Land Use Regulation: Incentives and Payoff

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Lecture 5

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Land Use Regulations

- Owners decide on use of land/building - e.g., commercial activities from residential areas.
- Further, owners make investment in land/property.
- Such investments affect the value of their business.
- However, the government can prevent the use to which the property is used for.
- If government does so, the investment on it will turn out to be a waste.

Question

1. *How does possible changes in land use regulation affect incentives to invest in property?*
2. *What is the optimum compensation to the affected parties - full compensation or less or more?*

Basic Idea I

Let,

- x be the (self-interested) investment made by the Owner in a 'land-use';
- V be the value to the Owner due to the investment x;

$$V = V(x),\ V'(x) > 0,\ V''(x) < 0$$

- There is possibility that the land-use will result in negative externality.
- E the level of externality
- $C(x)$ be the Compensation paid by the G to the O, if there is change in LUR - the current land-use is disallowed

So, ignoring compensation, the net benefit to O from x is:

$$V(x) - x \text{ if no change in LUR}$$
$$b - x \text{ if change in LUR}$$

Assume: Project is financed by a total lump sum tax T.

A Context I

Assume that

- There are n individuals with one plot of land each; plots are identical
- m owners have opted for a specific land use
- E be the level of externality
- However, E is a random variable drawn from $[0, \bar{E}]$, $0 << \bar{E}$
- $F(E)$ and $f(E)$, respectively, be the distribution and density functions of E.
- The compensation expenses are funded using lump sum tax/transfers

A Context II

Remark

Suppose the identity of m owners with the 'problematic' land use is known in advance.

Remark

The time line as follows:

- Date $t = 1$: individuals choose x.
- Date $t = 3/2$: E gets known to all parties including government.
- Date $t = 2$: the decision about the project is taken. Land acquired iff project is taken up.

First Best I

Suppose, we are date 2. At date $t = 2$ note that:

- x is a sunk cost
- the opportunity cost of implementing the changes in LUR is $mV(x)$ - since m owners will loose the benefits
- Therefore, according to K-H criterion, for any given level of x, G should change LUR iff $E > mV(x)$.

That is, for given x,

- The efficient Decision Set $DS^*(x) = \{E | E > mV(x)\}$

Suppose, the decision set is efficient. Note that:

- By assumption, identify of m owners in problematic use is known.
- $1 - F(mV(x))$ is the probability that change in LUR will be implemented.

First Best II

Therefore, the SOP can be written as

$$\max_x \left\{ mF(mV(x))V(x) - \int_0^{mV(x)} EdF(E) - mx \right\}, i.e.,$$

$$\max_x \left\{ \int_0^{mV(x)} mV(x)f(E)dE + \int_0^{mV(x)} EdF(E) - mx \right\} \quad (1)$$

The FB investment, x^*, solves:

$$F(mV(x))V'(x) - 1 = 0. \quad (2)$$

Note: $F(mV(x)) < 1$. If change in LUR was always undesirable, the socially optimum x will solve

$$V'(x) - 1 = 0. \quad (3)$$

Let $\bar{x}^*$ solve (3). Clearly,

$$\bar{x}^* > x^*.$$

Is Full Compensation Desirable?

Suppose,

- Full compensation $C(x) = V(x)$
- The Decision Set is efficient, i.e., $DS^*(x) = \{E|E > mV(x)\}$

When, $C(x) = V(x)$, O will choose x to maximize

$$\int_0^{mV(x)} V(x)f(E)dE - \int_0^{mV(x)} (E/n)f(E)dE + \int_{mV(x)}^{\bar{E}} V(x)f(E)dE - \int_{mV(x)}^{\bar{E}} tf(E)dE - x.$$

When $e = 0 = t$, the foc is

$$V(x) - x, \; i.e.,$$

the x opted by the Owner solves

$$V'(x) - 1 = 0. \tag{4}$$

That is, O will choose $\bar{x}^*$ - excessive investment.

Location: Rent and Prices I

Let,

- **a** be the vector of amenities and locational advantages of a plot; $\mathbf{a} \equiv a$, $a \in \Re_+$
- p be the per-unit price of housing service; $p : p(a)$
- l be the per-parcel price of land;
- r be the per-unit price of capital

Suppose, the housing production function is:

$$H = H(L, K) = L^{\alpha} K^{1-\alpha}$$

Assume:

- r does not depend on a
- for given a there are several plots available

Location: Rent and Prices II

Profit from production of housing services:

$$\begin{aligned} \pi &= pH - rK - lL \\ &= p(a)L^{\alpha}K^{1-\alpha} - rK - l(a)L \end{aligned}$$

Let,

- k^* be the profit maximizing, land-capital ratio; $k^* = \frac{K^*}{L^*}$.
- $k^* = k^*(a, \alpha, r, l(a))$

Suppose, the following holds

$$\frac{dk^*}{da} > 0.$$

For given $p(a)$, the value of Marginal Product of land is

Location: Rent and Prices III

$$V_L(a) = p(a)MP_L = p(a) \times \alpha \left(\frac{K}{L}\right)^{(1-\alpha)}$$
$$= p(a) \times \alpha k^{*(1-\alpha)}(a) = g(a),$$

where $g'(a) > 0$. So, the 'rent' enjoyed by land increases with a.

Land Use Regulation I

Land Use Regulation are restrictions on:

- Minimum plot size per-housing unit
- Minimum front, side and backyard widths
- Maximum 'floor-area ratio' (FAR)
  - FAR = 0.5 implies permission to construct a two-story house covering 25% of plot
  - FAR = 10 implies permission to construct a forty-story house covering 25% of plot

Implications of LUR:

- Reduces the supply of housing service per-plot (and overall)
- Reduces level of capital K per-plot (and in housing)

Let

Land Use Regulation II

- Z be the index of LUR.
- k^p be permissible level of K-L ratio; $k^p(Z)$

We have

$$\frac{\partial k^p(Z)}{\partial Z} < 0.$$

Now, the value of MP of land can be captured as

$$\begin{aligned} V_L(a,Z) &= p(a) \times MP_L(Z) = p(a) \times \alpha \left(\frac{K}{L}\right)^{(1-\alpha)} \times h(Z) \\ &= = g(a) \times h(Z), \end{aligned}$$

where $h'(Z) < 0$. So, given $p(a)$,

- the 'rent' enjoyed by land decreases with Z.

Land Use Regulation III

Question

Can Z have a bearing on $p(a)$?