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Education of Researchers for an Inclusive Regional Innovation and the Sustainable Future

INTERNATIONAL WORKSHOP ON OLIGOPOLY THEORY

Online Webinar

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April 23, 2021

Department of Economics, Chonnam National University, Korea
BK21 FOUR, Department of Economics, CNU

Index

Tax versus Regulations: An Analysis of Robustness to Polluter Lobbying against Near-Zero Emission Targets

Joint work with Akifumi Ishihara
and Kosuke Hirose

Ultra Low Emission Economy
Net Zero Emission Society

Ultra Low Emission Society

(1) Bio Society

(2) Hydrogen Society （水素社会）

(3) Electrification Society （電化社会）

Bio Society

Bio fuel

Bio-power generation

Problems

Cost is high. (Higher than the costs of PV and Wind).

Food versus fuel→the dilemma regarding the risk of diverting farmland or crops for biofuels production to the detriment of the food supply.

Bio fuel production may promote deforestation, local pollution, and/or global warming.

Zero Emission Hydrogen

Zero-Emission Hydrogen

~ Green, Bule, and Purple Hydrogen

Hydrogen from renewable, nuclear, or fossil fuel (coal, natural gas or oil) + Carbon Capture and Storage (CCS) or Carbon Capture and Utilization (CCU)

(Henceforth, CCS+CCU=CCSU)

Hydrogen Society

Zero-Emission Hydrogen

Fuel cell vehicles (FCV) , Hydrogen ship, airplane

Cogeneration by fuel cell

Hydrogen and Ammonia (NH_3) power generations

Methanation (CH_4) ~ Main material of town gas

Hydrogen distribution networks

Problems ⇒Cost is high.

Electrification Society

Oil, Gas, Coal → Electricity

Decarbonization of the power supply

Conventional Fuel Thermal⇒Nuclear, Renewable, Fuel Thermal +CCSU

Bio power generation + CCSU⇒Negative Emission

Electrification + Decarbonization of the power supply

⇒Ultra Low-Carbon Economy

Hydrogen and Bio can also play important roles in electrification society.

Net Zero Emission Society

To meet this standard,

(a) High level of energy saving,

(b) Electrification

(c) The emission of current heavy emission industries such as electric power supply, steal, cement, transportation, must be close to zero.

Inevitable positive emissions in some sectors are canceled by negative emission such as afforestation, DACS, BECCS

Zero Emission of Electricity Industry

Renewable

Nuclear

Fossil Fuel Thermal + CCUS

Zero-Emission Fuel Thermal

Zero-Emission Hydrogen + Fuel Cell

electric power demand-supply adjusting reservation capacity →Zero emission (Minus-emission) thermal, Pumped-storage hydropower, Battery, DR(Demand Response)

Zero Emission of Steal Industry

Coal →Zero Emission Hydrogen

or

CCSU

Blast Furnace(高炉)→Electric Furnace(電炉)

Emission Intensity Regulation

Emission Cap versus Emission Intensity

Emission Cap Regulation ~ Restriction of Total Emission

Emission Intensity Regulation ~ Restriction of Total Emission per Output (Restriction of Unit Emission)

Emission Cap Regulation (Emission tax) versus Emission Intensity Regulation

Japanese government traditionally prefers emission intensity regulation to emission cap regulation, but it is repeatedly criticized by other governments and environment protection group.

Firm has a weaker incentive to reduce its output level under emission intensity regulation than emission cap regulation, which yields distortions in perfectly competitive markets.

My Recent Papers on Emission Intensity Regulation that are not presented today

(a) The Equivalence of Emission Tax with Tax-Revenue Refund and Emission Intensity Regulation (Economics Letters, 182, 126-128, September 2019)

(b) Promoting Green or Restricting Gray? An Analysis of Green Portfolio Standards (Economics Letters, 198, 2021, 109650)

(c) Optimality of Emission Pricing Policies Based on Emission Intensity Targets under Imperfect Competition (Energy Economics, 98, June 2021, 105238)

An Advantage of Emission Intensity Regulation for Emission Cap Regulation in a Near-Zero Emission Industry

⇒A Comparison between Emission Intensity and Emission Cap Regulations, Energy Policy, vol. 137, 2020, 111115

Joint work with Kosuke Hirose

Efficiency of Emission Intensity Regulation

Under perfect competition, emission cap regulation can yield the first best, but emission intensity regulation can not (because output level becomes excessive for social welfare).

However, this property may be desirable under imperfect competition.

In this study, we show that emission intensity regulation dominates emission cap regulation in near-zero emission society.

The Model

Symmetric Cournot oligopoly. All are private.

This paper compares emission cap and emission intensity regulation under emission equivalence.

(In our setting, emission cap regulation is equivalent of emission tax because we consider symmetric oligopoly.)

Emission Cap versus Emission Intensity

Emission cap regulation ~ Restriction of total emission per firm (or equivalently restriction of total emission in the industry in our model because the number of firms is given exogenously)

Emission intensity regulation ~ Restriction of total emission per output (Restriction of unit emission)

Emission Cap versus Emission Intensity

Japanese government prefers emission intensity regulation to emission cap regulation, but it is repeatedly criticized by other governments and environment protection groups.

Firm has a weaker incentive to reduce its output level under emission intensity regulation than emission cap regulation. Therefore, emission intensity regulation may be better than emission cap in oligopoly markets.

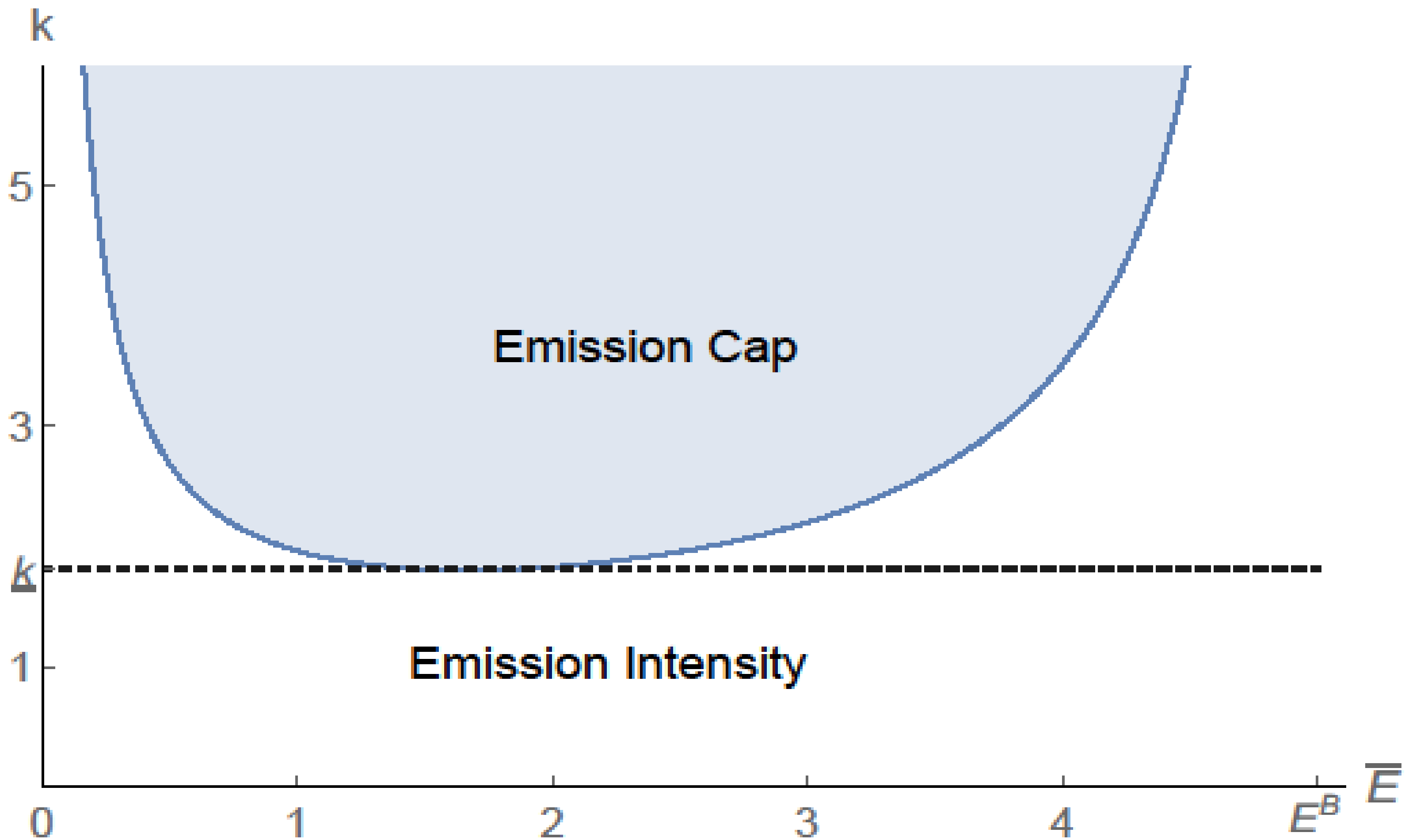
Results

(1) Emission intensity regulation is better than emission cap regulation if the emission target is close to zero or the busyness-as usual level.

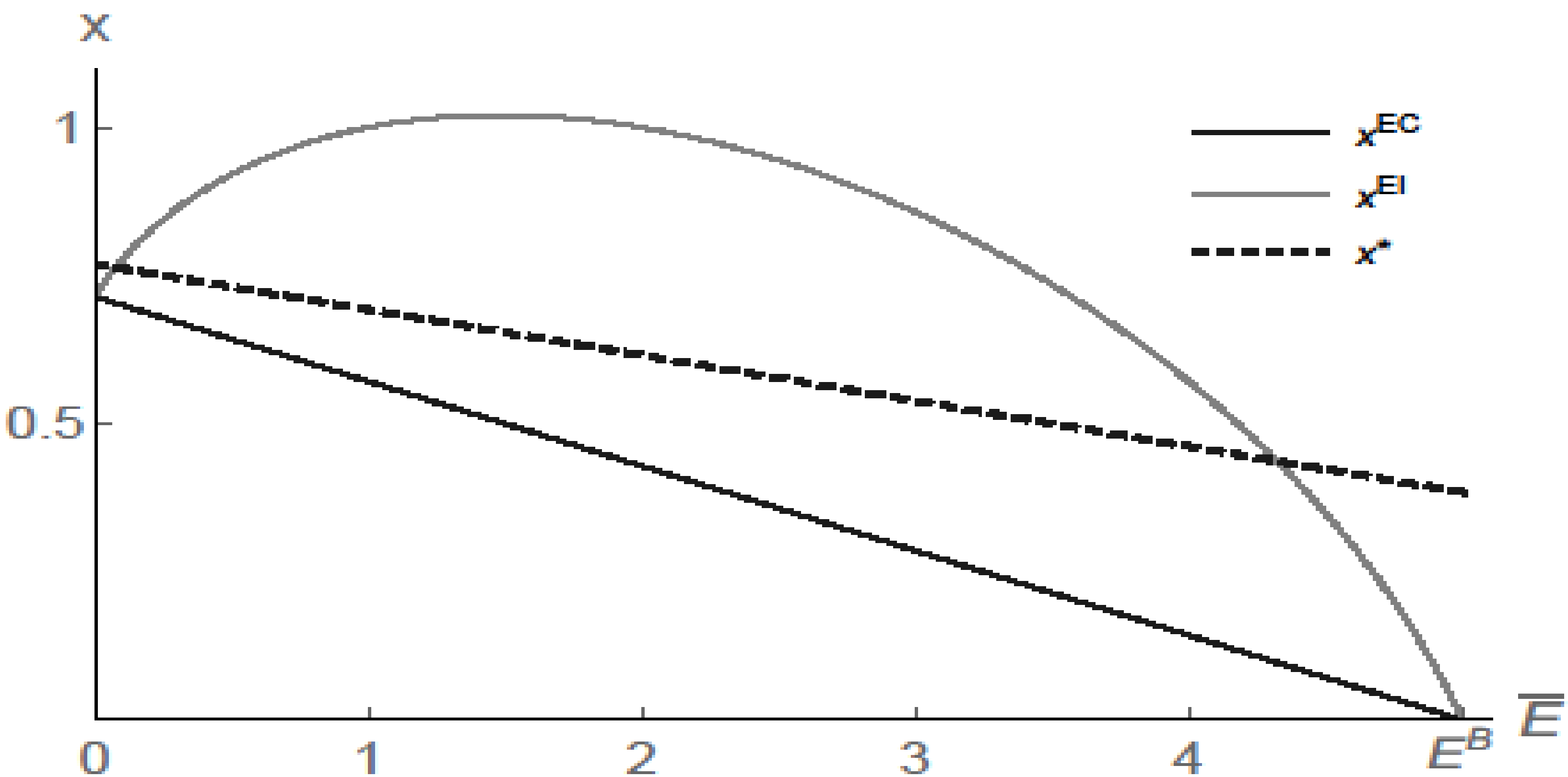
(2) Emission cap may be better than emission intensity regulation if the emission target is moderate.

(3) Abatement level is decreasing in the emission target under emission cap regulation but may not under emission intensity regulation.

Area for the Advantage of Emission Cap Commitment



Comparison of the abatement level among the second best, emission cap, and emission intensity cases



Tax versus Regulations: An Analysis of Robustness to Polluter Lobbying against Near-Zero Emission Targets

Joint work with Akifumi Ishihara
and Kosuke Hirose

Emission Restricting Policies are Implementable?

Emission restricting policies reduce firms' profits.

→Firms have incentives to manipulate the emission target. Firms have stronger incentive of manipulation when an increase in the emission target increases their profits more significantly.

Therefore, how emission target affects firms' profits is important.

The Model

We consider a monopoly market. Firm chooses q (output level) and a (abatement level) with cost c(q,x) and emission e(q,x).

c is increasing in q and a.

E is increasing in q and decreasing in a.

p(q) is demand function where p’<0, p’+p’’q $\leqq$0.

We assume interior solution.

$E \in (0, E^B)$

Three Policies

(a) Emission cap regulation, $e \leqq E$.

(b) Emission intensity regulation, $e/q \leqq \alpha$.

(c) Emission tax, the firm pays the tax te.

The government chooses α or t such that the resulting emission is equal to E (emission equivalence)

Tariff-Quota Equivalence

Because of Tariff-Quota Equivalence, Emission cap regulation and emission tax policy yield the same equilibrium allocation, q and a. However, two policies yield different profits.

Therefore, we consider three polices, not two policies, like Hirose ad Matsumura (2020, Energy Policy) .

Proposition 1

(i) $\Pi^C(0)=\Pi^I(0)=\Pi^T(0)$

(ii) $\Pi^C(E)>\Pi^I(E)$ and $\Pi^C(E)>\Pi^T(E)$ for $E\in(0,E^B)$

(iii) There exists $E_0>0$ such that $\Pi^I(E)>\Pi^T(E)$ for $E\in(0,E_0)$.

Suppose that the initial emission target is zero.

The willingness to pay for lobbying is

$\Pi^i(E^r)-\Pi^i(0)$ and this is the smallest when i=T as long as E^r is not too large.

Parametric Analysis

$P=a-bQ$, $c=\beta q+\gamma x^2/2$, and $e=\kappa q-x$, where a is sufficiently large to ensure the interior solution.

E^r : Realized emission target after lobbying

E^o : Initial emission target before lobbying

$L(\Delta E)$:Lobbying cost, $L'>0$, L'' is sufficiently large.

$\Delta E := E^r - E^o$

Propositions 2 and 3

Proposition 2

$\Pi^C(E) > \Pi^I(E) > \Pi^T(E)$ for $E \in (0, E^B)$

Proposition 3

$d\Pi^C(E)/dE > d\Pi^I(E)/dE > d\Pi^T(E)/dE$ for $E \in (0, E_1)$

and

$d\Pi^C(E)/dE < d\Pi^I(E)/dE < d\Pi^T(E)/dE$ for $E \in (E_1, E^B)$.

Numerical Examples

$L=h(\Delta E)^2$

E^r is smallest (largest) when E^o is small (large) and h is large (small).

If the government is ambitious and tough, the emission tax policy is the best from the viewpoint of implementation.

Oligopoly

We obtain the same implications from symmetric oligopoly models.

However, $\Pi^C(E)$ is decreasing in E when E is close to E^B and $\Pi^I(E)$ can be decreasing in E when E is close to E^B (Hirose et al. 2020).

These results strengthen our implications (If E^o is large and h is small, emission tax policy yields the largest E^r).

Thank you very much for your kind attention!!

多謝!!

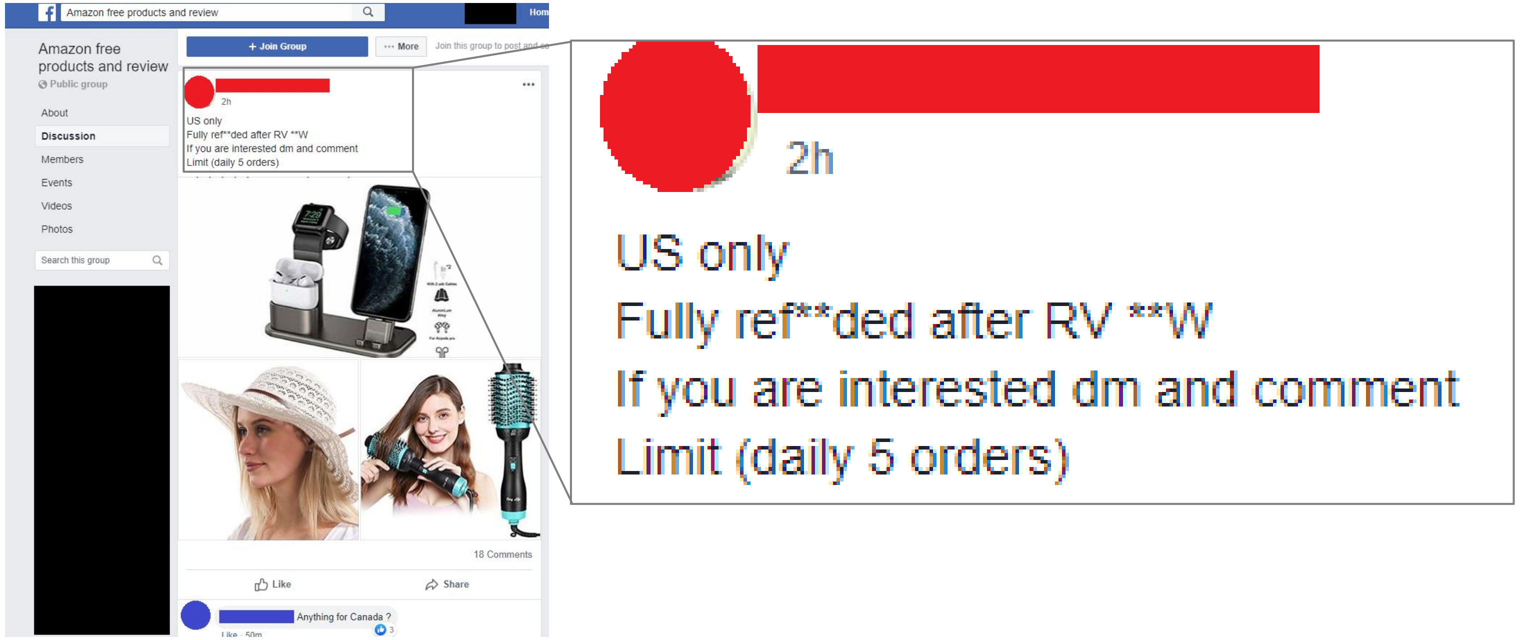
감사합니다 !!

Controlling Fake Reviews

Yuta Yasui (University of California, Los Angels)
April 23, 2021 @Chonnam National University

Introduction

- **Rating systems** play key roles in platform markets:
    - e.g.) Hollenbeck et al (2019), Reimers and Waldfogel (2020)
- Platform markets are **growing**,
    - so does the **incentive to make fake reviews**.



Research Question

Question: (How) Should a platform reduce fake reviews?

- Are fake reviews **harmful?**
  - Rational buyers might not be fooled by the fake reviews.
  - Boosted ratings might work better as a signal of good quality.
    - if high-quality sellers are making fake reviews

- Instruments of the platform:
  1. intensity of **censorship** on fake reviews
  2. **weights** on old/new reviews

Contributions

Rating Design:

- Horner and lambert (2018), Bonatti and Cisternas (2019), Vellodi (2020)

Fake Review:

- Mayzlin (2006), Dellarocas (2006)

Signaling Promotion:

- Nelson (1970, 1974), Kihlstrom and Riordan (1984), Milgrom and Roberts (1986)

- This paper:
  - Combining a rating system and fake reviews
    - Filtering policy and the rating system
    - Both rational and naïve consumers
  - Dynamic model of fake reviews/promotions
    - New implications to empirical analysis

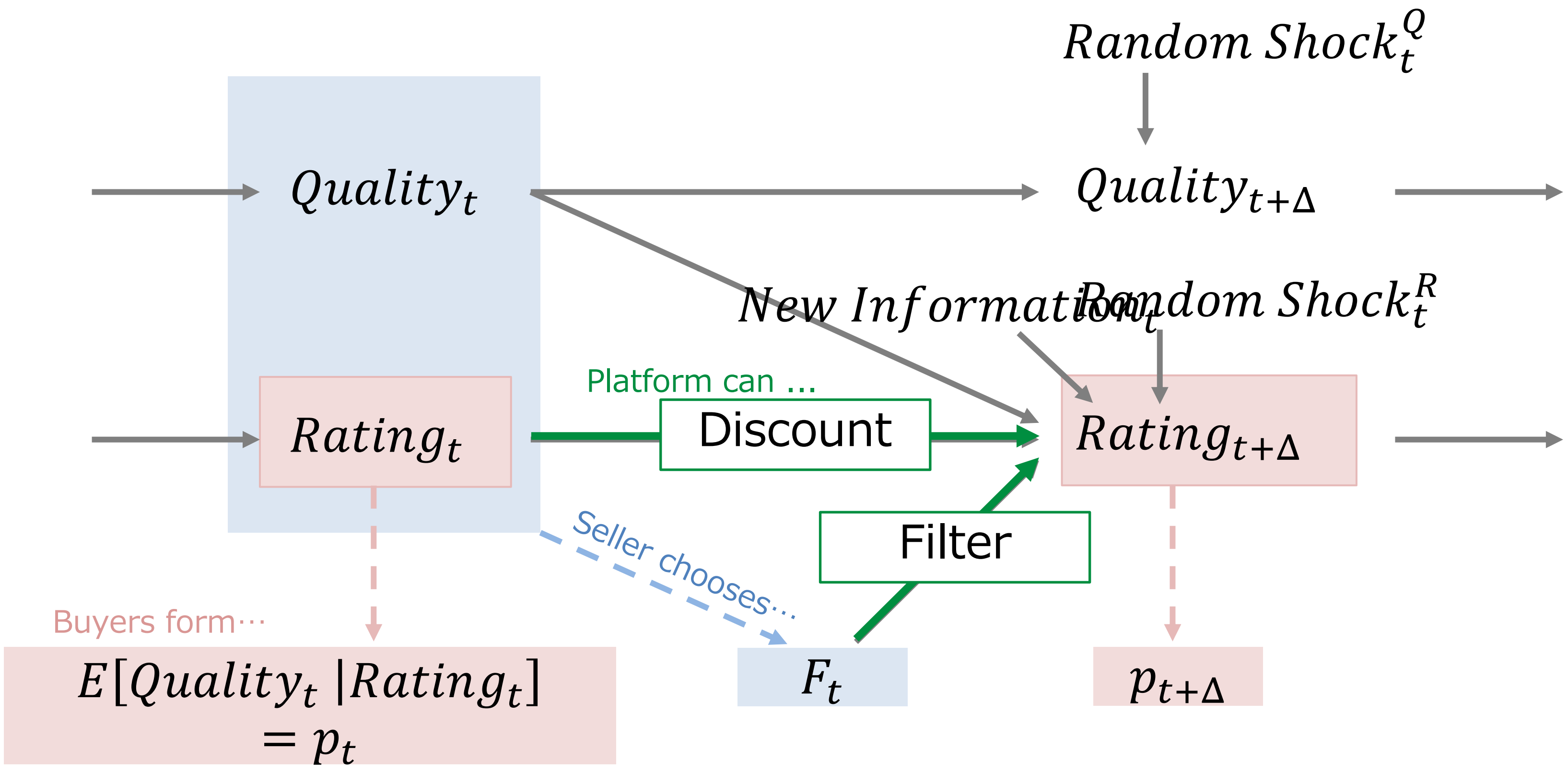
Motivating Example

- Fake reviews with **“verified purchase”** on Amazon
  1. The seller **posts info** of the product and offers full refund (+ extra)
  2. Fake reviewers **buy** the product and **write a good review** on Amazon.
  3. After verifying the review, the seller **refunds** via Paypal.
  4. Amazon detects and deletes a part of the fake reviews
- Note:
  - The platform takes a **transaction fee** from each fake review
    - (Revenue from the fake sales) < (Refund of the fake sales)

Outline of the Model

- Time: $t \in [0, \infty)$
- Players:
  - a long lived seller
  - many short lived buyers
- Action at time t
  - Seller:
    - choose the amount of the fake reviews: F_t
    - (sell q units of the product: fixed/normalized to 1)
  - Buyers:
    - buy the product, or not
    - form the equilibrium price: $p_t = E[Quality_t | Rating_t]$
- Seller's payoff at time t
  - $Profit_t =$ **Revenue** $-$ **Refund** $-$ Other costs

Rating and Fake Reviews / Equilibrium



Rating and Fake Reviews / Equilibrium

Definition of eqm.

- Seller chooses F_t to maximize discounted value of the profit
- $E[Quality_t \,|Rating_t]$ is based on the Seller's strategy
- F_t is **linear** in $Quality_t$ and $Rating_t$
- $(Quality_t, Rating_t)$ is **stationary Gaussian**

Results

Properties of Equilibrium

Properties of eqm

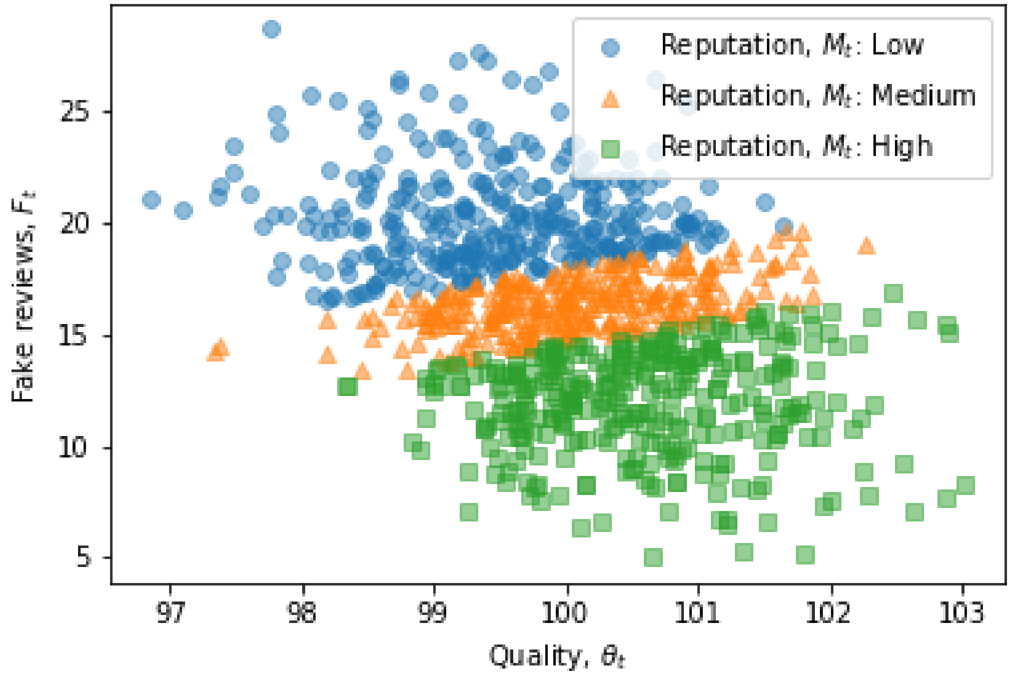
- Equilibrium always exists
- It is unique under a loose condition
- $Rating_t \uparrow \Rightarrow F_t \downarrow$
- $Quality_t \uparrow \Rightarrow F_t \uparrow$

  Intuition:

  - $Rating_t \uparrow \Rightarrow p_t \uparrow \Rightarrow \tau p_t F_t \uparrow \Rightarrow F_t \downarrow$
  - $Quality_t \uparrow \Rightarrow Rating_{t+\Delta} \uparrow \Rightarrow \partial V_{t+\Delta} / \partial Rating_{t+\Delta} \uparrow \Rightarrow F_t \uparrow$

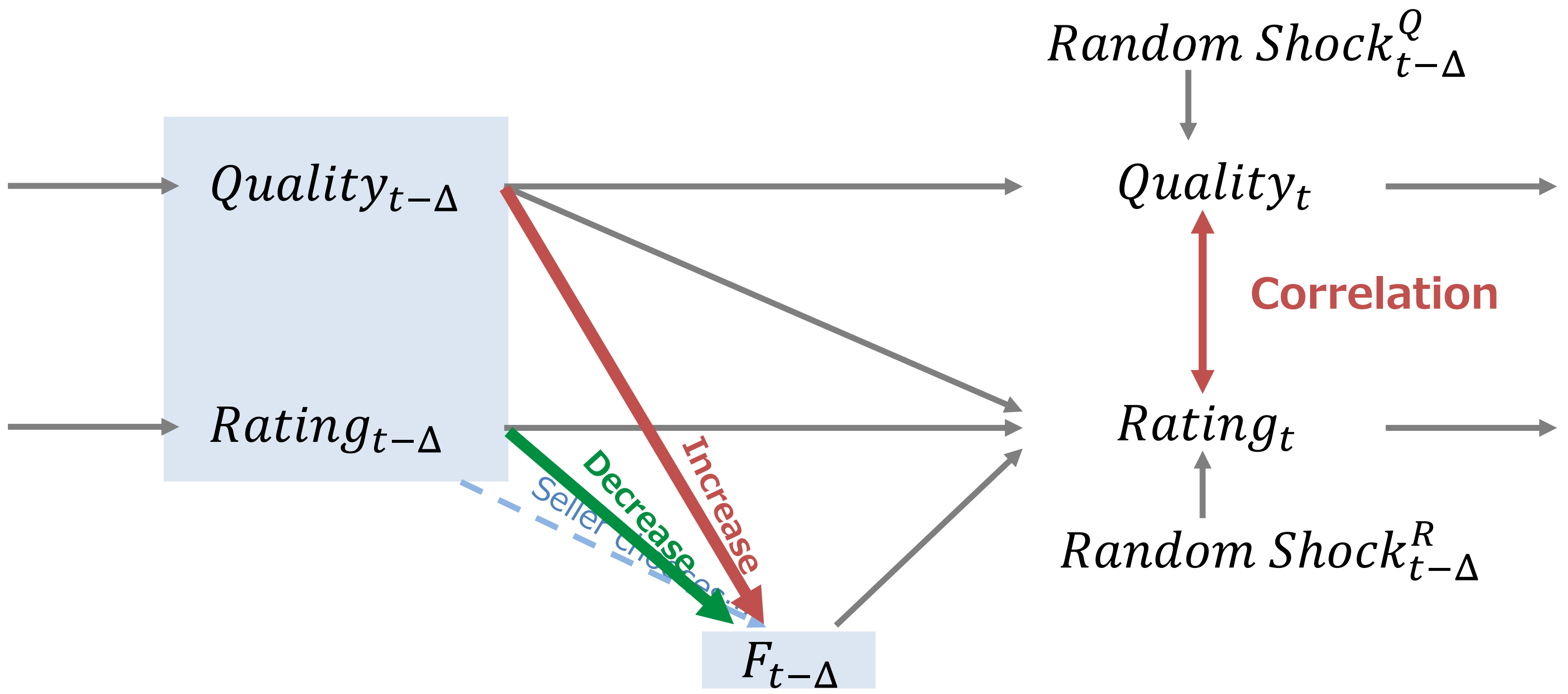
Relevance to empirical analysis

- $Rating_t \downarrow \Rightarrow F_t \uparrow$: consistent with Luca and Zervas (2016)
- $Rating_t \uparrow \Rightarrow F_t \downarrow$ & $Quality_t \uparrow \Rightarrow F_t \uparrow$:
  - Rating $\neq$ proxy of quality
  - Even if we have data on quality, we should control ratings



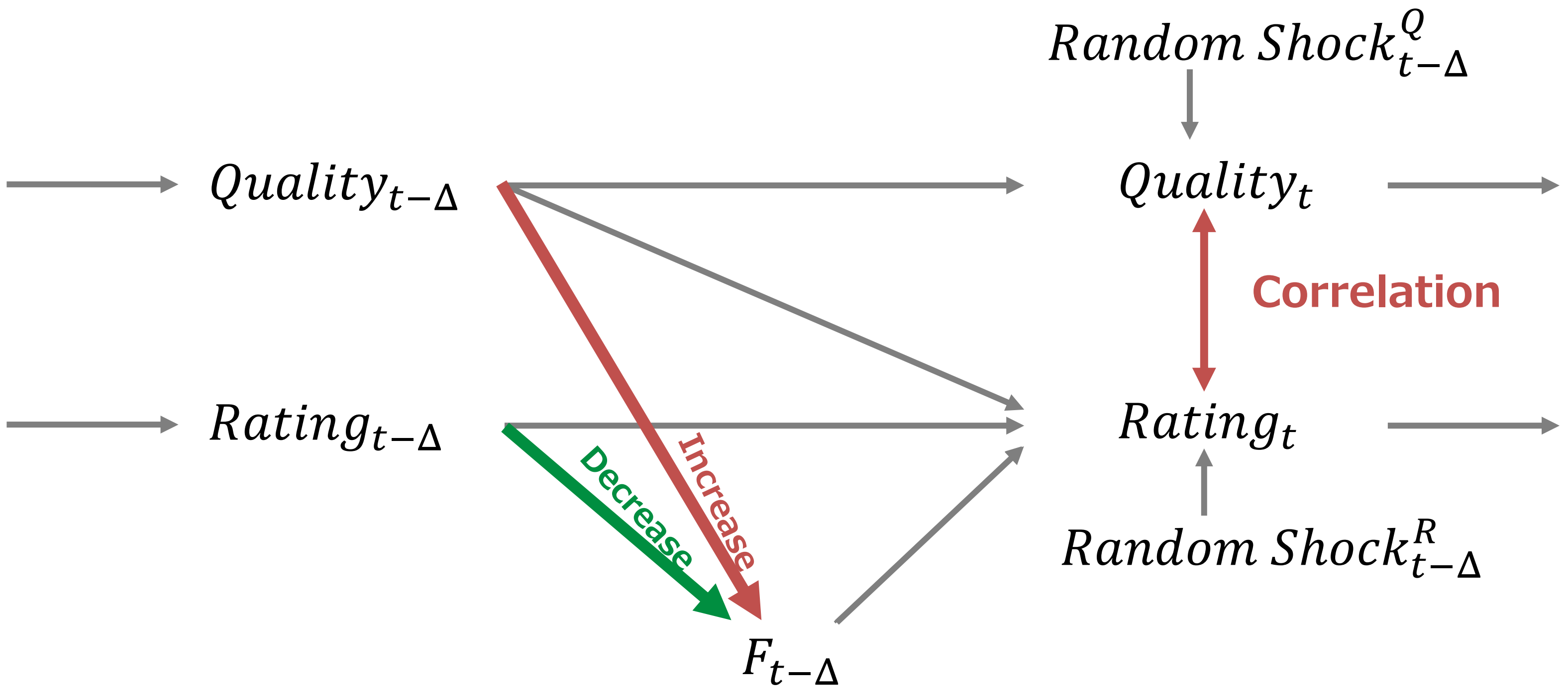
Information Maximization: Intro

- Criteria: Correlation b/w $Rating_t$ and $Quality_t$
- Two eqm effects:
  - $Quality_t \uparrow \Rightarrow F_t \uparrow$: Increase correlation
  - $Rating_t \uparrow \Rightarrow F_t \downarrow$: Decrease a weight on old info



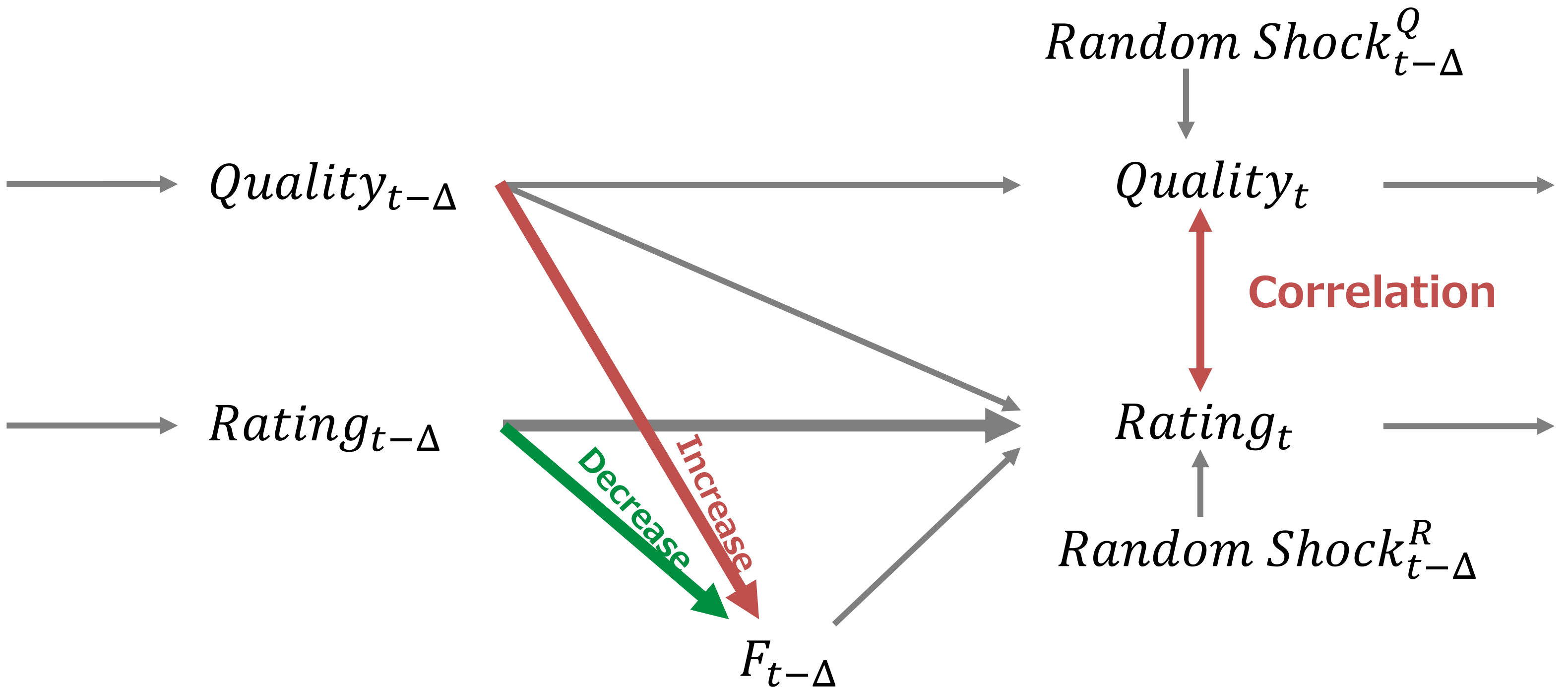
Information Maximization: Filtering

- Filter fake reviews ⇒ diminish the effects of fake reviews
- This **decreases information** if
  - The first effect is large, or
  - The weight on the old information was originally too high



Information Maximization: Weights on Reviews

- The best weight on the old information balances
  - Robustness to shocks in new info
  - Slow updates on changing quality
- Fake reviews lower the weight on old info
  ⇒ Platform should push it back (i.e., **higher weight** on old info than one without fake reviews)



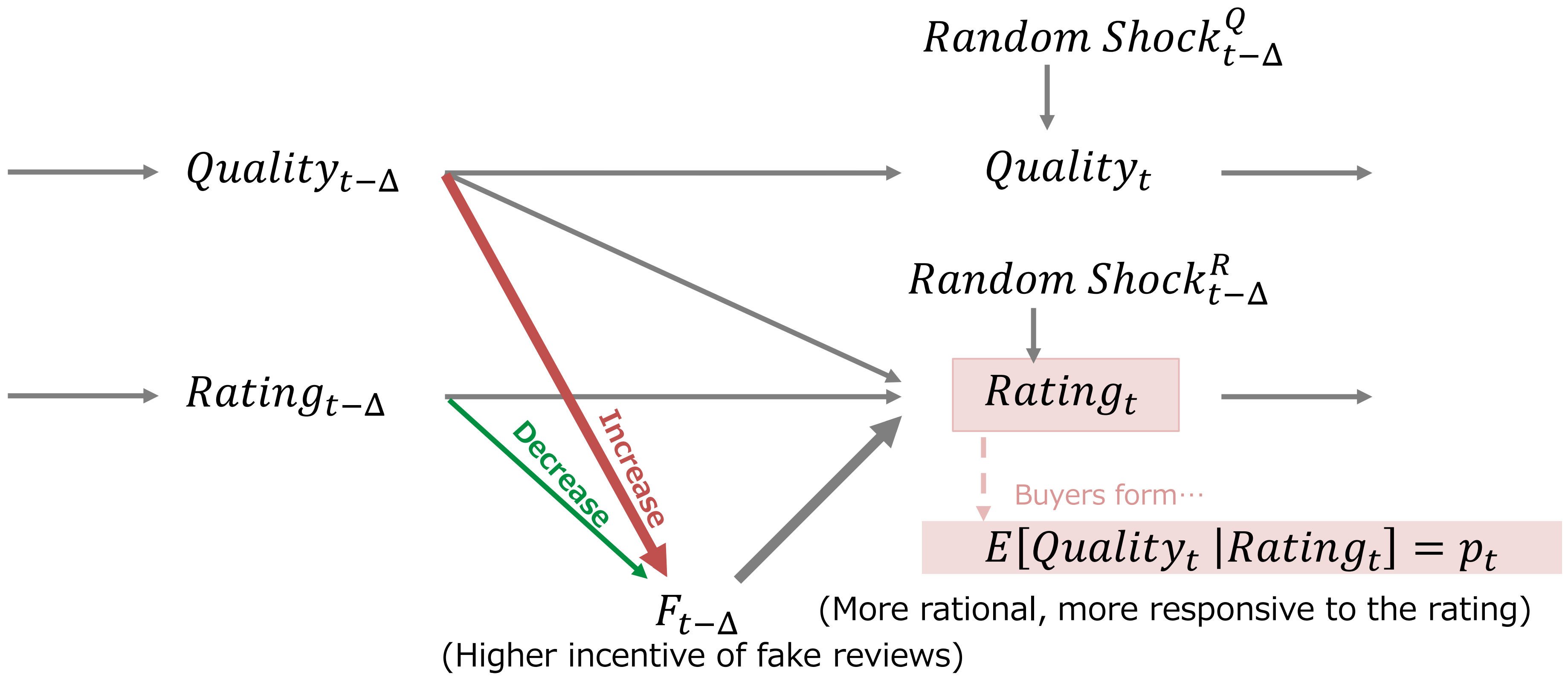
Bias Reduction: Intro

- When buyers form $E[Quality_t \mid Rating_t]$,
  - Rational buyers take the Seller’s strategy into account
    - (i.e., discount the boosted rating)
  - Naïve consumers **cannot**.
    - The boosted rating is attributed to high quality
    - Upward bias in their $E[Quality_t \mid Rating_t]$
      as long as fake reviews are positive

- Consider a mixture of rational and naïve buyers.

Bias Reduction: Results

- More filtering, less bias (under a reasonable parameter set)
  - Trade-off: Filtering ...
    - is good for naïve consumers
    - can be bad for rational consumers
- More rational buyers in mkt, more fake reviews (more bias to naïve buyers)



Summary

Positive Analysis:

- The number of fake reviews is
  - increasing in the quality,
  - decreasing in the rating.
- More fake reviews in market with rational consumers

“Normative” Analysis:

- <u>For rational buyers</u>:
  - Compared to ones w/o fake reviews,
    - a rating can be more informative with fake reviews
    - a weight on the past info should be higher with fake reviews
- <u>For naïve buyers</u>:
  - The more stringent filtering, the less bias
- Trade-off between info for rational/naïve buyers

Optimal tariff policies with emission taxes under non-restrictive two-part licensing strategies by a foreign eco-competitor

Seung-Leul Kim & Sang-Ho Lee

Kangwon National University *Chonnam National University*

April 23, 2021

Chonnam National University (Online Conference)

Background

► During the last generation, technology innovation and free trade stance have drastically expanded the volume of international trade and globalization all over the world. Owing to the liberalization and deregulation of economic activities, however, the scope and nature of trade and environmental problems have also been diversified without being limited to a specific region or country.

► In January 2018, Trump imposed tariffs on solar panels and washing machines of 30 to 50 percent. Later the same year he imposed tariffs on steel (25%) and aluminum (10%) from most countries. (**Tariff**)

► Recently, tighter environmental regulations (**Emission tax**) and technological innovation have contributed to the emergence of an abatement market, eco-industry. Moreover, most eco-technologies are likely to be patented. (**Licensing**).

Background

► The studies of the interaction between trade policy and environmental regulation :

- Copeland, 1994; Gulati and Roy, 2008; Hatzipanayotou, 2009
  : focused on the interest of government revenue in how to adjust tariffs and emissions taxes to improve welfare

- Recent works examined the optimal policies and showed that trade liberalization results in less-stringent environmental regulations, which suggests that policies regulating trade and the environment are positively correlated.

- Tsai et al. (2014), however, showed that positive relationship between tariffs and environmental taxes may not be applicable under the eco-technology which can fully abate pollution through ER&D.

- Chao et al. (2012) also showed that when both environmental taxes and tariffs are employed, welfare is maximized with the first-best optimal policy which is free trade and a Pigouvian tax on consumption-based pollution.

Previous studies

► The studies of trade policy with licensing :

- Kabiraj and Marjit (2003) and Mukherjee and Pennings (2006) : show that the role of government in technology licensing under an open economy. In such an economy, tariff policy induces fee licensing than royalty licensing with consideration of maximizing domestic welfare.

- Meanwhile, Wang et. al (2012) examine the relation of strategic trade policy and welfare with consumer-friendly initiative of foreign exporting firm.

- Kabiraj and Kabiraj (2017) show that with two-part licensing of cost-reducing technology, a tariff can be chosen to induce fee licensing and maximize both consumers' surplus and domestic welfare in an international duopolistic model.

- Yang et al. (2020) extend to foreign Stackelberg leadership model

Main purpose of this study

Thus, the main point of this paper is **how the trade policy affects welfare consequences with licensing strategies of foreign innovated firm in domestic market, under environmental regulation.**

In particular, we investigate strategic **two-part licensing contracts** by a foreign innovator. (with Restrictive vs. Non-restrictive assumption)

- Liao and Sen (2005) introduced subsidy in licensing with combinations if upfront fee and negative royalty.

We also examine **policy relations between tariffs and emission taxes** facing when the government coordinate the optimal policy with the introduction of eco-technology.

Structure

► No-licensing

$$\pi_d = P(Q)q_d - cq_d - tq_d$$

$$\pi_f = P(Q)q_f - cq_f - \tau q_f$$: zero-pollution eco-technology

► Two-part licensing

$$\pi_d^T = P(Q)q_d - cq_d - rq_d - f$$

$$\pi_f^T = P(Q)q_f - cq_f - \tau q_f + rq_d + f$$

i) Restrictive case: $r \geq 0 \quad and \quad f \geq 0$

ii) Non-restrictive case: $r \gtreqless 0 \quad and \quad f \gtreqless 0$

Contributions

- Extension to Eco-technology market with emission tax and tariff

- Consideration of model without non-negative constraint on r and f under two-part licensing : Liao and Sen (2005)

- Comparision of restrictive and non-restrictive two-part licensing contracts

- Non-restrictive two-part licensing is better to the society : Kabiraj and Kabiraj (2017)

- Negative relation between emission tax and tariff to obtain social optimum : Tsai et al. (2014)

Timing of the game

► At stage 1: for given emission tax and tariff, the foreign firm announces the provision of eco-technology and decides a per-unit royalty and a fixed-fee.

► At stage 2: given the two-part licensing contract, the domestic firm decide whether to purchase a license.

► Finally, each domestic and foreign firm chooses output levels q_d and q_f in a Cournot-fashion in the last stage.

Benchmark: no-licensing

The profit functions of a foreign firm and a domestic firm are as follows:

$$\pi_d = P(Q)q_d - cq_d - tq_d \quad \text{and} \quad \pi_f = P(Q)q_f - cq_f - \tau q_f$$

The Cournot quantities of the firms are:

$$q_d = \frac{a-c-2t+\tau}{3} \quad \text{and} \quad q_f = \frac{a-c+t-2\tau}{3}$$

and profits are

$$\pi_d^N = \left(\frac{a-c-2t+\tau}{3}\right)^2 \quad \text{and} \quad \pi_f^N = \left(\frac{a-c+t-2\tau}{3}\right)^2$$

The non-prohibitive tariff condition : $\max\left[0\,,\,2t+c-a\right] \le \tau < \dfrac{a-c+t}{2}$

$$\tau_M \equiv 2t+c-a \quad \text{and} \quad \tau_D \equiv \frac{a-c+t}{2}$$

Restrictive
Two-part licensing

Restrictive Two-part licensing

Non-restrictive two-part licensing case : $r \gtreqless 0$ **and** $f \gtreqless 0$

The profit functions of a foreign firm and a licensed domestic firm are determined with unit royalty and the fixed-fee as follows:

$$\pi_d^T = P(Q)q_d - cq_d - rq_d - f \quad \text{and} \quad \pi_f^T = P(Q)q_f - cq_f - \tau q_f + rq_d + f$$

The Cournot quantities of the firms are:

$$q_d^T = \frac{a-c-2r+\tau}{3} \quad \text{and} \quad q_f^T = \frac{a-c+r-2\tau}{3}$$

and profits are

$$\pi_d^T = \left(\frac{a-c-2r+\tau}{3}\right)^2 - f \quad \text{and} \quad \pi_f^T = \left(\frac{a-c+r-2\tau}{3}\right)^2 + rq_d + f$$

Then, the foreign innovated firm's profit maximization problem:

$$\max_r \left(\frac{a-c+r-2\tau}{3}\right)^2 + rq_d^T + f(r) \quad \text{s.t.} \quad f(r) = \pi_d^T - \pi_d^N = \frac{4}{9}(r-t)(r+c+t-a-\tau)$$

$$\Rightarrow \quad r^* = \frac{a-c-5\tau}{2} \quad \text{and} \quad f(r^*) = \frac{(5\tau-a+2t+c)(a-2t-c+7\tau)}{9}$$

Restrictive Two-part licensing

Proposition 1. With a non-negative constraint on royalty and fixed-fee, the optimal two-part licensing is following as

(a) $r^* = t$, $f^* = 0$ if $\tau \le \tau^R = \dfrac{a-c-2t}{5}$,

(b) $r^* = \dfrac{a-c-5\tau}{2}$, $f(r^*) = \dfrac{(5\tau - a + 2t + c)(a - 2t - c + 7\tau)}{9}$

if $\dfrac{a-c-2t}{5} < \tau \le \dfrac{a-c}{5}$,

(c) $r^* = 0$, $f(0) = \dfrac{4t(a+\tau-t-c)}{9}$ if $\tau > \tau^F = \dfrac{a-c}{5}$.

Restrictive Two-part licensing

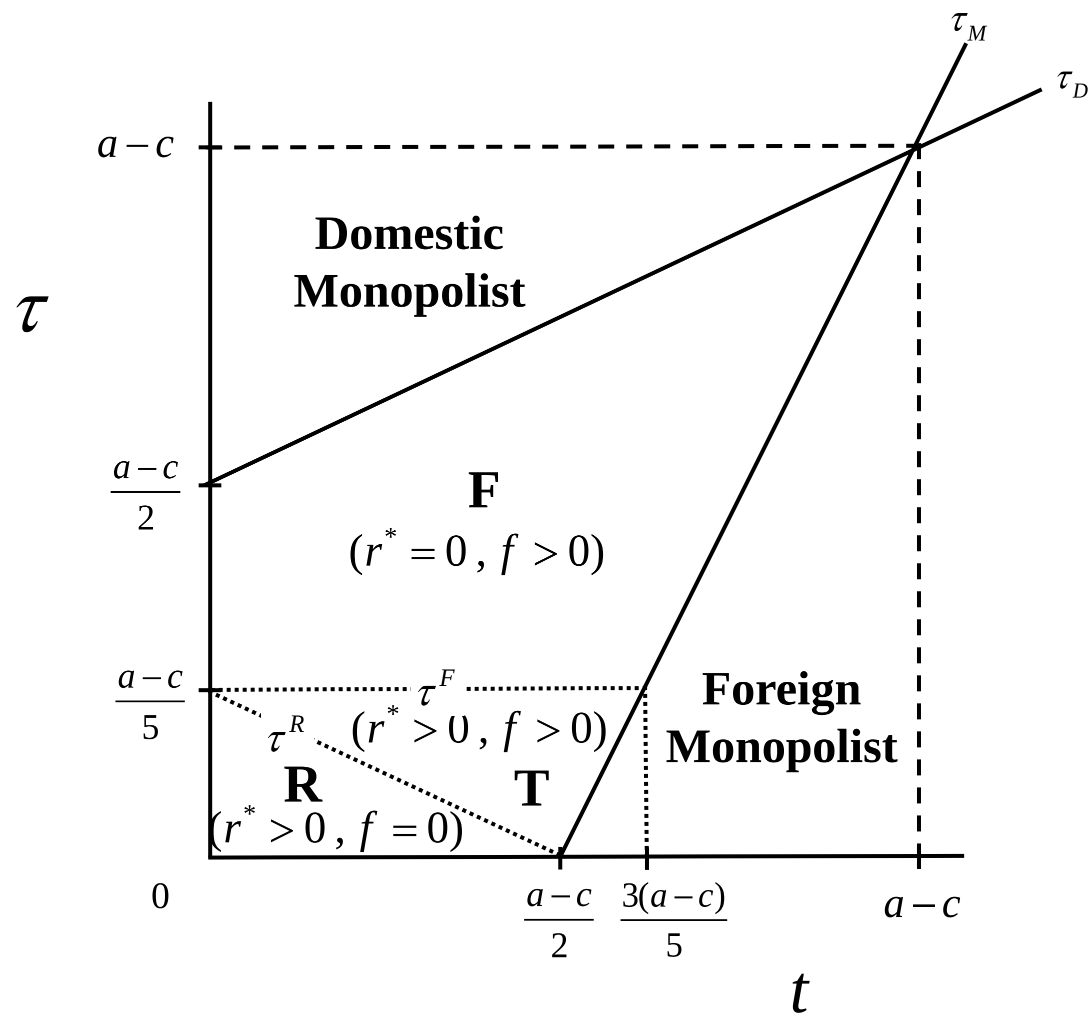


Fig. 1. Optimal licensing strategies of foreign firm with restriction r and f

Restrictive Two-part licensing

The profits of the domestic firm and the foreign firm are as follows:

Under royalty licensing,

$$\pi_d^R = \left(\frac{a-c-2t+\tau}{3}\right)^2 \quad \text{and} \quad \pi_f^R = \frac{(a-c)(a-c+5t-4\tau)+4\tau^2-t\tau-5t^2}{9}$$

Under fixed-fee licensing,

$$\pi_d^F = \left(\frac{a-c-2t+\tau}{3}\right)^2 \quad \text{and} \quad \pi_f^F = \frac{(a-c)(a-c+4t-4\tau)+4(\tau^2-t^2+\tau t)}{9}$$

Under two-part tariff licensing,

$$\pi_d^T = \left(\frac{a-c-2t+\tau}{3}\right)^2 \quad \text{and} \quad \pi_f^T = \frac{(a-c)(5a-5c-26\tau)+41\tau^2+16t(a-c-t+\tau)}{36}$$

$$\Rightarrow \quad \pi_f^R > \pi_f^N, \quad \pi_f^F > \pi_f^N, \quad \text{and} \quad \pi_f^T > \pi_f^N \quad \text{for any } \tau \text{ and } t$$

Restrictive Two-part licensing

Welfare function of non-licensing :

$$W^N = \int_0^Q P(u)du - cq_d + \tau q_f - dE$$
$$= \frac{1}{6}\left[2(a-c)^2 - 2d(a+\tau-2t-c) + 2\tau(a+t-c) - t(2a-2c+t) - 3\tau^2\right]$$

Welfare function of two-part tariff licensing :

$$W^L = \int_0^Q P(u)du - cq_d - pq_f + \tau q_f - rq_d - f$$

$$W^R\{r^*, f=0\} = \frac{1}{6}\left[2(a-c)(a-c-2t+\tau) + 3(t^2-\tau^2)\right]$$

$$W^F\{r^*=0, f(0)\} = \frac{1}{18}\left[6(a-c)(a-c+\tau) - 8t(a+\tau-c-t) - 9\tau^2\right]$$

$$W^T\{r^*, f(r^*)\} = \frac{1}{72}\left[17(a-c)^2 + 70\tau(a-c) - 32t(a+\tau-c-t) - 91\tau^2\right]$$

Restrictive Two-part licensing

In order to focus on the welfare effect of the tariff, we suppose that $t = d$.
: Chao *et al*. (2012)

Proposition 2. In the case that $t = d$, we have

(i) $W^R = W^N$, (ii) $W^T > W^N$,

and (iii) $W^F \underset{<}{\overset{>}{=}} W^N$ if $\tau \underset{>}{\overset{<}{=}} \tau_W^*$ where $\tau_W^* = \dfrac{4(a-c)-t}{8}$ satisfies $W^F = W^N$.

Restrictive Two-part licensing

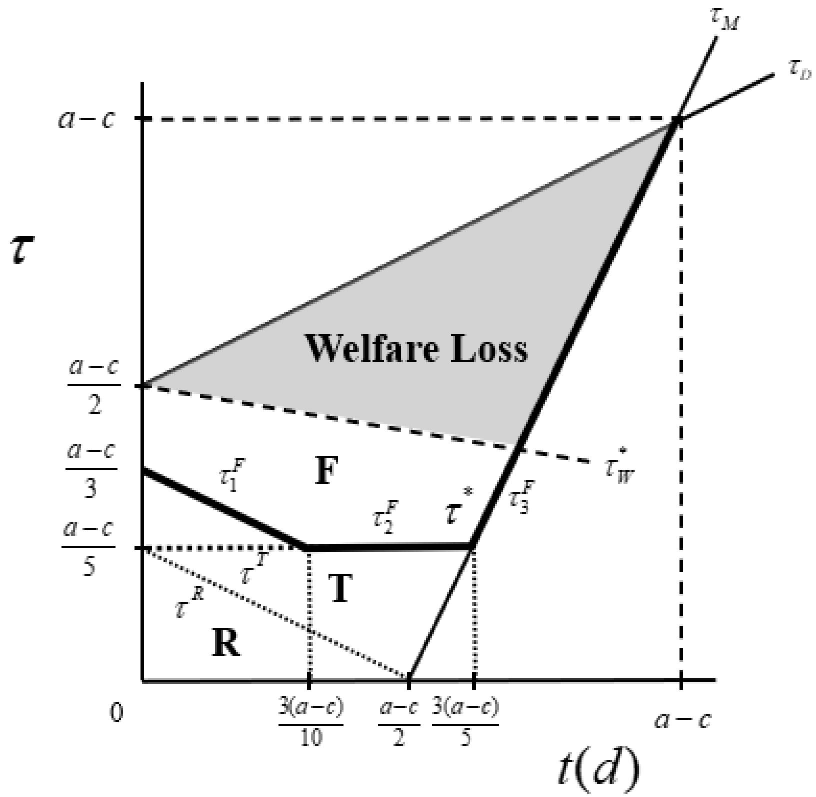


Fig. 2. Welfare losses and optimal tariff with restriction on r and f

Restrictive Two-part licensing

Proposition 3. The optimal tariff schedules of each licensing are following as

(i) Royalty licensing: $\tau^R = \frac{a-2t-c}{5}$ where $0 \le t < \frac{a-c}{2}$,

(ii) Two- part licensing: $\tau^T < \frac{a-c}{5}$ where $0 \le t < \frac{3(a-c)}{5}$,

(iii) Fixed-fee licensing:

$$\tau_1^F = \frac{3(a-c)-4t}{9} \quad \text{where} \quad 0 \le t < \frac{3(a-c)}{10} ,$$

$$\tau_2^F = \frac{a-c}{5} \quad \text{where} \quad \frac{3(a-c)}{10} \le t < \frac{3(a-c)}{5} ,$$

$$\tau_M = \tau_3^F = 2t+c-a \quad \text{where} \quad \frac{3(a-c)}{5} \le t < (a-c) .$$

Restrictive Two-part licensing

Lemma 1. Under optimal tax schedules, $W^{F*} > W^{T*} > W^{R*}$.

: Kabiraj and Kabiraj (2017)

Proposition 4. Under restrictive two-part licensing, the overall optimal tariff schedules by τ^* are as follows:

$$\tau^* = \begin{cases} \tau_1^F \quad if \quad 0 \le t < \dfrac{3(a-c)}{10} \\ \tau_2^F \quad if \quad \dfrac{3(a-c)}{10} \le t < \dfrac{3(a-c)}{5} \\ \tau_M \quad if \quad \dfrac{3(a-c)}{5} \le t < (a-c) \end{cases}$$

Non-restrictive
Two-part licensing

Non-restrictive Two-part licensing

Non-restrictive two-part licensing case : $r \gtreqless 0$ **and** $f \gtreqless 0$

Then, from same profit maximization problems for the foreign eco-innovated firm, we have the same optimal royalty as (11):

$$r^* = r = \frac{a-c-5\tau}{2}$$

The difference of the previous analysis is that the optimal royalty can be positive or negative, i.e., $r \gtreqless 0$ if $\tau \gtreqless \frac{(a-c)}{5}$.

Non-restrictive Two-part licensing

Proposition 5. Foreign eco-innovated firm's optimal two-part licensing schemes without non-negativity constraints are as follows:

(a) $r^* = t$, $f^* = 0$ if $\tau = \tau^R$,

(b) $r^* = 0$, $f(0) = \dfrac{4t\{6(a-c)-5t\}}{45}$ if $\tau = \tau^F$,

(c) $r^* = \dfrac{a-c-5\tau}{2} > 0$, $f(r^*) = \dfrac{(5\tau - a + 2t + c)(a - 2t - c + 7\tau)}{9} < 0$ if $\tau < \tau^R$,

(d) $r^* = \dfrac{a-c-5\tau}{2} < 0$, $f(r^*) = \dfrac{(5\tau - a + 2t + c)(a - 2t - c + 7\tau)}{9} > 0$ if $\tau > \tau^F$,

(e) $r^* = \dfrac{a-c-5\tau}{2} > 0$, $f(r^*) = \dfrac{(5\tau - a + 2t + c)(a - 2t - c + 7\tau)}{9} > 0$ if $\tau^R < \tau < \tau^F$.

Non-restrictive Two-part licensing

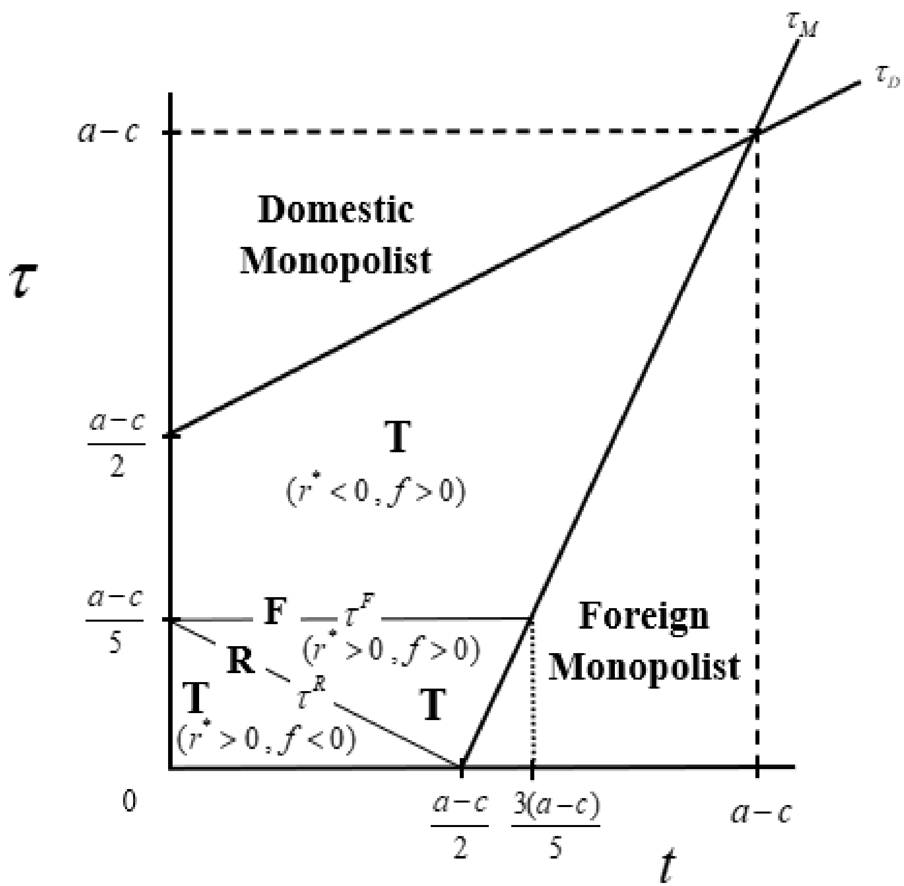


Fig. 3. Optimal licensing strategies of foreign firm with non-restriction on r and f

Non-restrictive Two-part licensing

Proposition 6. In the case that $t = d$,

we have (i) $W^T < W^N$ if either $\tau > \tau_W^{**}$ or $\tau < \tau^R$,

(ii) $W^T \geq W^N$ if $\tau^R \leq \tau \leq \tau_W^{**}$

Where $\tau^R = \tau_W^{***} = \dfrac{a-2t-c}{5}$ and $\tau_W^{**} = \dfrac{7(a-c)-2t}{11}$ satisfies $W^T = W^N$.

Proposition 7. Under non-restrictive two-part tariff licensing,

the overall optimal tariff schedules by τ^{**} are as follows:

$$\tau^{**} = \begin{cases} \tau^T & if \quad 0 \leq t < \dfrac{7(a-c)}{11} \\ \tau_M & if \quad t \geq \dfrac{7(a-c)}{11} \end{cases}$$

Non-restrictive Two-part licensing

Proposition 8. The optimal tariff schedule τ^{**} can improve domestic welfare when the two-part licensing contract is forthcoming, but it has negative relation with emission tax.

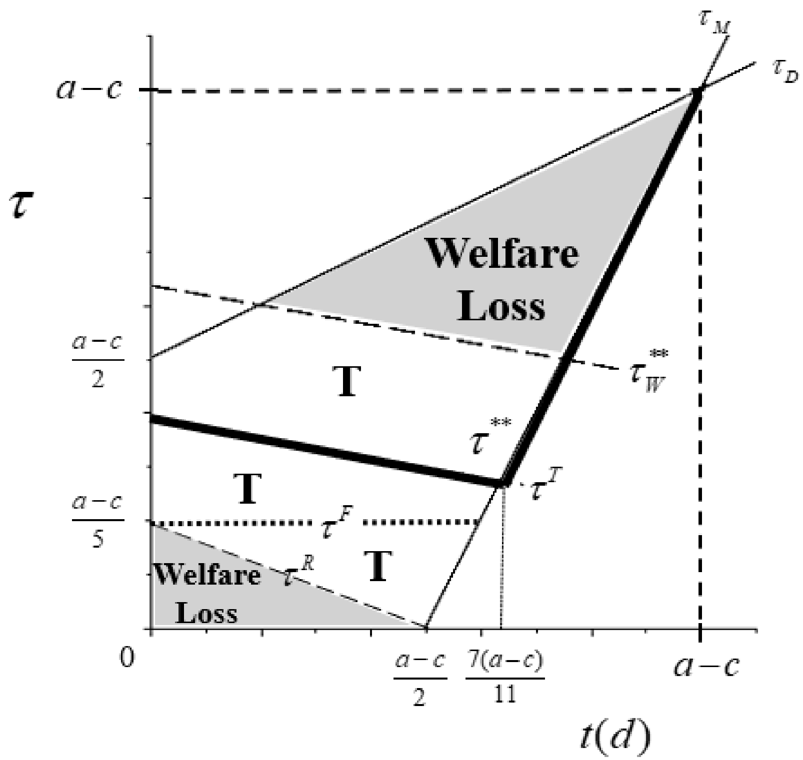


Fig. 4. Welfare losses and optimal tariff with non-restriction on r and f

Comparison:

Restrictive vs. Non-restrictive
Two-part licensing

Restrictive vs. Non-restrictive Two-part licensing

Proposition 9. Foreign competitor prefers non-restrictive two-part licensing to restrictive licensing. ($\pi_f^{T**} > \pi_f^{F*}$ and $\pi_f^{T**} > \pi_f^{R*}$)

Proposition 10. Under non-restrictive two-part licensing contract, welfare loss is lessen $\tau_w^{*} < \tau_w^{**}$ where while welfare loss arises in the ranges where $\tau < \tau^{R}$.

Proposition 11. Under non-restrictive two-part licensing contract, the optimal tariff schedule τ^{**} can improve welfares.

Restrictive vs. Non-restrictive Two-part licensing

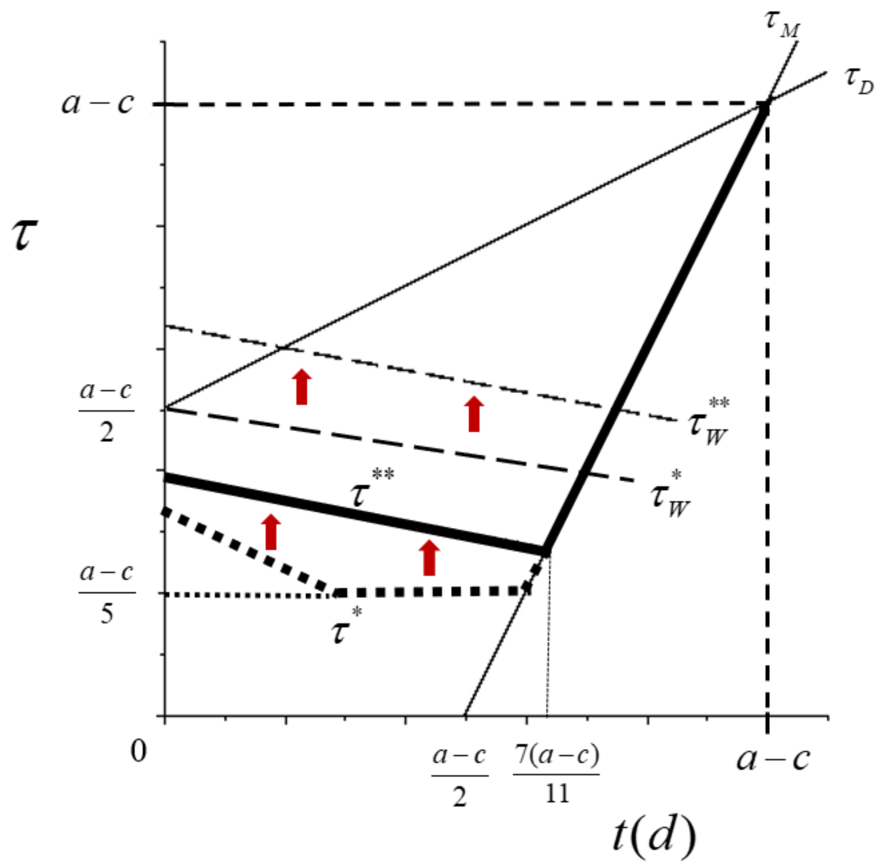


Fig. 5. The overall optimal tariffs of restrictive vs. non-restrictive two-part licensing

Conclusion

1) We examined the two-part licensing contracts of eco-technology by a foreign-innovator and investigated the government's optimal tariff policies facing with an emission tax. We also compared the two-part licensing contracts with and without non-negative royalty and fixed-fee.

2) The foreign eco-innovator will choose the non-restrictive two-part licensing contracts with a negative royalty or a fixed fee, depending on the levels of emission tax and tariff.

3) The non-restrictive two-part licensing contract is better off to the domestic welfare than that with restrictive two-part licensing contract.

4) The optimal tariff policy under the non-restrictive licensing contract has a negative relation with emission tax.

5) In the future research, the possible extensions are to analyze trade policy and emission regulation with the leader-follower model and the asymmetric cost model in the international duopoly.

Q & A

Usage Lock-In and Platform Competition under Multihoming

Susumu Sato (Hitotsubashi University)
April 23@International Workshop on Oligopoy Theory

Preliminary, comments welcome

Background: Platform economy

Platforms abound:

- E-commerce
- Software and apps
- Food delivery
- Content streaming

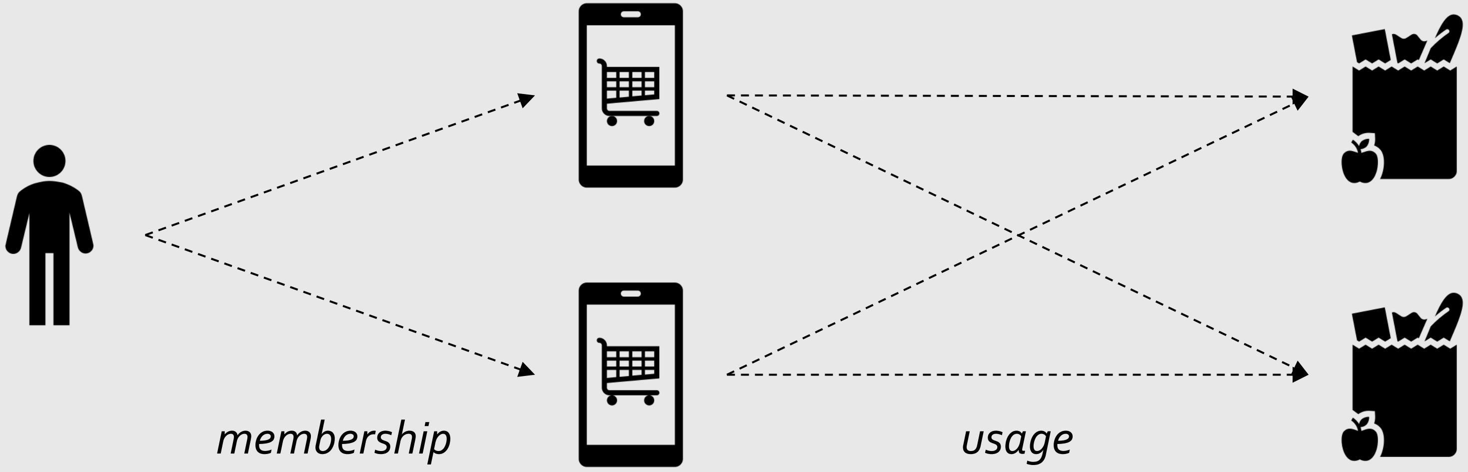
Background: Multihoming

Consumers often join multiple platforms:

- Amazon/Rakuten
- Windows/iOS/Linux
- Ubereats/Demae-kan
- Prime Video/Netflix

Background: Competition for usage

Platforms compete for *usage* as well as for *membership.*



Background: Competition for usage

Research Question: What is the property of competition for usage?

- Is there any change in welfare properties of equilibria?
- How competition, modes of usage, and homing structure affect welfare?

Current literature provides limited analysis on this topic

- ➢ leading to the lack of guidance for competition policy.

Model overview

Modelling challenge: diversity in platform's strategic instruments:

- Platforms compete in fees, recommendar systems, or other designs.

Competition-in-utility framework (Armstrong and Vickers, 2001):

- Platforms compete in per-transaction consumer utility u_i and membership fees.
- Then seller surplus and platform profit are given by $v(u_i)$ and $\pi(u_i)$.

Overview of the results

Welfare property of platform design:

- Excessively high consumer utility
- Competition is often inversely related to welfare
    - entry, merger, limit pricing.

Mode of usage and homing pattern matter:

- *Bundled usage* leads to excessive competition
- Lower multihoming costs intensifies the competition for usage

Some policy implications

Amazon Japan corrals outside vendors into rewards program

Independent sellers push back over increased costs

Amazon Japan is offering what Japanese consumers love: rewards points. © Reuters

Sellers ask antitrust body to probe Rakuten's free shipping policy

Rakuten Inc. unveiled a plan to ship all orders exceeding ¥3,980 with no fee during an event in August in Yokohama. The system is scheduled to start in March. | KYODO

Related literature

- Multihoming with membership:

  Anderson, Foros, and Kind (2018); Bakos and Halaburda (2020);

  Adachi, Sato, and Tremblay, (2021)

- Usage model of platform competition:

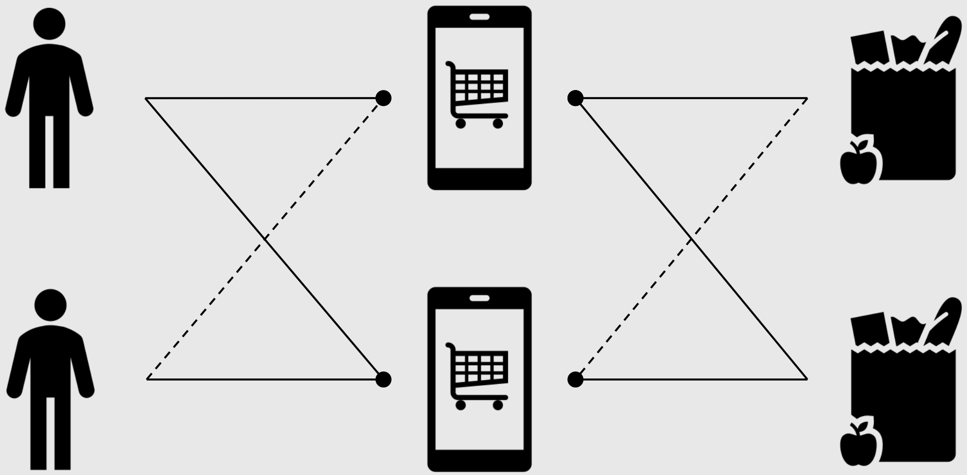
  Rochet and Tirole (2003); Liu, Teh, Wright, and Zhou (2020)

- This study:
  - incorporating both usage and membership margin
  - establishing excessive competition for usage.

Model: players

Players:

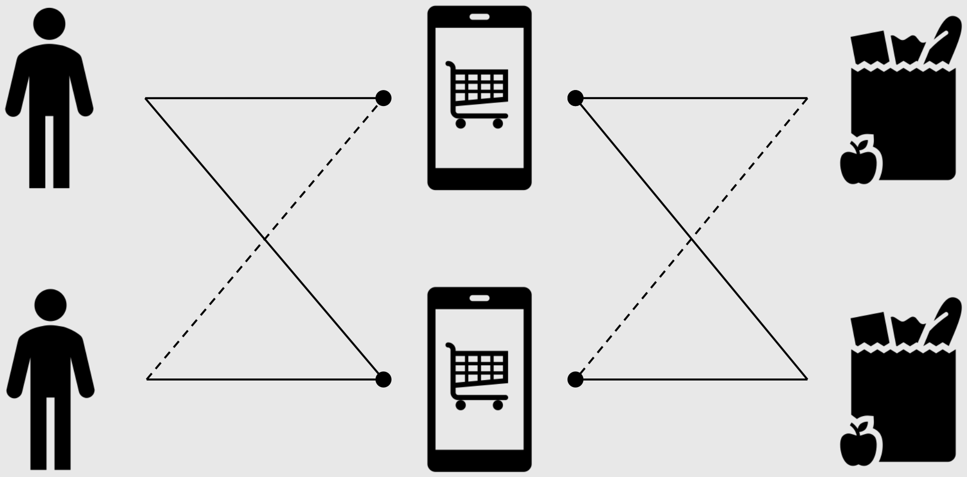
- n platforms
- 1 direct channel (non-strategic)
  - e.g., D2C sales, OSS
- a mass of consumers
- a mass of sellers



Model: players

Players:

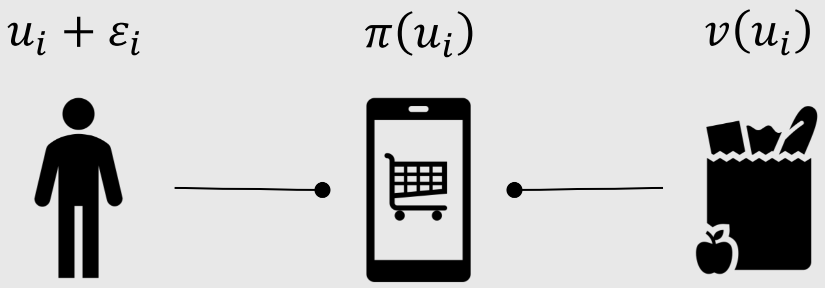
- Consumers/sellers
  - join platforms and
  - make transactions on them.
- Platforms
  - design trade surplus and
  - set membership fees.



Model: primitives

Per-transaction surplus on platform i:

- consumer surplus $u_i + \varepsilon_i$,
  - u_i set by platform i,
  - $\varepsilon_i \sim F$ with density f.
  - cf. Perloff and Salop (1985).
- seller surplus $v(u_i)$,
- platform profit $\pi(u_i)$.
- u_0, v_0 on the direct channel.



Model: primitives

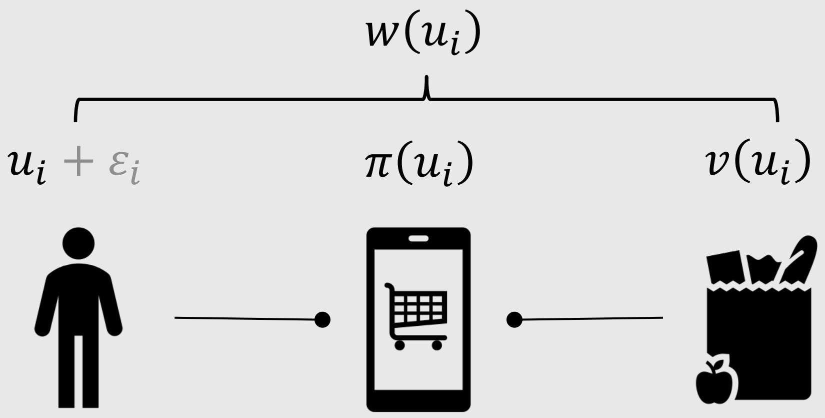
Joint transaction surplus

$$w(u_i) \equiv u_i + v(u_i) + \pi(u_i):$$

- weakly concave and
- has nonnegative maximum.

Examples:

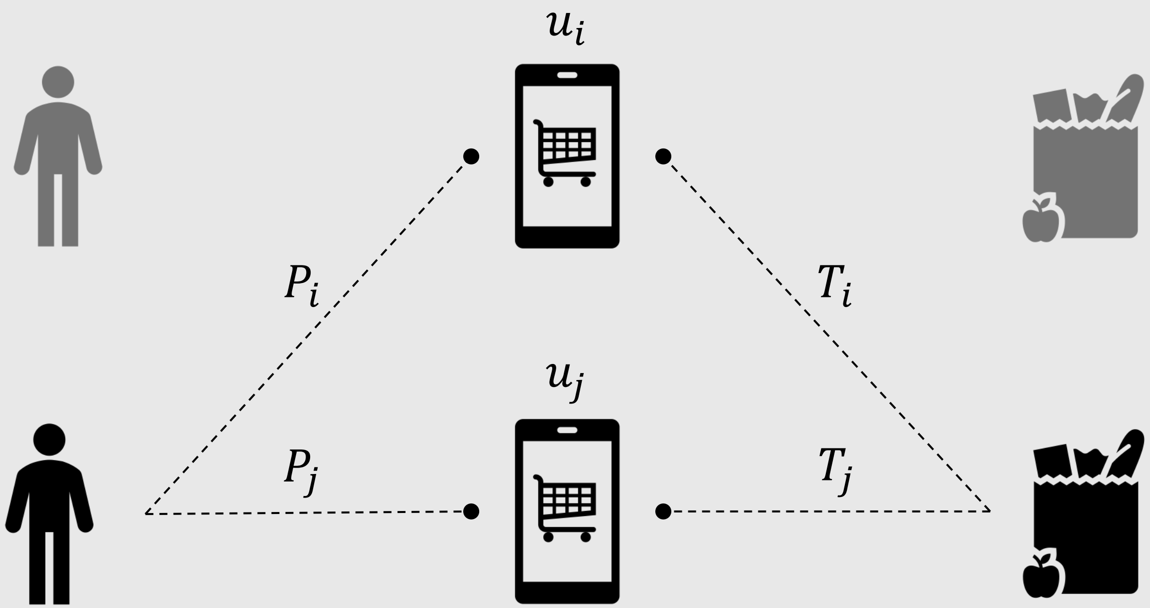
- transaction fees,
- number of 1st-party products,
- design of recommender systems



Model: membership choice

Membership choice:

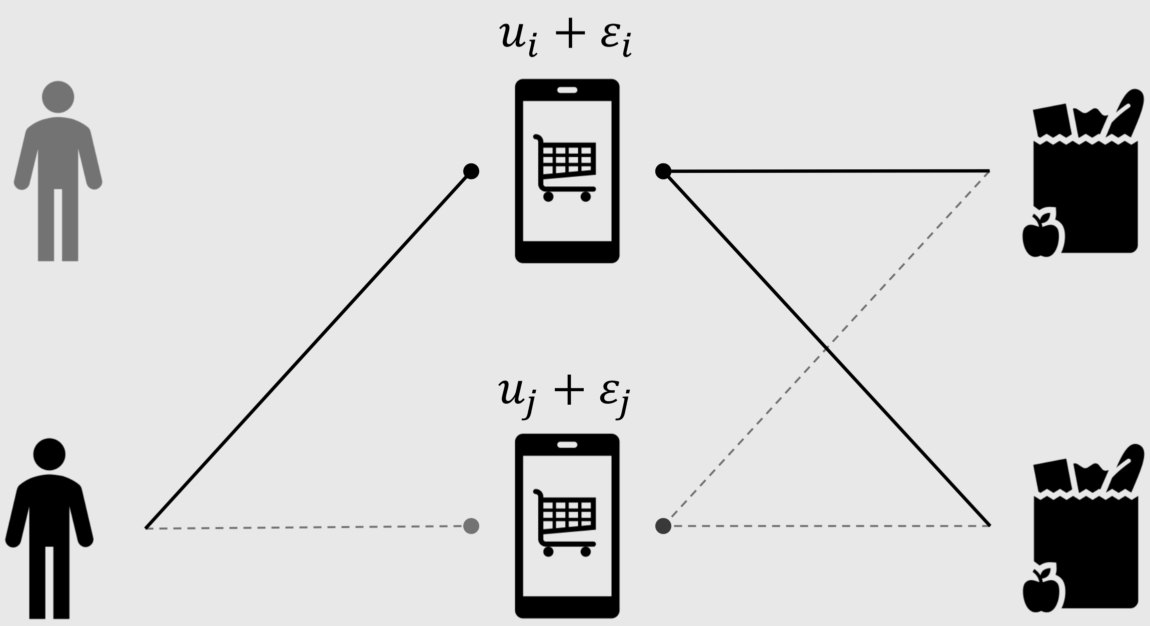
- consumers and sellers are ex-ante homogeneous.
- they choose the sets of platforms to join before observing ε_i.
- there are membership fees:
  - P_i for consumers
  - T_i for sellers



Model: mode of usage

Bundled usage:

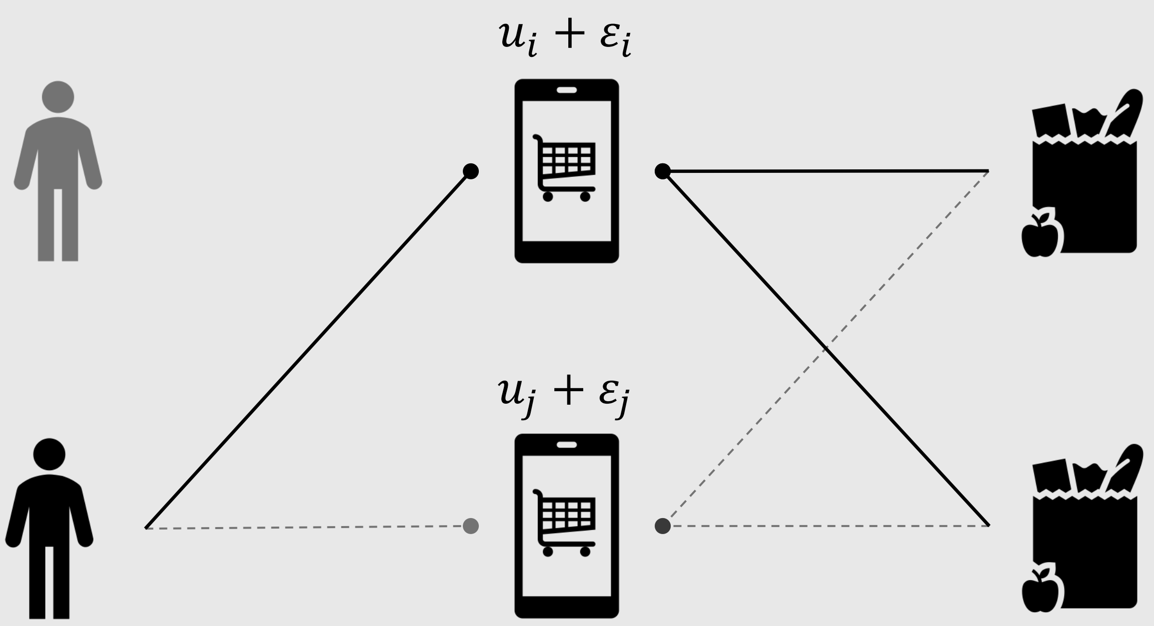
- after observing ε_i for $i \in S$, consumers choose which platform to use *for all transactions*
- source: shopping/switching/search costs, various discounts, etc.
- ex) online shopping, ride-hailing, software platforms
- Can be weakened to some extent



Model: timeline

Timeline

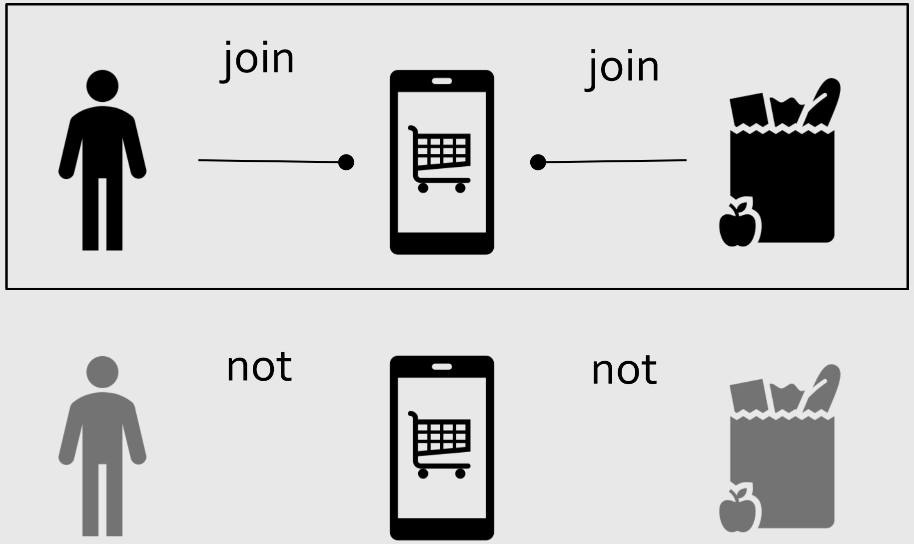
1. Platforms set u_i
2. Platforms set membership fees
   - P_i to consumers
   - T_i to sellers
3. Consumers and sellers choose sets of platforms to join
4. Consumers observe ε and choose which platform to use.



Model: equilibrium concept

Solution concept:

- Subgame-perfect equilibria
- Equilibrium selection:
  - favorable beliefs.
  - cf., pessimistic belief.



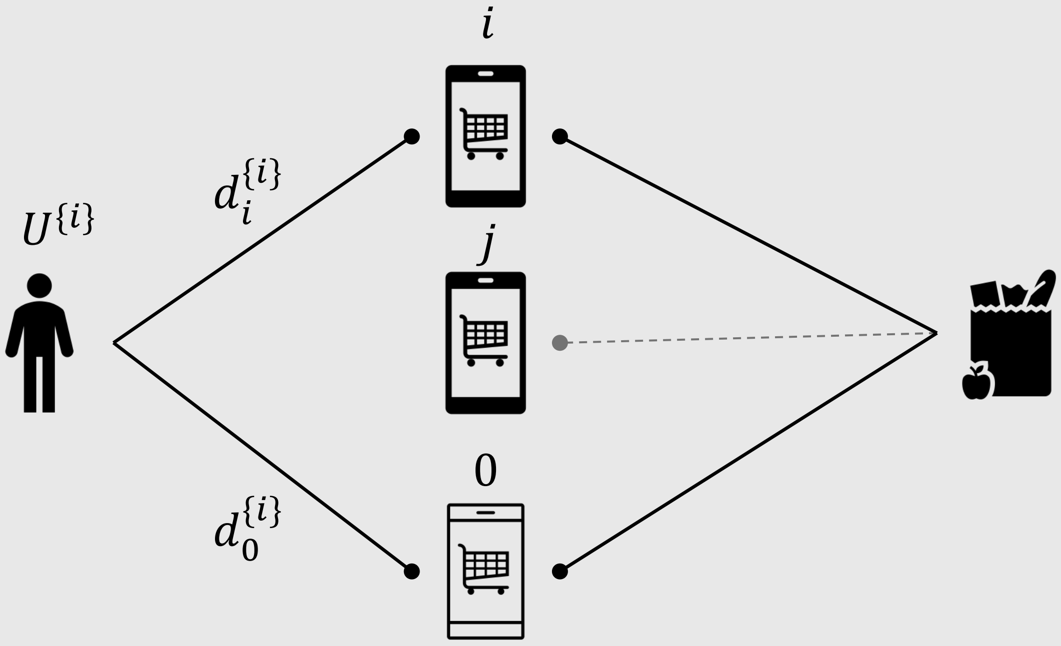
Equilibrium: usage choice

Usage choice:

- A consumer with access to sellers on set S of platforms uses a platform with probability

$$d_i^S = \Pr(u_i + \varepsilon_i > \max\{u_j + \varepsilon_j, u_0\}, \forall j \in S)$$

- Let U^S be the indirect utility given S.



Equilibrium: usage choice

Membership choice:

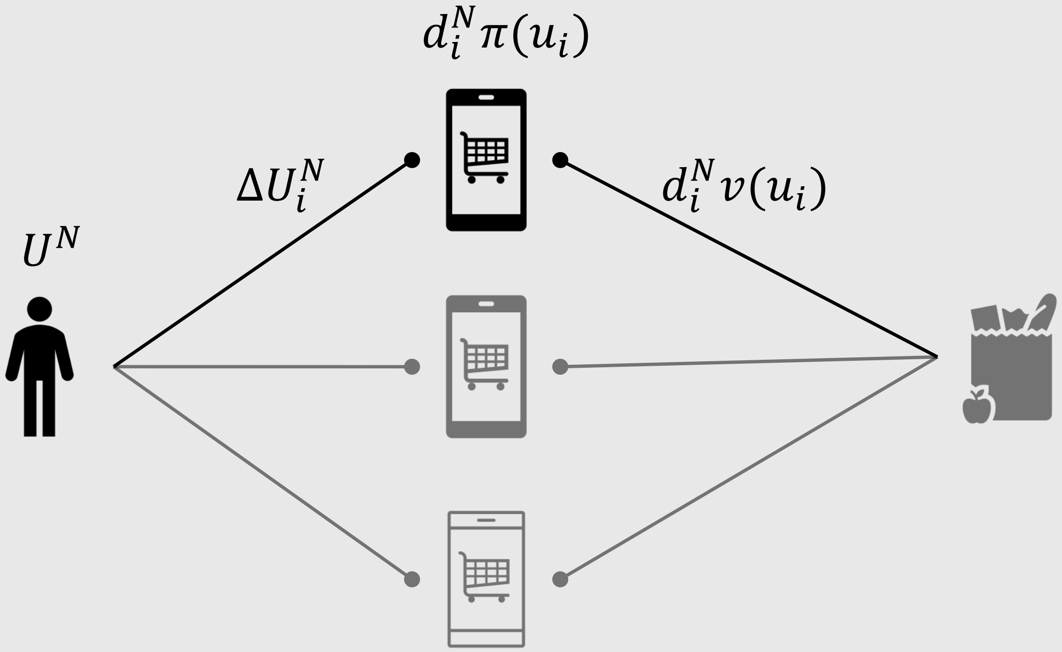
- A seller joins platform i if and only if

  $d_i^N v(u_i) \geq T_i$

- Each buyer joins platform if and only if

  $\Delta U_i \geq P_i$, where

  - $\Delta U_i \equiv U^N - U^{N\setminus\{i\}}$ is the incremental value of the platform.



Equilibrium: usage choice

Membership pricing:

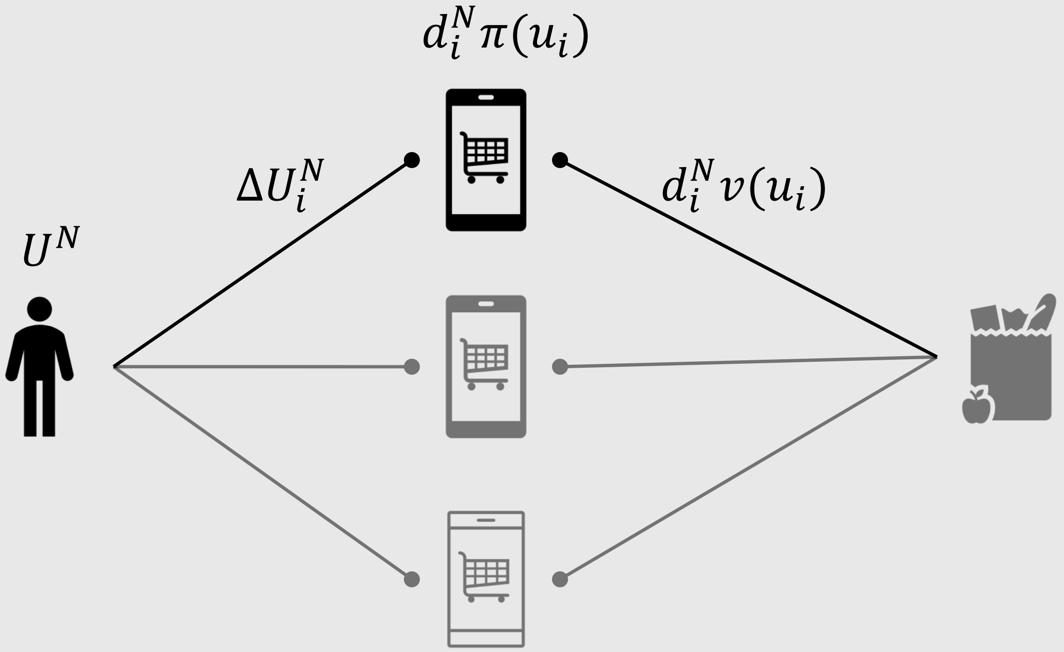
Proposition: membership fees are given by

- $T_i = d_i^N v(u_i)$.
- $P_i = \Delta U_i$.

- a version of incremental-value pricing (Anderson, Foros, and Kind).

Consequently, platform's profit is written as

$$\Pi_i = \Delta U_i + d_i^N [v(u_i) + \pi(u_i)]$$



Equilibrium: platform design

- Symmetric equilibrium utility u^* is given by the FOC:

$$\frac{\partial \Pi_i}{\partial u_i} = d_i^N w'(u^*) + \frac{\partial d_i^N}{\partial u_i}[v(u^*) + \pi(u^*)] = 0$$

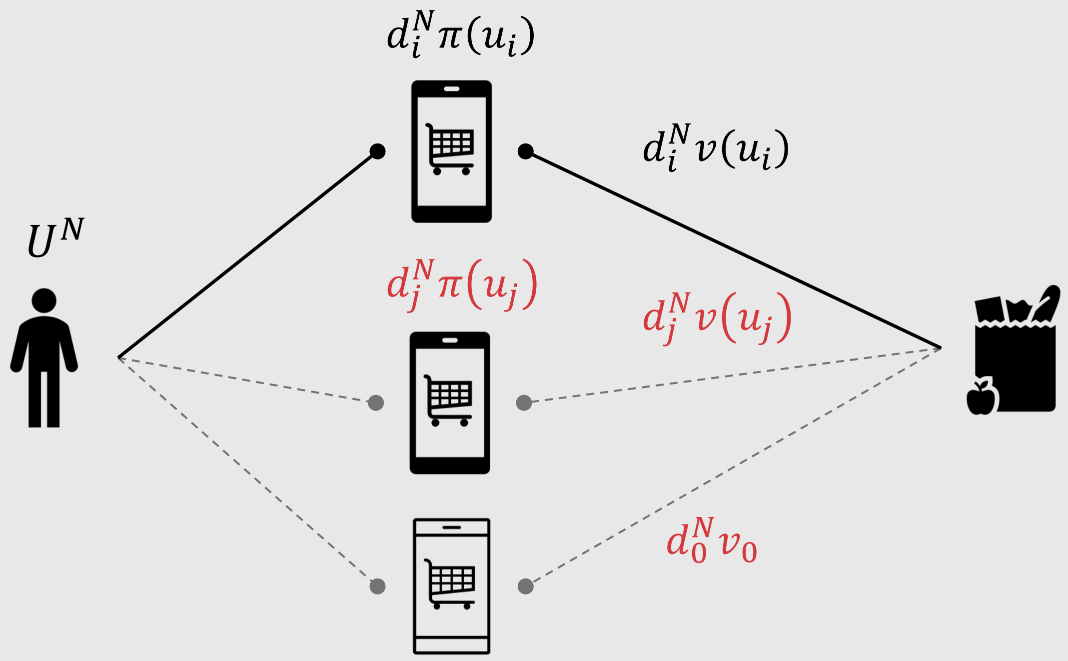
- it is determined by the tension between:
  - the change in appropriable trade surplus, and
  - the profit from attractive usage.
- Uniqueness of u^* guaranteed if $1 - F$ is log-concave

Equilibrium: welfare properties of equilibria

- Aggregate welfare W is given by

$$W = U^N + d_i^N[v(u_i) + \pi(u_i)] + \sum_{j \neq i} d_j^N[v(u_j) + \pi(u_j)] + d_0^N v_0.$$

- Red part ignored by each platform.
- Excessive incentive to divert transactions from other channels.
- Proposition: u^* is excessively high.



Implication to the competition policy

Implication:

- A rationale for policy intervention to practices that benefits consumers at the cost of sellers.
- If the competition is excessive, a naïve promotion of competition may hurt the welfare:
- Examples:
  - entry → possibly lowers the welfare
  - merger → improves the welfare
  - threat of entry and limit pricing → lowers even the short-run welfare

Modes of usage and homing structure

What causes the excessive competition?:

Two sources: (1) bundled usage and (2) multihoming

- If usage is separated, equilibrium u^* becomes lower
- multihoming costs (in mixed-homing extension) lowers u^*

Conclusion

Takeaways:

- Competition for usage is often excessive.
- Naïve promotion of competition may lower welfare.
- Shifting the mode of usage from bundled to separate usage may be a better alternative.

Future directions:

- Generalizing homing structure and modes of usage.

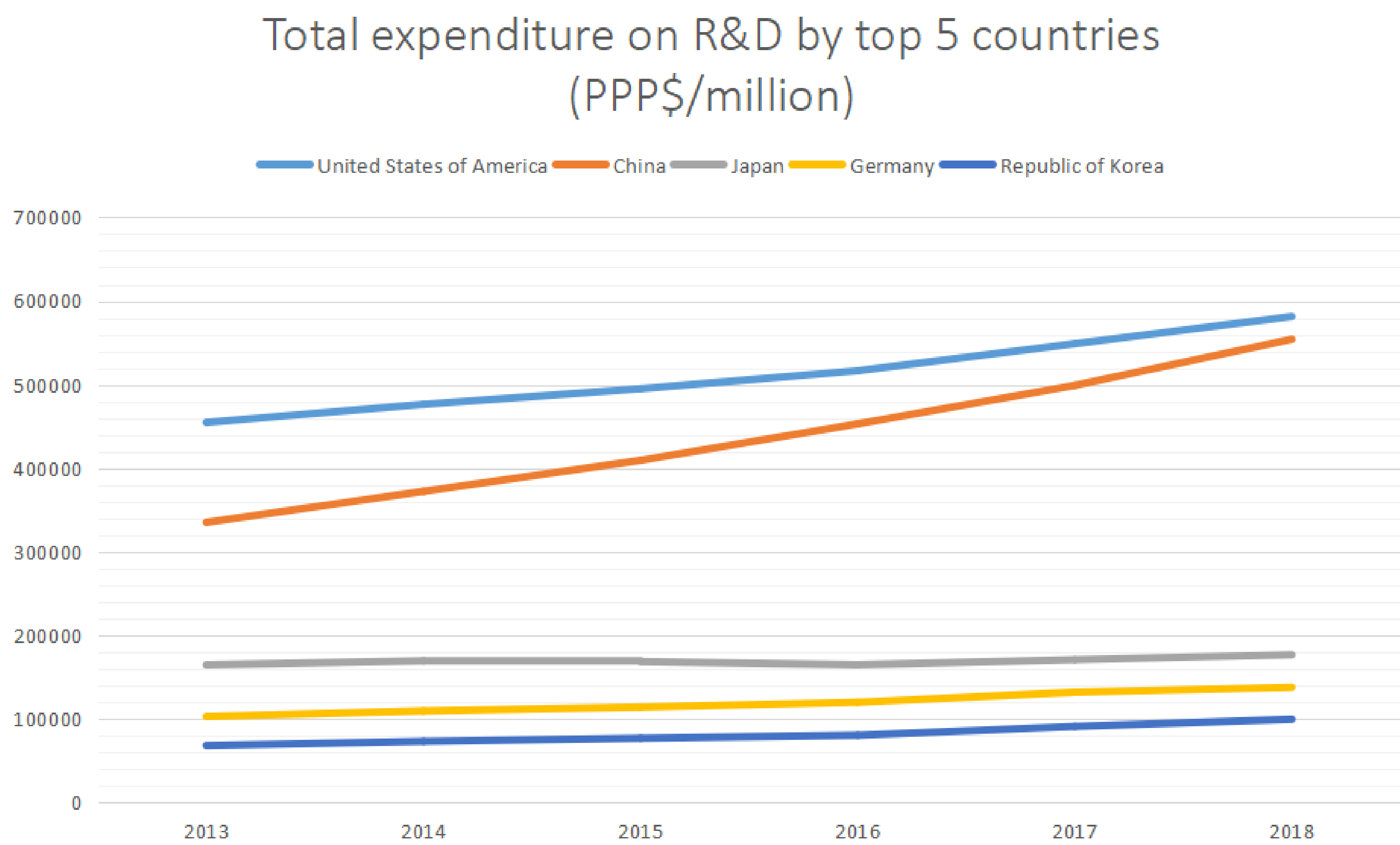
Comparisons of Output Subsidy and R&D Subsidy in a Differentiated Market

Jiaqi Chen and Sang-Ho Lee
Chonnam National University
2021.04.23

CONTENT

Introduction and Literature Review

- Since Dixit (1979) and Singh and Vives (1984):
  - Comparisons between Cournot and Bertrand competition in a differentiated product duopoly market
- Owing to the rapid development of new technologies, the cost-reducing R&D investments (research and development) become more and more important during production activities.
  - D'Aspremont and Jacquemin (1988), Poyago-Theotoky (1995) and Lee (1998) considered R&D competitions under quantity competition.
  - Qiu (1997), Hinloopen and Vandekerckhove (2009) considered R&D investments with spillovers in heterogenous duopoly private markets and showed Cournot firms invest more R&D and gain more profit than Bertrand firms, while social welfare is more in Bertrand than Cournot competition.
  - Kabiraj and Roy (2002) considered different marginal costs with R&D investment in a differentiated private market.
  - Basak and Wang (2019) studied endogenous choice of price and quantity competitions with R&D investment in a mixed differentiated duopoly market and showed that Bertrand competition is the equilibrium.



PPP: Purchasing Power Parity

Introduction and Literature Review

- Studwell (2013) shows that subsidies, along with other policies, played an important role in the economic development of Asian countries such as Japan, South Korea, and China.

- For example, according to China National Bureau of Statistics, from 1980 to 2018, China's national funding for R&D increased from 6.459 billion yuan to 228.501 billion yuan.

Introductrion and Literature Review

- Recently, a number of studies also considered the welfare consequences of R&D activities in the light of governmental intervention.
  - Yang and Nie (2015) and Lee and Muminov (2020) studied R&D subsidies with asymmetric information in a Cournot competition.
  - Kesavayuth and Zikos (2013), Lee and Tomaru (2017), Lee et al. (2017) and Lee and Muminov (2020) compared output and R&D subsidy policies in a mixed market in a Cournot competition and showed that social welfare is higher under output subsidies than R&D subsidies.

Introductrion and Literature Review

However, the previous literatures did not consider how the output and R&D subsidy policies affect firms' and government's decisions with R&D investment when there is product differentiation.

Research Questions

In a differentiated duopoly private market with cost-reducing R&D investment:

① Quantity or price? Which competition will firms choose if government grants output subsidies?

② Quantity or price? Which competition will firms choose if government grants R&D subsidies?

③ Output or R&D subsidy? Which subsidy policy will government choose if firms compete in a quantity competition?

④ Output or R&D subsidy? Which subsidy policy will government choose if firms compete in a price competition?

Basic Model

There are 2 private firms (firms 1 and 2) produce differentiated commodities.

- Utility function: $U = a(q_1 + q_2) - \frac{(q_1{}^2 + 2bq_1q_2 + q_2{}^2)}{2}$, where $b \in (0,1)$ represents the degree of product differentiation.
- Inverse demand function: $p_i = a - q_i - bq_j$
- Cost function: $C_i = (c - x_i)q_i$, where c is the initial cost level with $a > c > 0$ and x_i denotes the amount of R&D investment required for firm *i* to reduce the cost level.
- Profit function: $\pi_i = p_iq_i - (c - x_i)q_i - \frac{r}{2}x_i^2 + s^Pq_i + s^Rx_i$, where *r* is the efficiency of R&D and s^P or s^R denotes the output and R&D subsidies, respectively.
- Social welfare: $W = CS + \sum_{i=1}^{2}\pi_i - \sum_{i=1}^{2}s^Pq_i - \sum_{i=1}^{2}s^Rx_i$, where $CS = U - p_1q_1 - p_2q_2$ is the consumer surplus.
- We will compare output subsidy of $\{s^P > 0$ and $s^R = 0\}$ and R&D subsidy of $\{s^P = 0$ and or $s^R > 0\}$ under Cournot or Bertrand, respectively.

Basic Model

Game structure

In the first stage, government grants output or R&D subsidies to maximize the social welfare.

In the second stage, firms 1 and 2 decide R&D investment simultaneously to maximize their profits.

In the third stage, firms compete in quantity or price competitions.

Results-output subsidy

- **Lemma 1.** $x_i^{CP} > x_i^F > x_i^C$, $q_i^F > q_i^{CP} > q_i^C$, and $W^F > W^{CP} > W^C$ for $b \in (0,1)$.

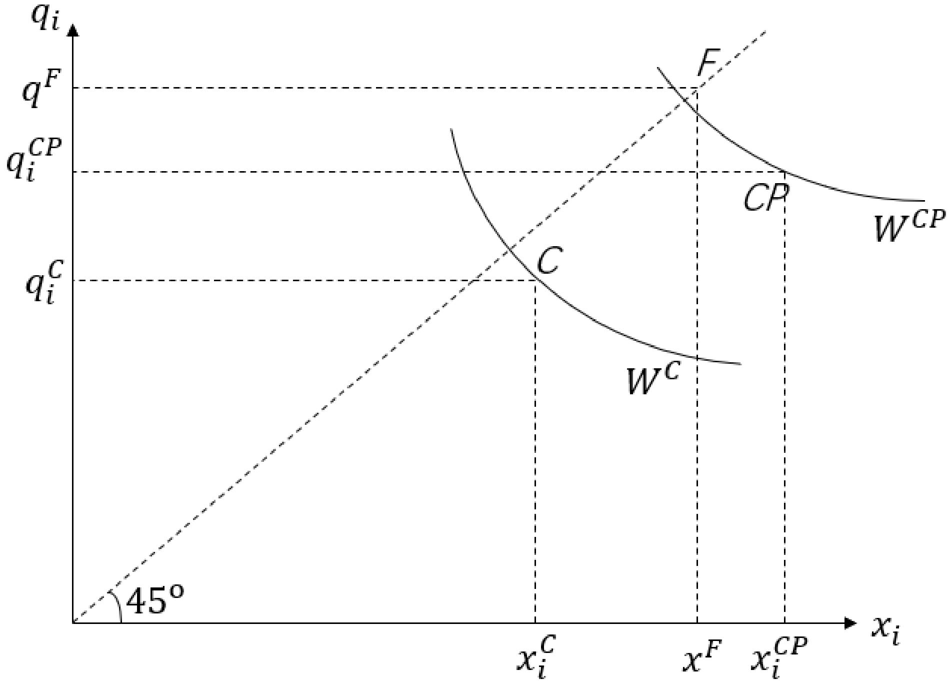


Figure 1: output subsidy vs. no subsidy under Cournot competition

Results-output subsidy

- **Lemma 2.** $x_i^F > x_i^{BP} > x_i^B$, $q_i^F > q_i^{BP} > q_i^B$, and $W^F > W^{BP} > W^B$ for $b \in (0,1)$.

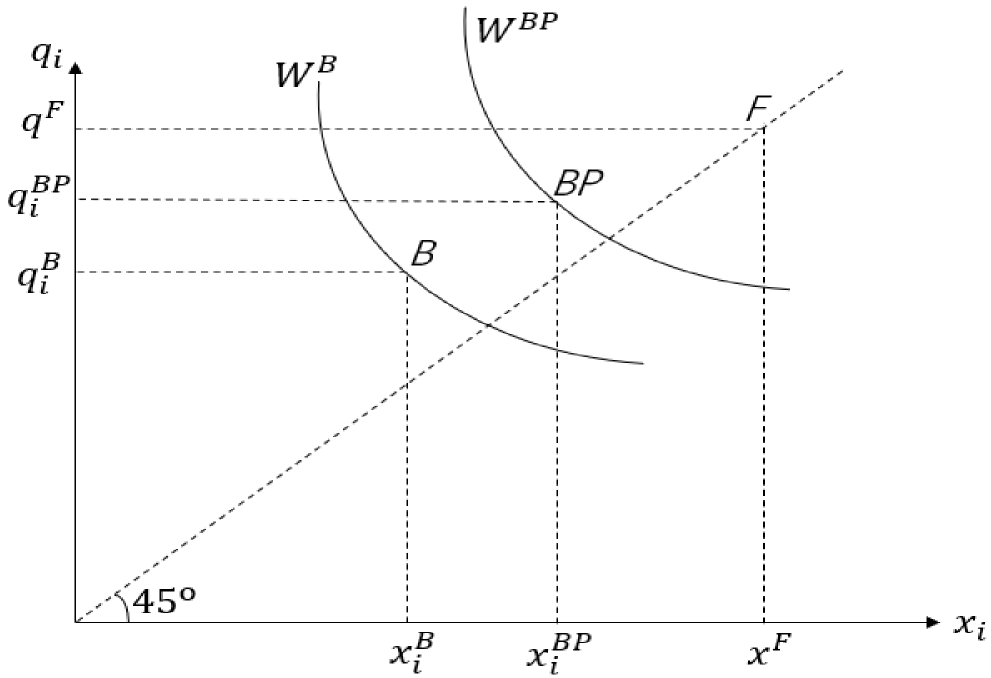


Figure 2: output subsidy vs. no subsidy under Bertrand competition

Results-output subsidy

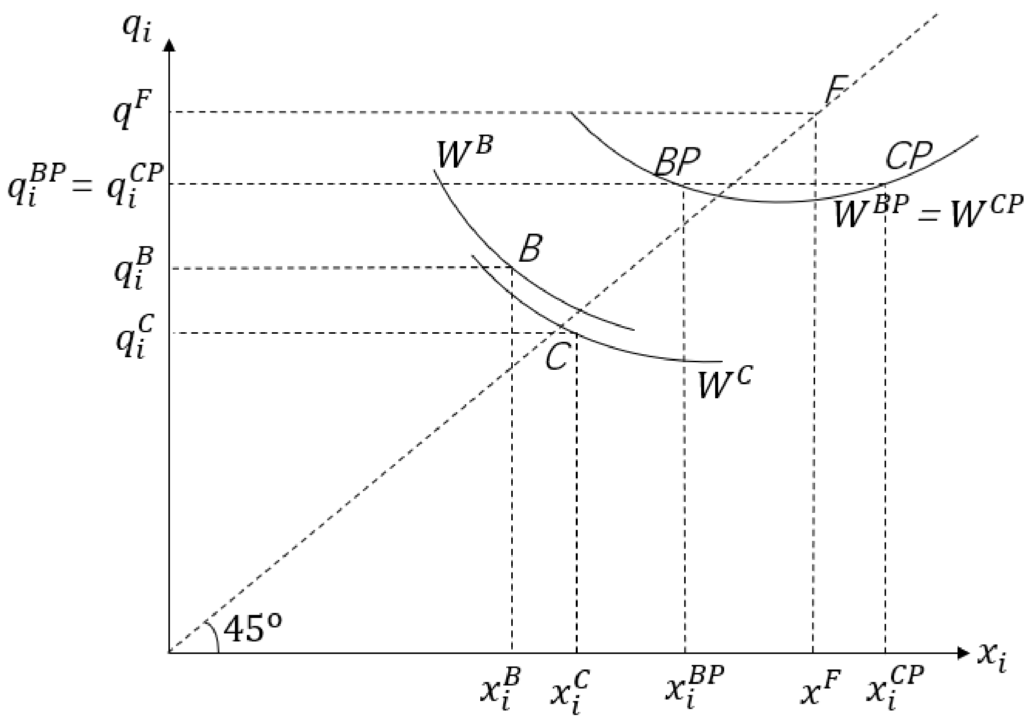


Figure 3: Welfare comparisons under output subsidies

- **Proposition 1.** $s^{CP} > s^{BP} > 0$ for $b \in (0,1)$.
- **Proposition 2.** $x_i^{CP} > x_i^{BP}$ for $b \in (0,1)$.
- **Proposition 3.** $q_i^{CP} = q_i^{BP}$ and $p_i^{CP} = p_i^{BP}$ for $b \in (0,1)$.

  (Note that $x_i^{CP} q_i^{CP} - \frac{r}{2}\left(x_i^{CP}\right)^2 = x_i^{BP} q_i^{BP} - \frac{r}{2}\left(x_i^{BP}\right)^2$)
- **Proposition 4.** $\pi_i^{CP} > \pi_i^{BP}$ for $b \in (0,1)$.
- **Proposition 5.** $W^{CP} = W^{BP}$ for $b \in (0,1)$.

Results-R&D subsidy

- **Lemma 3.** $x_i^F > x_i^{CR} > x_i^C$, $q_i^F > q_i^{CR} > q_i^C$ and $W^F > W^{CR} > W^C$ for $b \in (0,1)$.

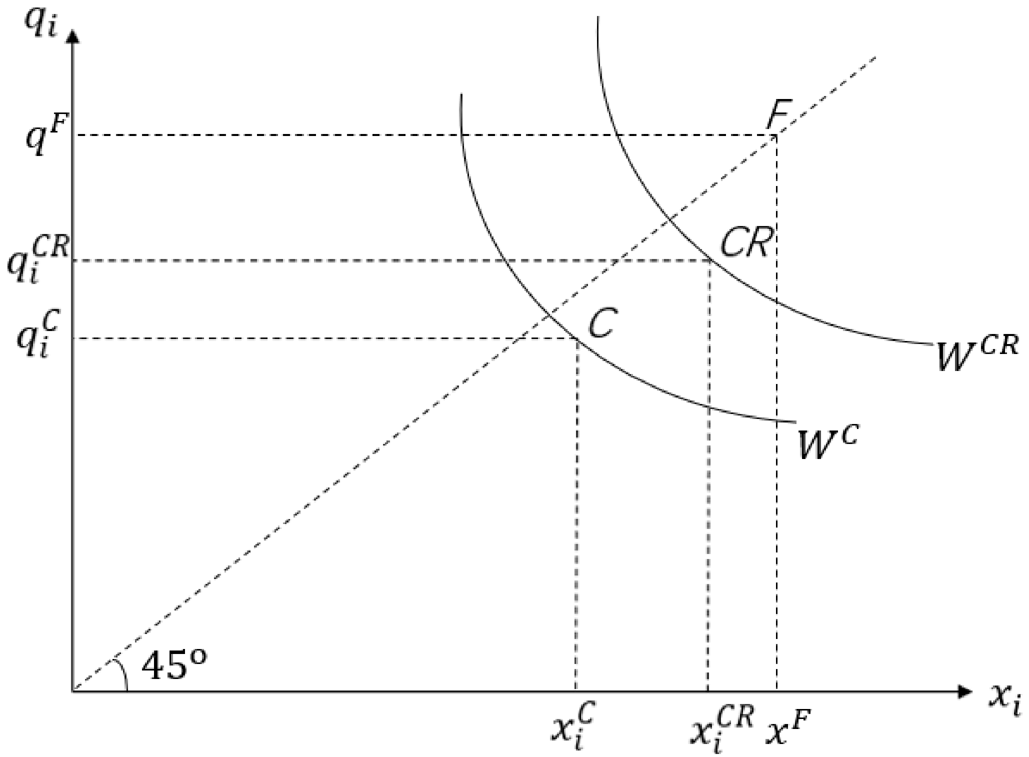


Figure 4: R&D subsidy vs. no subsidy under Cournot competition

Results-R&D subsidy

- **Lemma 4.** $x_i^F > x_i^{BR} > x_i^B$, $q_i^F > q_i^{BR} > q_i^B$ and $W^F > W^{BR} > W^B$ for $b \in (0,1)$.

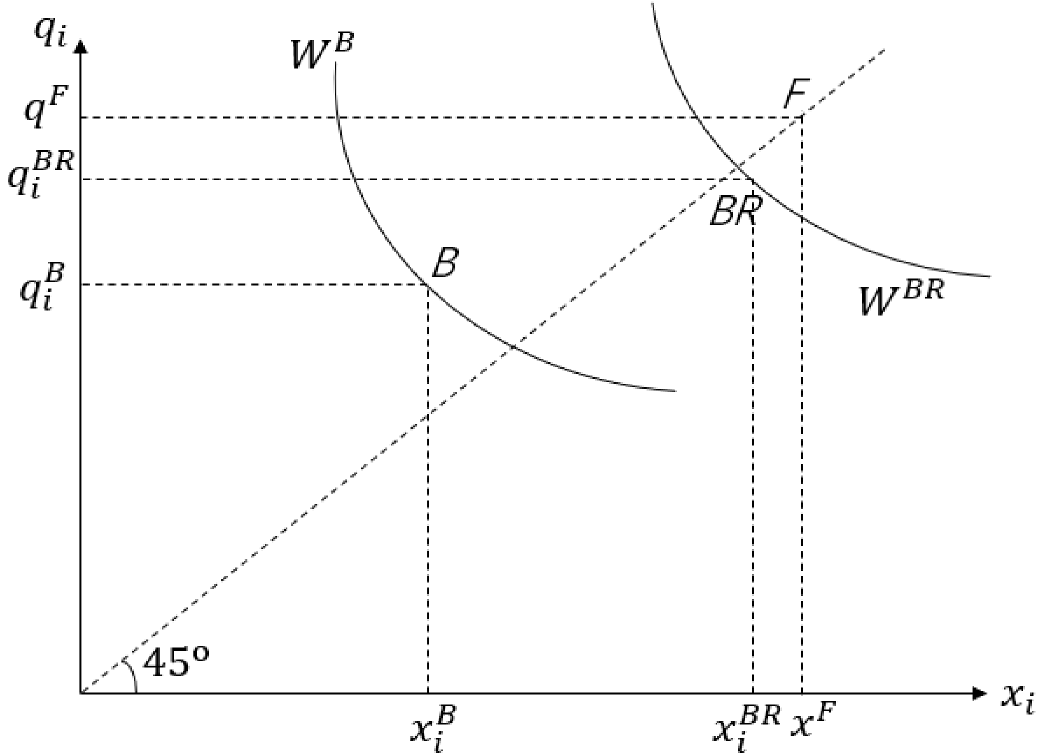


Figure 5: R&D subsidy vs. no subsidy under Bertrand competition

Results-R&D subsidy

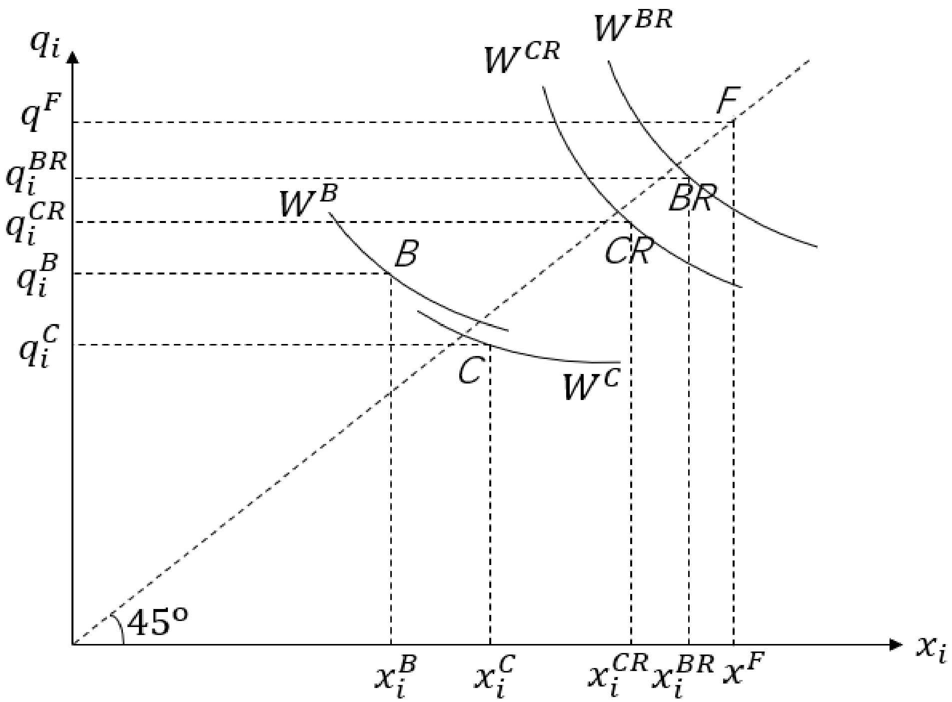


Figure 6: Welfare comparisons under R&D subsidies

- **Proposition 6.** $s^{BR} > s^{CR} > 0$ for $b \in (0,1)$.
- **Proposition 7.** $x_i^{CR} < x_i^{BR}$ for $b \in (0,1)$.
- **Proposition 8.** $q_i^{CR} < q_i^{BR}$ and $p_i^{CR} > p_i^{BR}$ for $b \in (0,1)$.
- **Proposition 9.** If $b > b_2$, then $\pi_i^{CR} > \pi_i^{BR}$; however, if $b < b_2$, then there exists $\bar{r}$ so that $\pi_i^{BR} \overset{>}{\underset{<}{=}} \pi_i^{CR}$ if $r \overset{\leq}{\underset{>}{=}} \bar{r}$.

(Note that $\frac{\partial s^{CR}}{\partial b} < 0$ and $\frac{\partial q_i^{CR}}{\partial b} < 0$ for any b, while $\frac{\partial s^{BR}}{\partial b} \overset{>}{\underset{<}{=}} 0$ and $\frac{\partial q_i^{BR}}{\partial b} \overset{>}{\underset{<}{=}} 0$ if $b \overset{\geq}{\underset{<}{=}} b_2$)

- **Proposition 10.** $W^{CR} < W^{BR}$ for $b \in (0,1)$.

Results-Discussions

- **Proposition 11.**

(i) $s^{CP} > s^{CR}$ and $s^{BP} \underset{<}{\overset{>}{=}} s^{BR}$ if $b \underset{>}{\overset{<}{=}} b_3 \equiv \frac{4a+c-\sqrt{16a^2-8ac+9c^2}}{2c}$.

(ii) $x_i^{CP} > x_i^{CR}$ and $x_i^{BP} \underset{<}{\overset{>}{=}} x_i^{BR}$ if $b \underset{>}{\overset{<}{=}} b_3$.

(iii) $q_i^{CP} > q_i^{CR}$ and $q_i^{BP} > q_i^{BR}$ for $b \in (0,1)$.

Results-Discussions

- **Proposition 12.**

(i) $\pi_i^{CP} > \pi_i^{CR}$ for $b \in (0,1)$ and $\pi_i^{BP} > \pi_i^{BR}$ if $b < b_3$. However, if $b > b_3$, then there exists $\hat{b} > b_3$ and $\hat{r}$ such that $\pi_i^{BP} < \pi_i^{BR}$ if $b > \hat{b}$ and $r < \hat{r}$, while $\pi_i^{BP} > \pi_i^{BR}$ if $b < \hat{b}$ and $r > \hat{r}$.

(ii) $W^{CP} > W^{CR}$ for $b \in (0,1)$ and $W^{BP} > W^{BR}$ if $b < b_3$. However, if $b > b_3$, then there exists $\hat{b} > b_3$ and $\hat{r}$ such that $W^{BP} < W^{BR}$ if $b > \hat{b}$ and $r < \hat{r}$, while $W^{BP} > W^{BR}$ if $b < \hat{b}$ and $r > \hat{r}$.

Conclusions

- Firms invest more (less) R&D and the government grants more (less) subsidies under Cournot than Bertrand competition with output (R&D) subsidy policies.
- Firms earn more profits under Cournot than Bertrand with output subsidy while the profits of firms can be higher under Bertrand than Cournot if the product substitutability and the efficiency of firms' R&D investment is low with R&D subsidy.
- Cournot and Bertrand competitions yield the same welfare with output subsidy while Bertrand yields higher welfare than Cournot with R&D subsidy.
- Firms' profits and social welfare are always higher under output subsidy in Cournot competition, while those can be higher under R&D subsidy in Bertrand competition if the products substitutability is high and the R&D investment of firms is efficient.

Thank you!!!