Public Goods

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Lecture 17
Regular Section
Elements of Economic Analysis II
Fall 2011

Introduction

Competition policy aims to prevent harmful collusion

- But at least as often we want to promote collaboration
- Today we'll talk about *public* projects that require this
  - Bring diffuse benefits/costs spread over society

$\Longrightarrow$ Voluntary individual initiative is insufficient

1. Collaboration as a dual of Cournot competition
   - Pessimistic corollary to Cournot's Theorem
2. Relationship to public goods
3. Definition and examples of public goods and bads
4. Private solutions: varieties and limitations
5. Why private provision of public goods cannot work
6. Coercion in public goods and bads
   - Complementary goods assembly and eminent domain
7. Brief wrap-up of the course

Cournot's model of collaboration

Cournot was a pretty smart guy

- Not just monopoly and competition but also *collaboration*
- N firms perfect complements rather than substitutes
  - Consumers need all of them to get any value
  - Cost of purchasing bundle is thus $P \equiv \sum_{i=1}^{N} p_i$

$\Longrightarrow$ Demand Q function of *sum of prices* P

- For simplicity, again, constant marginal cost c_i
- Each firm's profits are $(p_i - c_i)\, Q(P)$ or $m_i Q\,(M - C)$
  - As usual, capital letters are the sum of small letters
- Optimal pricing?
  - $Q + Q' m_i = 0$ or $m_i = -\frac{Q}{Q'}$ or $M = -N\frac{Q}{Q'}$
  - Notice: exact opposite of competition, $M = -\frac{Q}{NQ'} = P'Q$

$\Longrightarrow$ More firms makes things worse! "Double marginalization"

A mathematical example of complementary monopoly

Let's consider example $Q = 1 - P$, $c_i \equiv 0$

- What is $-\frac{Q}{Q'}$?
  - $-\frac{1-P}{-1} = 1 - P$
- What is equilibrium price?
  - $P = N(1 - P)$ so $(N + 1)P = N$, $P = \frac{N}{N+1}$
- What is quantity?
  - $1 - \frac{N}{N+1} = \frac{1}{N+1}$
- So what happens as number gets large?
  - Price rises towards 1, chokes off all demand!
  - Exact opposite of what happens with Cournot
  - Firms don't account for harm to others from high price
- In fact, formulas exactly the same as with linear Cournot
  - Suggests a deeper similarity between situations

$\Longrightarrow$ In fact they are equivalent/dual to one another

Duality and the effect of complementarity

Let's compare the two problems:

1. Cournot quantity competition
   - Everyone takes others quantities as given
   - Price depends on sum of quantities
   - Profits are product of mark-up and quantity
2. Cournot collaboration
   - Everyone takes others prices as given
   - Quantity depends on sum of prices
   - Profits are product of mark-up and quantity

These problems are exactly identical!

- Just interchange prices/mark-ups and quantities

$\Longrightarrow$ Any result in Cournot model applies here...reversed!

- Firms hurt others by raising *price* rather than quantity
- Prices too high even from firms' perspective

Bergstrom's Corollary to Cournot's Theorem

Each scrambling for its piece of the pie rather than growing

$\Longrightarrow$ Merger would actually lower the price!

- Different policy towards "vertical" mergers
  - When one firm supplies to other, complements
  - Called "vertical" because of diagram
- Similarly policy towards pools of complementary patents
- What is reverse of Cournot's Theorem?

Bergstrom's Corollary

As N goes to ∞, q goes to 0 with complements.

- Mark-ups individually small, but collectively kill all demand
  - Very pessimistic! Layers of monopoly
  - "Tragedy of commons"

Complementary monopoly and public goods

Let's consider a very similar, even more famous problem

- We basically saw this problem in Problem Set 3
- We can make costly contributions to charity a_i
- Each of us gets value $v^i(A)$ where $A = \sum_i a_i$
  - Assume $v^{i'} > 0$ for all i
- So value to each is is $v^i(A) - a_i$, society is $V(A) = \sum_i v^i(A)$

$\Longrightarrow$ Contribution brings total value V' but individual gets $v^{i'}$

- For example, if symmetric, $\frac{V'}{N} = 1$ rather that $V' = 1$

$\Longrightarrow$ Same result as Cournot!

- Everyone "free-rides", hopes others will contribute

The Collective Action Problem

In a large population with voluntary contribution, "public goods" become arbitrarily under-provided.

Definition of a public good

What, exactly, makes something a public good though?

- We just gave example, but what were broader conditions?
  1. Non-rival: most important
     - One person receiving benefits does not preclude others
     - Zero marginal cost of supplying to others
  2. Non-excludable: secondary
     - Everyone receives the benefit regardless
     - No way to exclude or charge for participation
- Examples failing first condition called “congestable’
- Examples failing second called “excludable”
  - IP that is potentially enforceable or not
  - Really an issue of the cost of exclusion: continuous
- More important is whether private guy knows value
  - Individuals know value better than entrepreneur

Examples of public goods

Pure public goods?

1. National defense
   - If you protect the country, everyone automatically
2. Environmental services (weather, etc.)
3. Existence value of goods, charity etc.
   - Everyone gets value of things continuing to exist
4. Ideas: but not obviously known to beneficiaries

Congestible?

1. Infrastructure (roads, bridges)
2. Amenities (lakes, parks, national and city, etc.)

Excludable?

1. Most things covered by IP
2. Land reform: breaking up estates for tenants

But these are only public *goods*: At least as important are bads!

Assembly problems and public bads

Many things bring diffuse *harms* rather than *benefits*:

1. Land takings (sometimes diffuse benefits too!)
   - Need a particular (or contiguous) block of land for project
   - Hurts all (or none) of those whose land is taken
2. Corporate acquisitions: all lose their shares
3. Debt settlements: all agree to avoid bankruptcy
4. FCC spectrum reassembly
   - Fragmented by auction, put together for Wi-Max
   - I've been working with them a bit on this
5. Patent pool assembly: avoiding multi-marginalization
6. Polluting projects: impact on wide number of people

Not different than exteranlities, but victims' knowledge important

- Collective action problem applies again, now "holdout"
  - Everyone demands large payment to accept harm

Can altruism provide public goods?

Problems sound pervasive; how can we solve them?

- I'll try to argue we need coercion often
- But first let's consider potential private solutions
- One is altruism:
  - Often people do public spirited things:
    - Giving to charity, voting, volunteering for military
  - While people choose, not classic "self-interest"
  - We explored in Problem Set 3, motivated by:
    1. Prestige: looks good to other people (mates?)
    2. "Warm glow": makes you feel good (regardless of effect)
    3. Signaling: shows you are good person, helps career, etc.
  - No question that these help, important social tools
  - But require slow development of culture

$\Longrightarrow$ Neglects many important problems (especially bads)

Tiebout competition and local public goods

If goods (bads) are local, easy to move...

- Then people can move to the place that is good
- This is called *Tiebout competition*
  - Local areas compete in provision to attract people
  - Important for many local public services
    - Street cleaning, schools, police, fire, etc.
- But depends crucially on *mobility*
  - People must be able to cheaply move to best area
  - Value of good must be independent of location

$\Longrightarrow$ But this makes essentially excludable!

- Can keep people out of moving
- And also a bit rival
  - Only so many people can live in the area, go to school

$\Longrightarrow$ Not a solution for “real” public goods

Lindahl pricing and unanimous consent

Most famous solution from Swedes: Lindahl and Wicksell

- Imagine the project is just building some: binary yes or no
  - Simpler, but everything can easily be extended
  - We'll focus on this case from now on
- Each citizen gets value v_i, cost C of undertaking
- You can ask each person to pay *share* $s_i \equiv \frac{v_i}{V}$ of C
- If $V > C$ (efficient) everyone agrees: $V > C \implies v_i > \frac{v_i}{V} C$
- So why not say:
  1. If everyone agrees, project built, you pay your share
  2. If *anyone* disagrees, project not built

$\Longrightarrow$ Succeeds exactly when efficient!

- Everyone is "pivotal" in decision, so all is good
- "Lindahl pricing/equilibrium" and "Wicksellian unanimity"

- Would this really work?

Intuitive practical problem with unanimity

Probably not, for a few reasons?

1. Might not be credible
   - If one person said no or "held out" government compromise
   - This might be addressed by reputation
2. More importantly, what if you don't know values?
   - *Everyone* has to agree for project to proceed
   - But people will agree only if $v_i > s_i C$
   - If s_i only approximates $\frac{v_i}{V}$, dangerous
   - Even with low probability of $v_i < s_i C$, so many people!
   - If even one says no, ruins it for everyone!
   - This is why it is hard to imagine using this
   - There is always at least one unpredictably stubborn person

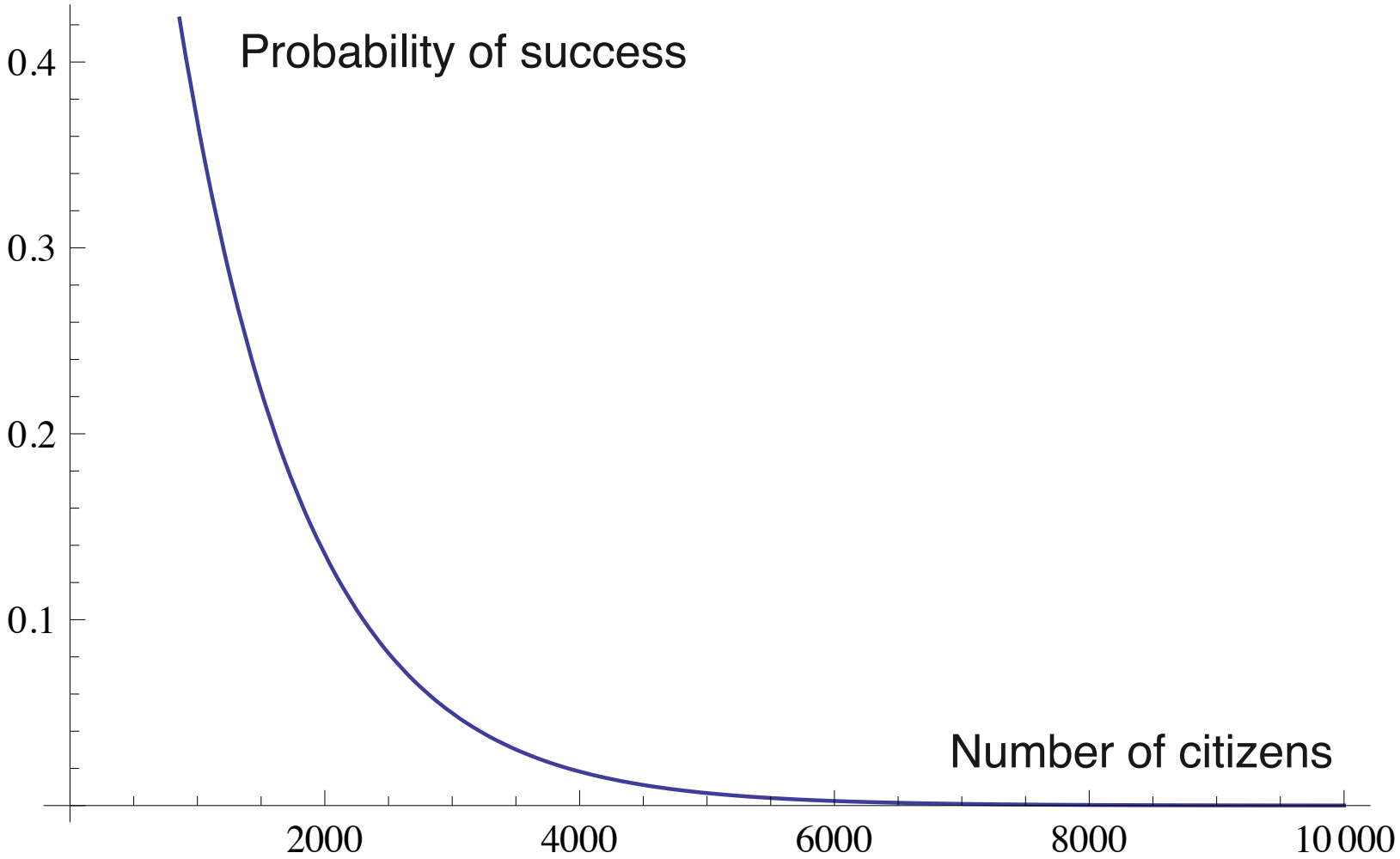
We can study this formally by crunching numbers

Proof that unanimity works poorly

Suppose the CDF of v_i, shares $\frac{1}{N}$ is $F(v_i)$, i.i.d.

- Then probability *any individual rejects* is $F\left(\frac{C}{N}\right)$
- Probability individual consents is $1 - F\left(\frac{C}{N}\right)$
- Probability that *everyone* consents is $\left[1 - F\left(\frac{C}{N}\right)\right]^N$
- Suppose we can get $F\left(\frac{C}{N}\right)$ as low as .001
  - Only one in a thousand would object! Very low!
- But once 1000 people, only 35% chance of success
  - With 10,000 (small town), less than one chance in 20,000!
- Adjusting shares cannot fix; call demand $Q \equiv 1 - F$
  - Divide to equate market powers $\frac{Q}{Q'}$ across individuals
  - May improve a bit when not i.i.d., but still high!

A graphical example of unanimity failing



The Mailath-Postelwaite Theorem

Not just true of this simple offer: any scheme basically same

- If we start letting payments depend on value reports...
  - Then we are back in the collective action problem!
  - No one will report high, free-ride on others
- But if we don't, we have the unanimity problem!

$\Longrightarrow$ Damned if you do, damned if you don't

- This is basis of fundamental theorem, like Cournot:

The Mailath-Postelwaite Theorem

If everyone must consent to their funding the project and no external funds are available, the probability the project is undertaken goes to 0 *as N gets large.*

$\Longrightarrow$ No private (voluntary and self-financing) system works

The necessity of coercion for public goods/bads

Thus we *always* run into collective action problem

- Public projects (good or bad) always requires coercion
- We did it for binary case, but true more broadly
- Coercion can operate in two (essentially identical) ways?
  1. Making members of community consent
     - This allows us to overcome basic problem
     - When some coerced, probabilities don't compound
  2. Raising external funds
     - We could also just raise and inject funds from outside
     - But where would this money come from?
     - Must be charity (insufficient) or taxes!
     - But if a tax, violates someone's consent to project

$\Longrightarrow$ Both strategies identical coercive tax-raising

Eminent domain and taxation

How in practice does this work?

1. Public goods funded by taxing beneficiaries
   - Local communities raise property taxes
   - Cities raise general revenue for many services
   - Much of (especially non-national) government spending
2. Public bads use some sort of coercion (eminent domain)
   - When land to be assembled, government allowed to “take”
   - Called “eminent domain” and requires “just compensation”
     - Typically based on “fair market value” for land
     - Below what people value their land at, reason for outrage
     - Expanded by Supreme Court decisions, backlashes
     - Allowed for private used as well as public
   - Similar for others (debt and corporate acquisition voting)
3. Coercive tax revenues from outside often help ease
   - Subsidies to locals, town revenue to pay off holdouts

Ways of deciding on public goods

How do we determine when to use coercive state?

- When is it worth building the project?
- Basically very similar to externalities discussion
- What ways did we talk about then?
  1. Assessment by experts
  2. Ineffective surveys
  3. Fancy mechanisms
- Used with declining frequency down this list
- Any key differences here?
  1. Especially with binary, very simple decision
  2. We think input from individuals is very important
  3. Very large number of individuals involved
- In these settings, we often use *voting* to decide
  - Everyone gets some weight, approved if over a threshold

Pros and cons mechanisms for social choices

This leaves us to choose (trade-off/combine) a range of evils

1. Expert analysis of decision; pros and cons?
   - Pros: allows expertise, reflection, less incentive problem
   - Cons: if individuals important, leaves out (undemocratic)
2. Vickrey-Clarke-Groves; pros and cons?
   - Pros: efficiently incorporates information
   - Cons: collusion, impractical, money-burning mess!
3. Voting; pros and cons?
   - Pros: incorporates individual values, simple
   - Cons: weak connection to efficiency (median v. mean)

Among available options, probably combine 1 and 3:

- What system of government might do this?
  - Representative democracy/republic: expertise plus voting
- My recent research asks if we can do better

Wrapping up the term

This term explored basic trade-offs in economic organization

- Hopefully better, nuanced, less ideological understanding
  - Quantifying and disaggregating “socialism” v. “capitalism”
- Quickly review some of the main components/roles of state
  1. Internalizing externalities and providing public goods/bads
     - Distortions from ignoring v. flaws of information, politics
  2. Redistributing income and providing social insurance
     - Insurance v. incentives to earn income
  3. Regulation and prizes
     - Static DWL v. innovation incentives, entrepreneurship
  4. Competition policy against cartels and mergers
     - Economies of scale v. DWL and creative destruction

$\Longrightarrow$ Not all the same, think carefully, don’t just package

- Combine the role of expert and voter, improve our world