Nash Equilibria in Models of Fiscal Competition with Unemployment

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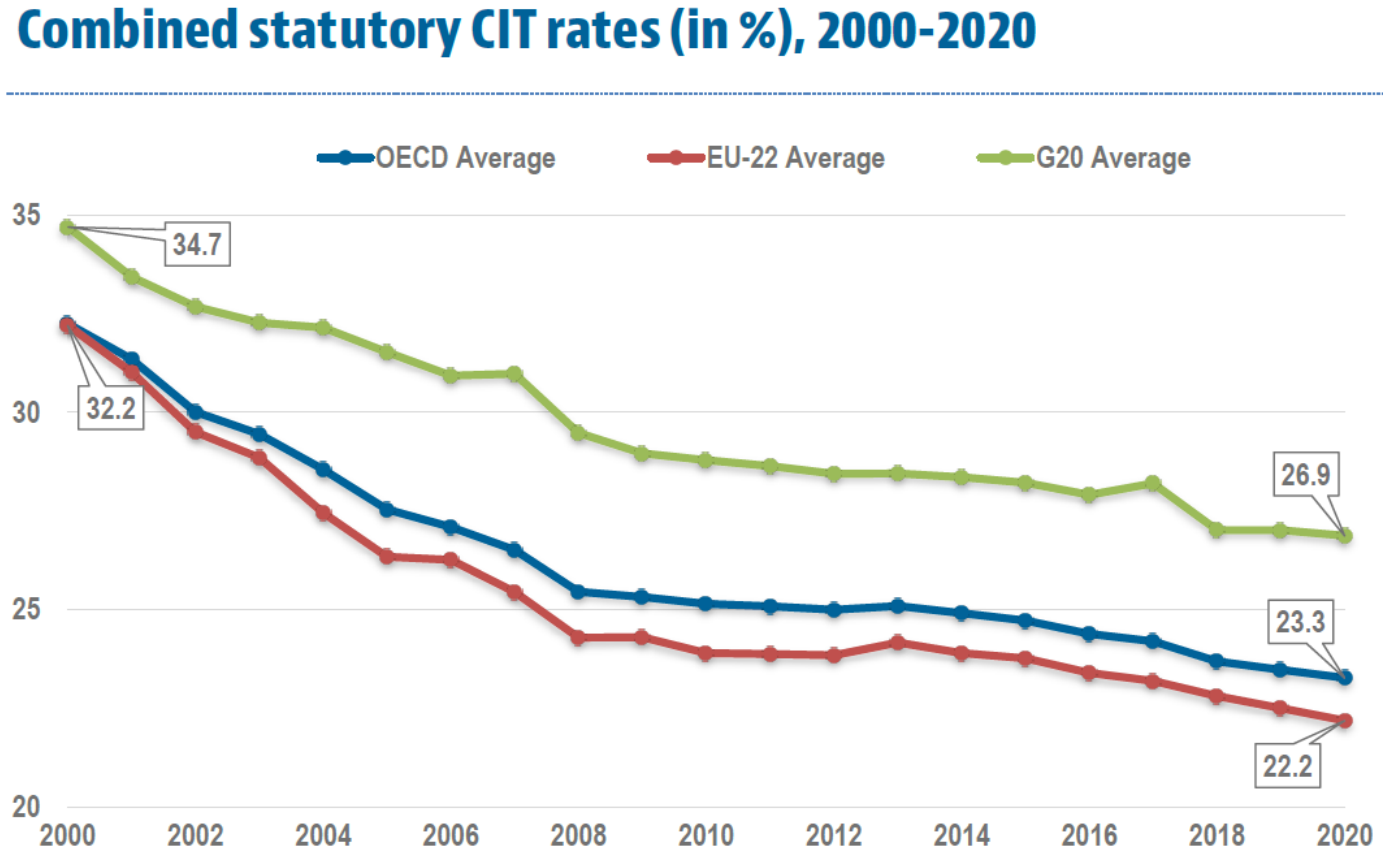
Introduction

Nash Equilibria in Models of Fiscal Competition with Unemployment

Introduction: Research question

- Fiscal competition
  - widely observed between countries and regions
  - recognized as representing “race to bottom”



(OECD, TAX DATABASE 2020)

Introduction: Research question

- The government is competing not only to encourage investment but also to create employment

- Some empirical studies showed the effects of corporate taxes on unemployment
  - Feld and Kirchgassner (2002), Harden and Hoyt (2003), Bettendorf et al. (2009), Felix (2009), Feldmann (2011), Zirgulis and Šarapovas (2017)

Introduction: Research question

- Some theoretical studies investigated the relationship between fiscal competition and unemployment
  - Ogawa et al. (2006), Aronsson and Wehke (2008), Sato (2009), Eichner and Upmann (2012), Exbrayat et al. (2012), Kikuchi and Tamai (2019)

- Their studies seem to support empirical evidence

Introduction: Research question

- However taxes aren't the only policy instrument the government can compete in the realistic world
- Countries/regions are facing intergovernmental competition for using other policy variable

- Several studies have analyzed the impact of taxes/public expenditures
  - Theoretical studies: Wildasin (1988), Wildasin (1991), Bayindir-Upmann (1998), Köthenbürger (2011)
  - Empirical studies: Bénassy-Quéré et al. (2007), Hauptmeier et al. (2012)

Introduction: Research question

➢Research question

- What policy variable should be implemented by the government under fiscal competition environment where unemployment exists?

➢Summary of results

In some cases,

- tax rates under tax competition are likely to be more competitive than under expenditure
- governments prefer to choose government expenditure as their strategic variable rather than tax rates

Model

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Model: Basic settings

- The basic setup is based on Wildasin (1988) and Ogawa et al. (2006)

- N regions: $N \geq 2$
- The population in each region is unity
- Economy-wide capital stock is fixed: $\overline{K}$

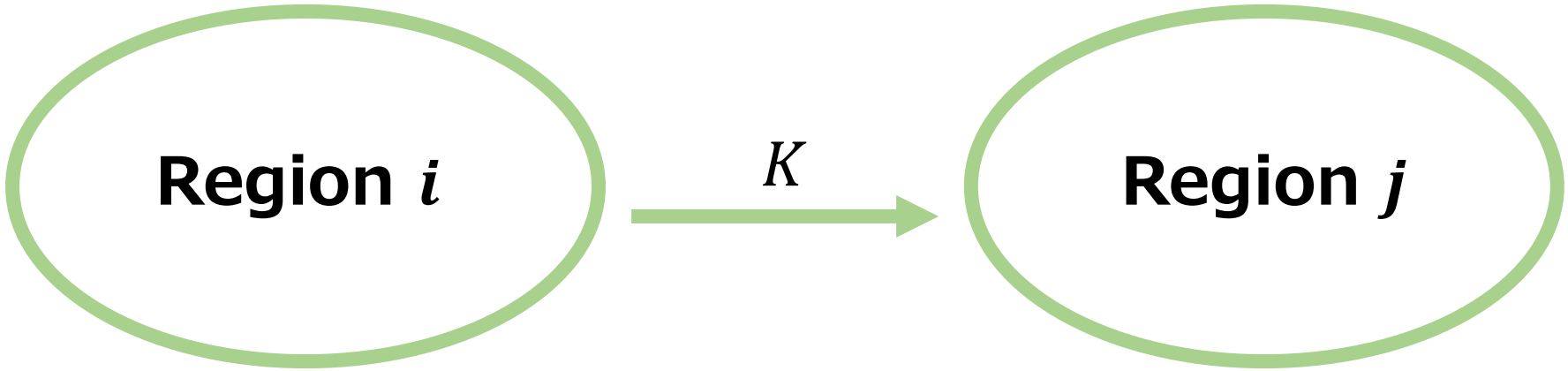
- Capital input : K_i (mobile), Labor input: L_i (immobile)
- Capital market: $\sum_{i=1}^{N} K_i = \overline{K}$

Model: Basic settings

- Two goods: X_i (private goods) and G_i (public goods)

- Private goods: perfect competitive markets
  - CRS production function: $F(\overline{H_i}, K_i, L_i) \equiv f(K_i, L_i)$ ($\overline{H_i}$: land input)
    - strictly concave
    - twice continuously differentiable
    - increasing in K_i and L_i
  - $\pi_i = f(K_i, L_i) - (\rho + t_i)K_i - \overline{w}_i L_i \Rightarrow \rho = f_K(K_i, L_i) - t_i \; and \; \overline{w}_i = f_L(K_i, L_i)$
    (ρ: common factor price, $\overline{w}_i$: exogenously fixed wage)
- Public goods: $t_i K_i = G_i$ (t_i: tax rate)

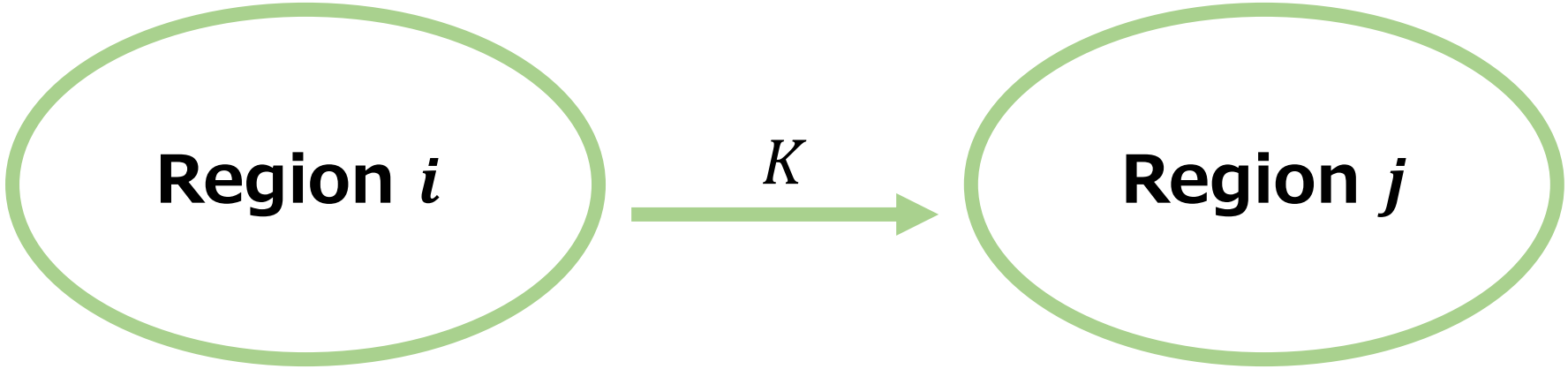
Model: Ogawa et al. (2006)



- $t_i \uparrow$

- $K_j \uparrow$: fiscal externality (positive)
- $K_j \uparrow \Rightarrow L_j$?: employment externality (positive or negative?)

Model: Wildasin (1988)



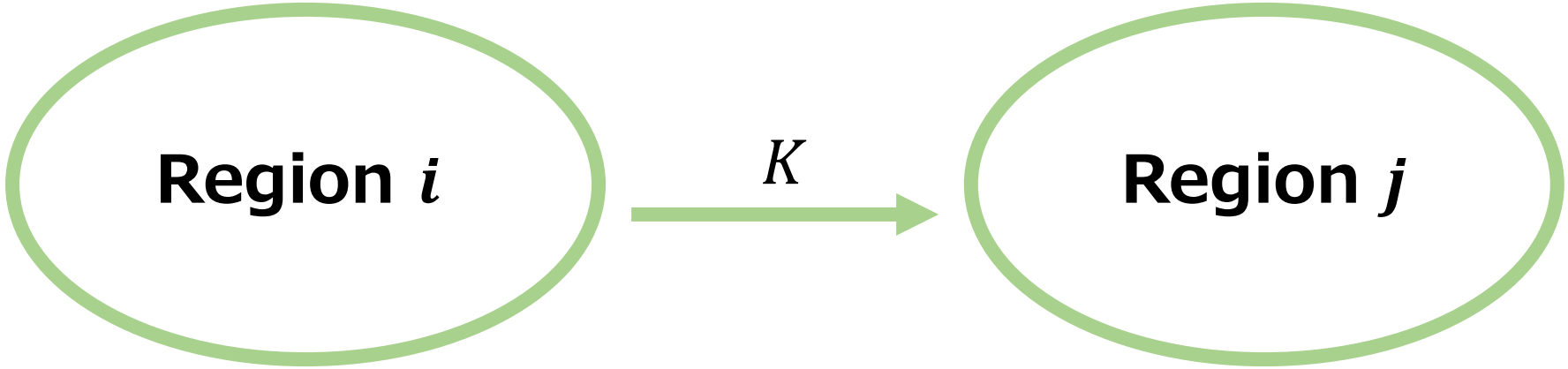
- $t_i \uparrow$
  (tax competition)

- $K_j \uparrow \Rightarrow G_j \uparrow$
  $\because t_j$ is given: $\bar{t}_j K_j = G_j$

- $G_i \uparrow (t_i \uparrow)$
  (expenditure competition)

- $K_j \uparrow \Rightarrow t_j \downarrow (\Rightarrow K_j \uparrow\uparrow)$
  : strategic effect
  $\because G_j$ is given: $t_j K_j = \bar{G}_j$

Model: Our model settings



• $t_i \uparrow$ (tax competition)	• $K_j \uparrow \Rightarrow G_j \uparrow$ • $K_j \uparrow \Rightarrow L_j? \Rightarrow \cdots \Rightarrow G_j?$
• $G_i \uparrow (t_i \uparrow)$ (expenditure competition)	• $K_j \uparrow \Rightarrow t_j \downarrow$ • $K_j \uparrow \Rightarrow L_j? \Rightarrow \cdots \Rightarrow t_j?$

Model: Basic settings

- Social welfare function: $U_i(X_i, G_i) = X_i + v(G_i)$
  - $v'(G_i) > 0$, $v''(G_i) < 0$, $v'(0) = \infty$, $v'(\infty) = 0$
  - $X_i = f(K_i, L_i) - K_i f_K(K_i, L_i) + \rho\theta_i \overline{K}$: residents' budget constraints (θ_i: the share of the capital stock owned by the residents)
  - $t_i K_i = G_i$: governments' budget constraints

- The regional government chooses **tax rate** or **expenditure level** to maximize social welfare function

Tax vs expenditure competition

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Tax vs expenditure competition

- Tax competition equilibrium

Definition 1:

T-equilibrium is a vector τ^* *that* t_i^* *is the solution to*

$$\max_{t_i} U_i\,(X_i, G_i)$$

subject to $\rho = \rho(\tau)$, $K_i = K_i(\tau)$, $L_i = L_i(\tau)$, *and* $t_j = t_j^*$ $(j \neq i)$

- Expenditure competition equilibrium

Definition 2:

G-equilibrium is a vector $g^\star$ *that* $G_i^\star$ *is the solution to*

$$\max_{G_i} U_i\,(X_i, G_i)$$

subject to $\rho = \rho\big(\tau(g)\big)$, $K_i = K_i\big(\tau(g)\big)$, $L_i = L_i\big(\tau(g)\big)$, *and* $G_j = G_j^\star$ $(j \neq i)$

Tax vs expenditure competition

- We focus on the symmetrical regions in all respects
  - Total capital income in the economy: $\rho\overline{K}$
  - Capital income in region i: $\rho\theta_i\overline{K}$
- Two cases of capital ownership are considered:
  - Absentee owners of capital have full ownership of capital: $\theta_i = 0$
  - Residents equally share the economy-wide capital stock: $\theta_i = N^{-1} \equiv n$

	Tax competition	Fiscal competition
Absentee ownership	**Case (a1)**	**Case (a2)**
Equally share	**Case (b1)**	**Case (b2)**

Comparative analysis

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Comparative analysis: Case (a)

- Absentee owners of capital have full ownership of capital
  : $\theta_i = 0$

	Tax competition	Expenditure competition
Absentee ownership	**Case (a1)**	**Case (a2)**
Equally share	**Case (b1)**	**Case (b2)**

Comparative analysis: Case (a)

➢Comparing case (a1) with case (a2)

Proposition 1:

- *There exists a unique symmetrical T-equilibrium and G-equilibrium*
- *The equilibrium tax rate and the expenditure level satisfy* $t^* > t^\star$ *and* $G^* > G^\star$

($*$: case of tax competition, $\star$: case of expenditure competition)

Comparative analysis: Case (a)

- Investigating whether tax rate and expenditure level are less than optimal

Proposition 2:

① $t^o \geq t^* > t^\star, U^o \geq U^* > U^\star \ (if\ n + \frac{(\bar{w}\mu+t)(1-n)\varepsilon}{f_K(K,L)} \leq 0)$

② $t^* > t^o > t^\star, U^o > \max(U^*, U^\star) \ (if\ 0 < n + \frac{(\bar{w}\mu+t)(1-n)\varepsilon}{f_K(K,L)} < -\frac{n\varepsilon t}{f_K(K,L)})$

③ $t^* > t^\star \geq t^o, U^o \geq U^\star > U^* \ (if\ 0 \leq -\frac{n\varepsilon t}{f_K(K,L)} < n + \frac{(\bar{w}\mu+t)(1-n)\varepsilon}{f_K(K,L)})$

Comparative analysis: Case (a)

- The interpretation of Proposition 2 is as follows

- Three effect in the economy
  - Fiscal external effect (positive)
  - Employment external effect (**positive** or **negative**)
  - Strategic effect in expenditure competition case (positive)

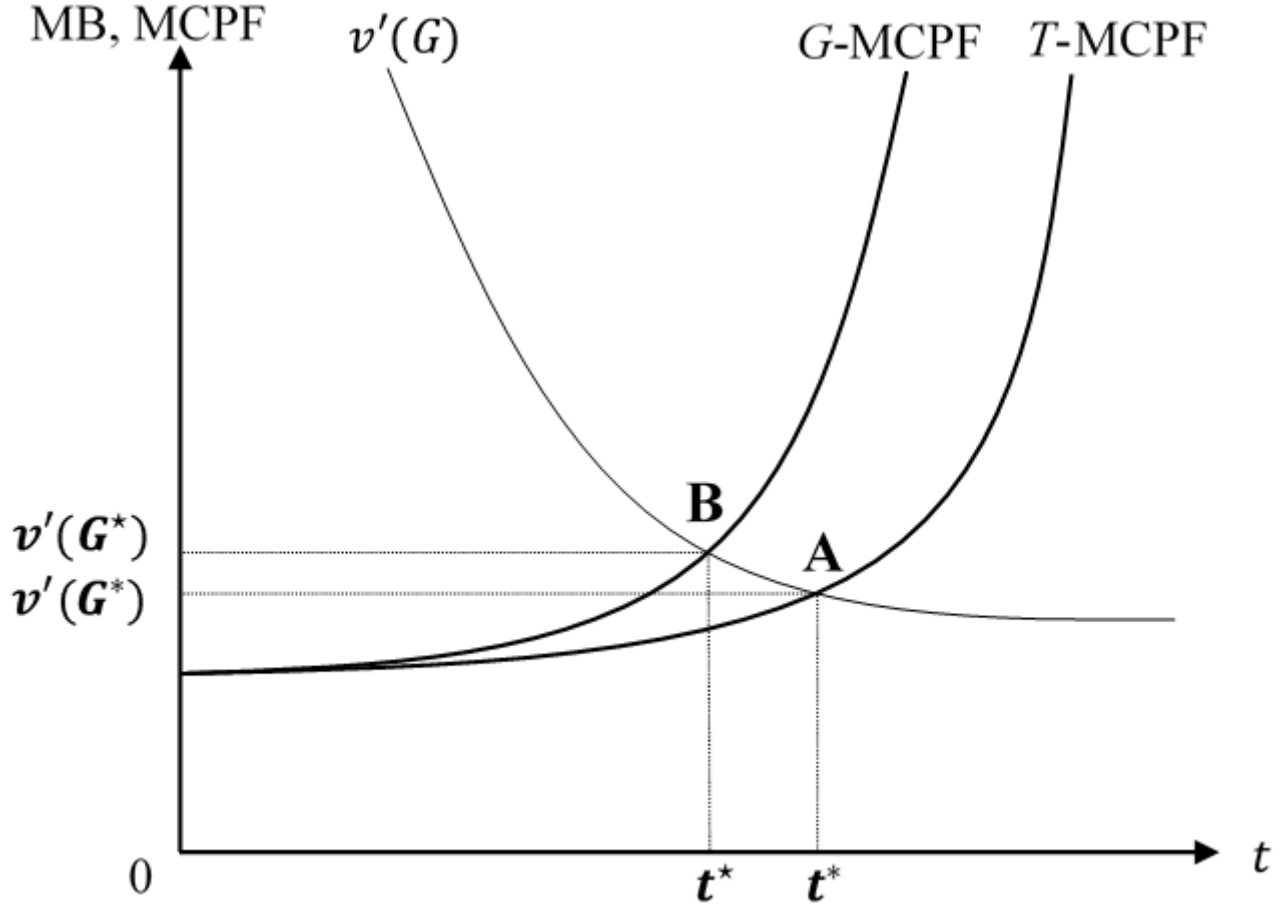
Comparative analysis: Case (a)

The interpretation of Proposition 2:

- **Positive** employment externality
  - All effects is positive ⇨ Public goods is under-provided (Proposition 2① $t^o \geq t^* > t^\star$)
- **Negative** employment externality
  - The employment external effect dominates the fiscal external effect and strategic effect ⇨ Public goods is over-provided (Proposition 2③ $t^* > t^\star \geq t^o$)
  - The relative size of all effects are all important (Proposition 2② $t^* > t^o > t^\star$)

Comparative analysis: Case (a)

- Right figure shows T-equilibrium (**A**) and G-equilibrium (**B**)



Comparative analysis: Case (b)

- Residents equally share the economy-wide capital stock
  : $\theta_i = 1/N \equiv n$

	Tax competition	Expenditure competition
Absentee ownership	**Case (a1)**	**Case (a2)**
Equally share	**Case (b1)**	**Case (b2)**

Comparative analysis: Case (b)

- Imposing the following assumption in order for equilibrium to exist

Assumption:

The level of the employment externality is not too small

$$v''\bar{k} < \left[(1-n)(\bar{w}\mu + t)\left(\frac{\bar{\varepsilon}}{\bar{f}_K}\right)^2\right] \Big/ \left(1 + \frac{\bar{\varepsilon}t}{\bar{f}_K}\right)^2$$

($\bar{k} = n\bar{K}, \mu \equiv dL/dK$: employment externality, $\varepsilon \equiv dlogK/dlog(\rho + t) < 0$: fiscal externality)

Comparative analysis: Case (b)

- Comparing case (b1) with case (b2)

Proposition 3:

- *There exists a unique symmetrical T-equilibrium and a unique symmetrical G-equilibrium*
- *These equilibria are characterized as* $t^* \gtrless t^\star \Leftrightarrow G^* \gtrless G^\star \Leftrightarrow \bar{w}\mu + t \gtrless 0$

Comparative analysis: Case (b)

➢Comparing the result of Proposition 1 and 3

- The ownership of capital is crucial
- The effect of the tax increase is weakened when the residents equally own the capital ⇨ the strategic effect is negligible ⇨ possibility of $t^* < t^\star$ and $G^* < G^\star$

(∵ Capital income in residents' budget constraints: $\rho\theta_i\overline{K}$)

Comparative analysis: Case (b)

- Investigating whether tax rate and expenditure level are less than optimal

Proposition 4:

① $t^o > t^* > t^\star, U^o > U^* > U^\star \ (if\ \overline{w}\mu + t > 0)$

② $t^o < t^* < t^\star, U^o > U^* > U^\star \ (if\ \overline{w}\mu + t < 0)$

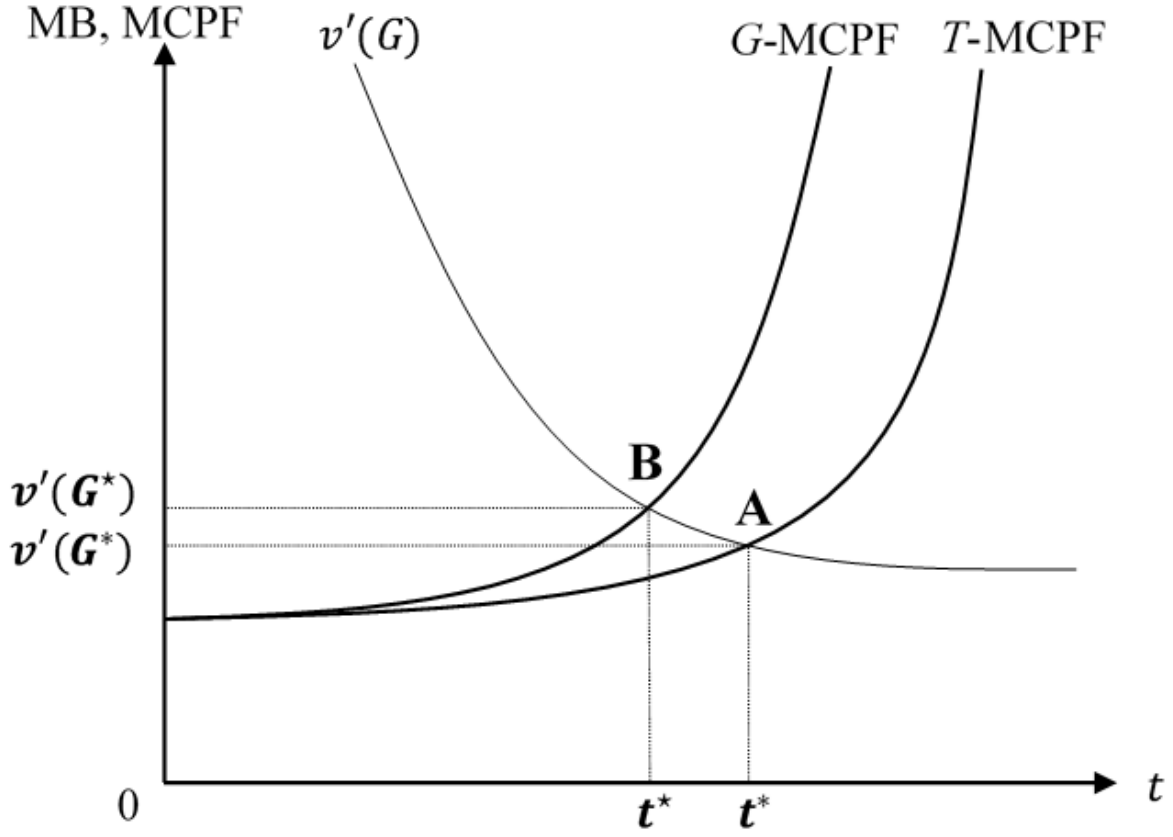
Comparative analysis: Case (b)

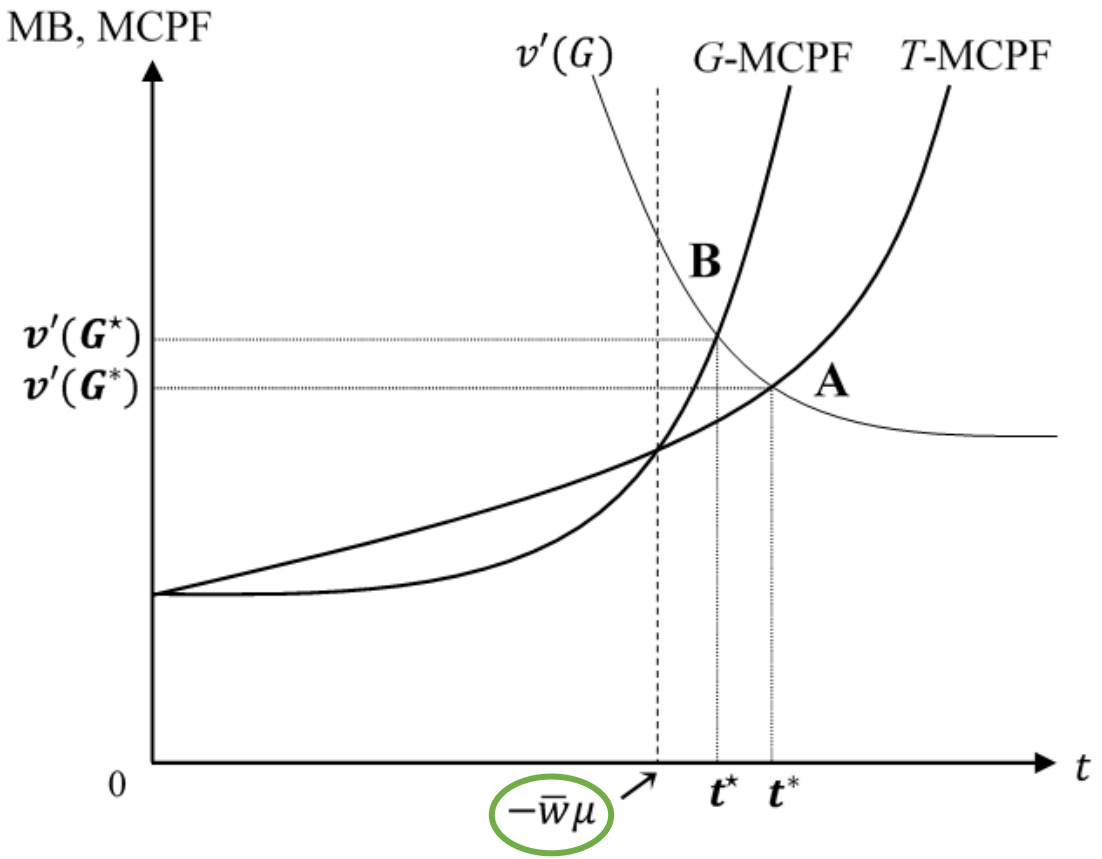
The interpretation of Proposition 4:

- Employment externality is **positive** or **not too negative**
  - Public goods is under-provided (Proposition 4① $t^o > t^* > t^\star$)
- Employment externality is **negative**
  - Public goods is over-provided (Proposition 4② $t^o < t^* < t^\star$)

Comparative analysis: Case (b)

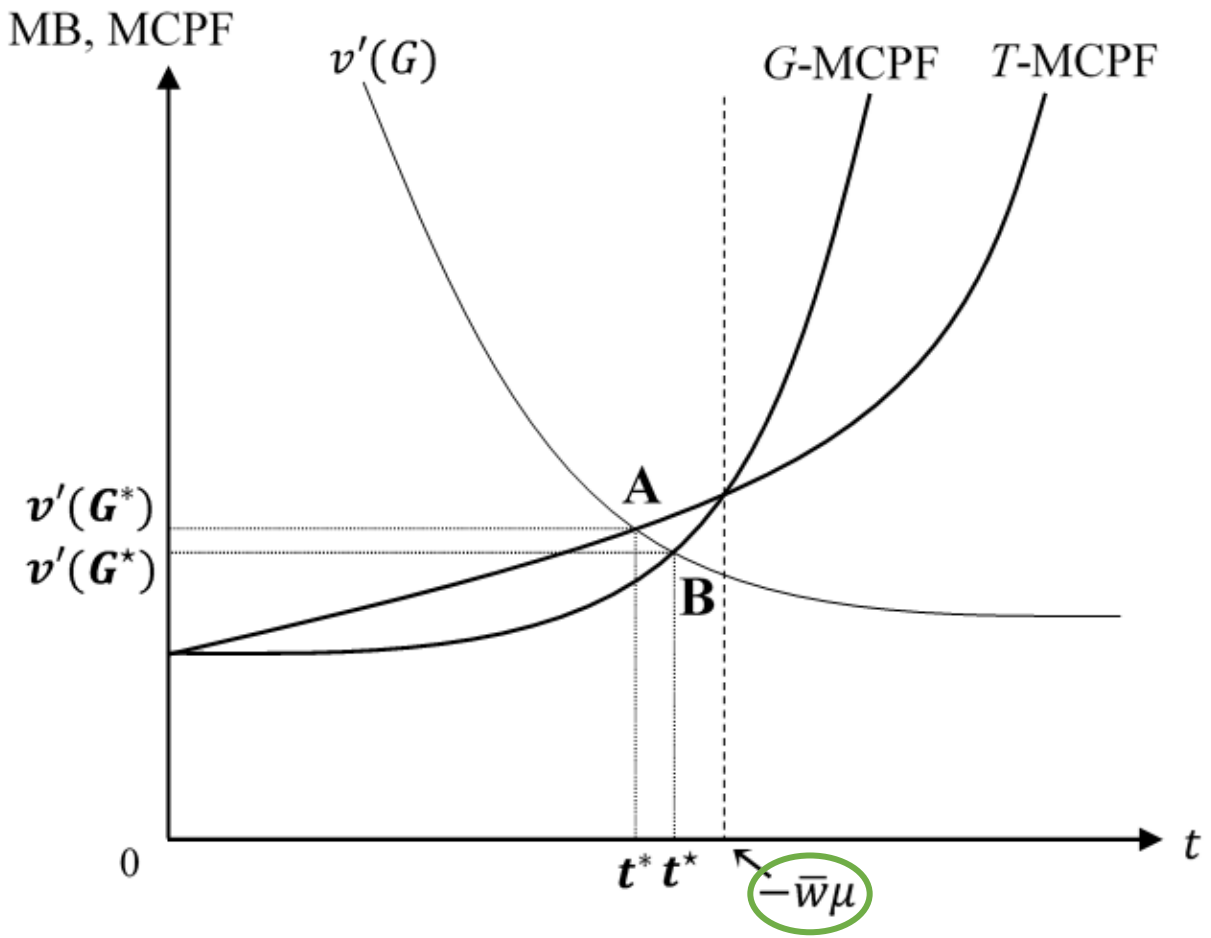
- These figures show T-equilibrium (**A**) and G-equilibrium (**B**) (Proposition 4①)





Comparative analysis: Case (b)

- The equilibrium tax rates are shown in the right figure (Proposition 4②)



Conclusion

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Conclusion: Summary of results

- **Research question**
  - What policy variable should be implemented by the government?

- **Summary of results**

  In some cases,
  - tax rates under tax competition are likely to be more competitive than under expenditure
  - governments prefer to choose government expenditure as their strategic variable rather than tax rates

Conclusion: Comparison

➢Comparison with previous studies

- **Wildasin (1988, 1991)**: Their studies analyzed the problem of policy variables and showed tax competition is desirable for strategic effect
- **Bayindir-Upmann (1998)**: He introduced public inputs to Wildasin (1988) and showed expenditure competition is desirable when fiscal externality is negative

➢Contribution of our paper

- We shows opposite results to Wildasin (1988, 1991)
- Our study revealed a new mechanism that differs from Bayindir-Upmann (1998)

Conclusion: Extensions

- **Public inputs case**
  - Bayindir-Upmann (1998)

- **Endogenous choice of policy variable**
  - Wildasin (1991): specification of production function

- **Different setting for labor market**
  - Sato (2009): job search and recruiting friction
  - Aronsson and Wehke (2008), Eichner and Upmann (2012) and Exbrayat et al. (2012): bargaining between unions and firms