Lecture Notes: Systems Competition
Chapter II.1: Capital Tax Competition - "Race to the bottom" view*

Michael Stimmelmayr

October 18th 2007

2 Tax Competition

2.1 Capital Tax Competition

based on Zodrow and Mieszkowski (1986)*

2.1.1 Basic set-up

one-period model

n symmetric regions

representative household in each region:

land endowment l

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

capital endowment $\overline{k}$

private consumption: $c = wl + r\overline{k}$, $w =$ price per unit of land

preferences $u(c, g)$, $c =$ private consumption and $g =$ public consumption

representative firm: $y = f(l, k)$

(i) $\partial f/\partial k \equiv f_k > 0$, $\partial f/\partial l \equiv f_l > 0$,

(ii) $\partial^2 f/\partial k^2 \equiv f_{kk} < 0$, $\partial^2 f/\partial l^2 \equiv f_{ll} < 0$, and

(iii) $\partial^2 f/\partial k \partial l = \partial^2 f/\partial l \partial k \equiv f_{kl} > 0$.

Constant returns to scale imply $f(k, l) = f_k k + f_l l$

profit $\pi = f(k, l) - (r + t)k - wl$

perfect capital mobility:$r =$ international interest rate

$\max_{k,l} \quad \pi \Rightarrow f_k = r + t$ and $f_l = w$

Differentiate the first-order condition $f_k^i = r + t^i$ with respect to k^i and t^i. This gives

$$f_{kk}^i \partial k^i = \frac{\partial r}{\partial t^i} \partial t^i + \partial t^i.$$

Solving for $\frac{\partial k^i}{\partial t^i}$ yields

$$\frac{\partial k^i}{\partial t^i} = \frac{\frac{\partial r}{\partial t^i} + 1}{f_{kk}^i}. \tag{1}$$

Analogously, differentiating the first-order condition for region j, $f_k^j = r + t^j$ $(j \neq i)$, with respect to k^j and t^i gives after rearranging

$$\frac{\partial k^j}{\partial t^i} = \frac{\frac{\partial r}{\partial t^i}}{f_{kk}^j}. \tag{2}$$

2.1.2 Market equilibrium

Capital market equilibrium: $n\overline{k} = \sum_{i=1}^{n} k^i$

Differentiating with respect to t^i: $\frac{\partial k^i}{\partial t^i} + \sum_{j \neq i}^{n} \frac{\partial k^j}{\partial t^i} = 0$

Since regions are symmetric the expression can be simplified to

$$\frac{\partial k^i}{\partial t^i} + (n-1)\frac{\partial k^j}{\partial t^i} = 0. \tag{3}$$

Now, inserting Eqs. (1) and (2) and solving for $\frac{\partial r}{\partial t^i}$ yields

$$\frac{\partial r}{\partial t^i} = -\frac{1}{n}. \tag{4}$$

- For $n = 1$, the interest rate response is -1. Any increase in the tax rate can be shifted onto capital owners via a proportional reduction in the interest rate.

- For $n \longrightarrow \infty$, the interest rate response vanishes, i.e. $\frac{\partial r}{\partial t^i} \longrightarrow 0$. In a small open economy, each region has no market power. The international interest rate cannot be influenced via local tax policy.

- For $1 < n < \infty$ the interest rate is reduced, but not proportionally to the tax rate increase. Formally, $-1 < \frac{\partial r}{\partial t^i} < 0$. A large open economy cannot completely shift the tax burden onto capital owners.

Substituting Eq. (4) into Eqs. (1) and (2) gives the overall capital demand responses

$$\frac{\partial k^i}{\partial t^i} = \frac{n-1}{n}\frac{1}{f^i_{kk}}, \tag{5}$$

$$\frac{\partial k^j}{\partial t^i} = -\frac{1}{n}\frac{1}{f^j_{kk}}, \qquad i \neq j \tag{6}$$

The magnitude of $\frac{\partial k^i}{\partial t^i}$ is inversely related to the magnitude of $\frac{\partial r}{\partial t^i}$.

- For $n = 1$ Eq. (5) reduces to $\frac{\partial k^i}{\partial t^i} = 0$. By construction, capital cannot leave a closed economy.

- For $n \rightarrow \infty$, $\frac{\partial k^i}{\partial t^i}$ reaches its maximum in absolute terms. Note for $n \rightarrow \infty$, $\frac{n-1}{n} \rightarrow 1$ from below.

- For $1 < n < \infty$ the response $\frac{\partial k^i}{\partial t^i}$ is positive but lower in absolute terms than in a small open economy. The response is increasing (in absolute terms) in the number of regions n, i.e. the higher n, the more strongly capital demand reacts to a marginal increase in t^i.

2.1.3 Regional government

Regional governments levy a source-based capital tax.

Tax revenues tk are recycled by providing a local public good g, $tk = g$.

The government chooses $t = \arg\max u(wl + r\bar{k}, tk)$

2.1.4 Efficiency

Production efficiency:

$$f_k^i = f_k^j, \qquad i \neq j. \tag{7}$$

Allocative efficiency:

$$\frac{u_g}{u_c} = 1, \tag{8}$$

where $\partial u/\partial c \equiv u_c$ and $\partial u/\partial g \equiv u_g$, respectively.

2.1.5 Equilibrium Tax Policy

Applying the Euler theorem rental income can be rewritten as $wl = f(k) - f_k k$. Therefore, private consumption is given by

$$c = f(k) - f_k k + r\overline{k}. \tag{9}$$

The local government sets t and, thereby, g, taking the reaction of the interest rate (4) and regional capital demand (5) into account. It behaves as a Nash competitor towards other regions, i.e. it takes the tax rates of other regions as given. Thus, it solves

$$\max_t \quad u\left(f(k) - f_k k + r\overline{k}, tk\right) \qquad \text{s.t. (4) and (5)}$$

The first-order condition is:

$$(t): \quad u_c\left(-f_{kk}\frac{\partial k}{\partial t}k + \frac{\partial r}{\partial t}\overline{k}\right) + u_g\left(k + t\frac{\partial k}{\partial t}\right) = 0. \tag{10}$$

At a symmetric equilibrium ($k = \overline{k}$), the first-order condition (10) reduces to

$$\begin{aligned} u_c\left[\left(-f_{kk}\frac{\partial k}{\partial t}+\frac{\partial r}{\partial t}\right)k\right]+u_g\left(k+t\frac{\partial k}{\partial t}\right) &= 0, \\ u_c\,(-k)+u_g\left(k+t\frac{\partial k}{\partial t}\right) &= 0. \end{aligned}$$

The last step follows from inserting Eqs. (4) and (5). Rearranging the terms yields the expression

$$\frac{u_g}{u_c}=\frac{1}{1+\epsilon_{k,t}} \qquad \text{with} \;\; \epsilon_{k,t} := \frac{\partial k}{\partial t}\frac{t}{k} < 0. \qquad (11)$$

Interpretation:

- The LHS gives the marginal rate of substitution, i.e. the marginal willingness to pay for public consumption

- The RHS depicts the marginal cost of public funds (henceforth MCPF). The MCPF measures how much private consumption has to be sacrificed in order to raise one additional unit of tax revenues. $\epsilon_{k,t}$ is the tax base elaticity which in absolute value is positively related to the MCPF.

Results:

- $\frac{u_g}{u_c} > 1 \Rightarrow$ public good provision is inefficiently low!

- The higher $\epsilon_{k,t}$, the more severe the underprovision tendency ("race to the bottom")

2.1.6 Policy Implications

Two policy measures are generally discussed:

(i) tax coordination and

(ii) exchange of information on foreign-source capital income in order to implement a residence-based tax system.

Tax Coordination Tax coordination involves some form of agreement between nation states that their tax rates can only be changed in a coordinated way. In practice coordination typically takes the form of imposing a lower bound on tax rates. The extreme form would be to only allow a simultaneous change in the tax rate. Formally, if all regions simultaneously increase the tax rate, the combined effect on the interest rate is

$$\begin{aligned}\sum_{j=1}^{n} \frac{\partial r}{\partial t^j} &= -n\frac{1}{n} \\ &= -1.\end{aligned}$$

Totally differentiating the first-order condition $f_k^i = r + t^i$ with respect to k^i, t^i and t^j $(j = 1, \ldots, n;\ j \neq i)$ yields

$$f_{kk}^i dk^i = \frac{\partial r}{\partial t^i} dt^i + \sum_{j=1, j\neq i}^{n} \frac{\partial r}{\partial t^j} dt^j + dt^i.$$

Thus,

$$\begin{aligned}\left.\frac{dk^i}{dt^i}\right|_{dt^i = dt^j} &= \frac{\sum_{j=1}^{n} \frac{\partial r}{\partial t^j} + 1}{f_{kk}^i} \\ &= 0.\end{aligned}$$

Capital does not react to a coordinated change in t^i. Tax harmonization shifts the tax burden onto capital owners via a proportional interest rate reduction. The MCPF reduces to unity - see Eq. (11) - which induces an efficient public policy.

Information Exchange A residence-based capital tax system is feasible if information on the foreign-source interest income of domestic residents is available to the fiscal authority. If feasible, the private budget constraint would read $I = wl + r\overline{k} - t\overline{k}$.

The public budget constraint becomes $g = t\overline{k}$.

Using the Euler theorem (i.e. $f(l,k) = f_k k + f_l l$) and the firm's first-order conditions $f_l = w$ and $f_k = r$, we can write $wl = f(l,k) - f_k k$. Consequently, $c = f(l,k) - f_k k + (r-t)\overline{k}$. The government chooses $t =$

arg max $u(f(l,k) - f_k k + (r-t)\overline{k}, t\overline{k})$. The first-order condition is

$$u_c\left(-\overline{k}\right) + u_g\left(\overline{k}\right) = 0.$$

Result: $\frac{u_g}{u_c} = 1 \Rightarrow$ public good provision is efficient as it is insulated from capital mobility.