Agglomeration, Tax Competition and Infinite Horizon

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Tax competition is becoming tougher

Corporate tax rates % (Source: OECD Tax Database).
Governments **dynamically** choose their corporate tax rate.

- **Japan**: The prime minister unveils plans to cut corporate tax rate (35% → below 30%) to spur economic growth.
- **Ireland**: The government has committed to the lowest corporate tax rate (12.5%) in the world.
- **Portugal**: Plan of lowering tax rate by half (31.5% → 17%) between 2014 and 2018.
Government time preference matters

- Tax rates are affected by how much governments value the future.
  - Japan, 35%: Changing prime ministers frequently.
  - Singapore, 17%: Development dictatorship.
Q. How government time preference affects the outcomes of tax competition?

- This study tackles the question by examining tax competition b/w two far-sighted governments in an agglomeration economy with far-sighted firms.
Setting

- Tax competition b/w two countries of symmetric size in a footloose capital version of NEG model.
- Unlike the standard NEG model, the economy is Counrnot competitive.
- Governments and firms maximize their discounted sum of payoffs.
Main result

1. The more patient government levies a lower tax rate and obtains more firms than the less patient one in steady state.

2. As trade costs decline, tax rates will converge but industrial distribution will become more unequal.
Intuition behind Result 1

- An increased tax rate raises current tax revenues but reduces future ones due to the erosion of tax base.

- The more patient government values the future more.

→ It sets a lower tax rate.
Intuition behind Result 2

- (# firms in the high-tax-rate (=impatient) country) < (# firms in the low-tax-rate (=patient) country)
  → The high-tax-rate country is less competitive.

- Trade costs ↓ → Imports from the foreign ↑ → Competition in the high-tax-rate country ↑

- Firms there becomes more sensitive to the tax difference.

- Some firms leave there and the government lowers its tax rate.
  → Tax difference ↓, Concentration of firms in the patient country ↑.
Related literature

- New economic geography.
  - Fujita et al. (1999); Ottaviano et al. (2002); Thisse (2010).

- Tax competition in public finance.
  - Bucovetsky (1991); Wilson (1991); Han et al. (2014).

- Tax competition in NEG:

- Forward-looking behavior in NEG:
  - Baldwin (2001); Ottaviano (2001); Oyama (2009a,b); Kato (2015)
Two countries: 1 and 2.

One factor: Internationally immobile labor $L$

$$(L_1, L_2) = (\theta L, (1 - \theta)L).$$

Assume two countries are **symmetric**: $\theta = 1/2$.

Two industries:

- Non-numéraire-homogeneous good: **Cournot competition** trade costs; use **capital** from the third country.
- Numéraire-homogeneous good: perfect competition; no trade costs; use workers.

Focus on the share of industrial (non-numéraire) firms in 1: $\lambda \in (0, 1)$. 
The quadratic utility function gives:

\[ p_1 = 1 - \frac{2Q_1}{L}, \]
\[ p_2 = 1 - \frac{2Q_2}{L}. \]

Both countries have the same slope of the demand curve.
For firms located in country 1:

\[ \pi_1 \equiv p_1 q_{11} + (p_2 - \tau)q_{12}. \]

For firms located in country 2:

\[ \pi_2 \equiv (p_1 - \tau)q_{21} + p_2 q_{22}. \]

\( \tau \): trade costs.

One unit of \( K \) is needed to set up a firm.

\( \rightarrow \) Reward to capital: \( r_i = \text{Operating profit: } \pi_i \).

In location equilibrium,

\[ \pi_1 = \pi_2, \]

\[ \rightarrow \lambda = 1/2 \ (= \theta). \]
Lump sum tax/subsidy $T_i$ on each firm operating in $i$.

Firms choose their location while considering the future payoffs.

$v_i(t) \equiv$ the discounted after-tax profits of a firm in $i \in \{1, 2\}$ at $t$:

$$v_i(t) = \int_t^{t+\Delta t} e^{-\rho_0(s-(t+\Delta t))} [\pi_i(s) - T_i(s)] ds + e^{-\rho_0 \Delta t} v_i(t + \Delta t).$$

$\rho_0$: the rate of time preference of firms.

$v(t) \equiv v_1(t) - v_2(t)$: shadow price of being in 1 rather than in 2.

$$\rho_0 v_1(t) = \dot{v}_1(t) + [\pi_1(t) - T_1(t)] - [\pi_2(t) - T_2(t)] \quad (1)$$
Relocation costs depend on congestion and tax difference.

Firms in 2 relocate to 1 if (shadow price) ≥ (relocation costs):

\[ v(t) \equiv v_1(t) - v_2(t) \geq \dot{\lambda}(t)/\gamma + \alpha[T_1(t) - T_2(t)]. \]

- \( \dot{\lambda}: \) relocation speed; \( \alpha: \) weight on tax difference.

No arbitrage condition:

\[ \dot{\lambda}(t)/\gamma = v(t) - \alpha[T_1(t) - T_2(t)]. \]  \( (2) \)
Forward-looking governments

- Governments try to raise tax revenue but keep their tax rate low.
- Instantaneous payoff of government $i$:
  \[
  W_i(T_i(t), \lambda_i(t)) \equiv K\lambda_i(t)T_i(t) - kT_i(t)^2/2.
  \]

- $\lambda_1 \equiv \lambda; \; \lambda_2 \equiv 1 - \lambda; \; k$: weight on tax rate.

- Government 1’s problem:
  \[
  \max_{\{\lambda(t), T_1(t)\}_{t=0}^{\infty}} \int_{0}^{\infty} e^{-\rho_1 t} W_1(T_1(t), \lambda(t))dt.
  \]
  \[
  \text{s.t. } \begin{cases}
  \dot{\lambda}(t)/\gamma = v(t) - \alpha[T_1(t) - T_2(t)], \\
  \lambda(t) \in [0, 1], \quad \lambda(0) \text{ and }\{T_2(t)\}_{t=0}^{\infty} \text{ are given}.
  \end{cases}
  \]

- $\rho_i$: the rate of time preference of government $i$.

- Suppose government 1 is more patient: $\rho_1 < \rho_2$. 
Timing and equilibrium concept

- Timing:
  1. Both governments announce their tax schedule and commit to it.
  2. Firm relocation occurs.

- We adopt open-loop Nash equilibrium in the differential game theory (just as Nash equilibrium in static games).
Solving the governments’ problem

- Set the Hamiltonian:

\[ H_1 = K\lambda T_1 - kT_1^2/2 + \mu_1\gamma[v - \alpha(T_1 - T_2)]. \]

- FOCs are:

\[ \rho_1\mu_1 = \dot{\mu}_1 + \partial H_1 / \partial \lambda, \quad \text{(FOC1)} \]
\[ \partial H_1 / \partial T_1 = K\lambda - kT_1 - \mu_1\gamma\alpha. \quad \text{(FOC2)} \]

- (FOC2) shows the trade-off between **current gains** and **future losses**

\[ T_1 = (K\lambda - \alpha\gamma\mu_1)/k. \]
Dynamics are characterized by four linear differential equations for 
\((\dot{\lambda}, \dot{v}, \dot{T}_1, \dot{T}_2)\).

There is a unique stable steady state.

\[
\begin{align*}
\lambda^{**} &= \frac{1}{2} - \frac{\gamma K (\rho_1 - \rho_2)(1 + \rho_0 K)}{2\Omega} \in [0, 1], \\
v^{**} &= \gamma BK^2 (\rho_1 - \rho_2) \Omega^{-1}, \\
T_1^{**} &= \rho_1 [(\gamma B + \rho_0 \rho_2)K + \rho_2 (1 + B)] \Omega^{-1}, \\
T_2^{**} &= \rho_2 [(\gamma B + \rho_0 \rho_1)K + \rho_1 (1 + B)] \Omega^{-1}.
\end{align*}
\]

\(B \equiv \tau^2 KL/(K + 1) > 0.\)

\(\Omega \equiv \gamma [2\gamma B + \rho_0(\rho_1 + \rho_2)]K^2 + [\gamma(\rho_1 + \rho_2)(1 + 2B) + \rho_0 \rho_1 \rho_2]K + 2\rho_1 \rho_2 (1 + B) > 0.\)
Main result 1: The more patient government levies a lower tax rate and hosts a more than proportionate share of firms. Under $\rho_1 < \rho_2$, we have $T_1^{**} - T_2^{**} < 0$, $\lambda^{**} > 1/2$.

From (FOC2): $T_1 = (K\lambda - \alpha\gamma\mu_1)/k$.

Increase the tax rate today $\rightarrow$ current tax revenue $K\lambda \uparrow$ but the shadow price of the share of firms $\mu_1 \downarrow$.

The more patient government emphasizes the latter.

$\therefore T_1^{**} < T_2^{**}$. 
Main result 2: comparative statics

- **Main result 2:** As *trade costs decline, tax rates will converge but the distribution of firms will become more disproportional.*
  
  Under $\rho_1 < \rho_2$, we see $|T_1^{**} - T_2^{**}| \downarrow$ and $\lambda^{**} \uparrow$ as $\tau \downarrow$.

- In the steady state: $\pi_1(\lambda^{**}) - \pi_2(\lambda^{**}) = (1 + \alpha \rho_0 / \gamma)(T_1^{**} - T_2^{**}) < 0$.
- Country 1 is more competitive because of $\lambda^{**} > 1/2$.
- Trade costs decline $\tau \downarrow \rightarrow \pi_1 \uparrow$ and $\pi_2 \downarrow$ due to the expansion of trade.

$$\pi_1(\lambda^{**}) - \pi_2(\lambda^{**}) \uparrow \rightarrow T_1^{**} \uparrow, \ T_2^{**} \downarrow \text{ and } \lambda^{**} \uparrow.$$
Concluding remarks

- Build a full-fledged dynamic tax competition model with agglomeration forces.
- The difference of discount rates of governments is a determinant of international tax difference.
- Globalization leads to a convergence of tax rates but to an unequal industrial distribution.
Future works

- Comparative statics of other key parameters: firms’ discount rate $\rho_0$; relocation speed $\gamma$.

- Asymmetric country size: $\theta \neq 1/2$.

- Empirics.


