Supplemental Notes: Place-Based Policies[a]

Jon Cohen

November 20, 2020

[a] Rosen-Roback section adapted from David Card's Lecture Notes

Recap of Owen's Lectures

1. **Lecture 1 (Rosen-Roback)**: Baseline spatial PF model
2. **Lecture 2 (Kline and Moretti)**: Augment RR with worker heterogeneity
3. **Lecture 3 (State and Local Incentives)**: Augment RR with firm heterogeneity

Place-Based Policies at a High Level

What is special about place?

1. Land
   - Fixed(?) supply
2. Mobility
   - Workers and firms choose where to locate
   - (Also: location as a tag)
3. Tradables vs. Non-tradables
   - Some goods can be consumed only in that place, while some goods produced in that place can be consumed worldwide

Above are the 3 equilibrating forces in most place-based models

Question: What do the above forces imply about the incidence of place-based taxes/subsidies? (*Hint*: Think back to standard incidence...)

Workhorse Model: Rosen-Roback

Simplest case:

1. **Tradables vs. Non-tradables**: local land l and global consumption good x
   - p_x fixed and normalized to 1
   - Also "non-traded" amenities s
2. **Land**: Fixed supply
   - rental price r
   - Denote l^c (l^p) consumer (producer) land
3. **Mobility**: Workers and firms indifferent across all places

Model Details

Worker problem (N workers in city):

$$V(w,r,s) = \max_{x,l^c} u(x,l^c,s) \;\text{ s.t. }\; x + rl^c = w$$

Firm problem (CRS, total output X):

$$c(w,r,s) = \min_{n,l^p} wn + rl^p \;\text{ s.t. }\; f(n,l^p) = 1$$

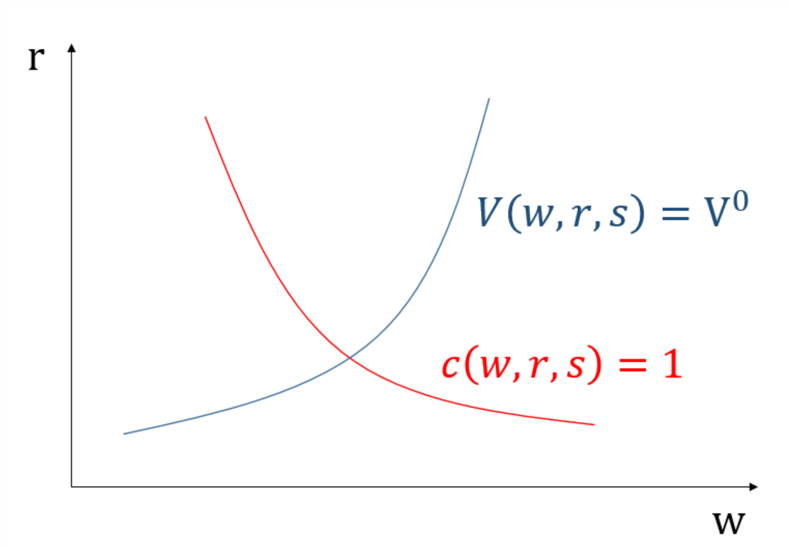
Indifference conditions:

$$V(w(s),r(s),s) = V^0$$

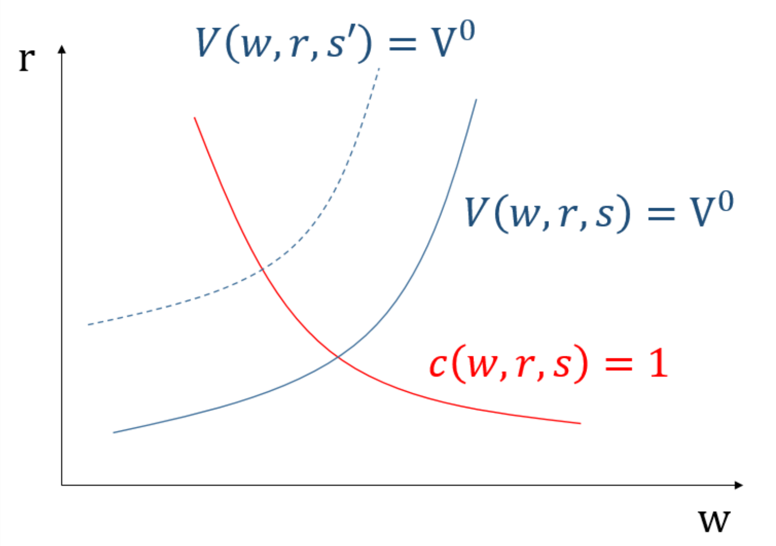
$$c(w(s),r(s),s) = 1$$

Question: How would you represent these conditions in (w,r) space?

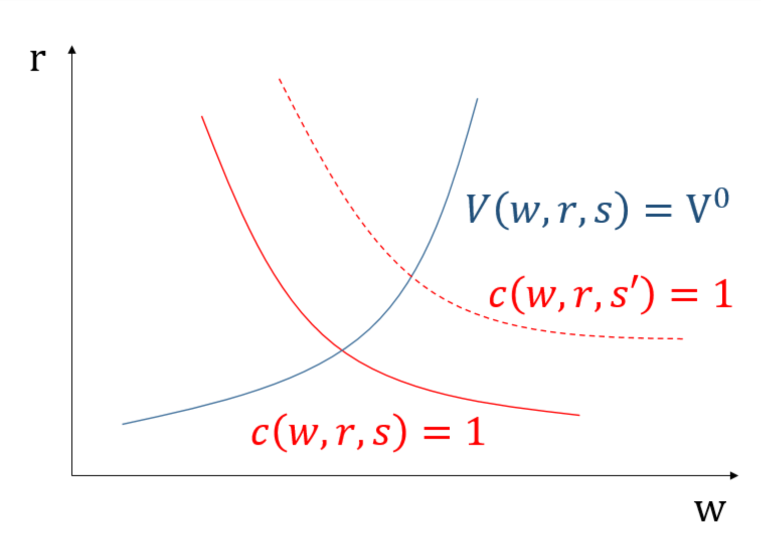
Baseline Equilibrium



Enjoyable Amenity ($V_s > 0, c_s = 0, s' > s$)



Productive Amenity ($V_s = 0, c_s < 0, s' > s$)



Mathematical Details

General strategy: Derive comparative statics by differentiating equilibrium condition w.r.t. parameters (e.g. first-order condition, indifference condition, etc.)

$$c_w w'(s) + c_r r'(s) + c_s = 0$$

$$V_w w'(s) + V_r r'(s) + V_s = 0$$

(Can either totally differentiate both and rearrange or directly apply Cramer's Rule)

Rosen-Roback Comparative Statics

$$\underbrace{\begin{bmatrix} c_w & c_r \\ V_w & V_r \end{bmatrix}}_{\text{A}} \underbrace{\begin{bmatrix} w'(s) \\ r'(s) \end{bmatrix}}_{\text{x}} = \underbrace{\begin{bmatrix} -c_s \\ -V_s \end{bmatrix}}_{\text{b}}$$

Define $\Delta = det(\text{A})$

$$w'(s) = \frac{\begin{vmatrix} -c_s & c_r \\ -V_s & V_r \end{vmatrix}}{\Delta} = \frac{V_r c_s - c_r V_s}{\Delta}$$

$$r'(s) = \frac{\begin{vmatrix} c_w & -c_s \\ V_w & V_s \end{vmatrix}}{\Delta} = \frac{V_s c_w - c_s V_w}{\Delta}$$

Throwback to 121: How can we further simplify these expressions?

Simplifications

1. Roy's Identity: $V_w = \lambda > 0, V_r = -\lambda l^c(w, r, s < 0)$
2. Shephard's Lemma: $c_w = N/X > 0, c_r = l^p/X > 0$

$$\Delta = c_r V_w - c_w V_r = \lambda l^p/X + \lambda l^c N/X$$
$$= \lambda(l^p + l^c N)/X = \lambda L/X > 0$$

Exploring Cases

- Each of N consumers' WTP for amenity: V_s/V_w
- Firm's unit cost savings from amenity: c_s
- *Example*: Suppose $c_r = c_s = 0$. Any guesses for what you'd expect?

General Welfare Effects from Marginal Amenities: Consumers

Total utility accounting for endogenous adjustments:

$$\Omega(s) = V(w(s), r(s), s)$$

Differentiating:

$$\Omega'(s) = V_w w'(s) + V_r r'(s) + V_s$$

Re-arranging and (and applying what property?):

$$V_s / V_w = l^c r'(s) - w'(s)$$

Money metric intuition?

General Welfare Effects from Marginal Amenities: Firms

Indifference condition across cities:

$$c(w(s), r(s), s) = 1$$

Differentiating:

$$c_w w'(s) + c_r r'(s) + c_s = 0$$

Putting it all together

$$
\begin{aligned}
dW &= N\frac{V_s}{V_w} - Xc_s && (1)\\
&= N(l^c r'(s) - w'(s)) + X(c_w w'(s) + c_r r'(s)) && (2)\\
&= Nl^c r'(s) + l^p r'(s) && (3)\\
&= Lr'(s) && (4)
\end{aligned}
$$

Questions:

1. Intuition?
2. Ideas for how this can be used when doing empirical work?

Taking it to the data

Estimating equations (of individuals i living in cities c with amenities Z_c):

$$\log w_{ic} = x_i\beta + \gamma_w Z_c + e_{ic} \tag{5}$$

$$\log r_c = \gamma_r Z_c + \epsilon_c \tag{6}$$

(Can you see why Rosen of hedonic regression fame gets credit for this model?)

Bringing it back to theory:

$$\begin{aligned} V_s/V_w &= l^c r'(z) - w'(z) && (7)\\ &= w\left[\frac{l^c r}{w}\frac{r'(z)}{r} - \frac{w'(z)}{w}\right] && (8)\\ &= w[\theta\gamma_r - \gamma_w] && (9) \end{aligned}$$

where $\theta = \frac{l^c r}{w}$ is *land's* share of income.

Aside: Multiplying/dividing to connect to estimable objects is applied theory gold!

So what does this have to do with public finance?

Amenities are often not explicitly traded. In fact, they're often public goods.

Thoughts for place-based policies

1. What would a place-based policy do in the Rosen-Roback model?
2. What are the most troubling omissions from the Rosen-Roback model?

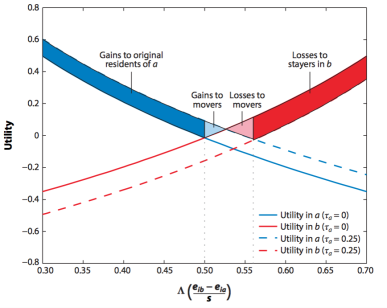
Standard PF Intuition #1: Incidence Falls on the Inelastic Factor

- Kline and Moretti Model sources of "inelasticity"
  - Worker mobility (i.e. strength of idiosyncratic preferences s)
  - Housing supply elasticity κ
  - See 2014 Annual Review article
- Additional Suarez-Serrato and Zidar source of "inelasticity"
  - Firm mobility (i.e. strength of idiosyncratic productivity σ^F)
  - Product demand elasticity ϵ^{PD}
  - See 2016 AER

Standard PF Intuition #2: Envelope Theorem

- Optimizing agents are indifferent at the margin
  - *Jargon*: behavioral response to marginal change has no first-order welfare effect
- But they don't internalize fiscal externalities on the government budget!

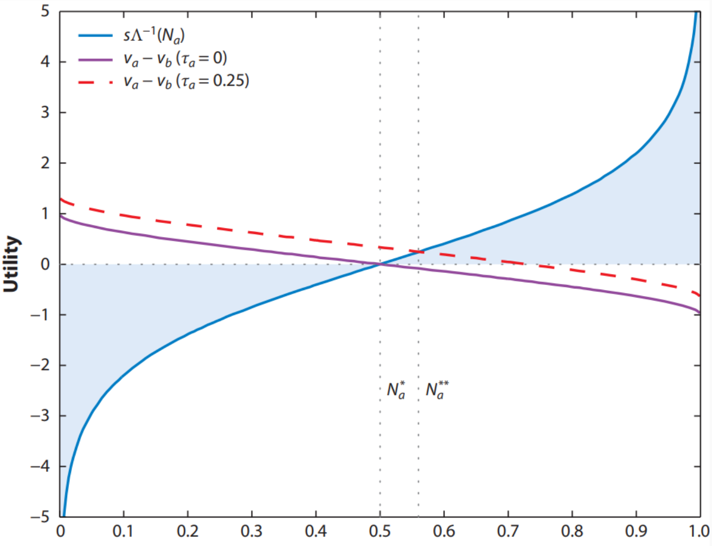
  $\Rightarrow$ deadweight loss from intervention
- Ex) Subsidy to place A financed by tax on place B (u^A shifts up, u^B shifts down)
  - Inframarginal transfers in dark colors on $(0, 0.5), [0.56, 1]$; vertical distance $=$ tax
  - Mover to A gains on $(0.5, 0.53)$ and Mover to A losses on $(0.53, 0.56)$ both ≈ 0 by envelope theorem (but receive full subsidy)



Standard PF Intuition #2: Envelope Theorem (cont.)

- How can we see the standard Harberger triangle?
  - Previous graph of utility levels helped emphasize some movers experience small losses, but it's hard to see how aggregate gains compare to aggregate losses
- **See next slide for graph, below for explanation!**
- Recall downward sloping line is the *difference* in *systematic* utility component, upward sloping line is the logit inverse CDF
- Subsidy to place A shifts up difference in utility line, inducing population growth from $N^* = 0.5$ to $N^{**} = 0.56$
- For movers (i.e. $(0.5, 0.56)$): the vertical distance between the red dashes and purple line is the subsidy cost, while the vertical distance between the red dashes and blue line is the value $\Rightarrow$ remaining area is the DWL (i.e. Harberger triangle)
  - All other welfare effects are inframarginal and thus non-distortionary
  - Government pays full cost of subsidy on $(0, 0.56)$ but it's valued fully only on $(0, 0.5)$

Standard PF Intuition #2: Envelope Theorem (cont.)



Standard PF Intuition #3: Atkinson-Stiglitz Uniform Commodity Taxation

- *Rough intuition*: If, conditional on income, consumption of any good doesn't have residual information on type, then it's inefficient to distort consumption when you can redistribute through a nonlinear income tax
  - *Technical assumption*: weak separability $u(v(x_1, ...v_n), l)$ w.r.t. labor supply
  - *Intuition #1*: Consumption conditional on income is informative about welfare weights (Saez 2002 JPubEc)
  - *Intuition #2*: Productivity type is unobserved, so differential complementarity between a certain good and leisure allows you to tax the untaxed good of leisure (Corlett and Hague 1953 RES)
- *Spatial PF application*: Location as a consumption good