$$

where $\Delta = M^2\alpha^2 + \bar{K}^2\bar{t}^2 - 4\bar{t}\bar{K}\alpha + 2\bar{K}M\bar{t}\alpha$ is the discriminant. □

According to Proposition 1, even if by taxing the capital while the others do not induces a diminution of the stock of capital in jurisdiction i, the quantity of public good in this jurisdiction is greater than everywhere else and this implies an improvement in the welfare of its representative consumer comparatively to the other jurisdictions. Given this result, $(t_i = 0, t_j = 0)$ is not an equilibrium since there is an incentive for a jurisdiction to deviate by improving its social welfare. It is also the case for $(t_i = \bar{t}, t_j = 0)$ since jurisdiction i can have an incentive to deviate in order attract more capital this at the expense of the social welfare.

3.2 All the other jurisdictions choose $t_j = \bar{t}$

jurisdiction i behaves like the others

As for $t_i = t_j = 0$, we will also have $K_i = K_j = \frac{\bar{K}}{M}$ at the equilibrium for $t_i = t_j = \bar{t}$. Thus, the utility of the representative consumer in jurisdiction i is :

$$U_i^{(\bar{t},\bar{t})} = (\bar{t}(\bar{K}/M) + \bar{H})c_i q^{1-\varepsilon} \tag{8}$$

Jurisdiction i behaves differently

For $t_j = \bar{t}$ and $t_i = 0$, net return in capital is $\frac{\alpha}{K_j} - \bar{t}$ in j and $\frac{\alpha}{K_i}$ in i. As before, we have at the equilibrium, $\frac{\alpha}{K_i} = \frac{\alpha}{K_j} - \bar{t}$.

Proposition 2. *Assume that all the jurisdictions decide to tax the capital and that there is one jurisdiction i that does not. It comes that the stock of capital $\check{K}$ is higher in this jurisdiction than anywhere else; but, the social welfare in this jurisdiction is identical to that where all the jurisdictions decide not to tax the capital: $U_i^{(0,\bar{t})} = U_i^{(0,0)}$. And $\check{K}_i$ is such that*

$$\check{K}_i = \frac{\sqrt{\Theta} + \bar{t}\bar{K} - M\alpha}{2\bar{t}} \tag{9}$$

with $\Theta = M^2\alpha^2 + \bar{K}^2\bar{t}^2 + 4\bar{t}\bar{K}\alpha - 2\bar{t}\bar{K}M\alpha$.

Proof. As jurisdiction i does not tax the capital while the others do, it records the best return of capital after taxation. So, at the equilibrium, $\check{K}_i$ the stock of capital in jurisdiction i will be greater than that we have when no jurisdiction taxes the capital, $\frac{\bar{K}}{M}$. Thus, $\check{K}_i > \frac{\bar{K}}{M}$. Let us know compute the value of $\check{K}_i$.

As the capital is assumed perfectly mobile, by equalizing the marginal net return at the equilibrium, it comes that :

$$
\begin{array}{rc}
 & \alpha/K_i = \alpha/K_j - \bar{t} = \rho \\
\Leftrightarrow & \alpha K_i - \bar{t}K_iK_j = \alpha K_j \\
\Leftrightarrow & \alpha K_i = \alpha(\bar{K} - \frac{K_i}{M-1}) + \bar{t}K_i(\bar{K} - \frac{K_i}{M-1}) \\
\Leftrightarrow & \alpha\,(M-1)\,K_i = \alpha\,(\bar{K} - K_i) + \bar{t}K_i\,(\bar{K} - K_i)\,\alpha K_i M = \alpha\bar{K} + \bar{t}K_i\bar{K} - \bar{t}K_i^2 \\
\Leftrightarrow & \bar{t}K_i^2 + K_i\,(\alpha M - \bar{t}\bar{K}) - \alpha\bar{K} = 0
\end{array}
$$

We end with a second degree equation. By solving this equation, we retain the greatest solution among the two found :

$$
\check{K}_i = \frac{1}{2\bar{t}}\left(-M\alpha + \sqrt{\Theta} + \bar{t}\bar{K}\right) \tag{10}
$$

where $\Theta = M^2\alpha^2 + \bar{K}^2\bar{t}^2 + 4\bar{t}\bar{K}\alpha - 2\bar{t}\bar{K}M\alpha$ is the discriminant. □

By deviating, jurisdiction i gains more capital but at the expense of the social welfare of it resident. If the departure point of our analysis was $t_i = t_j = 0$ and that all the other jurisdictions move to $t_j = \bar{t}$, this will be in favor of jurisdiction i since it will attract more capital without any variation of social welfare because $U_i^{(0,0)} - U_i^{(0,\bar{t})} = 0$.

3.3 The Nash equilibrium and the central government's choice of the standards

To summarize the above results, we end with what follows:

$$
\left\{
\begin{array}{l}
U_i^{(0,0)} = U_i^{(0,\bar{t})} \\
U_i^{(\bar{t},0)} > U_i^{(0,0)} \\
U_i^{(\bar{t},\bar{t})} > U_i^{(0,0)}
\end{array}
\right\} \tag{11}
$$

According to equation (11), whatever the tax strategy of the other communities $j \neq i$, community i always has an interest to tax the capital because this will induce an improve in the social welfare of its resident. Since the M communities were assumed identical, they will all adopt the same fiscal behavior. Thus, $(t_i^* = \bar{t}, t_j^* = \bar{t})$ is the Nash-equilibrium no matter the quality of the local public good and the elasticity-cost of the quality. So, the stock of capital in each jurisdiction is

$$
t_i^* = t_j^* = \bar{t} \Rightarrow K_i^* = \frac{1}{4\bar{t}}\left(\alpha + \sqrt{\alpha^2 - 8\bar{K}\bar{t}\alpha}\right) \tag{12}
$$

and it follows that the level public good's quality is:

$$q^* = \left(\frac{U_i}{\left(\bar{t} \frac{\bar{K}}{M} + \bar{H} \right) c_i} \right)^{\frac{1}{\varepsilon - 1}} \tag{13}$$

According to equation (13), at the equilibrium, the central planer should adapt his choice in respect with the elasticity-cost ε of the quality.

4 Conclusion

We have analyzed a model of tax competition in which local governments bear the financial choices in terms of the quality of the public good imposed by a central government. We found that, when all the jurisdictions behave similarly, the stock of capital is equally distributed no matter they all tax the capital or not. If on contrary, a jurisdiction decided to not behave like the others by taxing the capital while the others do, we found that even though the stock of capital is reduced in this jurisdiction, there is an improvement of the welfare of its resident. If all the jurisdictions tax the capital except one, we found that no matter the increase in the capital stock in this jurisdiction, there is no improvement of the welfare of its resident. We then conclude that each jurisdiction always have an interest to tax the capital: in such a configuration the welfare of the representative resident in each jurisdiction is better than what we have when they all choose to not tax the capital.

As the quality of the public good was the key matter in our paper, it comes out that the central planer should adapt his choices in respect with the elasticity-cost of the quality. In other words, it is the value of the cost necessary to implement the standards required which lead the central planner to be more demanding or not regarding the quality of the public good.

Nonetheless, our model suffers from some limits. Our analysis was based on a utility function assumed multiplicative : what would become to our findings if another form of the utility function was assumed? In analyzing the behavior of local governments, we have assumed a static game. It will be interesting to see what happen when a dynamic game is supposed. All these questions are opened paths for future works.

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