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Research Areas

A brief research profile:

1. Regulation and competition in network industries (papers published on RAND, IJIO, JINDEC, JEMS)
2. Impact of digital technologies on different economic outcomes (papers published on IJIO, JEMS, ICC)
3. Data and market competition:

- «User data and endogenous entry in on-line markets», (2024) Abrardi L., Cambini C., Congiu R. e F. Pino, *Journal of Industrial Economics*
- «Data Brokers Competition, Synergic Datasets and Endogenous Information Value», (2025) Abrardi L., Cambini C. and F. Pino, *International Journal of Industrial Organization*.

Professional profiles

I acted as:

1. *Chief Economist* at the Italian Regulatory Authority for Transport (2015-2021).
2. *Economic Expert* at the Italian Presidency of Council («Draghi» Government; 2021-2022)
   - Italian Presidency of Council, Department of Public Policy
   - Ministry of Digital Transition
   - Ministry of Mobility, Infrastructure and Sustainability
3. Involved in several Competition Policy cases:
   - Mergers (mobile industry, Thailand)
   - Horizontal agreements and Damage evaluation (paper and paperbord manufacturing; cement industry)
   - Abuses of dominant position (Telecoms)

I was invited as Keynote speaker at the ACCC Conference (AUS), Commerce Commission (NZ) and BEREC (Association of EU Telecom NRAs).

I am currently appointed as President of the *Italian Society of Industrial Economics and Policy*.

The Polito Japan Hub

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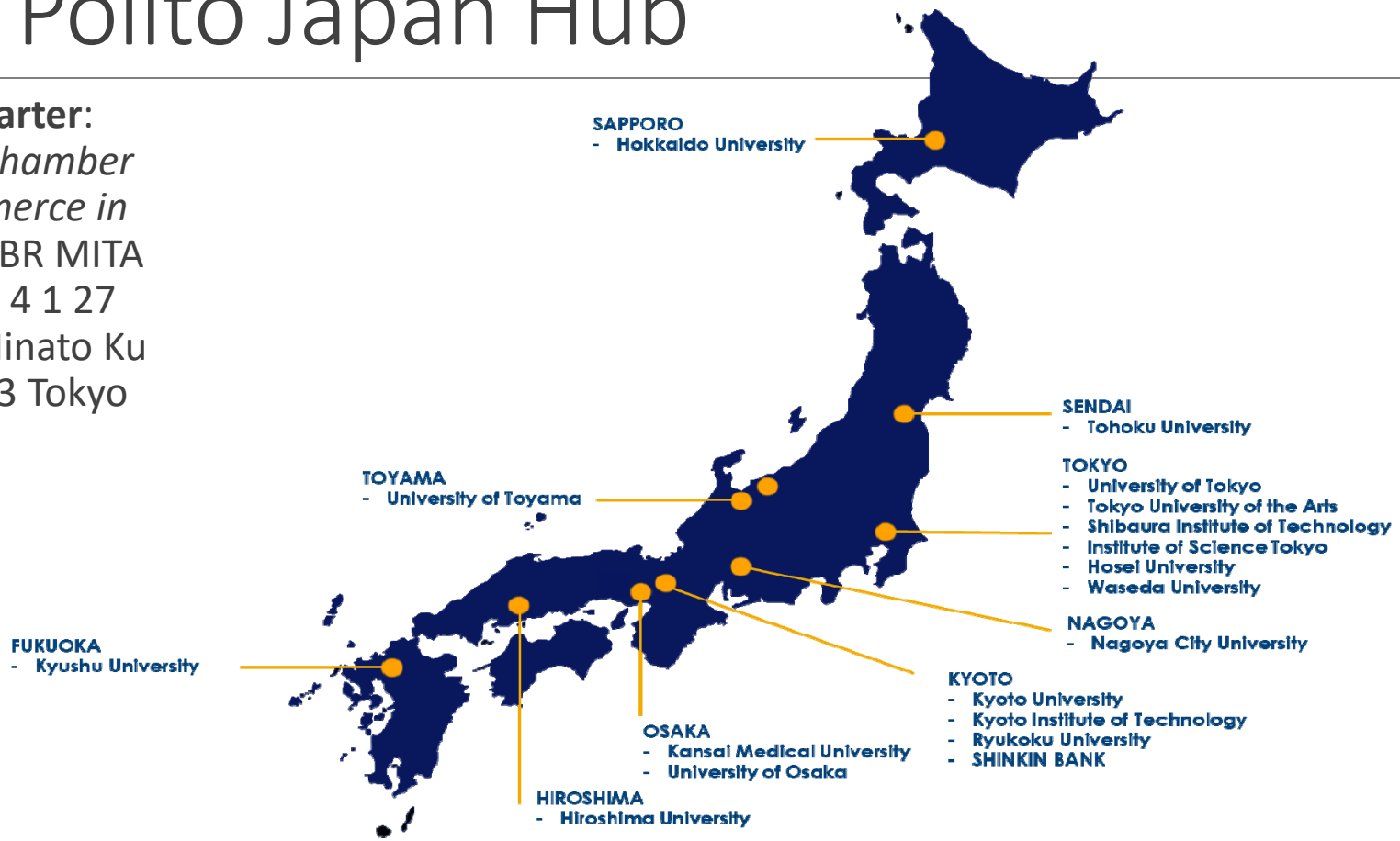
Italian Chamber of Commerce in Japan, FBR MITA Bldg. 9F, 4 1 27 Mita , Minato Ku 108 0073 Tokyo



Machine data sharing and innovation incentives

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Motivation

The EU has recently introduced many regulations that concern data markets and data use:

- GDPR: rules on personal data protection
- DGA: enabling trusted data sharing (especially for public sector data)
- DMA: additional constraints for digital gatekeepers
- DSA: regulates content moderation and transparency in digital platforms
- **Data Act** (https://eur-lex.europa.eu/eli/reg/2023/2854): improve access to and sharing of industrial (non-personal) data

The EU27 data market will reach €118 billion by 2030. However, currently 80% of industrial data is not used.[1]

[1] European Data Market Study 2021–2023

The EU Data Act: economic features/1

The Data Act aims at opening up the market for industrial data.

Main obligations:

- Granting users access to machine data produced by products they own.
- Obliging manufacturers to share machine data with third parties if users request it.
- Mandating fairness in B2B data sharing ("Fair and Reasonable non discriminatory rule" - FRAND).

Main limitation: the Data Act **only applies** when the third party ("data recipient") does **not** compete with the **connected product** sold by the manufacturer ("data holder").

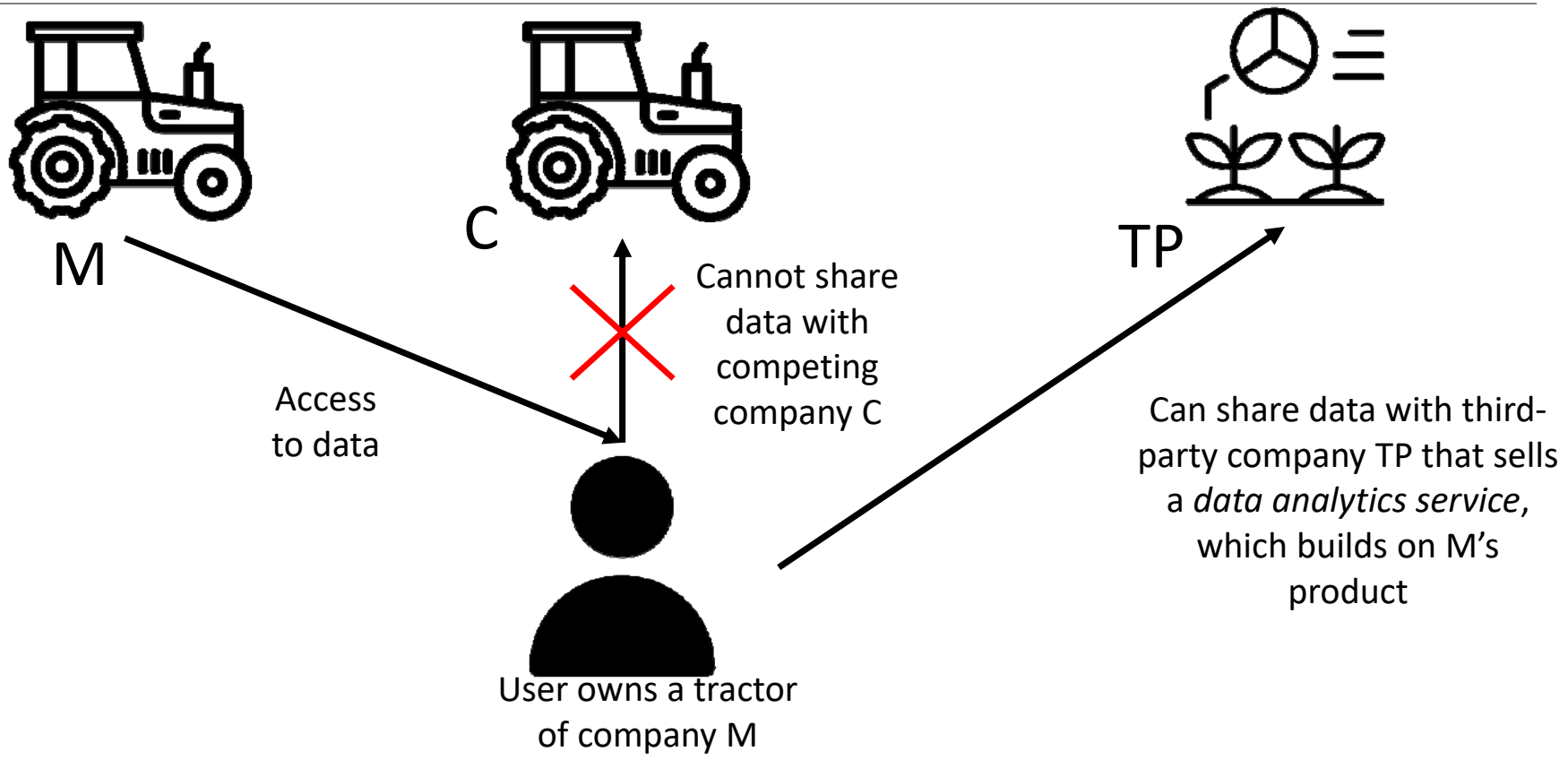
The EU Data Act: economic features/2

- A manufacturer cannot discriminate between different third parties, i.e., he must ask the same compensation for the same data.
- Compensation should take into account:

1. The cost of sharing data with the third party.
2. Investments made by the manufacturer to collect such data.
3. A reasonable margin.

- If the third party is a SME (small-medium enterprise) or a non-profit firm, compensation may only be based on the cost of sharing data (i.e., 1 above).

Example


M
C
TP
Cannot share data with competing company C
Access to data
Can share data with third-party company TP that sells a *data analytics service*, which builds on M's product
User owns a tractor of company M

Data Act goals and research question

The Data Act postulates that, as of now, companies/manufactures are not incentivized to provide third party data access.

However, it only intervenes when data sharing is requested from a third party that **does not** compete with the company's base product.

Thus, we investigate two inter-related questions:

1. Are there cases where a manufacturer would not want to share data with a non-competing third-party?
2. What would be the effects of the «fairness» (FRAND) mandate on incentives to innovate? And how to implement «FRAND» conditions on data?

Preview of the model

We consider two types of third-party products:

- **Add on service**, that extends or enhances the functionality or features of the related service, so that consumers may want to use both services together.

  Example: Caterpillar's CatConnect provides real-time data collection from heavy equipment to monitor performance, Trimble fleet management provides an independent fleet tracking service that offers GPS-based monitoring of construction equipment.

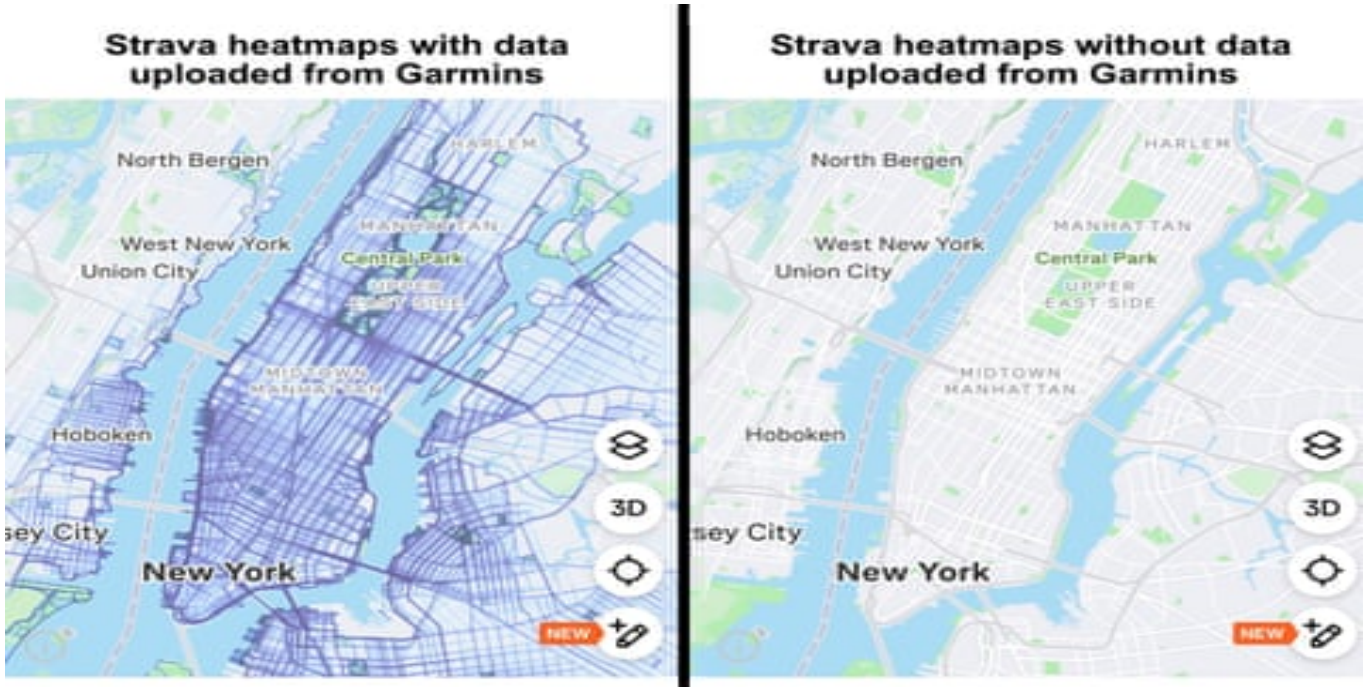
- **Replacement service**, that offers similar functionality as the manufacturer's original service (but can be of higher quality than the original service) so that consumers never want to consumer both services together.

  Example: Siemens's own monitoring system on its wind turbines vs General Electric's remote monitoring system. Once the user determines that one is better than the other, it will only use one.

And two types of royalties: **per-unit fee** (based on total data shared) and **revenue sharing** (based on TP's revenues).

Recent example (October 2025): Garmin - Strava

- Garmin produces smart watches, Strava is the most popular running App → **Add on service**
- Strava uses data from Garmin devices to fuel its own features.



Preview of Main Findings

1. Manufacturer **never** has an incentive to outright block third-party provider → Data sharing provision of the Data Act may be lifted.
2. Free data sharing **never** maximizes equilibrium quality (both M's and TP's).

	Add-on	**Replacement**
Per-unit fee	• TP always enters • Quality increasing in r • $r_{CS}^* = r_{TW}^* = r_M^* > 0$ • Higher CS^* than Revenue Sharing case.	• TP does not enter if r too high • Quality increasing in r • $r_{CS}^* = r_{TW}^* = r_M^* > 0$ • Higher CS^* than Revenue Sharing case.
Revenue Sharing	• TP always enters • Quality increasing then decreasing in r • $r_M^* = r_{CS}^* \geq r_{TW}^* > 0$	• TP does not enter if r too high • Quality increasing then decreasing in r • $0 < r_{CS}^* < r_{TW}^* < r_M^*$

Literature review

- Largely unexplored topic. Two main papers on data pricing and machine data:
  - Bisceglia and Tirole (2024): data pricing in digital ecosystems under the DMA (including App interoperability or Stores) → FRAND implemented through the Baumol, Ordover and Willig (1997 Yale JR)'s Efficient Component Pricing Rule (ECPR), so called *retail minus* approach;
  - Calzolari et al. (2024, MS): analysis of the machine data markets (i.e. data fragmentation, data ownership and sharing) where manufactures share data and compete in presence of a data aggregator (with market power) → not related to Data Act regulation.
- Similarities/differences with other strand of literatures:
  - *Licensing and FRAND in innovation*: how to price a patent's licence to avoid hold-up problems (Carlton and Shampine, 2013 JCLE; Lerner and Tirole, 2015 JPE) → we analyse whether the hold-up problem emerges in the setting defined in the EU Data Act;
  - *Access pricing to networks*: Laffont and Tirole (2000, MIT Press), among others → competition between vertically integrated incumbents and entrants in the *same* retail segment (≠ from our setting!).

Model

- We propose a model where a manufacturer (M) sells a connected product and can (costly) **invest to improve** the data analytics attached to the product.

- A third-party (TP) **only sells** its own data analytics service. Consumer need to buy M's product if they want to use TP's service.

- The TP's service may be an *add-on* (complement) or a *replacement* (substitute) of M's data analytics.

Model/2

Singh and Vives (1984) representative consumer, extended to include **endogenous quality**.

If a consumer only buys from manufacturer M, it obtains:

$$u_M = (\alpha + \epsilon_M)D_M - p_M D_M - \beta \frac{D_M^2}{2}$$

α: base product quality (exogenous)

ϵ_M: M's data analytics quality (endogenous)

D_M: total quantity bought by the representative consumer

Model/3

If a consumer buys from both manufacturer M and TP, it obtains:

$$u_{M,TP} = (\alpha + \gamma\epsilon_M)D_M - p_M D_M - \beta\frac{D_M^2}{2} + (\epsilon_{TP} - p_{TP})D_{TP}$$

where $\gamma \in [0,1]$, degree of complementarity between M's and TP's own analytics.

As long as $p_{TP} \leq \epsilon_{TP} - (1-\gamma)\epsilon_M = \bar{p}_{TP}$, all that buy from M also buy from TP ($D_{TP} = D_M$). Else, the TP is inactive. Thus, demands are (with $\beta = 1$)

$$D_M = \begin{cases} 0 & \text{if } p_M > (\alpha + \epsilon_M) \text{ and } p_{TP} > \bar{p}_{TP} \\ (\alpha + \epsilon_M) - p_M & \text{if } p_{TP} > \bar{p}_{TP} \text{ or } TP \text{ not present} \\ (\alpha + \gamma\epsilon_M + \epsilon_{TP}) - (p_M + p_{TP}) & \text{if } p_{TP} \leq \bar{p}_{TP} \text{ and } TP \text{ present} \end{cases}$$

$$D_{TP} = \begin{cases} 0 & \text{if } p_{TP} > \bar{p}_{TP} \\ (\alpha + \gamma\epsilon_M + \epsilon_{TP}) - (p_M + p_{TP}) & \text{if } p_{TP} \leq \bar{p}_{TP} \end{cases}$$

TP's product cases

In the **Add-on case**, we have $\gamma = 1$. Thus, if the TP is present, we have

$$D_M = (\alpha + \epsilon_M + \epsilon_{TP}) - (p_M + p_{TP}) \text{ and } \bar{p}_{TP} = \epsilon_{TP}.$$

In the **Replacement case**, we have $\gamma = 0$. Thus, if the TP is present, we have

$$D_M = (\alpha + \epsilon_{TP}) - (p_M + p_{TP}) \text{ and } \bar{p}_{TP} = \epsilon_{TP} - \epsilon_M.$$

Royalty cases

- Under **revenue sharing royalty**, profits functions are

$$\pi_{TP} = p_{TP}(1-r)D_{TP} - c_{TP} * \frac{\epsilon_{TP}^2}{2} \quad \text{and} \quad \pi_M = (p_M + r * p_{TP})D_M - c_M * \frac{\epsilon_M^2}{2}$$

- Under **per-unit royalty**, profits functions are

$$\pi_{TP} = (p_{TP} - r)D_{TP} - c_{TP} * \frac{\epsilon_{TP}^2}{2} \quad \text{and} \quad \pi_M = (p_M + r)D_M - c_M * \frac{\epsilon_M^2}{2}$$

assuming that each unit sold produces a unit of data on which the per-unit royalty is applied.

- r is exogenously set, chosen by a regulator.
- Technical assumption: $c_M, c_{TP} > \frac{1}{2}$ (concavity)

Timing

The timing is the following:

1) The Manufacturer chooses his quality level ϵ_M.
2) The Third party chooses its quality level ϵ_{TP}.
3) Prices p_M, p_{TP} are set simultaneously.

In what follows, we assume the manufacturer cannot deny access to the TP (the obligation forseen in the Data Act is in place), and then check whether he would prefer to deny access absent the regulation.

Case I - Per-unit royalty, Add-on case

For simplicity, set $\alpha = \beta = 1$ (results are qualitatively the same).

Quantity consumed is equal to:

$$D^*_{M,TP} = 1 + \epsilon_M - p_M + \epsilon_{TP} - p_{TP}$$

Equilibrium prices are:

$$p^*_M = \frac{1}{3}(1 - 3r + \epsilon_M + \epsilon_{TP}) \text{ and } p^*_{TP} = \frac{1}{3}(1 + 3r + \epsilon_M + \epsilon_{TP})$$

M's price decreases with r, TP's price increases with r.

TP's pricing strategy

We must check that $p_{TP}^{*} \leq \epsilon_{TP}$ so that users buy from TP!

The condition holds if :

$$\epsilon_{TP} \geq \overline{\epsilon_{TP}} = \frac{1}{2}(1 + 3r + \epsilon_M)$$

After this threshold, TP sets $p_{TP}^{*} = \epsilon_{TP}$, and the manufacturer's equilibrium price is:

$$p_M^{*} = \frac{1}{2}(1 - r + \epsilon_M)$$

TP's quality effect on M's price

In general, we have that M's best price response is:

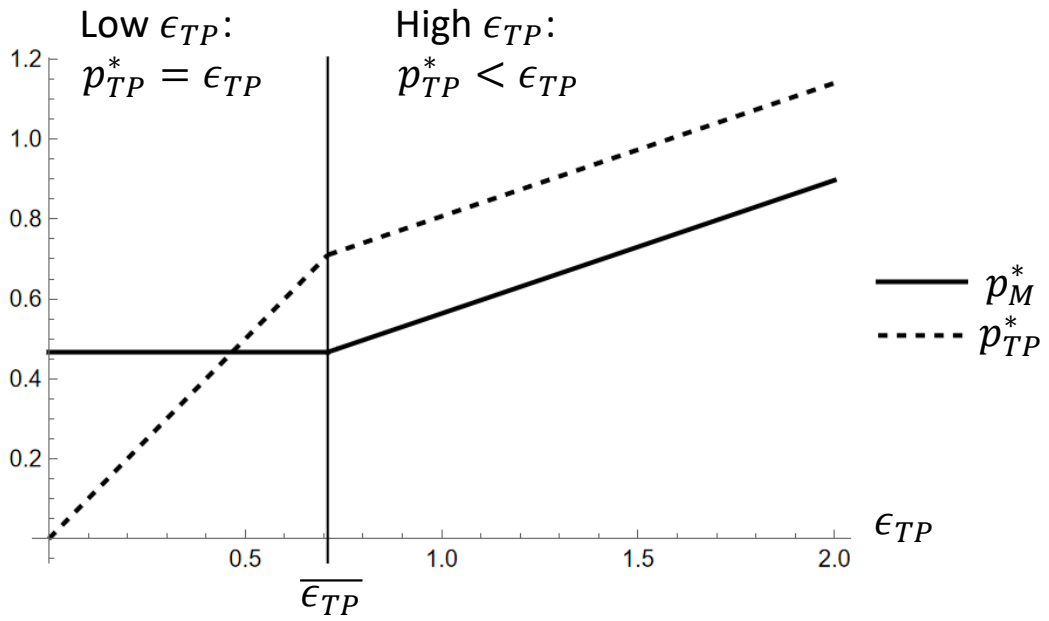
$$p_M^{BR} = \frac{1}{2}(1 - r - p_{TP} + \epsilon_M + \epsilon_{TP})$$

In particular, we have

$$\frac{\partial p_M^{BR}}{\partial \epsilon_{TP}} = \frac{1}{2}\left(1 - \underbrace{\frac{\partial p_{TP}}{\partial \epsilon_{TP}}}_{\text{TP's quality effect (+)}}\right)$$

When $\epsilon_{TP} < \overline{\epsilon_{TP}}$, $p_{TP}^* = \epsilon_{TP}$, and $\frac{\partial p_M^{BR}}{\partial \epsilon_{TP}} = 0$ → M's price is unaffected by TP's quality.

Equilibrium prices



- If TP's quality is low, it must set $p^*_{TP} = \epsilon_{TP}$ in order to sell. Demand becomes $D_M = D_{TP} = 1 + \epsilon_M - p_M$, and M's profits are unaffected by TP's quality.
- If TP's quality is high, both firms anticipate that their respective prices have an impact on their (common) demand.

TP's profits – low r

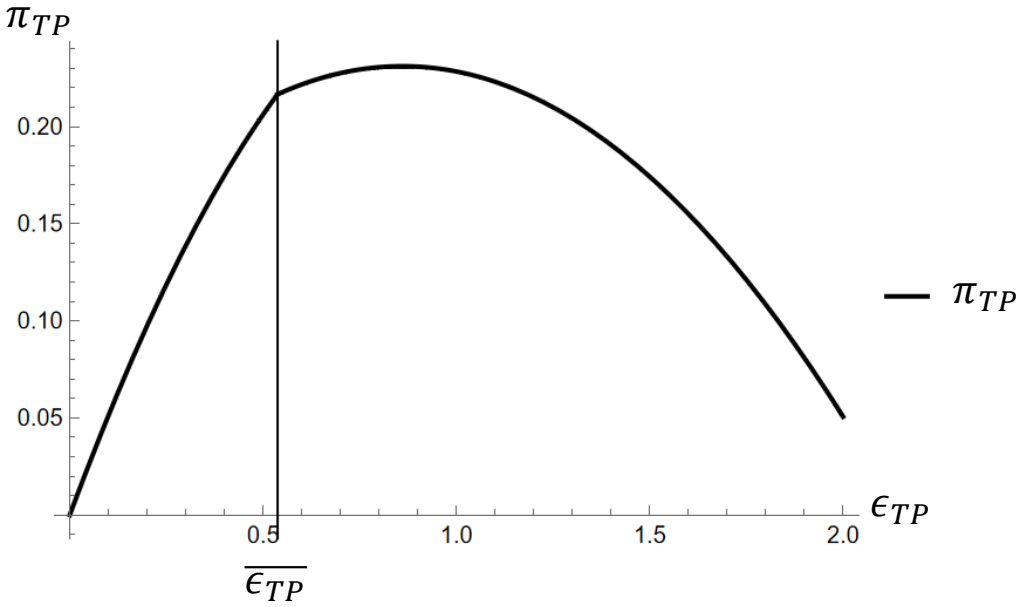


Figure: TP's profits for low r

Depending on r, TP's profits may be maximized in each of three cases:

- Low r: TP anticipates that an *unconstrained* equilibrium will occur ($\epsilon_{TP}^{*} > \overline{\epsilon_{TP}}$), which is indeed fulfilled for the quality level that solves the first-order condition.

TP's profits – high r

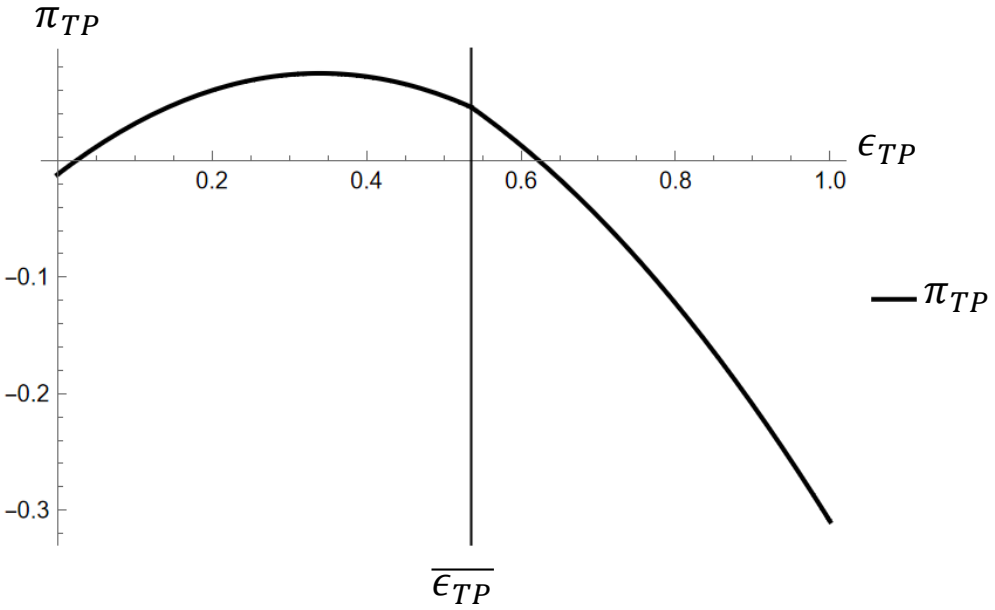


Figure: TP's profits for high r

Depending on r, TP's profits may be maximized in each of three cases:

- High r: TP anticipates that a *constrained* equilibrium will occur ($\epsilon_{TP}^{*} < \overline{\epsilon_{TP}}$, leading to $p_{TP}^{*} = \epsilon_{TP}$), which is indeed fulfilled for the quality level that solves the first-order condition.

TP's profits – intermediate r

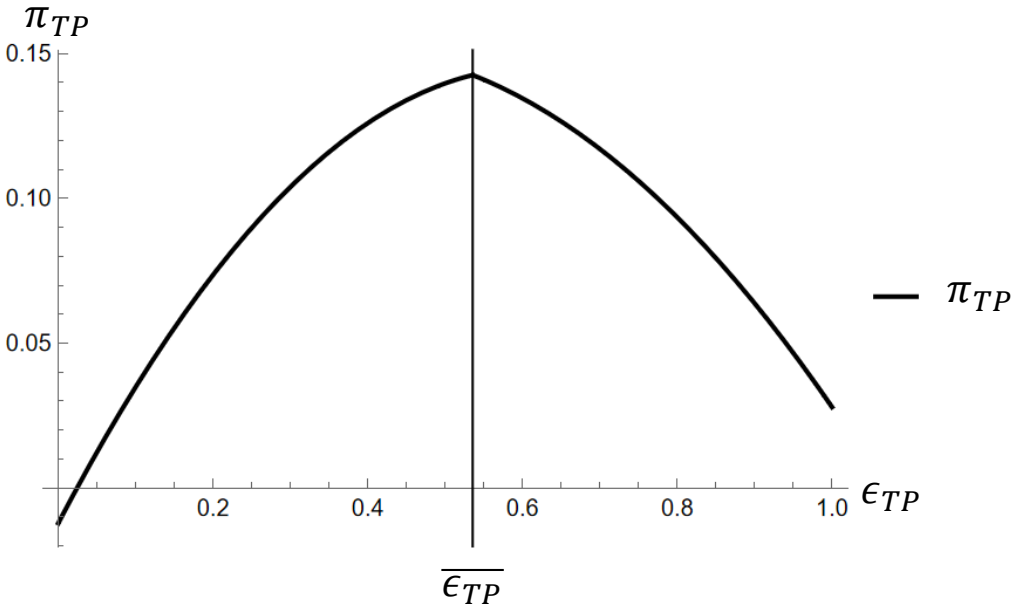


Figure: TP's profits for intermediate r

Depending on r, TP's profits may be maximized in each of three cases:

- intermediate r: neither the first-order condition anticipating an unconstrained pricing equilibrium, nor the first-order condition anticipating a constrained pricing equilibrium can be fulfilled. Thus TP sets $\epsilon_{TP}^{*} = \overline{\epsilon_{TP}}$

Equilibrium TP's quality

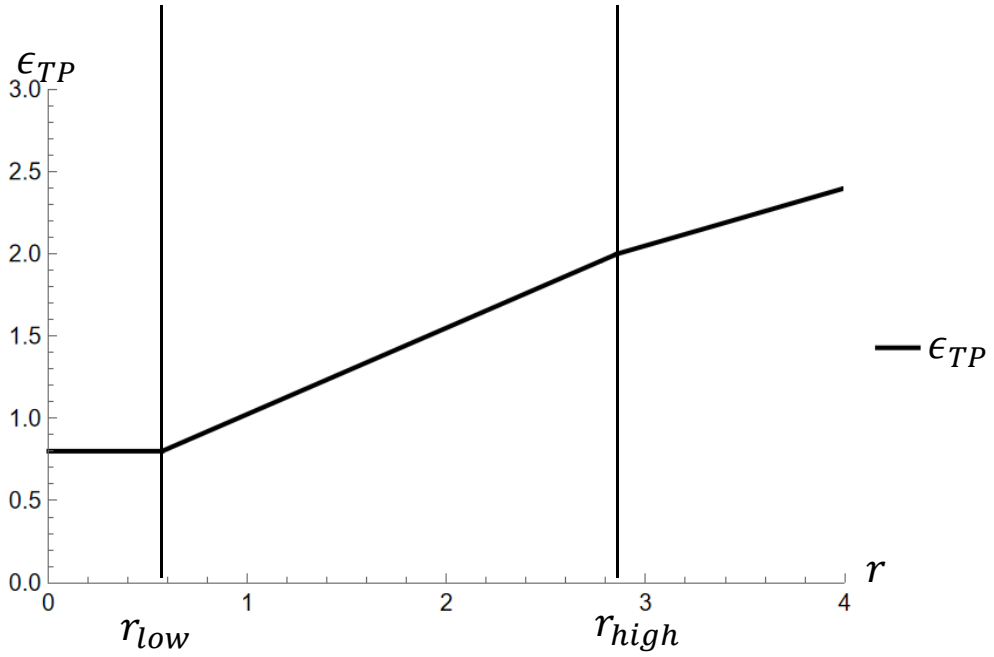
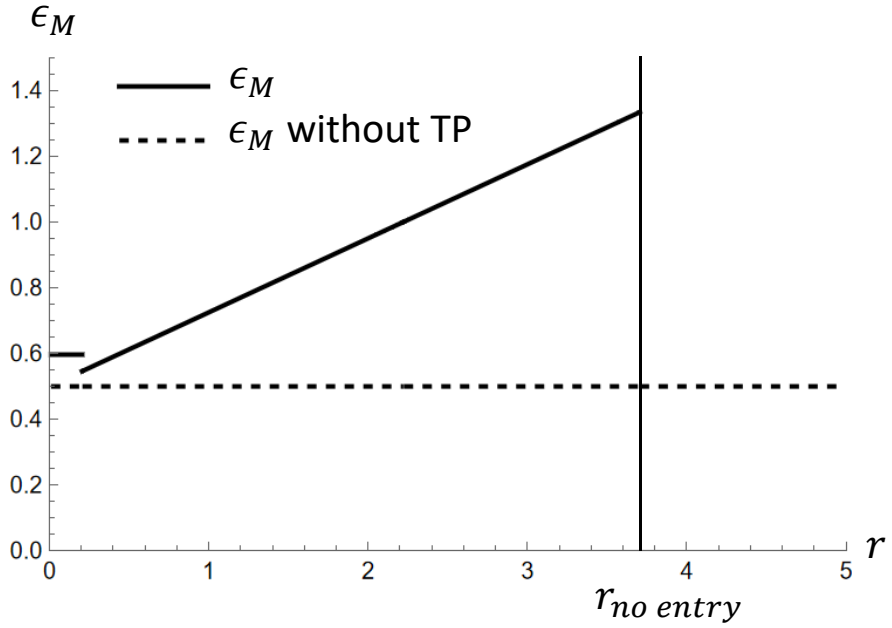


Figure: TP's equilibrium quality as a function of r

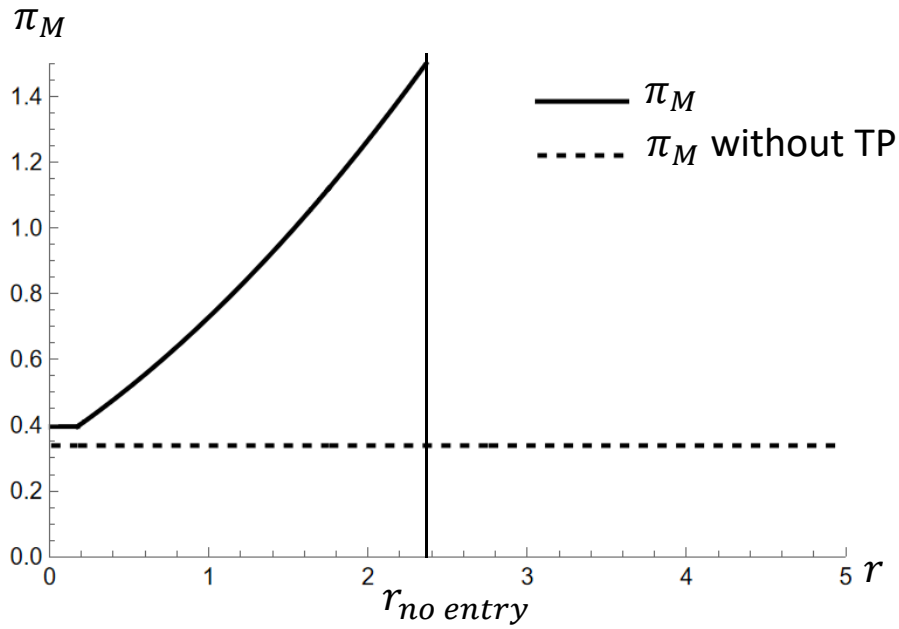
- For low r, TP sets $p_{TP}^* = r + \frac{1}{3}(1 + \epsilon_M + \epsilon_{TP})$, fully passing the royalty onto consumers. Its profits are constant with respect to r, and so is its equilibrium quality.
- For intermediate and high r, TP sets $p_{TP}^* = \epsilon_{TP}$ and does not expand demand.
- **Quality increases with *r***: An increase in r lowers M's price, leading more consumers to buy and incentivizing TP to increase its own quality.

Manufacturer's equilibrium quality



- For low r, M sets $p_M^* = \frac{1}{3}(1 + \epsilon_M + \epsilon_{TP}) - r$, fully absorbing the royalty. Its profits are constant with respect to r, and so is its equilibrium quality.
- For intermediate and high r, M sets $p_M^* = \frac{1}{2}(1 - r + \epsilon_M)$. An increase in r increases the revenues M makes on the marginal consumer, incentivizing him to increase ϵ_M.
- M's equilibrium quality is always higher than when TP is absent.

Manufacturer's equilibrium profits



- Intuitively, an increase in r weakly increases M's profits.
- As M's profits are always higher than in the absence of TP, he would **never refuse to share data.**

Welfare analysis

- Both TP and M's equilibrium qualities are (weakly) increasing in r.
- We find that CS and TW are also weakly increasing in r.
- Thus, a social planner would set $r_{CS}^{*} = r_{TW}^{*} = r_{no\ entry}$, i.e., the highest r that fully extracts TP's profits.
- If M could choose r without being constrained by the DA's FRAND requirement, he would also set $r_{M}^{*} = r_{no\ entry}$.

Case II – Per-unit royalty, Replacement case

- Under the replacement case, firms' pricing strategy remain similar to the previous ones.
- However, as TP's service now replaces M's, the maximum price TP can set is equal to:

$$\overline{p_{TP}} \leq \epsilon_{TP} - \epsilon_M$$

- Equilibrium prices follow the same trends as in **Case I**.
- And similarly for TP's quality.

Case II – M's quality

- The Replacement case instead has a **notable effect on M's strategy**, as he anticipates that TP must beat his quality in order to sell:

  - If c_M is very low (case A), M sets the monopolistic quality level, and TP does not enter the market.
  - If c_M is low (case B), M sets the highest quality that still allows TP to profitably enter the market.
  - If c_M is medium (case C), M invests in quality to influence TP's quality choice.
  - If c_M is high (case D), M does not invest in quality, leaving all the investment to TP.

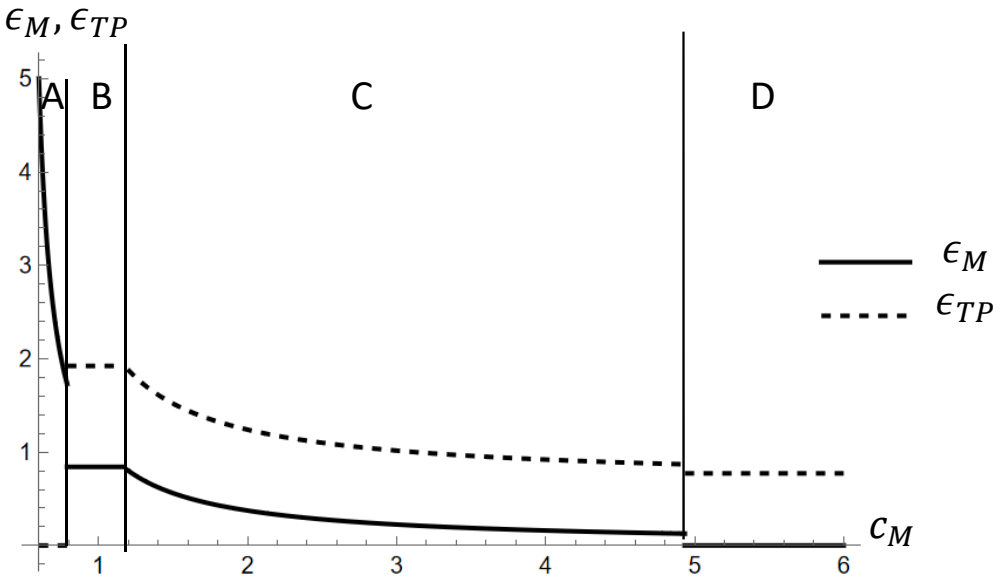


Figure: TP's and M's equilibrium quality as a function of c_M

Case II – Effect of royalty on equilibrium qualities

- In the *Replacement case*, the total quality offered to consumers is equal to ϵ_{TP}, as TP's service replaces M's.
- Similarly to Case I, we find that TP's quality is weakly increasing in the royalty level, as a higher royalty makes M lower his price and expand his (and TP's) demand.
- However ($\neq$ Case I), when *r* is too high, TP does not invest any longer

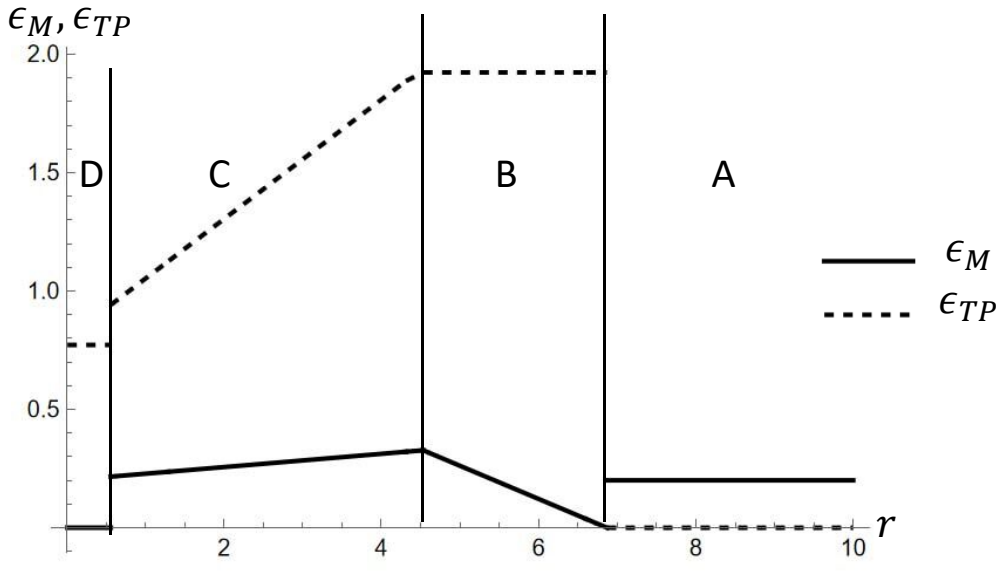


Figure: TP's and M's equilibrium quality as a function of r

Case II – Does M want to deny TP's entry?

- We find no evidence that M would want to **deny TP's entry**, i.e., he would always share data with TP.

- Indeed, in the case where TP does not enter (case A), M optimally plays the monopoly quality level, and TP prefers not to enter as beating M's quality would be unprofitable.

- Welfare results mimic those of **Case I**: a social planner would set $r_{CS}^* = r_{TW}^* = r_{no\ entry}$, i.e., the highest r that fully extracts TP's profits, and, If M could choose r without being constrained by the DA's FRAND requirement, he would also set $r_M^* = r_{no\ entry}$.

Case III - Add-on case, revenue sharing fee

Under the revenue sharing fee, firms' pricing strategy remain similar to the previous ones. However, M's best price response is

$$p_M^{BR} = \frac{1}{2}\left(1 + \epsilon_M + \epsilon_{TP} - p_{TP}(1 + r)\right)$$

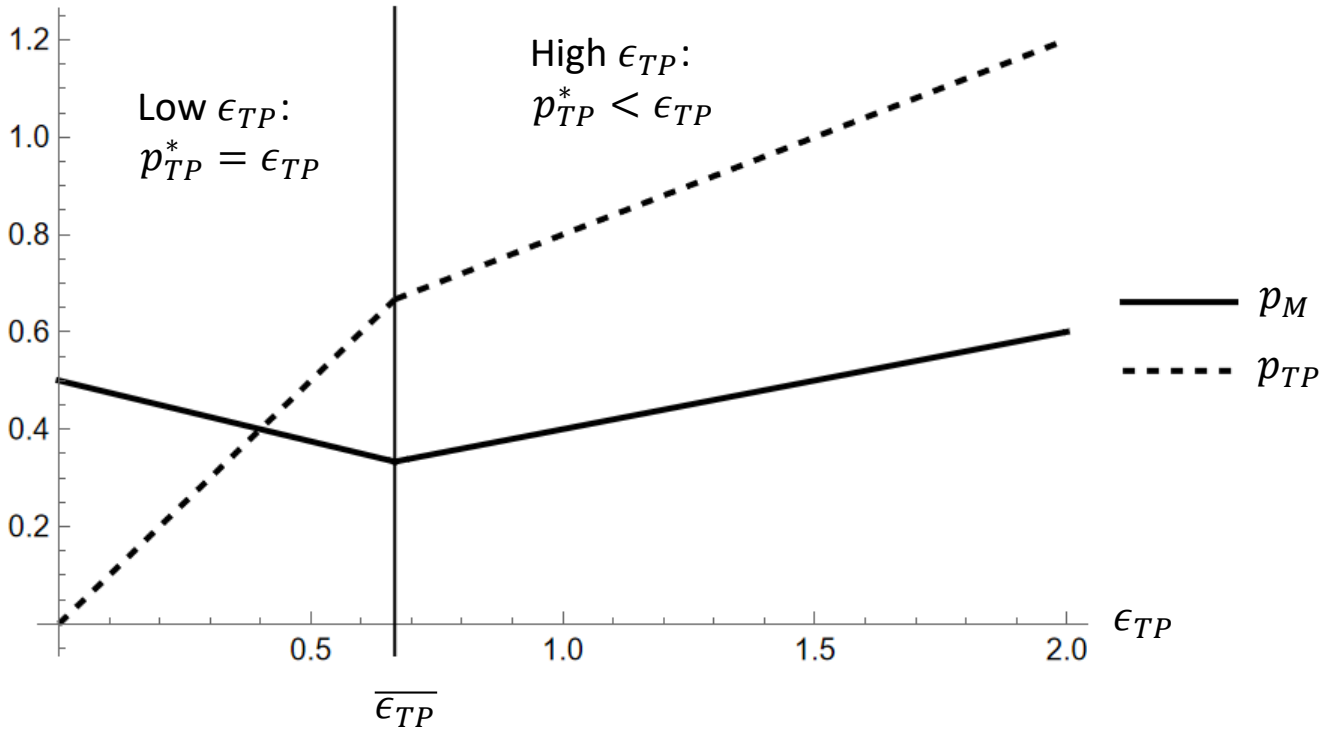
Leading to

$$\frac{\partial p_M^{BR}}{\partial \epsilon_{TP}} = \frac{1}{2}\left(1 - \overbrace{(1 + \mathrm{r})}^{\textit{Royalty effect}} \underbrace{\frac{\partial p_{TP}}{\partial \epsilon_{TP}}}_{\textit{TP's quality effect}}\right)$$

When $\epsilon_{TP} < \overline{\epsilon_{TP}}$, $p_{TP}^* = \epsilon_{TP}$, and $\frac{\partial p_M^{BR}}{\partial \epsilon_{TP}} = -\frac{\mathrm{r}}{2}$ → M's price is decreasing in TP's quality.

The intuition is that an increase in TP's quality increases M's royalty revenues, incentivizing him to attract more consumers by lowering his price.

Equilibrium prices



TP's equilibrium quality

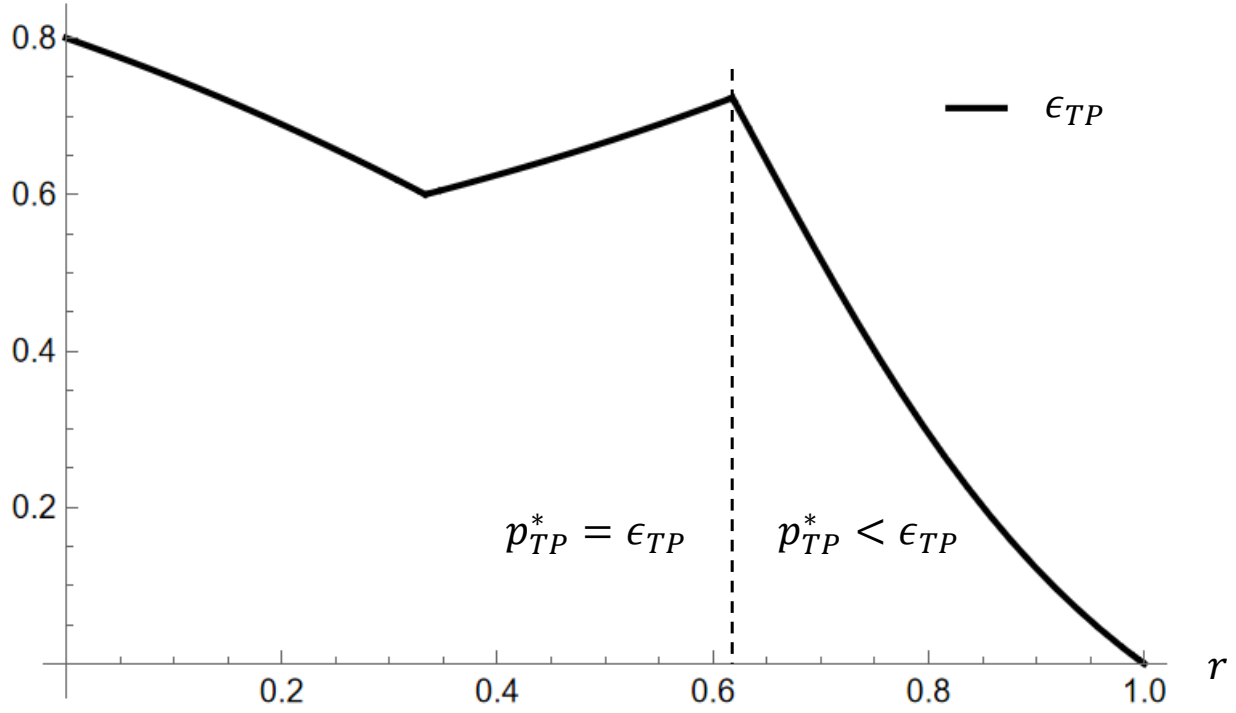
- The royalty rate affects TP's profits in two ways:

  1. First, it reduces the revenues it makes on the marginal consumer;
  2. Second, it incentivizes M to lower his price, leading to a demand increase.

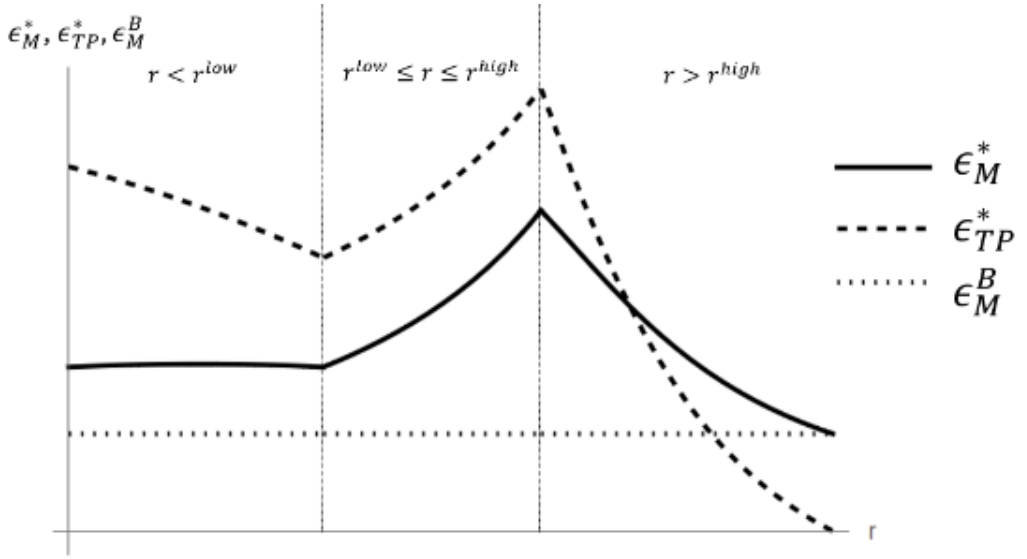
- For high or low values of r, TP's equilibrium quality is governed by its first-order condition like in the per-unit fee case. As its marginal revenues decrease in r, its equilibrium quality also does.

- For intermediate values of r, TP sets $\epsilon_{TP}^{*} = p_{TP}^{*} = \overline{\epsilon_{TP}}$. Due to the *royalty effect*, a higher r incentivizes **M to aggressively decrease his price**, leading to a sharp increase in market share. The effect in 2 dominates the effect 1, and TP's quality is increasing in r.

TP’s equilibrium quality

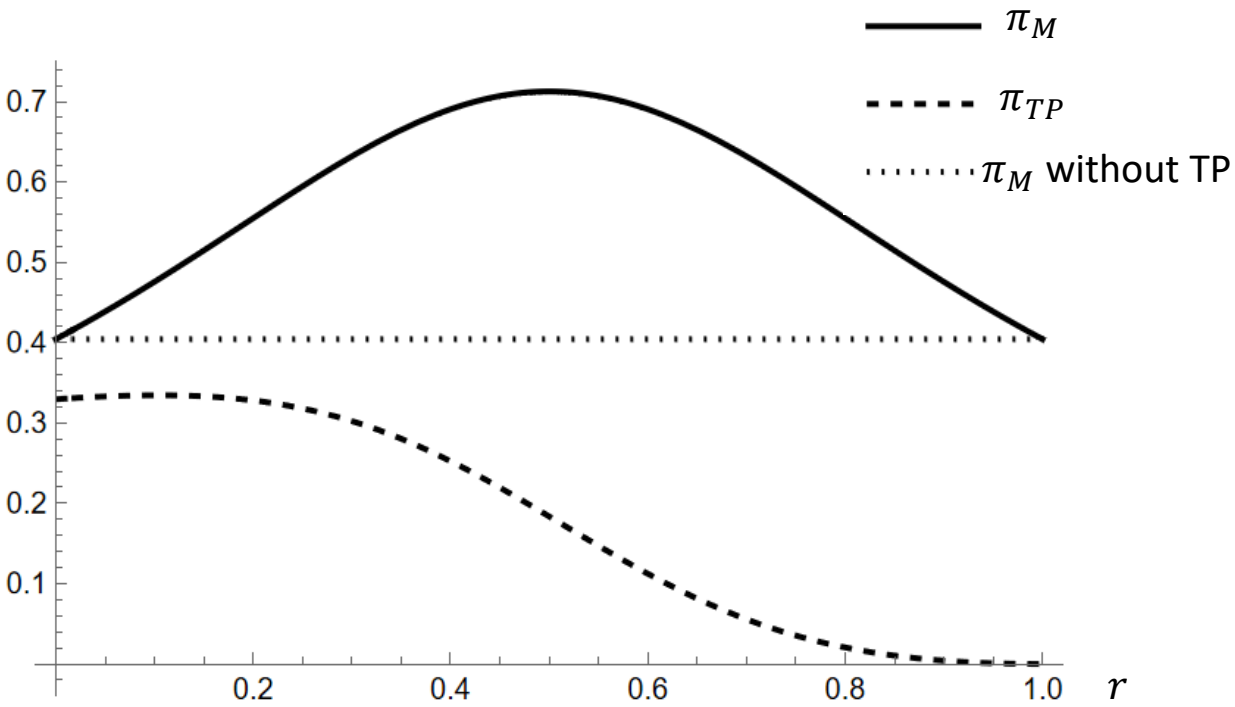


M's equilibrium quality



- M's equilibrium quality follows similar trends to TP's.
- Intuitively, TP's presence incentivizes M to increase his quality with respect to the benchmark case where TP is absent.

Profits and denial of service



- Manufacturer would never refuse service to the TP.

Welfare

- If TP is quality efficient, i.e., c_{TP} is low, TP's and M's qualities are maximized for the same royalty level r^*. In particular, r^* maximizes M's profits, CS and TW.

- If TP is quality inefficient, i.e., c_{TP} is high, TP's quality is maximized for a royalty level higher than r^*. A social planner aiming to maximize CS, as well as M, would still choose r^*. A social planner aiming to maximize TW would instead choose $r^*_{TW} < r^*$.

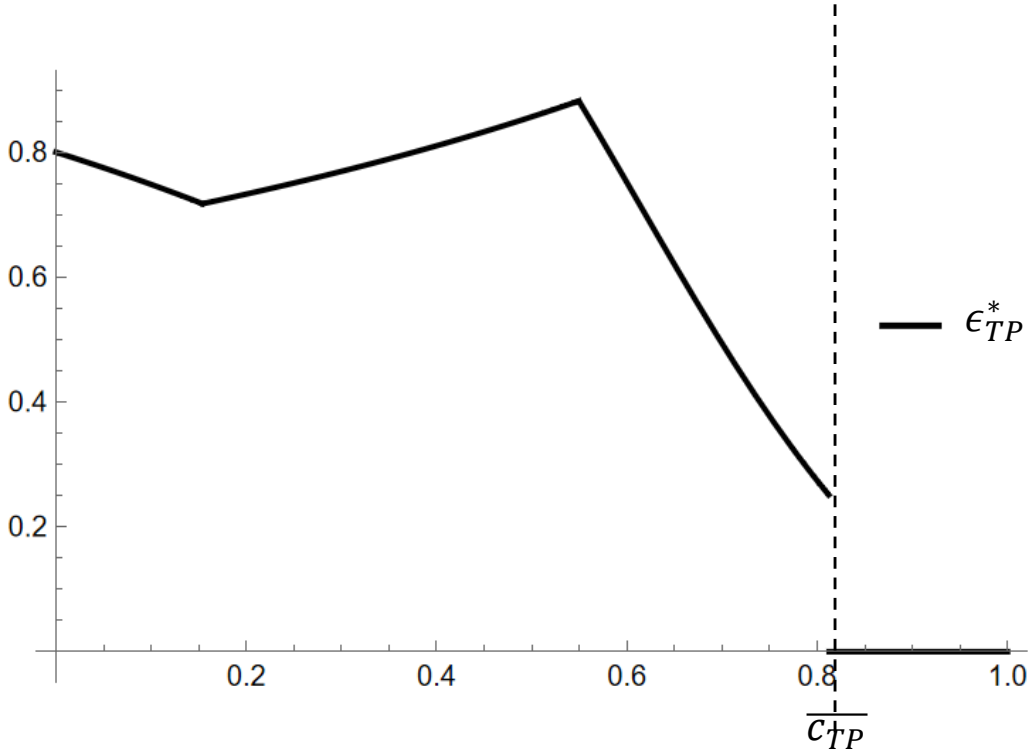
- Maximum CS and TW are lower than the maximum obtainable under the per-unite fee royalty scheme.

Case IV - Replacement case, revenue sharing fee

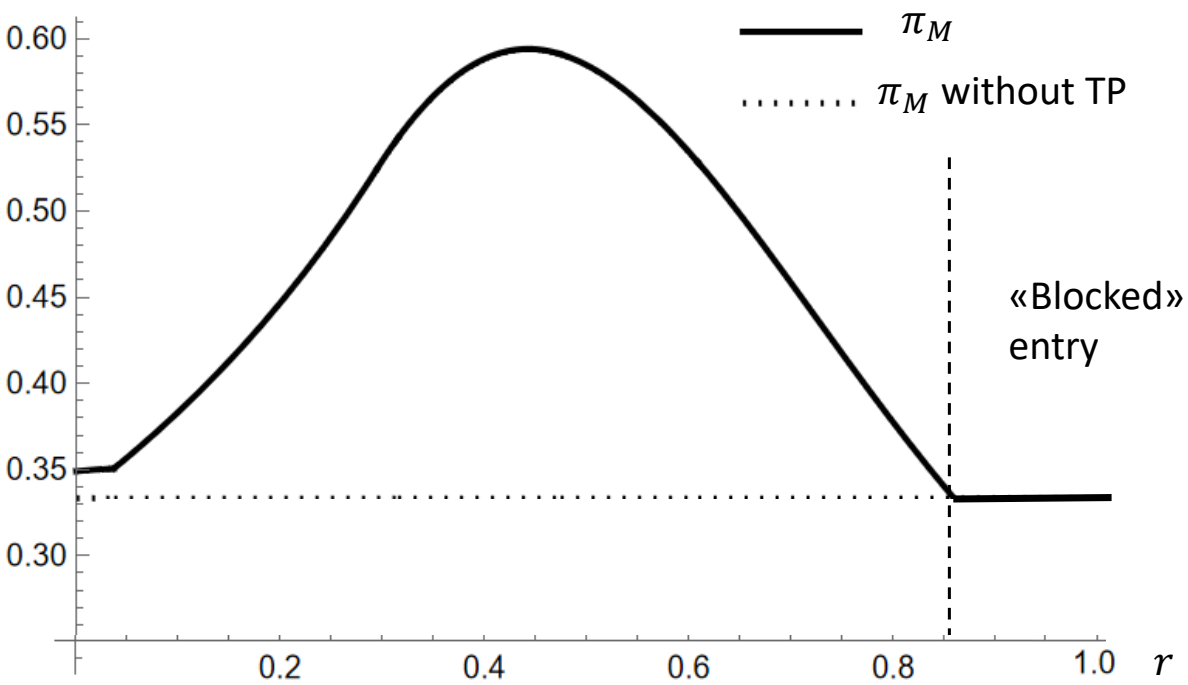
TP's price and quality choices follow the add-on case very closely.

Notable differences are:

- TP's quality choice depends on both r (exogenous) and ϵ_M (endogenous).
- If $c_{TP} > \overline{c_{TP}}$, beating M's product is too costly and TP prefers not entering.



Manufacturer's profits



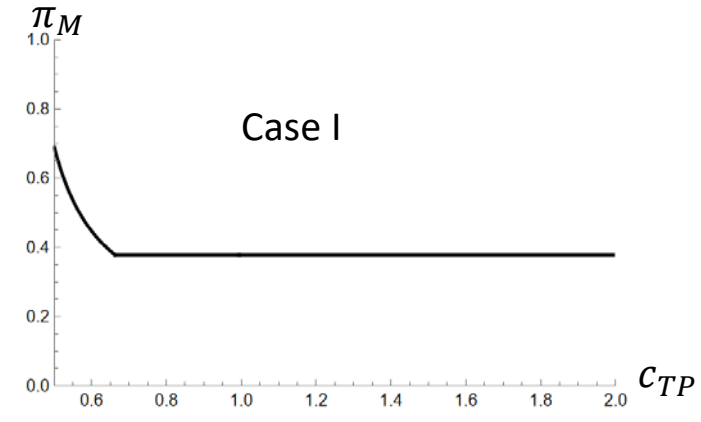
- The only case in which monopoly profits are higher than the profits with the TP are the cases in which the TP **chooses** not to enter.
- We find **no incentive** for the manufacturer to deny service to the TP, even in the replacement case.

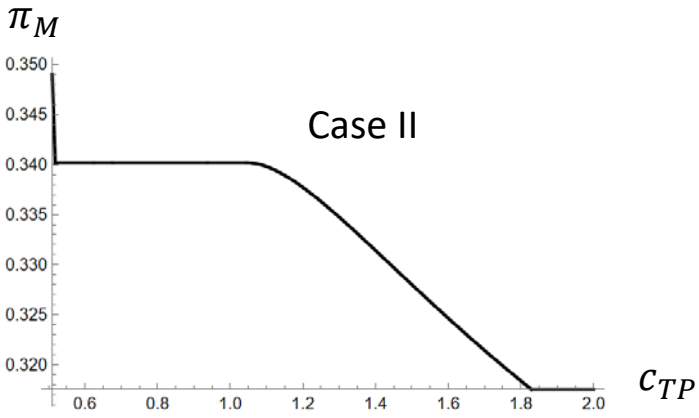
Welfare

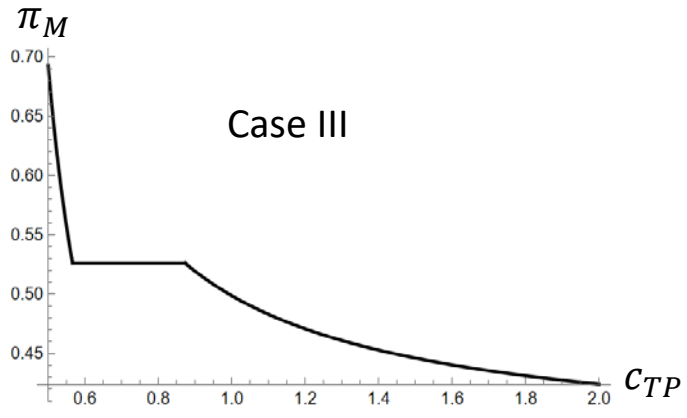
- In the replacement case, M's profits are maximized for a royalty level r_M^*, which is higher than the royalty level that maximizes TP's quality.
- Conversely, a social planner aiming to maximize CS would set $r_{CS}^* < r_M^*$ to maximize TP's quality.
- A social planner aiming to maximize TW would set an intermediate royalty level $r_{CS}^* < r_{TW}^* < r_M^*$.
- Royalty regulation may thus be welfare increasing, though a zero-royalty is never optimal.

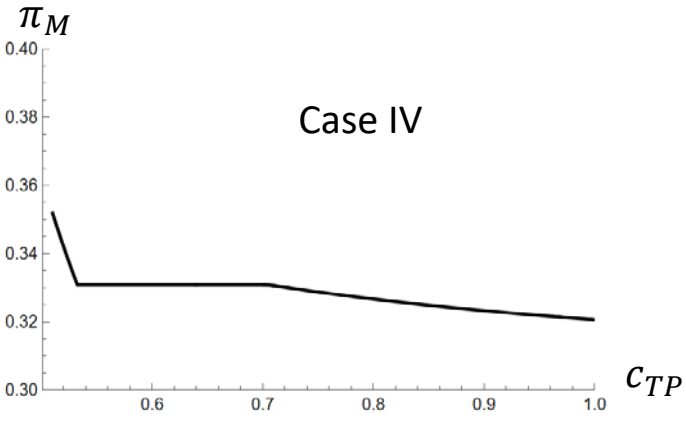
Extension: Would M like to increase TP's cost?

- The Data The Act explicitly requires sharing data of the same quality and machine-readable, commonly-used formats.
- However, by requiring appropriate confidentiality & technical safeguards, M could increase TP's quality cost.
- Would M have an incentive to do so?









- Although TP's quality may be increasing in the royalty, it is always decreasing in TP's cost of quality.
- A reduction of TP's quality also negatively affects M's profits, as the overall value of the bundle offered decreases.
- We find no evidence that M would want to increase TP's cost of quality.

Conclusions/Policy Discussion

- We find **no evidence** that **firms would refuse data access to third parties** in the scenarios regulated by the Data Act, nor that they would want to increase third parties' quality costs.
- Regulating the data sharing contract "in favor" of the TP (lowering the royalty fee) is likely to reduce welfare. In all cases considered, **FRAND-style regulation** can only lead to improved welfare outcomes if two conditions are satisfied simultaneously:
  a) the TP provides a replacement service; and
  b) data is shared based on a revenue-sharing contract.

In this case, data regulation could benefit consumers by avoiding TP rent expropriation and thus incentivizing TP's investment.

- Pricing on **value of input of TP** (i.e. *unit fee* on data) **is socially better than pricing on value of output** (i.e. *revenue* of TP).

Arigato gozaimasu

ありがとうございます