

# 2020年度寡占理論 (7)

## Endogenous Public and Private Leadership with Diverging Social and Private Marginal Costs

### 今日の講義の構成

- (a) Mixed Oligopolies
- (b) Endogenous Timing Game
- (c) Endogenous Timing in Mixed Oligopolies
- (d) Diverging Social and Private Marginal Costs
- (e) Endogenous Public and Private Leadership with Diverging Social and Private Marginal Costs

# 報告論文情報

Title

Endogenous Public and Private Leadership with Diverging Social and Private Marginal Costs.

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Journal

Manchester School, forthcoming

# 報告論文の構成要素

- (1) Mixed Duopoly
- (2) Foreign Ownership in the Private Firm
- (3) Endogenous Timing Game (Observable Delay Game)
- (4) Externality

# Mixed Oligopolies, Mixed Markets

State-owned public firms compete against private firms

# Examples of mixed oligopolies in Japan

Banking: Postal Bank, DBJ, Iwate Bank

Private Funds: DBJ, Industrial Revitalization Corporation of Japan

Life Insurance: Postal Life Insurance (Kampo)

Overnight Delivery: Japan Post

Energy: Public Gas Corps (Narashino, Fukui,...), TEPCO

Telecom: NTT

Broadcasting: NHK

# Examples of mixed oligopols in other countries

Banking: Postal Banks (New Zealand, U.K., Germany,...)

Automobiles: Renault, VW

Medicine: Public Institute in Brazil

Defense, Aviation: EADS, Airbus

Airline: airlines (Swiss, Belgian, France,...)

Overnight Delivery: USSP

Energy: Electricite de France, Gas de France

Broadcasting: BBC

# Differences between public and private firms

(1) Public firms are less efficient than private firms.

→ Many empirical works do not support this view (and many other papers do support this view).

(2) Difference of objective function

→ Private firms maximize their own profits, whereas public firms might care about social welfare.

# Payoff of Public Firms

The standard model formulation in the literature on mixed oligopolies: Public firm's objective is convex combination of welfare and its own profits, and the weight depends on the governments' ownership share (Matsumura, 1998).

Welfare includes private firm's profit if they are domestically owned.

→ Nationality of the private firms affect the behavior of the public firm.



# Foreign Ownership in Private Firms and Behavior of the Public Firms

Public firm is more aggressive under foreign ownership in private firms (Fjell and Pal, 1996).

In the observable delay game in mixed duopolies, the public firm is more likely to become the follower when the private firm is domestic (Pal, 1998), while the inverse is true when the private firm is foreign (Matsumura, 2003).

The optimal degree of privatization is decreasing (increasing) in the foreign ownership share in private firms (the public firm) (Lin and Matsumura, 2012)

# Endogenous Timing Games

# Stackelberg or Cournot

Cournot (Bertrand) model and Stackelberg model yield different results.

Simultaneous move model and sequential move model yield different results.

Which model should we use ? Which model is more realistic?

An incumbent and a new entrant compete  
→ sequential-move model

There is no such asymmetry between firms  
→ simultaneous-move model

However, in reality, firms can choose both how much they produce and when they produce.

# Timing Games

Firms can choose when to produce.

Formulating a model where both Cournot (simultaneous-move game) and Stackelberg (sequential-move game) outcomes can appear, and investigating whether Cournot or Stackelberg appears in equilibrium.

# Stackelberg Duopoly

Firm 1 and firm 2 compete in a homogeneous product market.

Firm 1 chooses its output  $Y_1 \in [0, \infty)$ . After observing  $Y_1$ , firm 2 chooses its output  $Y_2 \in [0, \infty)$ .

Each firm maximizes its own profit  $\Pi_i$ .

$\Pi_i = P(Y)Y_i - C_i(Y_i)$ ,  $P$ : Inverse demand function,

$Y$ : Total output,  $Y_i$ : Firm  $i$ 's output,  $C_i$ : Firm  $i$ 's cost function

I assume that  $P' + P''Y_1 < 0$  (strategic substitutes)

$\Rightarrow$  First-Mover Advantage

# Stackelberg's discussion on the market instability

In the real world, it is not predetermined which firm becomes the leader.

Because of the first-mover advantage, both firms want to be the leaders.

Struggle for becoming the leader make the market instable.

~ This is just an idea of endogenous timing game.

However, he did not present a model formally.

Some papers discussing this problem appeared since the end of 70s.

# Four representative timing games

- (1) Observable delay game
- (2) Action commitment game
- (3) Infinitely earlier period model
- (4) Seal or disclose
- (5) Two production period model

# Action Commitment Game

Hamilton and Slutsky (1990)

Duopoly

First stage: Two firms choose period 1 or period 2.

Second Stage: **Without observing** the timing, the firm choosing period 1 chooses its action.

Third Stage: After observing the actions taking at the second stage, the firm choosing period 2 chooses its action.

Payoff depends only on its and the rival's actions (not period).



# Equilibrium in the Action Commitment Game-Two Period Model

- (1) Both firms choose period 1 (Cournot)
- (2) Only firm 1 chooses period 1 (Stackelberg)
- (3) Only firm 2 chooses period 1 (Stackelberg)

Except for one outcome where both firms choose period 2 can be equilibrium outcomes.

This result does not depend on  $R'$  (whether strategic substitute or complement)

# Equilibrium(1)

(1) Both firms choose period 1 (Cournot)

Suppose that firm 1 deviates from the equilibrium strategy and chooses period 2.

Firm 2 has already chosen its output before observing this deviation and it is Cournot output.

Firm 1 chooses the same output before the deviation in period 2.

⇒ Firm 1 obtains exactly the same profit before the deviation.=No improvement of the payoff.

# Equilibria(2)(3)

- (2) Only firm 1 chooses period 1 (Stackelberg)
- (a) Suppose that firm 2 deviates from the above strategy and chooses period 1. Firm 1 has already chosen its output before observing this deviation. Firm 2 chooses the same output before the deviation in period 1.  $\Rightarrow$  Firm 2 obtains exactly the same profit before the deviation. = No improvement of the payoff.
- (b) Suppose that firm 1 deviates from the above strategy and chooses period 2. Firms face Cournot competition. Firm 1 obtains the smaller profit before the deviation. = No improvement of the payoff.

# Instability of Cournot Outcome in the Action Commitment Game

(1) Both firms choose period 1 (Cournot)

Suppose that firm 1 deviates from the equilibrium strategy and chooses period 2.

Firm 2 has already produces Cournot output in period 1  
1 → Firm 1 chooses Cournot output in period 2 ⇒ Firm 1 obtains exactly the same payoff as before.

What happens off the equilibrium path ?

# Instability of Cournot Outcome in the Action Commitment Game

off path:

Suppose that firm 2 chooses period 2.

⇒ After and before deviation the outcome is Cournot.

~The deviation does not change the payoff.

Suppose that firm 2 chooses period 1 and chooses the output that is not equal to the Cournot output. ⇒ the deviation improves payoff.

Choosing period 1 and producing Cournot output is weakly dominated by choosing period 2.

**Cournot is not robust.**

# Introducing Small Interest Costs

Suppose that the firm pays additional cost  $e > 0$  if it produces in period 1, may be inventory cost or interest cost.

→ Waiting until period 2 strictly dominates producing Cournot output in period 1.

⇒ (1) fails to be an equilibrium.

~Cournot is not robust.

# Introducing Small Incomplete Information

Suppose that each firm obtains additional information on the cost of rival. In period 1, each firm knows its own cost. It also knows that the rival's cost is  $c_N$  with probability  $1-e$  and is  $c_A$  with probability  $e \in (0,1)$ . In period 2 each firm knows its rival's cost.

→ Waiting until period 2 strictly dominates producing Cournot output in period 1.

⇒ (1) fails to be an equilibrium.

~Cournot is not robust

# Instability of Cournot Outcome in the Action Commitment Game Revisited, Matsumura et al. (2011)

There are two pure strategy equilibria with positive waiting gain. → There must be a mixed strategy equilibria.

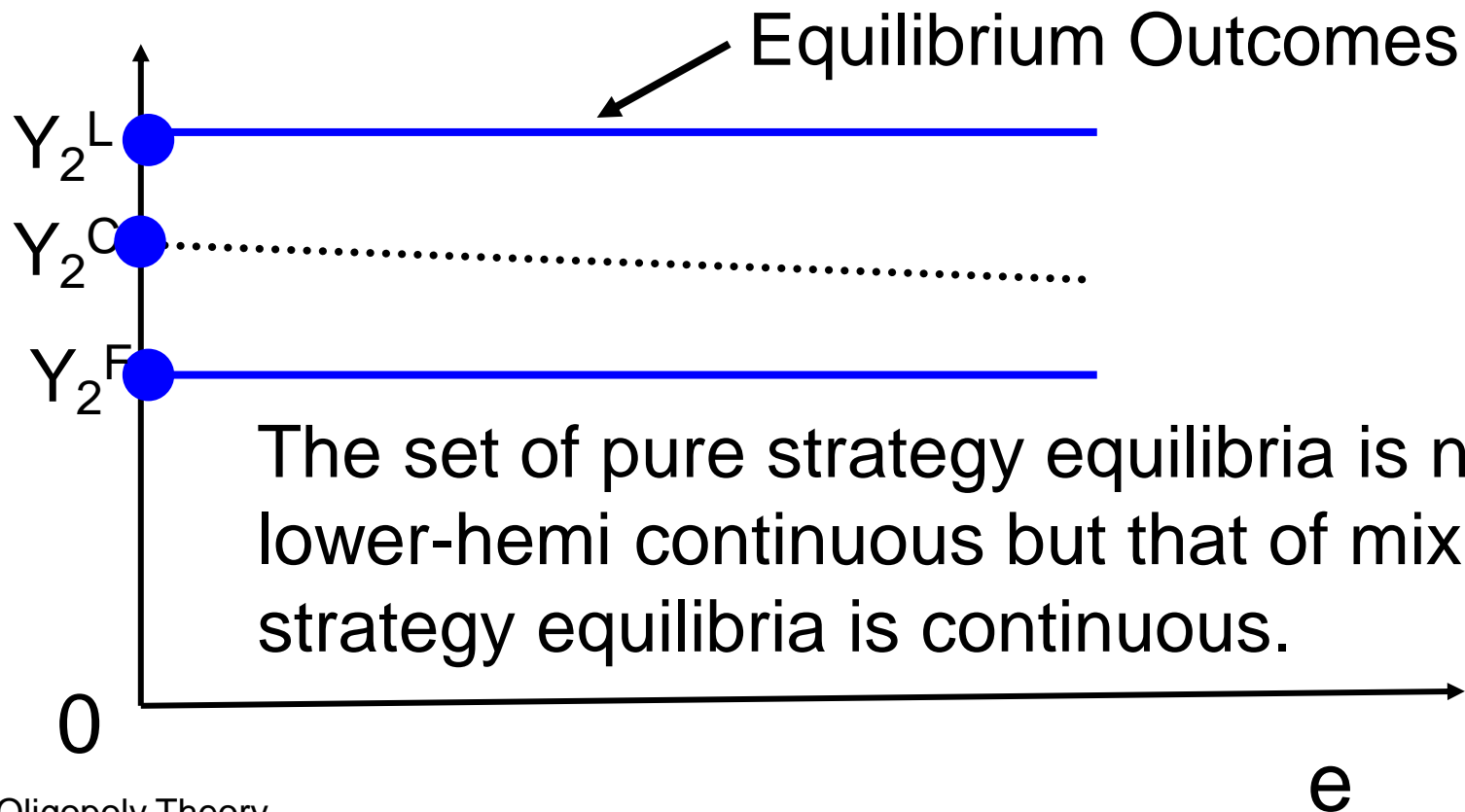
If waiting gain  $e$  converges to zero, the mixed strategy equilibrium converges to the Cournot.

In the action commitment game, (1) is a degenerated mixed strategy equilibrium.



# The Set of Equilibria in Quantity-Setting Game

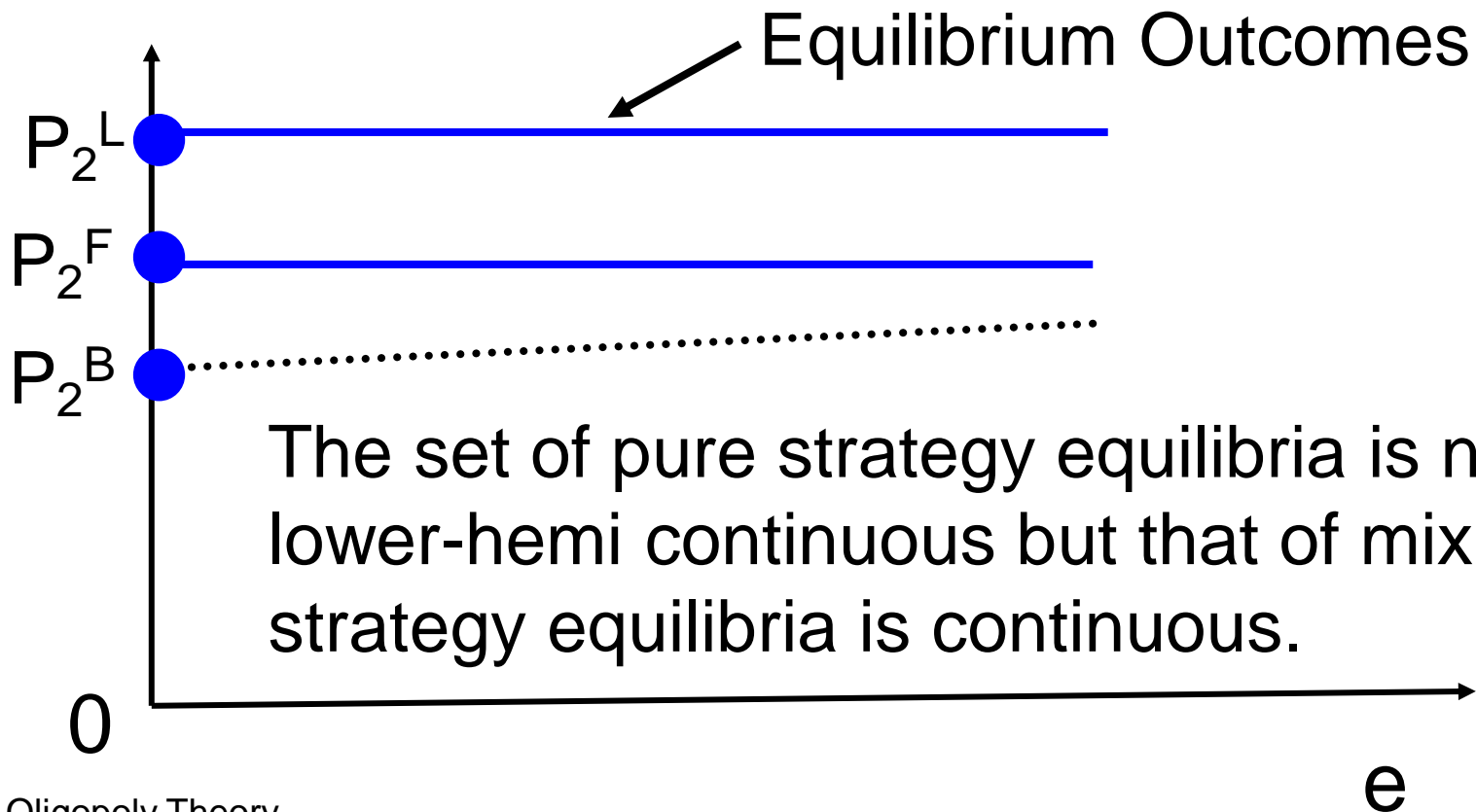
Equilibrium  $Y_2$



The set of pure strategy equilibria is not lower-hemi continuous but that of mixed strategy equilibria is continuous.

# The Set of Equilibria in Price-Setting Game

Equilibrium  $P_2$



The set of pure strategy equilibria is not lower-hemi continuous but that of mixed strategy equilibria is continuous.

# Observable Delay Game

Hamilton and Slutsky (1990)

Duopoly

First stage: Two firms choose period 1 or period 2.

Second Stage: After observing the timing, the firm choosing period 1 chooses its action.

Third Stage: After observing the actions taking at the second stage, the firm choosing period 2 chooses its action.

Payoff depends only on its action (not period).

# Possible Outcomes

Both firms choose period 1  $\Rightarrow$  Cournot

Both firms choose period 2  $\Rightarrow$  Cournot

Only firm 1 chooses period 1  $\Rightarrow$  Stackelberg

Only firm 2 chooses period 1  $\Rightarrow$  Stackelberg

# Equilibrium of the Observable Delay Game in symmetric private duopolies

## Strategic Substitutes

⇒ Both firms choose period 1 (Cournot)  
since Leader  $\gg$  Cournot  $\gg$  Follower

## Strategic Complements

⇒ Only firm1 chooses period 1 (Stackelberg) or  
Only firm2 chooses period 1 (Stackelberg)  
since Leader  $\gg$  Cournot  
and Follower  $\gg$  Cournot.

# Asymmetric Cases

It is possible that two firms have different payoff ranking.  
e.g., Price Leadership (5th Lecture)

Suppose that firm 1 has a Cost Advantage.

Firm 1 Leader » Follower » Bertrand

Firm 2 Follower » Leader » Bertrand~Ono (1978,1982)

Firm 2 Leader » Follower » Bertrand

Firm 1 Follower » Leader » Bertrand~Hirata and  
Matsumura (2011)

It is quite natural to think that firm 1 becomes a leader  
(follower) in the former (latter) setting in equilibrium.  
cf Ono (1978,1982)

Is it true?

# Matsumura and Ogawa (2009)

Assumption  $U_i^L \geq U_i^C$

Result If  $U_1^L > U_1^F$  and  $U_2^F > U_2^L$ ,

(i) firm 1's leadership is the unique equilibrium outcome,

(ii) equilibrium outcomes other than firm 1's leadership is supported by weakly dominated strategies,

or (iii) firm 1's leadership is risk dominant

⇒ Pareto dominance implies risk dominance in the observable delay game.

# Endogenous Role in Mixed Duopolies

Observable Delay Game

Quantity Competition

Pal (1998)  $\Rightarrow$  Stackelberg,

Public firm is the follower when the private firm is domestic, whereas it is the leader when the private firm is foreign (Matsumura, 2003).

Price Competition

Barcena-Ruiz (2007)  $\Rightarrow$  Bertrand.



# Endogenous Role in Mixed Duopolies

この後山のようにvariantが。

外部性を入れる。

垂直的取引関係を入れる。

ライセンスを入れる。

補助金政策。課税政策を入れる。

こういうexercisesを量産するのはもうやめましょう。  
社会的限界費用と私的限界費用の乖離、私企業の外国人  
持ち株比率の2要素で全部説明できます。

～今日の論文

# The Model

Observable delay in Mixed duopolies.

Firm 0: Public firm that maximizes domestic welfare.

Firm 1: Private firm that maximizes its own profits.

The foreign ownership share in firm 1 is  $\theta$ .

Price competition.

Linear demand (b represents the degree of product differentiation: a smaller b implies larger product differentiation.)

Constant private and social marginal costs.

$c_i$ : Firm i's private marginal cost

$s_i$ : Firm i's social marginal cost

$\Delta_i := s_i - c_i$

# 社会的限界費用と私的限界費用が乖離する原因

- (1) 技術的外部不経済
- (2) 垂直的取引関係による 2重マージンの発生
- (3) ライセンス料
- (4) 税・補助金

# 価格・数量競争共通の基本的な特性

$\Delta_0$ は企業行動に影響を与えない。

私企業にとっては $c_1$ だけが問題。公企業には $s_0, s_1, c_1$ が問題。だから $c_0$ は誰の行動にも影響を与えない。

# 価格競争モデルの基本的な特性

## Lemma 1

$\Delta_1$ が小さいとき

公企業はリーダーになるとライバルの価格を下げる誘因を持つ（私企業の価格は高すぎ、生産量が小さすぎるから）。戦略的補完であるから、公企業は同時手番より低い価格をつける。

$\Delta_1$ が大きいとき

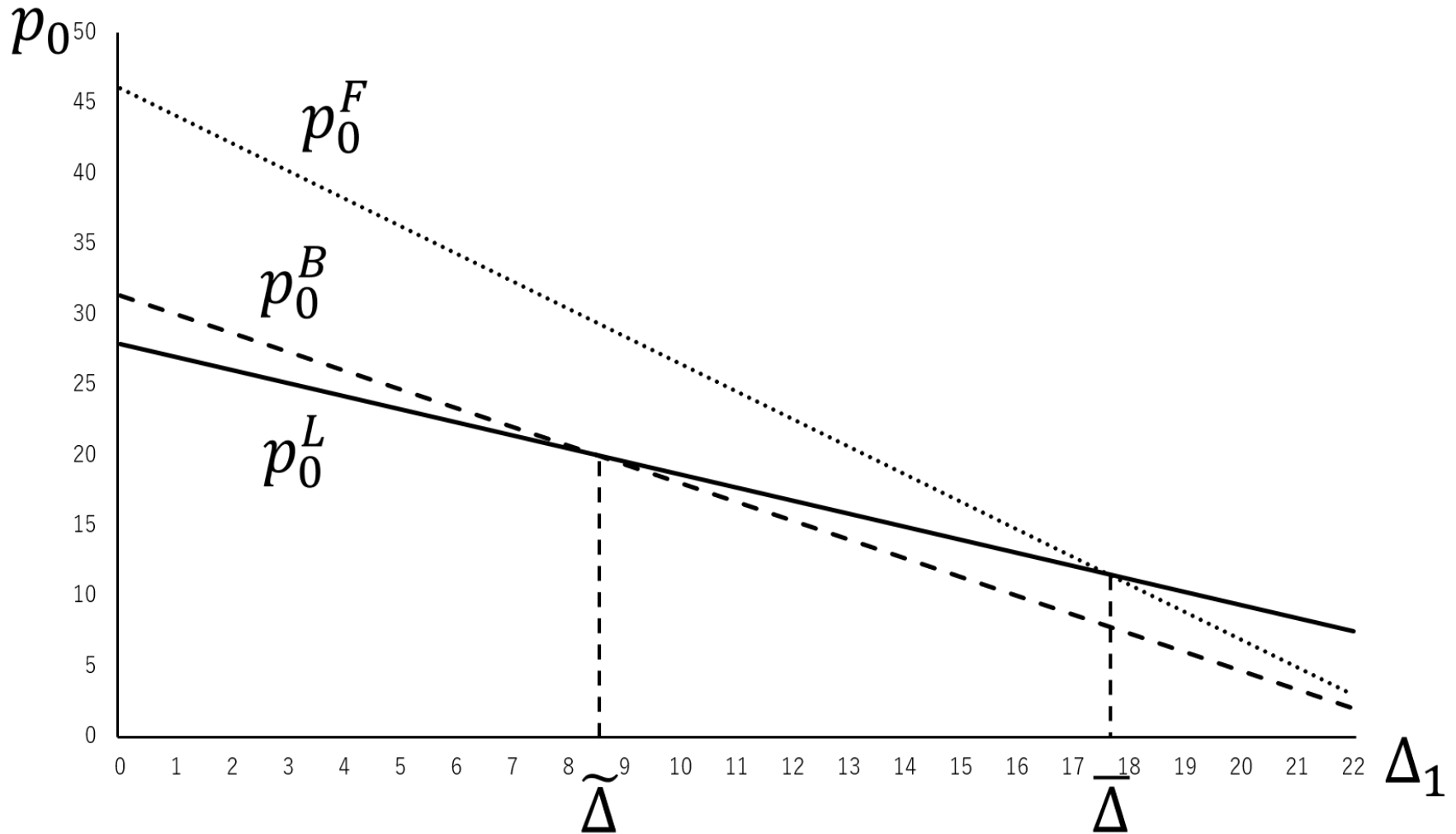
私企業の実産量は過大となる。これを抑制するため公企業はライバルに高い価格をつけさせる誘因を持つ。公企業は同時手番より高い価格をつける。

# Lemma 2

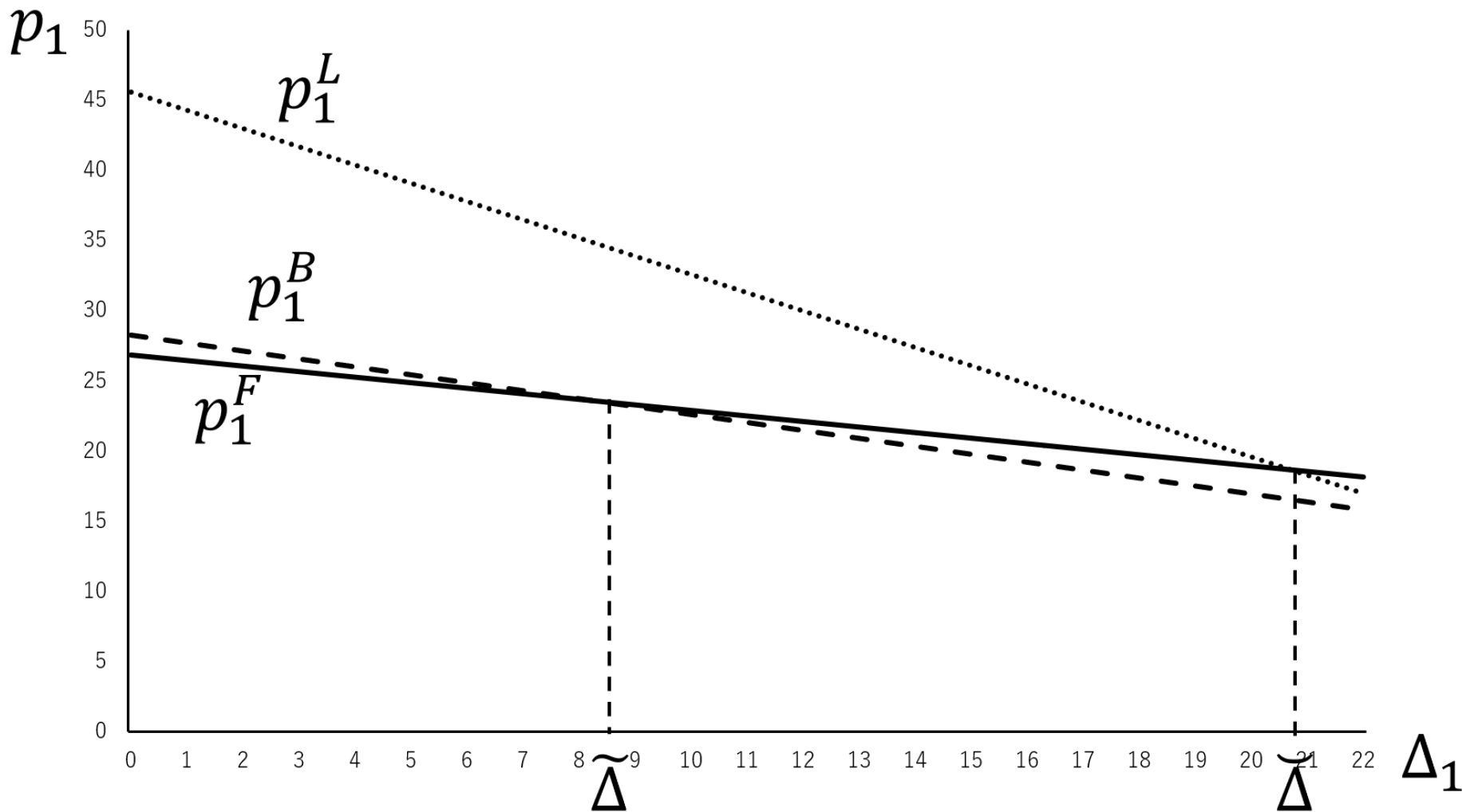
(i)  $\Delta_1$ が大きくなると3つのゲーム全てで公企業の価格が下がるが、その下がり方は公企業がleaderである時が最大

(ii)  $\Delta_1$ が大きくなると3つのゲーム全てで私企業の価格が下がるが、その下がり方は公企業がleaderである時が最大

# Lemma 3(i)



# Lemma 3(ii)





# Proposition 1 (私企業の外国人持ち株比率が100%未満のケース)

- (i)  $\Delta_1$ が大きくなるにつれ、均衡はBertrand→unique Stackelberg→two Stackelbergと変化する
- (ii) unique Stackelbergがpublic leadership equilibriumになるかprivate leadership equilibriumとなるかは私企業の外国持ち株比率に依存し、外国持ち株比率が大きいときにはprivate leadershipとなる。

# Proposition 2 (私企業の外国人持ち 株比率が100%のケース)

- (i)  $\Delta_1$ が大きくなるにつれ、均衡はBertrand→unique Stackelberg→two Stackelbergと変化する
  - (ii) unique Stackelbergは常にprivate leadership equilibrium
  - (iii) private leadership equilibriumとBertrandの均衡価格は等しくなる
- ⇒ $\theta=1$ のケースは特殊。robustness checkが必要

# Proposition 3 :Welfare and profit ranking (私企業の外国人持ち株比率が100%未満のケース)

- (i) welfare ranking:  $\Delta_1$ が大きくなるにつれ、public leadership優位→private leadership 優位→public leadership優位と変わる～nonmonotone relationship
- (ii) profit ranking:  $\Delta_1$ が大きくなるにつれ、private leadership 優位→public leadership優位と変わる～monotone relationship

# Proposition 4 :Welfare and profit ranking (私企業の外国人持ち株比率が100%のケース)

- (i) welfare ranking: public leadershipが常に優位  
⇒ $\theta=1$ のケースは特殊。robustness checkが必要
- (ii) profit ranking:  $\Delta_1$ が大きくなるにつれ、private leadership 優位→public leadership優位と変わる

# The Model

Observable delay in Mixed duopolies.

Firm 0: Public firm that maximizes domestic welfare.

Firm 1: Private firm that maximizes its own profits.

The foreign ownership share in firm 1 is  $\theta$ .

**Quantity competition.**

Linear demand (b represents the degree of product differentiation: a smaller b implies larger product differentiation.)

Constant private and social marginal costs.

$c_i$ : Firm i's private marginal cost

$s_i$ : Firm i's social marginal cost

$\Delta_i := s_i - c_i$

# Proposition 5 (私企業の外国人持ち株比率が100%未満のケース)

- (i)  $\Delta_1$ が大きくなるにつれ、均衡はtwo Stackelberg → unique Stackelberg → Cournotと変化する
- (ii) unique Stackelbergがpublic leadership equilibriumになるかprivate leadership equilibriumとなるかは私企業の外国持ち株比率に依存し、外国持ち株比率が大きいときにはprivate leadershipとなる。

# Proposition 6 (私企業の外国人持ち 株比率が100%のケース)

- (i)  $\Delta_1$ が大きくなるにつれ、均衡はCournot→unique Stackelberg→two Stackelbergと変化する
  - (ii) unique Stackelbergは常にprivate leadership equilibrium
  - (iii) private leadership equilibriumとCournotの均衡価格は等しくなる
- ⇒ $\theta=1$ のケースは特殊。robustness checkが必要

# Proposition 7 :Welfare and profit ranking (私企業の外国人持ち株比率が100%未満のケース)

- (i) welfare ranking:  $\Delta_1$ が大きくなるにつれ、private leadership優位→public leadership 優位→private leadership優位と変わる～nonmonotone relationship
- (ii) profit ranking:  $\Delta_1$ が大きくなるにつれ、public leadership 優位→private leadership優位と変わる～monotone relationship



# Proposition 8 :Welfare and profit ranking (私企業の外国人持ち株比率が100%のケース)

- (i) welfare ranking: public leadershipが常に優位  
⇒ $\theta=1$ のケースは特殊。robustness checkが必要
- (ii) profit ranking:  $\Delta_1$ が大きくなるにつれ、public leadership 優位→private leadership優位と変わる

# まとめ

- (1) 価格競争か、数量競争か、私企業の外国人持ち株比率はどれだけか、私企業の社会的限界費用として期限会費用がどれだけ乖離しているか、の3要素に依存して observable delay game の均衡や welfare, profit ranking が決まる。
- (2) 私企業の外国人持ち株比率が低いとき、唯一の均衡が public leadership になり得る。
- (3) 残念ながらいくつかの結果は線形の需要関数に依存。需要関数が concave だと外国人持ち株比率が高いときに public leadership が唯一の均衡になり得る。←線形の需要関数はナイフエッジの結果の可能性もある。

**Thank you very much for your kind  
attention!!**

**非常感謝**