Information, incentives and mechanism design in regulation: a theoretical road-map

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FONDAZIONE PER L’AMBIENTE
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LECTURE OUTLINE

PART I: THE BACKSTAGE
Maps and reality
Economic freedom, choices and Institutions

PART II: INFORMATION AND GAMES
Information
Motivations and Choices
Strategic and not strategic contexts
Games

PART III: INFORMATION AND REGULATION
A TRIP

The journey between...

A) Individuals
B) Institutions/organizations
C) Markets
THREE LEVELS AND MULTIDISCIPLINARY APPROACH

• Information
• Knowledge
• Awareness
THROWN INTO UNCHARTED TERRITORIES?

- Road maps with sufficient granularity in all situations are not available
- Map of rationality
- Map of competition
INSTITUTIONS AND ORGANIZATIONS

• INST: systems of established and prevalent social rules that structure social interactions

• ORG: special institutions with
  (a) criteria for boundaries and membership
  (b) principles of sovereignty
  (c) chains of command
ECONOMIC CHOICES AND UNCERTAINTIES

\[ EV_a = f(\Theta_1, \Theta_2, \Theta_1 \ldots \Theta_n) \]
INSTITUTIONS AND ECONOMIC FREEDOM

• $a_i \in A_i$.

• $EV_a = f(\Theta_1 p_1, \Theta_2 p_2, \Theta_3 p_3 ... \Theta_n p_n)$

• Extractive/inclusive
• The presence of regulatory agencies is not a guarantee of regulatory success
TRANSACTIONS, MARKETS, INSTITUTIONS

A- in markets
B- within firms
C- with other institutional arrangements
The role of transaction costs and incomplete contracts
JUDICIAL SYSTEM, CONTRACTS, UNCERTAINTY

- Judicial activism
- Risk aversion
- Incomplete contract
- Options for freedom
PUBLIC HAND

- Politics
- Policy
- Polity
INFORMATION: A ROAD-MAP?
WHAT IS A PUBLIC INFORMATION?

An information $k$ is common knowledge if:

- Everyone knows $k$
- Everyone knows that everyone knows $k$
- Everyone knows that everyone knows that everyone knows $k$
- Everyone knows that....

This is Interactive epistemology!
Public information is the amniotic fluid in which choices are made in the CP model.
A CASE FROM INDUSTRIAL COSTS

• The cost $\mu$ for extraordinary maintenance of a water infrastructure
• The regulated firm knows $\mu$
• The regulator also knows $\mu$
• The regulated firm knows that the regulator knows $\mu$
• The regulator knows that the regulated firm knows that the regulator knows $\mu$
• *Try to outline the consequences of just the first 3 steps changing the scenarios from knows to don’t know*
PUBLIC INFORMATION AND THE PARADOX OF BACKWARD INDUCTION

• If I know that you know that I know ....Backward induction drives us to the traps of Nash equilibrium....

• ... WITH SOME PARADOXES (see traveler’s dilemma by Kaushik Basu)
WHAT IS A PRIVATE INFORMATION?

• An information that is not shared
• Asymmetry
• Markets extract private information and aggregate relevant private information

A goal of microeconomics: which design, institution, contract is best suited to minimize the economic losses generated by private information?
WHAT ARE YOU PROTECTING?
CLEANING MESSAGES

The owner of the bin locks it in order to clean the message on his own individual demand of service
TRYING TO HIDE INFORMATION: THE CASE OF MULTISERVICE UTILITY

- $C_a = K_a + aQ (\eta C_b)$
- $C_b = K_b + bQ$
TRYING TO HIDE INFORMATION: THE CASE OF DARK POOL

Dark pools as an interesting case of information hiding circa 8% of stock trades.
Is the context incentive compatible? (I know that your best interest is to reveal information).
BID - ASK SPREAD

BID

BUY/SELL

ASK

BID

INSIDER TRADING

ASK

ASK
Mechanism design theory defines institutions as non-cooperative games.

A mechanism can be described as a game: each part owns private info and send messages... rules assign outcomes

(Leonid Hurwicz, 1960)

Equilibrium happens when all participants in the mechanism send a message that maximise their own expected payoff.
THE ROLE OF MD

• Mechanism design has modernized and unified existing lines of research (industrial economics, contract theory, commons, finance, oligopoly, policy design…) and is surprisingly present in every day life as the following picture shows…
(Buy 3 and pay the cheaper 1 €)
HIDDEN MATHEMATICS BUT...

1) Max $R(x,p)$
2) $j \in i$
3) $x_1 p_1, x_2 p_2, x_3 p_3,$
4) con $p_3 < p_2 < p_1$
5) $U(x_1 p_1 + x_2 p_2 + x_3 g) > U(x_1 p_1 e x_2 p_2 e x_3 p_3)$
6) Alternatives: $(x_1 p_1 + x_2 p_2 + x_3 p_3)/3 < (x_1 p_1 + x_2 p_2 + x_3 g)/3$
7) Incentive:
   - Max $(p_3 - g)$
   - or
   - Max $(x_1 p_1 + x_2 p_2 + x_3 p_3)/3 - (x_1 p_1 + x_2 p_2 + x_3 g)/3$
...SIMPLE REALITY

aligning incentives!
INCENTIVE INCOMPATIBILITY
(MISALIGNED INCENTIVES)
IN PRIVATE EQUITY

Fees paid to private equity managers depend on the “reported” asset value!
ACTIONS AND REVELATION

An action reveals information

The more general question is how one’s behaviour affects other actors knowledge.

In the long run you cannot use information without revealing it and, consequently, destroying it.
The question: is the context incentive compatible?

(I know that your best interest is to reveal information)
CONFLICTS AND INFORMATION

• Many environmental conflicts are unresolved because of distrust caused by private information.
• Even if resolved, private information and distrust lengthen the process.
• Expert opinion is the most common way to cancel the effect of private information (on costs, mainly).
Public goods could not be provided at an efficient level...
...because people would not reveal their true WTP
Are there possible mechanisms in which (a) truthful revelation of one’s willingness to pay is a dominant strategy, and (b) the equilibrium level of the public good maximizes the social surplus?

YES (Edward Clarke, 1971 and Theodore Groves, 1973)
ONE-SHOT AND REPEATED GAMES

Revenge, altruism, trust, self-destructive threats can be explained only in a context of repeated game.
Everyone is in a corner thanks to NON-COOPERATION and absence of trust/information.
FOLK THEOREM

• Egoistic outcomes in repeated games correspond to cooperative outcomes in one-shot games.

• Non-cooperative strategic behaviour in the repeated game yields Cooperative behaviour.
### The Student’s Work-Group Game

<table>
<thead>
<tr>
<th></th>
<th>You</th>
<th>You</th>
</tr>
</thead>
<tbody>
<tr>
<td>Me</td>
<td>2 at me</td>
<td>8 to you</td>
</tr>
<tr>
<td>Me</td>
<td>2 at me</td>
<td>2</td>
</tr>
<tr>
<td>Me</td>
<td>8 to you</td>
<td>0</td>
</tr>
</tbody>
</table>

Nash equilibrium: non cooperation, mistrust?

Pareto optimum: trust, cartel

*(Franco Becchis revistation of the President dilemma, see Sergiu Hart presentation of Bob Aumann)*
# THE DUOPOLIST GAME

\[ Q = 20 - P \quad \text{C} = 15 + 8Q \]

<table>
<thead>
<tr>
<th>Quantity (FIRM A)</th>
<th>Quantity (FIRM B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Nash equilibrium / Cournot

Pareto optimum / cartel

[Diagram showing payoff matrix with Nash equilibrium and Pareto optimum highlighted]

# GAMES
### THE MAYOR AND THE UTILITY

<table>
<thead>
<tr>
<th>MAYOR</th>
<th>Clean</th>
<th>Not to clean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean</td>
<td>8</td>
<td>-4</td>
</tr>
<tr>
<td>Non to clean</td>
<td>-2</td>
<td>0</td>
</tr>
</tbody>
</table>

**Utility Matrix:**

- Clean Clean: 8
- Clean Not to clean: -4
- Non to clean Clean: -2
- Non to clean Not to clean: 0

**Common Knowledge:**

- The dominant strategy for both the mayor and the utility is to choose the strategy where they both do not clean.

**Turin School of Local Regulation:**

- The dominant strategy is indicated by the yellow circle.
But in the case of a repeated game...

<table>
<thead>
<tr>
<th>MAYOR</th>
<th>Clean</th>
<th>Non to clean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean</td>
<td>6</td>
<td>-2</td>
</tr>
<tr>
<td>Non to clean</td>
<td>-1</td>
<td>-3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>U dominant strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean</td>
</tr>
<tr>
<td>Not to clean</td>
</tr>
</tbody>
</table>

-3

-4

Turin School of Local Regulation
### THE CHICKEN GAME

<table>
<thead>
<tr>
<th></th>
<th>Leave</th>
<th>Stay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leave</td>
<td>5 5</td>
<td>3 6</td>
</tr>
<tr>
<td>Stay</td>
<td>6 3</td>
<td>0 0</td>
</tr>
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A (publicly) correlated equilibrium

Another Nash equilibrium

Another correlated equilibrium:
- after signal L plays Leave
- after signal S plays Stay

(Franco Becchis revision of the President dilemma, see Sergiu Hart presentation of Bob Aumann)
The firm can decide to invest in pollution abatement technologies (A) or not (N), the consumers can decide to protect themselves from pollution (P, double glasses, water filters..) or not (NP).

<table>
<thead>
<tr>
<th>Firm</th>
<th>Consumers</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>P</td>
</tr>
<tr>
<td>N</td>
<td>P</td>
</tr>
<tr>
<td>A</td>
<td>NP</td>
</tr>
<tr>
<td>N</td>
<td>NP</td>
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POLLUTER-POLLUTED GAME: THE PROTEST

If we have a second round of the game protest can arise, and the firm pay off can be eroded (litigation, PR, bad press, pressures from politicians).

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<tbody>
<tr>
<td></td>
<td>P</td>
</tr>
<tr>
<td>Firm</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>N</td>
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In the third round government impose a tax on polluter.

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HELPING THE POOR: COMPLICATED GAMES?

SCENARIO 1 – when for the donor mission and efficacy weight as follows:
- Mission (70)
- Effectiveness (30)

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<tr>
<th>CHANGE</th>
<th>GIVE</th>
<th>NOT TO GIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>NOT TO CHANGE</td>
<td>70</td>
<td>30</td>
</tr>
<tr>
<td>150</td>
<td>0</td>
<td>0</td>
</tr>
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HELPING THE POOR: COMPLICATED GAMES?

**SCENARIO 1** – when for the donor mission and efficacy weight as follows:
- **Mission (30)**
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</tr>
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<td><strong>NOT TO CHANGE</strong></td>
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<td>0</td>
</tr>
<tr>
<td><strong>NOT TO GIVE</strong></td>
<td>30</td>
<td>70</td>
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</tbody>
</table>
END OF PART I AND II

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