



Cooperation in Tax Competition in a Repeated Game Setting

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Abstract

Within a basic model of capital tax competition we analyze the forces to gain from a coordination of tax rates. Specifically, we study regions which may cooperate by forming coalitions. While allowing every possible coalition structure to form, we first derive the optimal tax rates and tax revenues for a given coalition structure. Second, we compare the tax rates and the tax revenues between different coalition structures. We analyze the sustainability of cooperative behavior for all possible coalition structures in a repeated game setting. We find that cooperation is easier to sustain the more cooperative behavior there exists ex-ante and the harsher the punishment is for deviation.

1. Introduction

We study the phenomenon of tax competition on capital income allowing regions to form coalitions in order to avoid the inefficient Nash tax competition equilibrium. Moreover, we introduce a repeated game in the tax competition model to analyze the dynamic sustainability of cooperation.

A number of recent studies, as for example Cardarelli et al. [3], Catenaro and Vidal [4] as well as Itaya et al. [5], have already investigated the repeated game mechanism in a capital tax competition framework. They analyze whether cooperation is sustainable among two countries employing grim trigger strategies. However, only Itaya et al. [6] consider a repeated tax competition game with more than two countries but they restrict the coalition formation process to partial harmonization, i.e., only one coalition may form. We investigate the more general case relaxing their constraint and allow more than one coalition to form.

2. The Tax Competition Model

We employ a standard tax competition framework, e.g., to be found in Wildasin [7].

There are N economically identical regions, indexed by $i \in \mathbb{N} = \{1, \dots, N\}$, with one regional government, households and firms. Households are supposed to be immobile, whereas capital is perfectly mobile. To get explicit solutions we specify the production function of region $i \in \mathbb{N}$ to be

$$f(k_i) = (A - k_i)k_i,$$

where $A > 0$ is the level of productivity, and k_i the per capita amount of capital employed in region i . We assume $A > 2k_i$ and A to be sufficiently large such that the equilibrium interest rate is positive. Public goods are financed by a source-based unit tax on capital τ_i for region i and production factor prices equal their marginal productivity. The overall capital stock is given by \bar{K} which is equally distributed in the regions giving each region $\bar{k} = \bar{K}/N$ units of capital. Let $\tau = (\tau_1, \dots, \tau_N)$ be the vector of tax rates chosen by the regions. We obtain the equilibrium interest rate $r^*(\tau)$ by

$$r^*(\tau) = A - 2\bar{k} - \bar{\tau}$$

where $\bar{\tau} = \frac{\sum_{i=1}^N \tau_i}{N}$ is the average capital tax of all regions.

The capital demand in equilibrium for region i is:

$$k_i^*(\tau) = \bar{k} + \frac{\bar{\tau} - \tau_i}{2}$$

The objective of the regional government is to maximize its tax revenue given by

$$\tau_i k_i^*(\tau).$$

3. Cooperative Behavior

Now, we allow governments to form coalitions. Taking as given a coalition structure, we calculate the tax rate and the tax revenues in equilibrium. A coalition structure is a partition of the set of players. Coalitions maximize the joint tax revenue of its members of which each region gets an equal share. The regions are assumed to behave cooperatively and symmetric within a coalition but non-cooperatively across coalitions.

Given a coalition structure $\{S_1, \dots, S_M\}$ that consists of at least two coalitions, $M \geq 2$, define

$$\alpha := \sum_{\ell=1}^M \frac{S_\ell}{2N - S_\ell} \in \left(\frac{1}{2}, 1\right).$$

The optimal tax rates for coalition S_m amounts to:

$$\tau_{S_m} = 2\bar{k} \left(\frac{N}{2N - S_m} \right) \left(\frac{1}{1 - \alpha} \right)$$

Then, the tax revenue is

$$\tau_{S_m} k_{S_m}^*(\tau) = 2\bar{k}^2 N \frac{(N - S_m)}{(1 - \alpha)^2 (2N - S_m)^2}.$$

Proposition 1 *The larger a coalition in a given coalition structure, the higher is its equilibrium tax rate and the smaller is its equilibrium tax revenue.*

Proposition 2 *Given a coalition structure $\{S_1, \dots, S_M\}$ with $2 \leq M \leq N - 1$. The tax revenue of every region is strictly higher than in the non-cooperative case with $M = N$.*

4. Dynamic Sustainability of Cooperation

We look at the simple dynamics of this model in a repeated game employing a grim trigger strategy. If we do not impose ex-ante cooperative behavior and force the regions to act cooperatively within the coalitions, the only Nash equilibrium with each region acting individually optimal is fully non-cooperative behavior.

Suppose we have a common discount factor denoted by $\delta \in [0, 1)$. Given a coalition structure $\{S_1, \dots, S_M\}$ we assume that each region in each coalition sets the equilibrium tax rate. This behavior implies in a repeated game that all regions act cooperatively within their coalitions if they do not observe any deviation from this behavior. If a region deviates from the cooperative behavior, then the deviating region is punished. As the deviation is observed by all regions we assume that all regions switch to a non-cooperative behavior in the period after the deviation has occurred. The total payoff for region j from deviating from coalition S_ℓ is given by

$$R_{jS_\ell}^D + \sum_{t=1}^{\infty} \delta^t R_j^{\pi^{[1]}} = R_{jS_\ell}^D + \frac{\delta}{1 - \delta} R_j^{\pi^{[1]}}.$$

The total payoff from not-deviating is given by

$$\sum_{t=0}^{\infty} \delta^t R_{S_\ell} = \frac{1}{1 - \delta} R_{S_\ell}.$$

The deviating region j optimally sets the deviation tax rate

$$\tau_{jS_\ell}^D = \frac{N\bar{k}}{N-1} \left(\frac{2N - S_\ell - 1}{2N - S_\ell} \right) \left(\frac{1}{1 - \alpha} \right)$$

and obtains a tax revenue of

$$R_{jS_\ell}^D = \frac{N\bar{k}^2}{2(N-1)} \left(\frac{2N - S_\ell - 1}{2N - S_\ell} \right)^2 \left(\frac{1}{1 - \alpha} \right)^2.$$

Proposition 3 *The maximal minimum discount factor to sustain cooperation as a sub-game perfect equilibrium taking deviations from any coalition in a given coalition structure into consideration is given by*

$$\delta = \frac{(S_{\max} - 1)^2}{((2N - S_{\max} - 1)^2 - 4(2N - S_{\max})^2(1 - \alpha)^2)}$$

where S_{\max} is the size of the largest coalition, denoted by S_{\max} , in the coalition structure $\{S_1, \dots, S_M\}$.

5. Conclusion

This paper analyzes forces to gain and forces to loose from tax competition and coalition formation. Our main results are: First, the deviating region underbids every other region continuing to act cooperatively with its tax rate and benefits from a one-shot deviation. Nevertheless, employing a harsh punishment scenario, we show that there exist critical minimum discount factors that allows to make deviations unprofitable and to sustain cooperation. Second, it is not clear a-priori that for an arbitrary coalition structure the discount factor, which is needed to sustain cooperation as a sub-game perfect equilibrium of the repeated tax competition game, crucially depends on the size of the largest coalition in this structure.

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