Lecture 19 – Land use regulations continued

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1 Problems

1. When the conditions stated in the Coase theorem are not met, then the problem is to design a set of government, legal, and market policies and institutions to maximise social welfare subject to the constraint that the conditions of the theorem are not met.

2. Why might the conditions of the theorem not be met?

   (a) Transaction and bargaining costs.

      i. These can be large (500,000 motorists on a highway, 10,000 people live next to the dry cleaners, people move in and out). Simply getting people together to discuss the solution can be a problem. The problem is made worse by the presence of asymmetric information. Different people have different information about the costs and benefits of various policies and different people may not know what information others have.

      ii. When these costs are large, different legal rules can lead to different outcomes. In general these outcomes will not be efficient (though they may be efficient under some circumstances). If the fully efficient outcome is not possible, then a legal rule should be sought that yields a "desirable" distribution of payoffs and is closest to being efficient.

   (b) Costs to measuring and defining property rights.

      i. For example, a fully efficient property rights system governing air pollution would have to monitor the pollution emissions of all land uses for every person and firm in the economy at every date and at every location. Such monitoring would be impossibly costly. Because of these costs, a compromise must be made that defines property rights in some cases and then seeks an outcome that is as close to the fully efficient outcome as possible, again taking into account concerns about the distribution of resources.

ii. As one indication of the size of the problem of measuring and defining property rights for land, consider the US. In the United States, there are 83,000 local governments each of which determines local laws governing land use and property rights. In a small US town with 8,000 people, the land use regulations run to 85 pages. Land use regulations in NYC are contained in several large volumes.

iii. Or, what are the costs of defining (and enforcing) property rights related to the emission of carbon dioxide? Virtually every sector of the economy including agriculture, industry, transportation, retail, household, mining and forestry emits carbon dioxide. Measuring the emissions (or storage) from every possible source is currently not technologically feasible.

iv. As a second indication, go to a book store, and scan the section on land law or property law. It is not a small section.

(c) Costs of enforcement.

i. Even in cases where rights are mostly clearly defined, the legal system must have some mechanism to enforce the rules and settle disputes. This enforcement mechanism involves police, inspectors, lawyers, economists, judges, the legal system, etc. All of these are costly and imperfect enforcement mechanisms.

2 Problem arising when bargaining costs are high: land assembly problem

1. 10 properties in a city. Current use each is worth £10. Suppose someone buys 5 of them spends £25 and converts into shopping mall and the new value of every property is £20. If $p < 10$, no one is willing to sell since p less than current value. If $10 \leq p < 20$, no one wants to sell since price is greater than current value but value afterwards is £20. If $p \geq 20$ no one wants to buy since can't make profit. Property owner 1 can't buy from 2-5 since would have to pay £105, value is only £100.

   (a) Everyone benefits from investment. Private benefit is less than cost. Total benefit greater than total cost.

   (b) If costly to bargain or cooperate, investment is not made.

   (c) If relatively costless to bargain, 3 owners might reach agreement. If owners 1-3 do nothing, their properties have a combined value of £30. If they get together and buy properties 4-5 at a price of £20 per property and redevelop, the cost would be £25+£40=£65. The value of their combined propertes minus costs would be 5*20 - 65 = £35.

(d) In this example it seems like it might be easy for two people to reach agreement. In more complicated examples, there might be disagreement about value of project, cost of project, costly to reach agreement. If government has a way to determine the social costs and benefits, should step in and force project through. Should make the investment, compensate those who are made worse off, tax those who are made better off. Sometimes it is difficult to determine who is harmed and who is benefitted and the size of the subsidy and tax. But, government must have information about costs and benefits.

3 The Coase Theorem and bargaining

Suppose a firm maximises profits by choosing action a. Profits are

$$\pi(a)$$

subject to $a \leq \overline{a}$ with $\frac{\partial \pi}{\partial a} > 0$. Suppose further that action a produces pollution which lowers the utility of other people in the city. The utility of the n other people in the city is

$$-u(a)$$

per person with $\frac{\partial u}{\partial a} > 0$. With no bargaining, the firm will choose $a = \overline{a}$ produce too much pollution if it has the right to pollute. Now suppose the people can bargain at cost $b(n)$ per person and reach an agreement to pay the firm to reduce a. In this case, if the people pay the firm p or $\frac{p}{n}$ per person, the firms profits are

$$\pi(a) + p$$

and the total utility of the other residents is

$$-nu(a) - nb(n) - p.$$

Suppose the residents decide to pay the firm to reduce the level of pollution to $a_1 < \overline{a}$. Then the firm will accept the payment if

$$\pi(a_1) + p \geq \pi(\overline{a}).$$

Each resident will be better off if

$$-u(\overline{a}) \leq -u(a_1) - b(n) - \frac{p}{n}.$$

Thus the residents and the firm will reach an agreement if

$$p \geq \pi(\overline{a}) - \pi(a_1) \tag{1}$$

and

$$p \leq -n(u(\overline{a}) - u(a_1)) - nb(n). \tag{2}$$

The firm will benefit if the payment is larger than their cost of reducing a. The residents will benefit as long as the payment is less than their gain from reducing a minus the bargaining costs. Note how the solution depends on the cost of reducing a, the benefit from reducing a, the number of people, and the bargaining costs.

How would the solution change if the firm had to pay the residents to be allowed to pollute?

4 Asymmetric information: Choice of location for airport

1. There are N possible locations for airport. None want it because it is noisy at all hours of the night. The government assures everyone that while the airport is noisy, the alternative of not having an airport is worse. The government wants to put the airport the lowest cost location. (Assume the benefits from the airport are the same regardless of the location.) No one wants the airport, but it is more harmful to some than to others. Suppose everyone has an amount of money they would accept as compensation for taking the airport in their community. Each community has a community official who negotiates with the government. Let v_i be the amount that community i would accept. That is, if community i were paid v_i pounds they would accept the airport.

2. How to find the lowest cost location and minimize the amount paid?

3. Government does not know the distribution of the v_i variables. If it did it could simply build the airport in the location with the lowest cost. This is the asymmetric information problem. The communities have information, the government does not.

4. How to induce communities to reveal their true values of v_i?

5. Second price auction.

   (a) Each community is required to provide a bid b_i revealing how much they desire to be paid if they accept the airport.

   (b) The government selects the location with the lowest bid and pays them an amount equal to the second lowest bid. If the two lowest bids are equal, the government selects the winner at random.

   (c) We will say that if community i is the lowest bidder it wins the auction. If it is not the lowest bidder, it loses the auction.

   (d) Incentives facing each community.

i. Consider community i. Let b_{-i} be the lowest bid of all other communities. If community i bids b_i then its payoff is

$$\left\{ \begin{array}{ll} b_{-i} - v_i & \text{if } b_i < b_{-i} \\ 0 & \text{if } b_i > b_{-i} \\ \text{either } 0 \text{ or } b_{-i} - v_i, \text{ each with probability } \frac{1}{2} & \text{if } b_i = b_{-i} \end{array} \right\}.$$

ii. If community i loses the auction, its payoff is zero.

iii. If community i wins, its payoff will be positive if $b_{-i} > v_i$, negative if $b_{-i} < v_i$, or zero.

iv. Community i will never make a bid b_i such that $b_i < v_i$. Why? If it does bid $b_i < v_i$, there are three possible types of outcomes. If $b_{-i} < b_i < v_i$, the community loses and obtains a payoff of zero. If $b_i \leq b_{-i} < v_i$, the community wins the auction (with probability of one half if $b_i = b_{-i}$) and earns a payoff of $b_{-i} - v_i < 0$. If $b_i < v_i \leq b_{-i}$, the community wins the auction and obtains $b_{-i} - v_i \geq 0$. The second type of event, $b_i \leq b_{-i} < v_i$, is a bad event from community $i's$ perspective. It can reduce the probability of this event to zero by increasing b_i so that $b_i \geq v_i$. As long as $b_i \leq v_i$ increasing b_i reduces the probability of obtaining a negative payoff without affecting the probability of a positive payoff. Thus, community i has an incentive to increase b_i so that $b_i \geq v_i$. Also, changing b_i only affects the probability of winning. It does not affect the payoff if they win.

v. However, community i also has an incentive to not bid $b_i > v_i$. If $b_i > v_i$, there is a positive probability that $b_i > b_{-i} \geq v_i$. In this event, community i obtains a payoff of zero but could have obtained $b_{-i} - v_i \geq 0$ by bidding $b_i \leq b_{-i}$. By bidding $b_i - v_i$, they give up a chance of earning the non-negative profit $b_{-i} - v_i$. They can reduce the probability of this event to zero by decreasing b_i until $b_i \leq v_i$. Reducing b_i only affects the probablity of winning. It does not affect the payoff if they win.

vi. Combining the previous two ideas, it is optimal for community i to choose $b_i = v_i$.

vii. As long as, $b_i > v_i$, lowering b_i increases the probability of winning a positive payoff without lowering the amount of the payoff.

viii. Suppose $v_i = 10$ and suppose b_{-i} is uniformly distributed between 8 and 18. Suppose you bid $b_i = 12$. Then you have a 60% chance of winning at least $12 - 10$ if $b_{-i} > 12$. You have a 40% chance of losing. However, if you lower your bid to 10, you still have a 60% chance of winning at least 2, but now you have a 20% chance of winning something between 0 and 2 and a 20% chance of not winning. By reducing bid to v_i you have maximized your expected payoff.

ix. The auction gives the communities incentive to reveal their true values since lowering bid does not affect realized payoff but does

increase probability of positive payoff. Positive incentive to bid lower.

6. Summary of second price auction.

   (a) Monetary incentive to bid true value.

   (b) Compensation is crucial. Much political opposition to undesirable facilities stems from the fact that most projects offer too little compensation to "winners".

   (c) Collusion causes problems for this scheme. If communities collude, they might all agree to bid $v_i + £1,000,000$. This will still result in the project being placed in the low cost location, but not at minimum cost.

   (d) This type of mechanism can be used for any facility such as an airport, a landfill, an incinerator, a prison, or a cell phone tower. It can be used for any public facility that causes harm.

   (e) A similar auction can be used for a public facility that causes positive externalities. In this case, each community bids b_i and must pay the government the maximum of the other bidders bids.

5 Issues related to the legal environment

1. Regulation vs taking.

   (a) In the US, local governments have "police power" to regulate land use without compensation. Regulations restrict the property rights of individuals. These restrictions reduce the property value of the land. The government is not required to compensate individuals for this dimunition in value.

   (b) However, if the government "takes" land it must provide "just" compensation.

   (c) The legal question is, what distinguishes "regulation" from "taking". Both restrict the property rights of land owners. Both reduce the value of land. Regulation does not require compensation. Taking does.

2. When is compensation not required?

   (a) There are a body of laws and court decisions which collectively define circumstances under which compensation is required. The law states that compensation is not required when a regulation benefits "public health, safety, morals or general welfare." Compensation is also not required if a restriction (or regulation) prevents public harm or nuisance. Such a regulation must use reasonable means to achieve the

public benefit or prevent the public harm and the impact of the regulation must not fall disproportionately on any individuals. Under these general circumstances a land use regulation does not require compensation. A large number of legal cases arise from disputes as to whether these conditions are met.

(b) Examples.

i. Police regulations can force motorists to stop at traffic lights without providing compensation for lost time.

A. Should governments provide compensation for lost time due to this restriction?

B. Regulations also force airline passengers to go through security checks. Such regulations "take" passengers time. Should passengers be compensated? Should these regulations only focus on a particular group of people? If the regulations focus on a particular group, should this group be compensated?

ii. Police can require people to reduce noise at a party or a concert. The noise is deemed to be a public nuisance.

iii. Police can force owners of historic dwellings to invest money to maintain the structures.

iv. Police can force landowners not to build on a beautiful beachfront land if new construction obstructs the views of others.

v. Suppose initially a cement plant exists at location A and no houses exist at location A. Then some people move into location A and build houses. Should the cement plant be forced to shut down at location A? Before the new houses were built, the cement plant was not a nuisance. After the houses are built, it is a nuisance and causes damage to the health of residents at location A.

3. The legal system defines general (not always entirely consistent) circumstances when compensation is required.

(a) A regulation or policy that involves the "physical invasion of property" is a taking and requires compensation.

(b) A regulation that causes "significant dimunition of value" and/or restricts "all reasonable, beneficial use" is a taking and requires compensation.

(c) A regulation whose costs outweigh its benefits, requires compensation.

(d) The interpretation of these conditions varies across legal jurisdictions, across legal cases, and across time.

6 Land use regulation (types and market effects)

1. Why zoning? Why land use controls? Why planning laws?
   (a) Externality.
      i. Two people live next two each other, one is a dry cleaner, one is a residential house. Market outcome without regulation could result in too much air pollution produced by dry cleaner or too little. Public policy might like to avoid this outcome perhaps by keeping the two separated or by regulating one of the two.
      ii. Public benefit from architectural or other character of a neighbourhood. Public benefit from protecting and preserving such character.
   (b) Economic justification: Conditions of Coase theorem are not met and government intervention leads to more efficient outcome and/or "better" distribution of wealth.
   (c) Legal justification for zoning laws in the US: "Promote public health, safety, and welfare".
   (d) Generous political use of legal language can lead to the use of these laws for other purposes.
   (e) In SF, in the 1880's, zoning restrictions were instituted in part to keep Chinese population separate from white population. At that time, there were restrictions on where Chinese population could work. Many worked in laundries. The law restricted laundries to certain locations. Purported reason to keep laundries out of residential areas and prevent public health and safety problems.
   (f) In NY 1916, many low wage women were working in the garment district and numbers were increasing. High street retailers feared these low wage workers would damage business and proposed legislation to limit building sizes and heights and hence garment factories. They claimed this was to prevent a public "nuisance" caused by tall buildings (shadows, blocked light, disruption of view). The new legislation helped reduce the "nuisance" but also helped high street retailers at the expense of consumers, garment production firms, and low wage workers.
   (g) Simple model of a city with a fixed number of residents and a fixed number of vacant lots.
      i. Owners of developed land benefit from increasing stringency of land use controls on undeveloped land.
         A. See Figure 1 at the end of these notes.
         B. The variable x measures the degree of stringency of the landuse controls. The variable ranges from 0 (no restrictions on landuse) to 1 (complete restrictions on landuse).

C. Aggregate marginal benefits (MB, the falling curve in the graph) fall as regulations become more stringent. Suppose there are 10 owners of developed land and increasing the stringency increases their property value, but at a diminishing rate.

D. Aggregate marginal costs (MC, the rising curve) rise. Suppose there is one developer. Increasing the stringency of regulations reduces the value of undeveloped land at an increasing rate.

E. The marginal benefits accruing to existing residents/landowners are positive and declining.

F. The marginal costs inflicted on the developer are positive and rising.

G. Suppose the residents and one developer vote on controls: Landowners prefer $x = 1$, developer prefers $x = 0$. Why? If they vote on whether to have $x = 1$ or $x = 0$, then the political equilibrium is $x = 1$.

H. An efficient outcome would be an intermediate value of x where $MC = MB$.

I. There is room for bargain to be made. If the residents and the developer could bargain, they would reduce x from 1 toward efficiency.

J. If $x = 1$, developer would be willing to pay residents to ease restrictions.

K. If $x = 0$, company owned town, residents would be willing to pay developer to cut back on development.

L. If it is costly to bargain, because the residents and the developer can't agree on how to split the surplus or because there is asymmetric information such that each person knows his own cost and benefit but no one knows anyone elses costs and benefits, then an efficient bargain will not be struck.

2. Many types of planning controls.

   (a) Nuisance zoning: restricts uses of land that have negative externalities.

   (b) Fiscal zoning: excludes households that do not pay fair share of local public property tax (ie high rise or small lot houses).

   (c) Performance zoning:

      i. Restricts uses of land, but more specific than nuisance zoning.

      ii. Factory can engage in manufacturing at location A if smoke emissions are less than 6 parts per million per hour.

      iii. Pub can open at location A if there is no "excessive noise" after 5:00 pm.

iv. Developer can build high rise at A if he/she provides 1.5 parking spaces for each new housing unit, if improves the highway access ramp, and is 10% of flats are "low-income" flats.

3. Nuisance zoning

   (a) Restrict location of activities that cause public "nuisance".

      i. In the US, land is categorized into zoning categories. Each category defines the type of land use that is allowed on land in that category. The categories and the restrictions vary from location to location but typically are as follows. There are roughly 5 categories: 1) residential big lot, 2) residential small lot detached house, 3) residential high rise, 4) retail, 5) industrial. Category 1 land may only be used for residential housing and the size of the lot must be larger than a minimum size. Category 5 land may generally be used for any use.

      ii. Other types of planning retrictions regulate alterations of historic structures, landscaping and gardening practices, colors, etc.

   (b) Benefits of such zoning/planning systems

      i. Seemingly very simple to institute, separate polluters from people. Optimal fee may change every time someone moves, might be expensive to calculate fee based on location.

      ii. Costly to monitor emissions and collect fees.

   (c) Costs of such systems.

      i. Inflexible, assumes all industries pollute equally and cannot change.

      ii. Static in outlook.

      iii. No incentive to reduce pollution.

      iv. Disputes resolved through courts and political process: not always maximise efficiency or equity of bargaining solutions.

4. One alternative to nuisance zoning: institute a tax that varies with location.

   (a) Example.

      i. Residents live in western part of city and commute to polluting steel mill in eastern part.

      ii. The longer the distance to the mill, the higher the wage must be to compensate workers for commuting cost.

      iii. d equals distance to mill.

      iv. t equals tons of effluent.

      v. The shorter the distance to the mill the higher the pollution costs. This type of pollution only causes health damage if it is emitted in proximity to people. Otherwise, it breaks down naturally.

vi. Start with industrial zoning policy where mill is located 10 miles from residential area.

vii. See Figure 2 at the end of these notes.

viii. The horizontal axis measures distance from the mill to the residential areas.

ix. The straight line is labour costs per ton as a function of distance: $c_1 = 20 + 4d$.

x. The lower curve measures the pollution costs per ton: $PC = 50\exp(-d) + 10$.

xi. The upper curve measures total social costs per ton: $TC = 20 + 10 + 4d + 50\exp(-d)$

xii. To minimize total social costs, the first-order condition is

$$\begin{aligned} 4 - 50\exp(-d) &= 0 \\ \ln 25 - \ln 2 &= d \\ 2.53 &= d \end{aligned}$$

and the optimal solution is $d = 2.53$.

xiii. Under a nuisance zoning law, the firm can't choose d which is fixed at 10. The total cost under zoning is: $30+40+50\exp(-10) = 70.002$.

xiv. If instead, the firm must pay an "effluent fee" or a "pollution tax" equal to $50\exp(-d) + 10$ per ton, the firm will choose $d = 2.53$.

xv. Total cost under effluent fee is $30 + 4(2.53) + 50\exp(-2.53) = 44.103$.

xvi. Benefits of the fee system.

A. Labour costs decrease.

B. Pollution moves closer to residents who can be compensated with revenue from fee.

C. Reduction in costs is larger than increased harm.

D. Optimal zoning could achieve same result but is less flexible.

E. If fee is tied to amount of pollution, firm has incentive to reduce pollution. Reducing pollution reduces fees.

F. Zoning offers no incentive to reduce pollution.

xvii. Costs

A. Determining right fee is difficult.

B. Allowing fee to adjust to circumstances is also difficult.

C. Compensating victims is costly: you must determine who they are and how much to compensate each one.

D. If these costs of introducing the fee based system are high, then the zoning system may be better.