A Case for Affirmative Action in Competition Policy

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Chaire Finance & Développement Durable

Motivating examples

Electricity market in China

- Regional monopolies with (to some extent) region specific technologies
- Inter-connection growing

Electricity market in Italy

- Historic monopoly: ENEL
- Entrants got rotten lots

Electricity market in France

- Historic monopoly with large capacity: EDF
- Basically no entry

Overview

Literature: static normative theories or dynamic descriptive theories

- Perry and Porter (1985), Farrell and Shapiro (1991)
- Besanko and Doraszelski (2004), Hanig (1986), Reynolds (1987), Cellini and Lambertini (2003)

The paper is policy oriented

1. Simple theory of site allocation (= opportunities)
2. Effect in the long-run
3. Effect during the transition

Intuitive and strong results

1. Status quo (almost) never the best option
2. Social optimum: symmetry in initial conditions and investment opportunities
3. If symmetry not possible
   - Firms' interest: concentrate all in a single firm
   - Consumers' interest: compensate smaller firm with better opportunities
     The case for affirmative action
4. Problem: commitment by regulators

Differential game approach

- A game of capacity accumulation
- Continuous infinite time $t \in [0, +\infty)$
- Duopoly : firm i and firm j
  i for generic firm (j for generic competitor)
- Smooth strategies
- Open-loop strategies (tractability and more)

Investment

Capacity accumulation

$$\dot{k}_i(t) = I_i(t) - \delta_i k_i(t)$$

Investment cost

- Quadratic

$$C_i(I_i) = \frac{I_i^2}{2\theta_i}$$

- (θ_i, θ_j) belongs to set $\Omega \subset \mathbb{R}_+^2$

Production cost

- Linear (set at zero here for simplicity)
- Full capacity utilization (relaxed in paper)

Sites = investment conditions

- Continuum of available sites parameterized by $\theta \in [\underline{\theta}, \overline{\theta}]$
- Site specific investment represented by function $z(\theta)$
- θ site-specific investment cost $\frac{z(\theta)^2}{2\theta}$
- **Firm i described by sites it owns (indicator $\omega_i(\theta)$)**
- Each firm optimizes investment within its sites

This gives a global constraint

$$\theta_i + \theta_j = \Theta = \text{Constant}$$

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Sharing existing sites: choice space at reform date

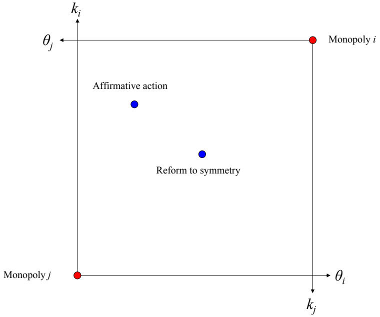

Figure: A kind of Edgeworth box

Competition

- Duopoly : firm i and firm j
- Inverse demand function at date t: $P(t) = A - q_i(t) - q_j(t)$

Firm i maximizes the present value of the profit flows

$$\max_{I_i(\cdot)} \int_0^{+\infty} \pi_i(t) e^{-\rho t} dt$$

where $\pi_i(t) = P(t) q_i(t) - \frac{I_i(t)^2}{2\theta_i}$

The open-loop Cournot-Nash equilibrium

- Control variables: $I_i(t)$ and $I_j(t)$
- State variables: $k_i(t)$ and $k_j(t)$
- Equilibrium when investments are reciprocal best responses
- Open-loop not an inferior concept
  - Information
  - Investment programming
  - Commitment
  - . . . **tractable!**

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- Dynamic equation

$$(\rho + \delta_i) I_i - \dot{I}_i = \theta_i \left[A - 2k_i - k_j \right]$$

- With accumulation equations

$$\ddot{k}_i + \delta_i \dot{k}_i - \left[2\theta_i + (\rho + \delta_i)\delta_i \right] k_i + \theta_i (A - k_j) = 0$$

- Define functions of time $h_i = \dot{k}_i$ and $h_j = \dot{k}_j$
- 2nd-order system of equations solved as a 4-dimensional 1st-order system:

$$\dot{H} = MH - N,$$

where $H = (k_i, k_j, h_i, h_j)^T$, $N = (0, 0, A\theta_i, A\theta_j)^T$ and

$$M = \begin{pmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 2\theta_i + (\rho + \delta_i)\delta_i & \theta_i & -\delta_i & 0 \\ \theta_j & 2\theta_j + (\rho + \delta_j)\delta_j & 0 & -\delta_j \end{pmatrix}$$

Proposition

M has two positive eigenvalues and two negative ones

- Weights given to diverging exponentials must be null
- So capacities, as a function of time, have the form

$$k_i(t) = c_i^0 + c_i^1 e^{\lambda_1 t} + c_i^2 e^{\lambda_2 t}$$

6 parameters identified with

- Initial conditions (2 equations)
- Particular solution of system = steady state (2 equations)
- Eigenvectors (2 equations—1 per vector)

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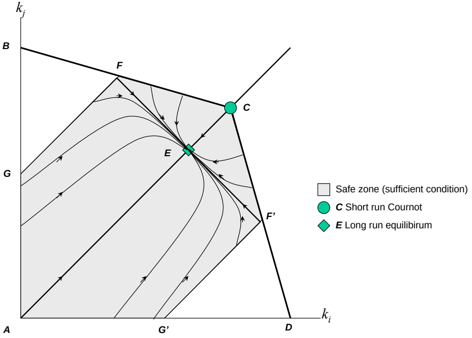
Trajectories



Comparative statics of long run

Proposition

Take $\delta_i = \delta_j$. *Equalizing investment costs*

1. *maximizes long run total capacity, thus consumer surplus*
2. *maximizes total surplus.*

More on the dynamics

- Where does it start from? **Critical choice**
- Where does the economy go? **Determined by choice above**
- How does it make the transition?
  - **A useful case** $\delta_i = \delta_j = \delta$
  - Eigenvalues and eigenvectors of M calculated explicitly
  - Look at **total** capacity over time = total consumption
  - Consumer surplus (actual value)
  - Profit (actual value)
  - Social surplus

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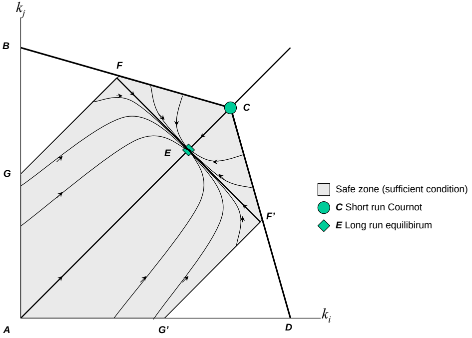


Convergence speed

Proposition

More asymmetric opportunities cause

- *faster growth*
- *longer durability of initial differences in capacities*

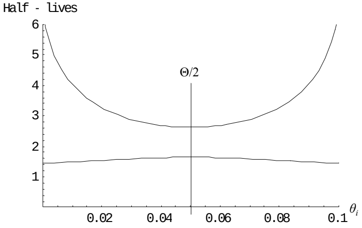


Figure: Half-lives: parallel growth and difference reduction

Persistance of initial conditions

Proposition

Fix θ_i and θ_j.
Assume wlog that $\theta_i \geq \theta_j$ (best for Firm i).
Fix total initial capacity K^0.
k_i^0 is the portion allocated to Firm i, while $K_0 - k_j^0$ goes to Firm j

1. *Total capacities at date 0 and in the long run are independent of initial sharing*
2. *Total capacity increases more slowly at date 0 for higher k_i^0*
3. *Total capacity at any date $t > 0$ is smaller for higher k_i^0*

Giving more to less efficient firm increases durably total capacity.

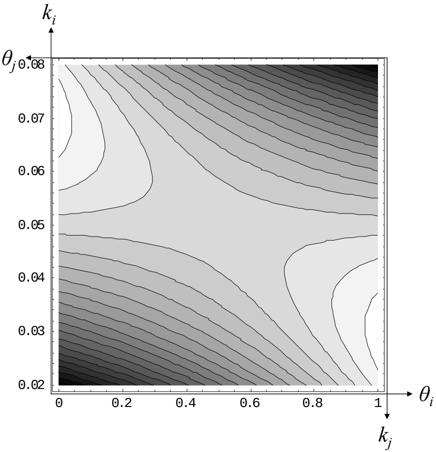
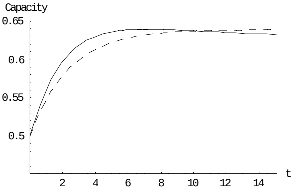


Figure: Consumers surplus

Asymmetric costs and capacities: an example

- $\delta = 0.05$, $\rho = 0.08$, $A = 1$, $\Theta = 1/10$ and $K_0 = 1/2$
- Two cases
  - Symmetric investment conditions
  - Asymmetric investment conditions



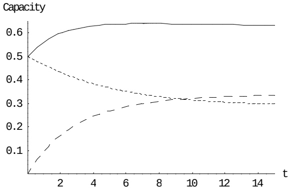


Figure: Total capacities. Firm specific and total capacities

Welfare: Why it's simple and complicated

Firms

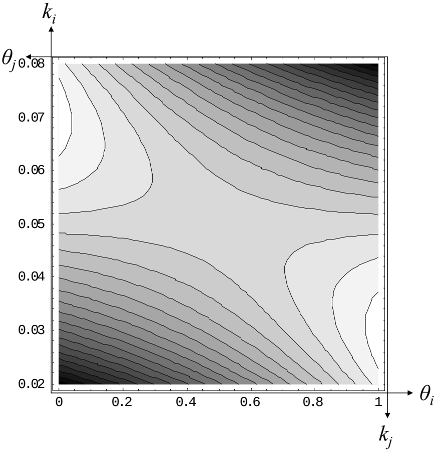
Collectively prefer very asymmetric costs (monopolization)

Consumers

Prefer strong contrasts (high cost/large capacity firm vs. low cost/low capacity firm)

Society

Total expected surplus maximized if reform renders all symmetric



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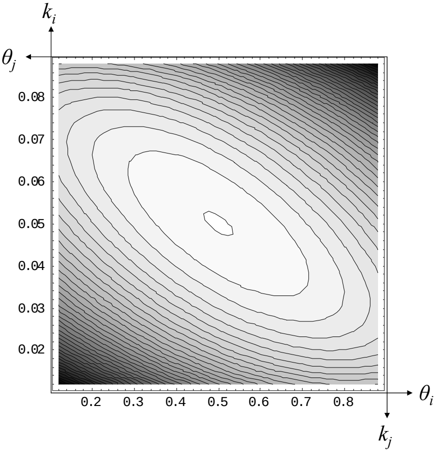
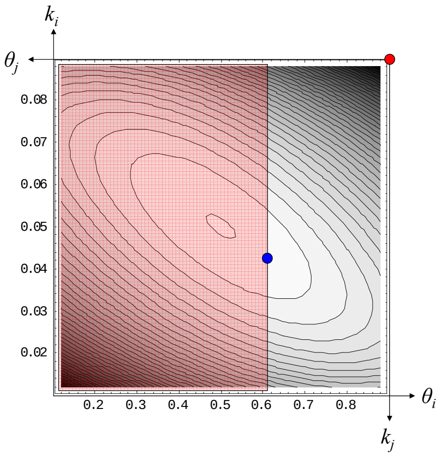


Figure: Social surplus



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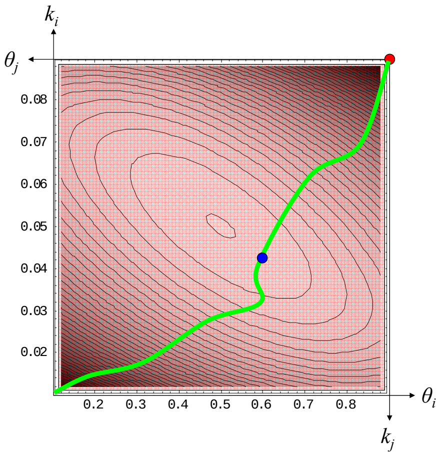

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Policy implication

- When priority is on long-run objective = symmetry dominates
- Asymmetric may be optimal for transition due to discounting
- Regulatory (in)consistency: symmetrize every so often