The Impact of Pharmaceutical Price Transparency

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Motivation

- Proliferation of confidential agreements in pharmaceutical markets

  $\longrightarrow$ observed list prices $\neq$ real net prices paid by buyers

- 2019 World Health Assembly resolution encouraging countries to share information

  $\longrightarrow$ heated debate on the effects of transparency on pharmaceutical pricing

- Transparency could:
  - » affect bargaining positions in negotiations between manufacturers and institutional payers
  - » render reference pricing truly effective
  - » lead to price uniformity and lower availability of new drugs

Can we estimate confidential discounts?

What would be the impact of transparency on profits and welfare in different countries?

This Project

Our goal

- Develop a model explaining formation of list and net prices in firm-country negotiations
- Take the model to the data to estimate net prices for different products and countries
- Simulate counterfactual where net prices can be used as reference by other countries

Data

- Focus on antithrombotic and antihemorrhagic drugs in the EU
- Use novel EURIPID data: list prices and quantities reported by national authorities
- Cross-reference with IQVIA information (from pharmaceutical companies)

Today: discussion of simple model

Model: Idea

Setup

- A (monopolistic) firm produces a good with zero marginal cost.
- Buyer 1 gets utility $\theta \geq 0$ from 1st unit and $\mu\theta$ from 2nd unit, where $\mu \in (0, 1)$.

  $\longrightarrow$ Interpret μ as probability of needing another unit, and $\mu\theta$ as expected utility.
- Buyer 2 gets utility 1 from 1 unit.
- There is no information asymmetry.
- Each buyer negotiates separately with the firm. $\longrightarrow$ Nash bargaining

Timing

- Stage 1: Firm and buyer 1 negotiate to set price of 1st unit (p_1).
- Stage 2: If agreement in Stage 1, firm and buyer 1 negotiate to set price of more units ($\tilde{p}_1$).
- Stage 3: All players observe buyer 1's realized valuation of 2nd unit.

  Firm and buyer 2 negotiate to set unit price p_2. In case of disagreement, buyer 1 can purchase an additional unit from the firm and resell it to buyer 2 at $\tilde{p}_1$.

solution

Model: Interpretation

In the status quo:

- p_1 is the price negotiated by buyer 1 for the unit he needs with certainty.
- $\tilde{p}_1$ is the price negotiated by buyer 1 for additional units he might need.
- $\tilde{p}_1$ also affects negotiation between firm and buyer 2, implying $p_2 \leq \tilde{p}_1$.

$\longrightarrow$ Interpret p_1 as the net price and $\tilde{p}_1$ as the list price used as reference in other negotiations.

$\longrightarrow$ Parallel trade is the channel through which the two negotiations are linked.

Under transparency:

- Buyer 1 has to negotiate a unique price p_1^T for all units.
- p_1^T now affects bargaining position in negotiation between firm and buyer 2.

$\longrightarrow$ Transparency as constraint to negotiate a single price that can be referenced by others.

Model: Results

In the status quo:

- If buyer 1 has high θ, $\tilde{p}_1 = p_1 = \tau_1\theta$ and $p_2 = \tau_2$, where τ_i is firm's bargaining power.

  $\longrightarrow$ If buyer 1's valuation is much higher, negotiations are effectively independent.
- For low values of θ, $\tilde{p}_1 > \tau_1\theta$, $p_1 < \tilde{p}_1$ and $p_2 = \tilde{p}_1$.

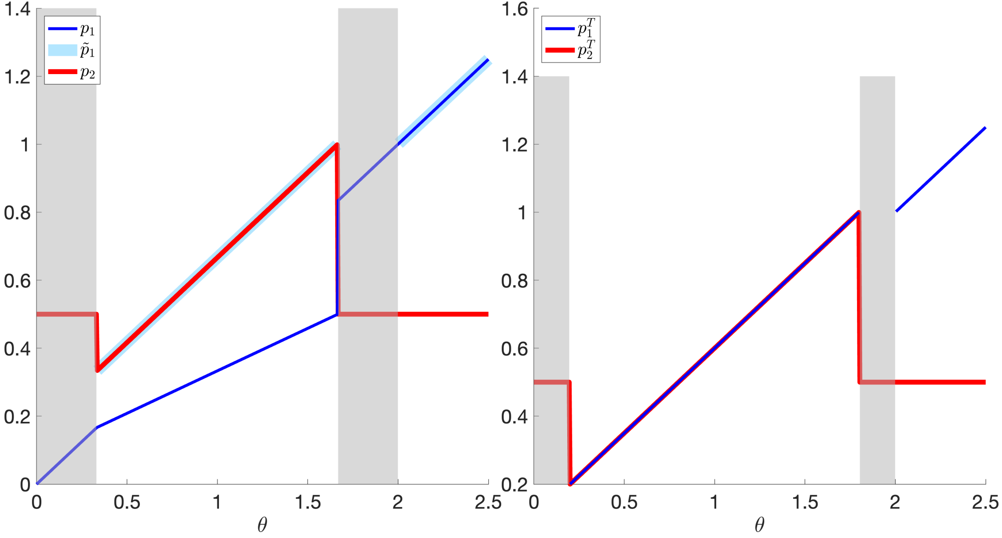
  $\longrightarrow$ If $\tilde{p}_1 \leq 1$, firm and buyer 2 can only agree to set $p_2 = \tilde{p}_1$.

  $\longrightarrow$ When negotiating on $\tilde{p}_1$, firm must be compensated for giving up τ_2 later.

Under transparency:

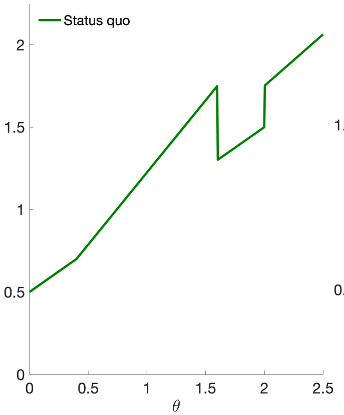
- For high θ, $p_1^T = \tau_1\theta$ and $p_2^T = \tau_2$. For low θ, $p_1 < p_1^T < \tilde{p}_1$ and $p_2^T = p_1^T$.
- Price uniformity becomes more likely.
- Buyer 1 loses and buyer 2 gains with respect to status quo. evidence
- Firm is worse off if θ is very low and better off otherwise.

Effect of Transparency: Prices

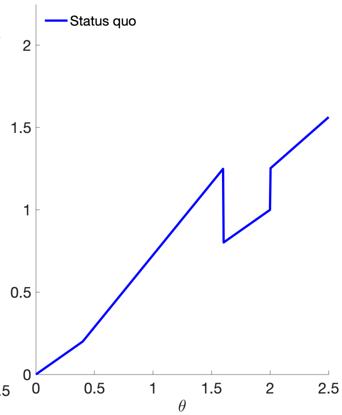


Bargaining parameters are $\tau_{\mathbf{1}} = \tau_{\mathbf{2}} = 0.5$, $\mu = 0.25$, θ is valuation of buyer 1 relative to valuation of buyer 2

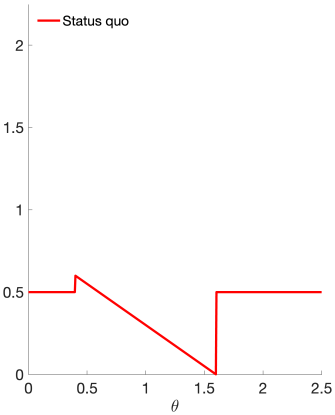
Effect of Transparency: Payoffs



Profits of the firm



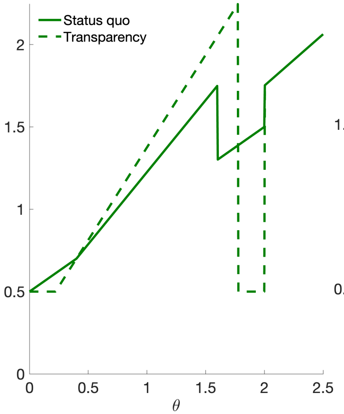
Surplus for buyer 1



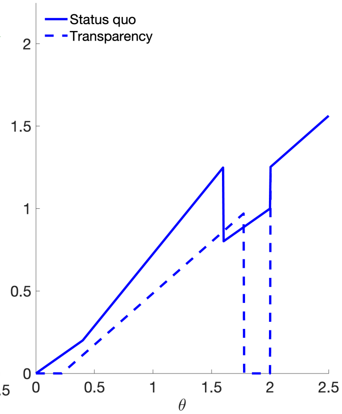
Surplus for buyer 2

Bargaining parameters are $\tau_1 = \tau_2 = 0.5$, $\mu = 0.25$, θ is valuation of buyer 1 relative to valuation of buyer 2

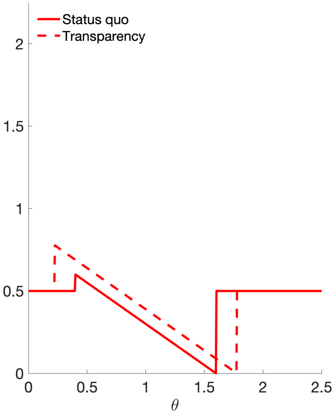
Effect of Transparency: Payoffs



Profits of the firm



Surplus for buyer 1



Surplus for buyer 2

Bargaining parameters are $\tau_1 = \tau_2 = 0.5$, $\mu = 0.25$, θ *is valuation of buyer 1 relative to valuation of buyer 2*

Solving the Model I

Stage 3: Firm and buyer 2 negotiate to set p_2

- In case of agreement, firm gets p_2 and buyer 2 gets $1 - p_2$
- In case of disagreement, buyer 1 can purchase an additional unit from the firm and resell it to buyer 2 at list price $\tilde{p}_1$ (so firm gets $\tilde{p}_1$ and buyer 2 gets $1 - \tilde{p}_1$)

$$p_2(\tilde{p}_1) = \begin{cases} \underset{0 \le p_2 \le 1}{\operatorname{argmax}} \{ p_2^{\tau_2} (1 - p_2)^{1-\tau_2} \} = \tau_2 & \text{if } \tilde{p}_1 > 1 \text{ or } \tilde{p}_1 = \emptyset \\ \underset{p_2 \ge \tilde{p}_1, \tilde{p}_1 \ge p_2}{\operatorname{argmax}} \{ (p_2 - \tilde{p}_1)^{\tau_2} [(1 - p_2) - (1 - \tilde{p}_1)]^{1-\tau_2} \} = \tilde{p}_1 & \text{if } \tilde{p}_1 \le 1 \end{cases}$$

Stage 2: In case of agreement in Stage 1, firm and buyer 1 negotiate to set list price $\tilde{p}_1$

- In case of agreement, buyer 1 gets $\mu(\theta - \tilde{p}_1)$ and firm gets $\mu \tilde{p}_1 + p_2(\tilde{p}_1)$
- In case of disagreement, firm gets τ_2 when negotiating with buyer 2

$$\tilde{p}_1 = \begin{cases} \underset{0 \le \tilde{p}_1 \le \theta}{\operatorname{argmax}} \{ [\mu \tilde{p}_1]^{\tau_1} [\mu(\theta - \tilde{p}_1)]^{1-\tau_1} \} = \tau_1 \theta & \text{if } \theta > \frac{1}{\tau_1} \\ \underset{\frac{\tau_2}{\mu+1} \le \tilde{p}_1 \le \theta}{\operatorname{argmax}} \{ [(\mu + 1)\tilde{p}_1 - \tau_2]^{\tau_1} [\mu(\theta - \tilde{p}_1)]^{1-\tau_1} \} = \tau_1 \left(\theta - \frac{\tau_2}{\mu+1}\right) + \frac{\tau_2}{\mu+1} & \text{if } \frac{\tau_2}{\mu+1} \le \theta \le \frac{\mu+1-\tau_2(1-\tau_1)}{(\mu+1)\tau_1} \\ \emptyset & \text{otherwise} \end{cases}$$

Solving the Model II

Stage 1: Firm and buyer 1 negotiate to set price of 1st unit p_1 (net price)

- In case of agreement, buyer 1 gets $\theta - p_1 + \mu(\theta - \tilde{p}_1)$ and firm gets $p_1 + \mu\tilde{p}_1 + p_2(\tilde{p}_1)$
- In case of disagreement, firm gets τ_2 when negotiating with buyer 2

$$p_1 = \begin{cases} \underset{-\mu\tau_1\theta \le p_1 \le \theta + \mu(1-\tau_1)\theta}{\operatorname{argmax}} \left\{ [p_1 + \mu\tau_1\theta]^{\tau_1} [\theta - p_1 + \mu(1-\tau_1)\theta]^{1-\tau_1} \right\} = \tau_1\theta & \text{if } \tilde{p}_1 > 1 \\ \underset{\tau_2 - (1+\mu)\tilde{p}_1 \le p_1 \le \theta + \mu(\theta - \tilde{p}_1)}{\operatorname{argmax}} \left\{ [p_1 + (1+\mu)\tilde{p}_1 - \tau_2]^{\tau_1} [\theta - p_1 + \mu(\theta - \tilde{p}_1)]^{1-\tau_1} \right\} = \tau_1\tilde{p}_1 & \text{if } \tilde{p}_1 \le 1 \\ \underset{0 \le p_1 \le \theta}{\operatorname{argmax}} \left\{ p_1^{\tau_1} [\theta - p_1]^{1-\tau_1} \right\} = \tau_1\theta & \text{if } \tilde{p}_1 = \emptyset \end{cases}$$

Finally:

$$\begin{cases} p_1 = \tilde{p}_1 = \tau_1\theta, \ p_2 = \tau_2 & \text{if } \theta > \frac{1}{\tau_1} \\ p_1 = \tau_1\tilde{p}_1, \ \tilde{p}_1 = p_2 = \tau_1\left(\theta - \frac{\tau_2}{\mu+1}\right) + \frac{\tau_2}{\mu+1} & \text{if } \frac{\tau_2}{\mu+1} \le \theta \le \frac{\mu+1-\tau_2(1-\tau_1)}{(\mu+1)\tau_1} \\ p_1 = \tau_1\theta, \ \tilde{p}_1 = \emptyset, \ p_2 = \tau_2 & \text{otherwise} \end{cases}$$

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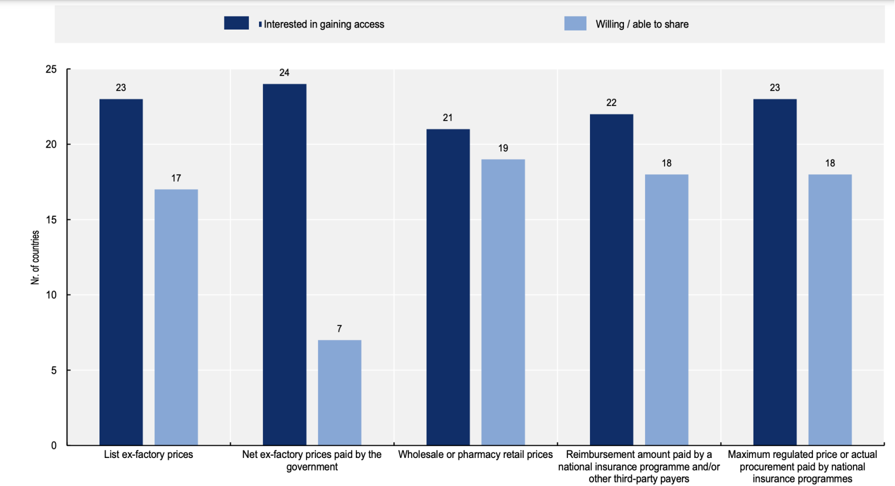
Results

	p_1	$\tilde{p}_1$	p_2
STATUS QUO			
$\theta > \frac{1}{\tau_1}$	$\tau_1\theta$	$\tau_1\theta$	τ_2
$\frac{\mu+1-\tau_2(1-\tau_1)}{(\mu+1)\tau_1} < \theta \leq \frac{1}{\tau_1}$	$\tau_1\theta$	$-$	τ_2
$\frac{\tau_2}{\mu+1} \leq \theta \leq \frac{\mu+1-\tau_2(1-\tau_1)}{(\mu+1)\tau_1}$	$\tau_1\tilde{p}_1$	$\tau_1\left(\theta-\frac{\tau_2}{\mu+1}\right)+\frac{\tau_2}{\mu+1}$	$\tilde{p}_1$
$\theta < \frac{\tau_2}{\mu+1}$	$\tau_1\theta$	$-$	τ_2
TRANSPARENCY			
$\theta > \frac{1}{\tau_1}$	$\tau_1\theta$		τ_2
$\frac{\mu+2-\tau_2(1-\tau_1)}{(\mu+2)\tau_1} < \theta \leq \frac{1}{\tau_1}$	$-$		τ_2
$\frac{\tau_2}{\mu+2} \leq \theta \leq \frac{\mu+2-\tau_2(1-\tau_1)}{(\mu+2)\tau_1}$	$\tau_1\left(\theta-\frac{\tau_2}{\mu+2}\right)+\frac{\tau_2}{\mu+2}$		p_1
$\theta < \frac{\tau_2}{\mu+2}$	$-$		τ_2

Buyers' interest in gaining/sharing price information (source: OECD)



Source: OECD survey on Price Transparency, 2022.

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