Strategic Interaction in Pharmaceutical Price Regulation and Innovation

Biomedical Innovation, The Pharmaceutical Industry And The Role Of Public Institutions

P. Pertile[1] S. Gamba [2] M. Forster[3]

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[1]University of Verona
[2]University of Milan
[3]University of York, University of Bologna

Motivation: strategic interaction

- Patents (monopolistic prices) as incentives to R&D investment: static vs. dynamic efficiency
- innovation as a global public good
- do countries free-ride on pharmaceutical pricing?
  - *'countries whose policies restrict the prices pharmaceutical firms can charge for their products were, it was suggested, potentially free-riding on the rewards and incentives for innovation provided by others'* (OECD, 2008, p. 21)
  - *'small subgroups in the population can benefit by free riding on the U.S. states willing to support market prices, but the United States as a whole benefits from maintaining market pricing everywhere'* (Filson, 2012, p. 112)

This paper's topic and an ongoing debate

- European Union and joint procurement:
  - joint procurement of Covid-19 vaccines
  - joint procurement of Covid-19 new therapeutics
- joint procurement was a possibility **before** the pandemic
  - Joint Procurement Agreement (JPA) in April 2014 (specific to vaccines)
  - joint procurement of pharmaceuticals feasible under Directive 2014/24/EC
- **Should it go beyond the pandemic?**

Motivation: joint procurement

- Expansion of the **market size** of contracting authority
- expected benefits in terms of **reduced prices**
- the role of increased **bargaining power** (Espín et al., 2016)
- other existing experiences: **Beneluxa initiative**
  - involves Belgium, the Netherlands, Luxemburg and Austria
  - among motivations: 'Improve the payers position in the market by joint (price) negotiations for specific products'

Aims

1. understanding **mechanisms** underlying strategic interaction among regulators
2. investigating **empirically** the relationship between **country level characteristics** and **equilibrium prices**
3. drawing **policy implications**, especially from the EU perspective

Outline

Innovation and patients' benefits

- **Two countries** (A and B) with one regulator in each
- **one firm** potentially selling in both markets
- **marginal willingness to pay** for the new drug in country c at the individual level:

$$\text{MWTP}^c = \kappa^c \delta(I) - b^c q^c,\ c \in \{A, B\},$$

with:

  - q^c: quantity consumed by each of N^c identical patients eligible for the drug in country c
  - κ^c: country specific parameter scaling MWTP
  - $\delta(I)$ ($\delta_I > 0$, $\delta_{II} < 0$): impact on MWTP (effectiveness) of R&D investment, I
  - I: level of R&D investment by the firm

The firm

- Sells in market c if p^c exceeds country-specific reservation price, r^c
- Given p^A, p^B, firm **chooses investment I to maximize global profit**:

$$\Pi = N\left[\mathbf{1}_{p^A \geq r^A}[n^A(p^A - m)q^A - C^A] + \mathbf{1}_{p^B \geq r^B}[(1 - n^A)(p^B - m)q^B - C^B]\right] - I \quad (1)$$

where:

- $N = N^A + N^B$: size of global market (normalized to 1)
- $n^A = N^A / N$: proportion of global market sales in A
- m: marginal production cost
- C^c: fixed cost to enter the market (see, e.g., Bennato and Valletti (2014))

Regulators

- Regulators A and B **choose prices to maximise own country welfare**:

$$W^A = \alpha^A CS^A(\cdot) + (1-\alpha^A)\lambda\Pi(\cdot)$$
$$W^B = \alpha^B CS^B(\cdot) + (1-\alpha^B)(1-\lambda)\Pi(\cdot)$$

  where:
  - CS^c: consumer surplus in country c
  - λ: fraction of global profits earned in country A
  - α^c: weight on CS relative to global profits earned in country c
- regulate efficient level of consumption: $MWTP(q) = p$

Firm optimal investment

- Timing:
  1. Regulators simultaneously set prices p^A and p^B and can commit to them (Grossman and Lai, 2008)
  2. the firm decides on the amount of investment, I
- Focus: stationary equilibria with **adoption in both countries**

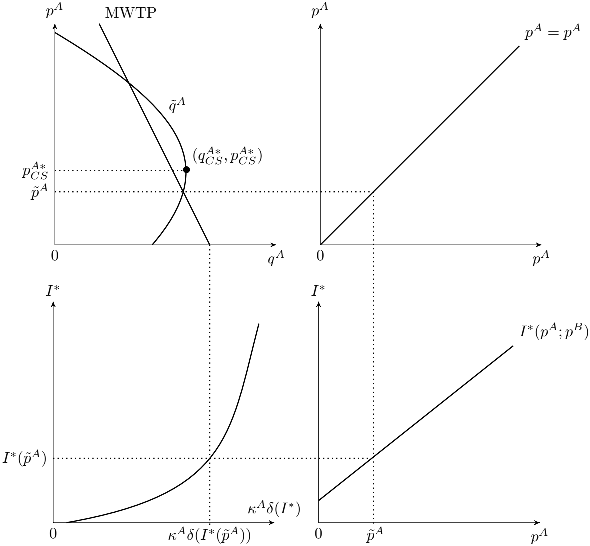
Regulators' optimal pricing

- Define, **feasible quantity**:

$$\hat{q}^A(p^A;p^B;\beta) := \frac{\kappa^A\delta(I^*(p^A;p^B;\beta)) - p^A}{b^A}$$

- Quantity consistent with I^* and $MWTP = p^A$

Optimal pricing



Reservation prices

- $\boldsymbol{r^A}$ and $\boldsymbol{r^B}$ **jointly defined** as minimum value to achieve non negative profits:

$$\begin{cases} \Pi^A = n^A(r^A - m)\hat{q}^A - C^A = 0, \\ \Pi^B = (1 - n^A)(r^B - m)\hat{q}^B - C^B = 0. \end{cases}$$

- reservation prices are **decreasing in domestic market share**

Nash Equilibria with interior solutions

Focus on situations with **prices strategic substitutes** leading to **stable equilibria** where **both countries adopt**

- In an equilibrium with **interior solutions** (NE^1):
  - $p_{NE}^{A*} > r^A$
  - $p_{NE}^{B*} > r^B$

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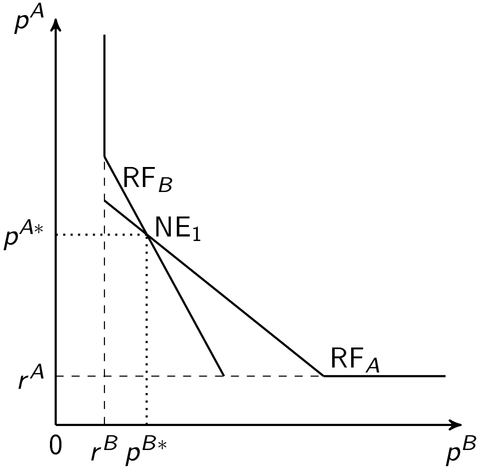

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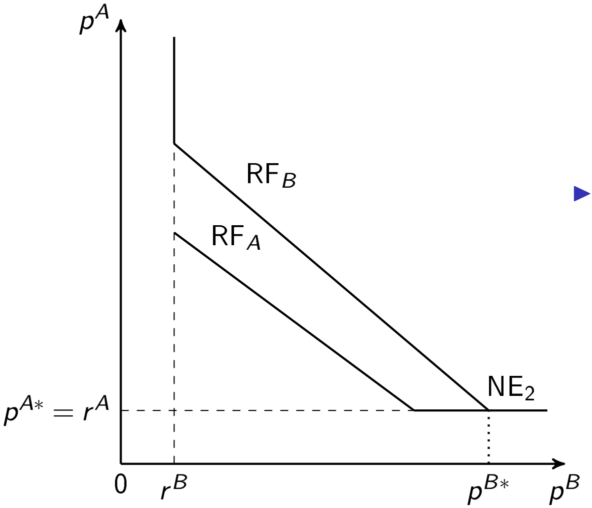
Nash Equilibria with corner solutions



- In an equilibrium with a **corner solution** (NE^2):
  - $p_{NE}^{A*} = r^A$
  - $p_{NE}^{B*} > r^B$

Comparative statics and equilibrium type

1. **Impact of n^A on equilibrium prices**:
   - $\frac{\partial r^A_{NE}}{\partial n^A} < 0$ if **equilibrium** is at a **corner**
   - $\frac{\partial p^A_{NE}}{\partial n^A} > 0$ if **equilibrium** is **interior**
2. If $\frac{\partial p^{A*}}{\partial n^A} > 0$, an increase in n^A shifts A's reaction f. upwards and B's reaction f. downwards, potentially reaching a **threshold** above which solution moves **from corner to interior**
3. **Implication**: eq. prices may be **U-shaped** in market share

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Outline

Econometric specification

$$\ln[p_{i,c,t}] = \alpha + \mu \frac{N_{i,c,t}}{Ntot_{i,t}} + \nu \left(\frac{N_{i,c,t}}{Ntot_{i,t}} \right)^2 + \delta' \mathbf{Z}_{c,t} + \zeta_i + \varepsilon_{i,c,t},$$

- $P_{i,c,t}$: price of drug i in country c at time t
- $N_{i,c,t}$: prevalence of the disease(s) treated by drug i in country c, at time t
- $Ntot_{i,t}$: total prevalence of disease(s) treated by drug i at time t in the sample
- $\mathbf{Z}_{c,t}$ includes, for country c at time t:
  - ln(GDP per capita), a proxy for WTP (κ^A)
  - ln(export of medicinal and pharmaceutical products), a proxy for λ
- ζ_i: product fixed effect

Data

- Sources:
  - prices: IMS Pricing Insights database
  - other: (Worlds Bank, UN)
- Period: quarters 2007-2017 (but shorter for some countries)
- Countries: 25 members of OECD in 2007
- Drugs: **83 on-patent cancer drugs** (ATC class: L01)

Why cancer drugs:

- largest therapeutic class in terms of sales value (similar to statins; OECD, 2008); rapidly increasing
- in recent years, key innovations

Descriptive statistics

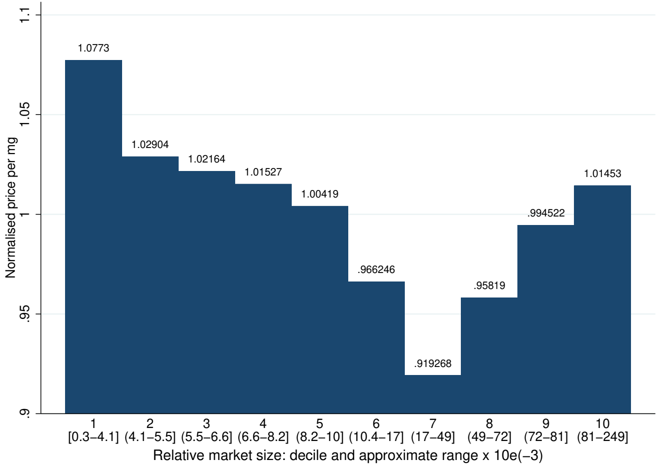

Figure: Standardized price by decile of relative mkt size

Results

	(1)	(2)
Relative market size	-1.410***	-1.790***
	(0.464)	(0.494)
Square of relative market size	9.422**	11.962***
	(3.965)	(4.241)
Natural logarithm of GDP per capita	0.165***	0.157***
	(0.019)	(0.019)
Natural logarithm of pharmaceutical exports	0.019***	0.022***
	(0.002)	(0.002)
Number of years since launch date		-0.024***
		(0.004)
Number of countries	24	24
Number of observations	20155	20155
Lind & Mehlum U-test (*p-value*)	0.013**	0.004***
Extreme point	0.075	0.075

Models include product-level fixed effects.
Standard errors (in parentheses) are clustered at the product level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table: Results of the main empirical analysis

Conclusion

- our theory combines different views on the role of market size as a determinant of drug prices:
  - monopsony power (often used to back proposals of joint procurement)
  - strategic interaction (Egan and Philipson, 2013)
- the two impacts may go in opposite directions
- relative importance dependent on market size: U-shape relationship
- implications of joint procurement:
  - impact **on prices**: depends on initial and final size of the market
  - impact on **social welfare**?

THANK YOU!

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