GOVERNMENT COLLUSION
IN JANEBA'S MODEL OF
MULTIJURISDICTIONAL TAX COMPETITION

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"Government Collusion in Janeba's Model of Multijurisdictional Tax Competition"[*]

Abstract

Eckhard Janeba (Dec 2000 "Tax Competition when Governments lack Commitment" *American Economic Review* **90,** 1508-19) has recently suggested a novel approach to modelling the relationship between governments and multinational firms. As part of ongoing research into various aspects of multijurisdictional tax competition, this paper investigates the possibility of allowing for collusion between governments when setting tax rates in the model. The findings show that a self-enforcing agreement is possible, with the beneficial effect of cutting the firm's excess profits, limiting investment in excess capacity, and raising government revenue.

1. Introduction

In his two recent papers (AER, 2000 and IER, forthcoming), Janeba has made an important contribution toward understanding the relationship between multinational firms and governments. Within a single framework, his model captures the conflicting literature regarding tax competition and lack of government commitment, while showing how these features may encourage firms to make capacity investment in more than one country. A novel explanation is thus presented for the increasing prevalence of multinational firms.

This essay studies the effect of allowing for collusion between governments when setting tax rates, in the same vein as work by Kehoe (1989). Contrary to the conclusions drawn from his model, I show that collusion is a beneficial strategy, cutting the firm's excess profits, limiting investment in excess capacity, and raising government revenue. Dhillon et al (1999) have suggested that rules are inadequate to deal with tax competition, but in this model a simple contract is shown to be sufficient.

The paper shows that a self-enforcing contract between governments is possible in Janeba's model, but the nature of this agreement will depend on whether or not the firm initially holds maximum capacity in the two countries. More specifically, a contract whereby both governments set their tax rates to unity is self-enforcing only when the firm holds maximum capacity in both countries. If the firm holds a lower capacity in the two countries, it is necessary to consider a different type of contract whereby the governments alternate between setting their tax rate equal to 1 and (1-ε), just less than unity, for the agreement to be self-enforcing.

Finally, I consider the implications for firm capacity. Assuming the firm's initial capacity is below the maximum, I show that knowledge of the onset of a collusive agreement results in an optimal strategy for the firm of leaving capacity unchanged.

2. The Model

The model investigates the behaviour of a single firm selling a homogenous good q, which may be produced in either of two countries. In order to produce the good in country i, the firm must invest in capacity, $\overline{q}_i$, for which there is a cost, $C(\overline{q}_i)$. The government in country i taxes any output at a rate t_i.

For simplicity, it is assumed that total demand for the good and the reservation price are both unity. The firm maximises profits net of tax and the governments maximise their tax revenues. The firm must choose capacities $(\overline{q}_1, \overline{q}_2)$ before the governments commit to their tax rates (t_1, t_2). Finally, the firm choose outputs (q_1, q_2) with t_1 and t_2 fixed. Janeba proceeds to solve for the subgame-perfect equilibrium in this one-period game.

If the firm chooses to enter the market, he concludes, it will always hold equal capacity in both countries with $1 < \overline{q}_1 + \overline{q}_2 \leq 2$. The optimal plant size will depend on the trade off between tax rates and the cost of investment. The cost function is assumed to have the properties $C_{\overline{q}}(\overline{q})$ > 0 and $C_{\overline{q}\overline{q}}(\overline{q}) \geq 0$. When $\overline{q}_1 + \overline{q}_2 = 2$, the tax rate will be competed down to zero. Otherwise, the governments randomise over tax rates, with government i earning expected revenue of $(1 - \overline{q}_j)$.

Janeba then briefly discusses the welfare effects of varying capacity cost before investigating a dynamic version of the model, the one-period game being played repeatedly over

an infinite horizon. He concludes that the firm's best strategy in this situation is to invest in maximum capacity in both countries immediately rather than building up capacity slowly in one country.

3. Collusion Between Governments

The modification to Janeba's model that I investigate is the possibility of collusion between governments. Collusion can only be considered in the dynamic form of the model, as any agreement would not be credible in the single-shot game.

Now, Janeba has shown that in his basic dynamic model a firm will always choose to set up maximum capacity in both countries immediately, rather than slowly building capacity in just one country. Competition between governments then lowers the tax rate to zero. Each government would therefore strictly prefer any agreement yielding positive revenue to this zero-revenue situation.

Suppose, therefore, that the firm has already set up maximum capacity in both countries[1]. At a later date, the governments both agree to set their tax rates equal to unity. According to the rules of the model, the firm would produce $\dfrac{\overline{q}_i}{(\overline{q}_1 + \overline{q}_2)} = $ ½ in each country and each government would collect revenue equal to this output in every period.

If the agreement is to hold, however, neither host government must have an incentive to deviate. If country i deviates in period τ, setting its tax rate $t_i = (1 - \varepsilon)$, just less than unity[2], the firm would switch its entire production to country i and the government would receive revenue of $(1 - \varepsilon)$. In order to deter such a deviation the government of country j can threaten to lower its tax rate to zero in this situation. The threat is credible because the firm will not produce in country j as long as $t_j > t_i$. A deviation by government i would therefore only yield one period of inflated revenue before revenue falls to zero in each successive period.

The incentive constraint for government i in every period τ is thus,

$$R_{ic}^{\tau} = ½ + \delta(\frac{1}{2}) + \delta^2(\frac{1}{2}) + ... \geq 1 - \varepsilon = R_{iD}^{\tau} \qquad\qquad \delta \geq \frac{(\frac{1}{2}) - \varepsilon}{1 - \varepsilon}$$

As ε is very small, this can be approximated as $\delta \geq ½$. The discount factor would therefore have to be extremely high (i.e. δ must be low) in order to make deviation from the agreement worthwhile. We can reasonably conclude that this collusion contract will be self-enforcing.

Given the possibility of collusion between governments, however, it is not still certain that the firm will choose to invest in maximum capacity in both countries. Would the governments still be able to agree a self-enforcing contract if $½ < \overline{q} < 1$?

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[1] We do not, therefore, need to address the firm participation constraint in the following analysis of collusion contracts because it is assumed that the firm has already recouped the investment costs.

[2] More specifically, ε is a 'small number' such that when multiplied by $\overline{q}$ yields the smallest currency unit.

In fact, it can be shown that such a contract is possible, but it must take on a different form to the agreement I have so far considered (which I shall now refer to as 'contract 1'). Let us first investigate the incentive constraints for this agreement under the new capacity levels.

The payoff from contract 1 is unchanged, with government i receiving revenue of ½ in each period. Without *any* agreement, government i would randomise its tax rate, receiving expected revenue of $(1-\overline{q}_j)$ in each period (see equation (7) in Janeba). Now consider the situation in which government i enters into contract 1, but then deviates from its agreement in period τ, setting its tax rate equal to $(1-\varepsilon)\overline{q}_i$ in period τ, while government j receives revenue of $(1-\overline{q}_i)$. In order to deter such a deviation, government j can threaten to punish i by returning to its previous strategy of randomising tax rates from period $\tau+1$ onward. This threat is credible if the government is risk-neutral, as the expected revenue from this strategy is equal to what it receives if t_j is left equal to unity.

The incentive constraint for government i is therefore,

$$R_{ic}^{\tau} = \frac{1}{2} + \delta(\frac{1}{2}) + \delta^2(\frac{1}{2}) + ... \geq \overline{q}_i(1-\varepsilon) + \delta(1-\overline{q}_j) + \delta^2(1-\overline{q}_j) + ... = R_{iD}^{\tau}$$

$$\delta \leq \frac{\overline{q}_i - [(1/2)+\varepsilon]}{\overline{q}_i + \overline{q}_j - (1+\varepsilon)}$$

As $\varepsilon \to 0$ this can be written as: $\qquad \delta \leq \frac{\overline{q}_i - (1/2)}{\overline{q}_i + \overline{q}_j - 1}$

As $\overline{q}_i = \overline{q}_j$, this expression reduces to $\delta \leq 1/2$. In order for the contract to be self-enforcing, therefore, the discount rate would have to be very high. We can thus conclude that contract 1 will not generally be self-enforcing when $1/2 < \overline{q} < 1$.

Now consider a slightly different collusion agreement, 'contract 2', in which the two governments alternate between setting the tax rate equal to 1 and (1-ε) respectively. With t_i=1 and t_j=(1-ε), the firm would wish to produce at maximum capacity in country j. Government I would then get revenue of $(1-\overline{q}_j)$ and government j would receive revenue of $(1-\varepsilon)\overline{q}_j$. The tax rates and revenue situations would then be reversed in the following period.

Let us examine government i's incentive constraint for contract 2 in each period τ. Assuming i sets t=1 in the first period[3] and noting $\overline{q}_i = \overline{q}_j = \overline{q}$,

$$R_{ic}^{\tau} = (1-\overline{q}) + \delta(1-\varepsilon)\overline{q} + \delta^2(1-\overline{q}) + \delta^3(1-\varepsilon)\overline{q} + ... \geq (1-2\varepsilon)\overline{q} + \delta(1-\overline{q}) + \delta^2(1-\overline{q}) + \delta^3(1-\overline{q}) + ... = R_{iD}^{\tau}$$

The payoff from deviating from the agreement is calculated by assuming government i lowers its tax rate slightly below government j in period τ. Government j is then punishes i by returning to its old strategy of randomising t_j in following periods. The threat is credible if j is risk-neutral as the expected payoff from randomising its tax rate would exceed that of keeping $t_j = (1-\varepsilon)$.

Rearranging the constraint,

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[3] Government i would clearly not gain from any deviation in a period when its agreed tax rate is already less than t_j.

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$$(1 - \overline{q}) + \delta(1-\varepsilon)\overline{q} + \delta^3(1-\varepsilon)\overline{q} + \delta^5(1-\varepsilon)\overline{q} + ... \geq (1-2\varepsilon)\overline{q} + \delta(1-\overline{q}) + \delta^3(1-\overline{q}) + ...$$
$$(2\overline{q}(1-\varepsilon)-1)\delta^2 + (\overline{q}(2-\varepsilon)-1)\delta - (2\overline{q}(1-\varepsilon)-1) \geq 0$$

As $\varepsilon \to 0$, this can be written as: $(2\overline{q}-1)\delta^2 + (2\overline{q}-1)\delta - (2\overline{q}-1) \geq 0$

Assuming $0 < \delta < 1$,

$$\delta \geq \frac{-(2\overline{q}-1) + \sqrt{(2\overline{q}-1)^2 + 4(2\overline{q}-1)^2}}{2(2\overline{q}-1)} = \frac{(\sqrt{5}-1)(2\overline{q}-1)}{2(2\overline{q}-1)} = \frac{\sqrt{5}-1}{2} \qquad \delta \geq 0.62$$

We can reasonably expect δ to satisfy this constraint, so we can conclude that the contract will generally be self-enforcing.

Finally, it is worth noting that contract 2 would not be chosen over contract 1 when the firm's capacity is unity in both countries, although it would still be a self-enforcing agreement, given the assumption $\delta \geq 0.62$. This can be seen by examining the incentive constraint for contract 2, noting that revenue is zero for government i when $t_i > t_j$:

$$R^\tau_{ic} = 0 + \delta + 0 + \delta^3 + ... \geq 1 - 2\varepsilon$$
$$(1 - 2\varepsilon)\,\delta^2 + \delta - (1 - 2\varepsilon) \geq 0$$

As $\varepsilon \to 0$, this can be written as: $\delta^2 + \delta - 1 \geq 0 \qquad \delta \geq 0.62$

Again, note that government i would clearly not gain from any deviation in a period where it's agreed tax rate is less than t_j, so this case is not considered.

The reason why contract 2 will not be chosen over contract 1 when $\overline{q} = 1$ is because the total discounted payoff to government i in period T, the first period in which the contract takes effect, will depend on whether i is the first to set its tax rate at the lower level, $(1-\varepsilon)$, or the higher level, unity. Suppose government 1 sets $t_1^T = (1 - \varepsilon)$ and government 2 sets $t_2^T = 1$. Comparing the payoffs from contract 1, R^{T1}, and contract 2, R^{T2}, for government 1 (and assuming $\varepsilon \to 0$),

$$R_1^{T1} = \frac{1}{2} + \delta(\frac{1}{2}) + \delta^2(\frac{1}{2}) + ... \geq 1 + 0 + \delta^2 + 0 + ... = R_1^{T2} \qquad (\delta-1)(\delta-1) \leq 0$$

The only solution to this is $\delta = 1$, which by assumption is not possible. So government 1 must prefer contract 2 over contract 1.

Now compare the payoffs to government 2:

$$R_2^{T1} = \frac{1}{2} + \delta(\frac{1}{2}) + \delta^2(\frac{1}{2}) + ... \geq 0 + \delta + 0 + \delta^3 + ...R_2^{T2} \qquad (\delta-1)(\delta-1) \geq 0$$

This constraint holds for $\delta \leq 1$, so government 2 must always prefer contract 1 over contract 2.

Instead of having to decide which government receives the larger payoff, it would be preferable to split the total benefits equally. Consider the total revenue received by *both* governments under contract 2 in every period τ:

$$R_1^{T2} + R_2^{T2} = 1 + \delta + \delta^2 + \delta^3 + ... = \frac{1}{1-\delta}$$

Now consider the total revenue generated by contract 1 in every period τ :

$$R_1^{T1} + R_2^{T1} = \frac{1}{2} + \frac{1}{2} + \delta(\frac{1}{2} + \frac{1}{2}) + \delta^2(\frac{1}{2} + \frac{1}{2}) + ... = \frac{1}{1-\delta}$$

The two contracts therefore generate the same total revenue, but contract 1 splits this revenue evenly between the two governments. In fact, the total revenue generated by contract 1 will be marginally higher than from contract 2, by a small factor ε in every period. For these two reasons, we know that the governments will prefer setting their tax rates equal to unity when $\overline{q}$ = 1 in both countries, under a collusion agreement.

As Janeba's paper is principally concerned with the determination of firm capacity, it is worth making a short remark on the implications of the introduction of government collusion into the model.

Assume the firm has initial capacity $\frac{1}{2} < \overline{q}^{\tau-1} < 1$ in each country. What is the firm's best strategy in period τ onward, given the knowledge that some form of collusion agreement between the two governments will be in effect?

The answer is that the firm should leave capacity unchanged, yielding a small positive profit $\varepsilon\overline{q}$ in every period. Although $\varepsilon\overline{q}$ is assumed strictly positive (otherwise contract 2 would fail to operate), it can be assumed that $\delta\varepsilon\overline{q} \to 0$. The firm maximises its profit by considering possible investment, I, in period τ alone[4]: $\Pi^\tau = \varepsilon(\overline{q} + I) - C(I)$. We may reasonably assume C(I) > ε I so, $\Pi^\tau = \varepsilon(\overline{q} + I) - C(I) < \varepsilon\overline{q}$.

The firm will thus maximise its profits by leaving capacity unchanged.

4. Conclusions

This paper has shown how it is possible for the governments in Janeba's model to create self-enforcing agreements yielding positive revenue to each. This modification also has the beneficial side effect of rendering unprofitable any further investment by the firm in excess capacity.

Of course, the basic model is a somewhat simplified version of reality. For example, it so far omits the possibility of differences between countries and the additional risk of exchange rate volatility. On the other hand, the conclusions may be applicable to the relatively homogenous selection of countries within the Euro-zone. This paper's analysis could then be seen as offering further support for the greater harmonisation of fiscal policy in the area.

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[4] Note I assume the entire investment takes place in the country with the lower tax rate in period τ.

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