Where does the infill housing go?

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Abstract

Big house for rich people not the poors.

1 Model

Consider a developer considering the intensity of development on a parcel of land with area normalized to one unit. Profits are a function of the (continuous, for simplicity) number of units n built on the lot. Zoning regulations impose a schedule of density limits $f(n)$ governing how many square feet f can be built on the lot as a function of n. The price p per square foot may also be functions of n and θ, a characteristic of the neighbourhood.

$$\pi(n) = f(n)\left[p\left(n, \theta\right) - c(n)\right] \tag{1}$$

The benefit from incrementing density is:

$$\frac{\partial \pi}{\partial n} = f'(n)\left[p\left(n, \theta\right) - c(n)\right] + f(n)\left[\partial p\left(n, \theta\right) \partial f - c'(n)\right] \tag{2}$$

Optimizing for $n^\star$ yields the first order condition:

$$f'(n^\star)\left[p(n^\star, \theta) - c(n^\star)\right] + f(n^\star)\left[\frac{\partial(n^\star, \theta)}{\partial n} - c'(n^\star)\right] = 0 \tag{3}$$

Implicitly differentiating (3) with respect to θ yields to find the effect of θ on optimal density:

$$\frac{dn^\star}{d\theta} = -\frac{f'\frac{\partial p}{\partial \theta} + f\frac{\partial^2 p}{\partial n \partial \theta}}{f''\left[p - c\right] + 2f'\left[\frac{\partial p}{\partial n} - c'\right] + f\left[\frac{\partial^2 p}{\partial n^2} - c''\right]}. \tag{4}$$

Assuming second order conditions hold, the denominator is negative, and:

- Infill (increasing n) is more attractive where the price per square foot is greater ($\frac{\partial p}{\partial \theta} > 0$).
- Infill is more attractive where price is declining more rapidly in density ($\frac{\partial^2 p}{\partial n \partial \theta}$ is more positive).

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