Graduate Public Finance

Local Public Finance: Tiebout, Sorting, and Fiscal Federalism

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Princeton
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Lecture 6

Outline

1. Overview
   - Key questions in local public finance
   - Club model of local provision of public goods
2. Preliminaries
   - Quality Differences
   - Hedonics
   - Hedonic Model Example: Travel time and Rent Gradients
3. Tiebout and Sorting
   - Tiebout (JPE, 1956)
   - Ellickson (AER, 1971)
   - Bayer Ferreira McMillan (JPE, 2007)
   - Social Interactions, Sorting, and Peer Effects
4. Fiscal Federalism
   - Oates (1972) and Oates (JEL, 1999)
   - Intergovernmental Grants
   - Tax Harmonization - FMSZ (Restud, 2018)

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Brief intro to local public finance and fiscal federalism

We should also know over which matters several local tribunals are to have jurisdiction, and in which authority should be centralized —Aristotle, Politics 4.15

The federal system was created with the intention of combining the different advantages which result from the magnitude and the littleness of nations —Alexis de Tocqueville (1835)

Brief intro to local public finance and fiscal federalism

- Fiscal federalism deals with role of different levels of government in providing goods and services
  - In the US: $\approx 1/3$ of public spending provided by state and local govs
  - Local fiscal autonomy varies considerably across countries & overtime
- Sub-federal public good provision can better satisfy geographically heterogeneous preferences
- But decentralized provision
  - Misses economies of scale
  - May not fully internalize externalities of local spending

$\Rightarrow$ **What is the optimal allocation of responsibilities across levels of government?**

Some key questions in local public finance

1. How large should local governments be? (theory of clubs)
2. Will equilibrium exist and is it efficient (Tiebout model and its issues)
3. What is the demand for local public goods (hedonics, sorting)?
4. Which public services can best be provided and financed at federal, state, or local level (fiscal federalism/IO of public sector)?
   - How much fiscal autonomy of local governments?
   - Effects of local versus national control?
   - Can/should state and local governments redistribute?
   - Can/should state and local governments play a role in stabilizing economies?
   - Effects of transfers from higher levels of government?
   - Effects of competition across governments?
   - Effects of (educ) financing approaches on spending and outcomes?

Club model of local provision of public goods

Optimal Provision of Local Public Goods

Overview:

- Goal: characterize optimal size of local governments
- Agents: individuals identical in taste and in incomes
- Pure public good is unaffected by N_c number of people in the community
- Private consumption must be forgone to produce public good

Relationship to Tiebout Model:

"The club model provides a natural introduction to the Tiebout model because it describes optimal public good provision within communities as well as optimal jurisdiction (or club) size. The Tiebout model focuses primarily on interjurisdictional optimality in a world of varying tastes and incomes, and should be viewed simply as an analysis of the optimal provision of public goods in a series of clubs or jurisdictions" Rubinfeld (Handbook of Public Economics, 1987).

Optimal provision for a fixed population

- Production function $Y = f(N)$ for both public and private goods
- $Y = XN + G$
  - X is per capita private consumption
  - G is the level of the public good
- For a given population,

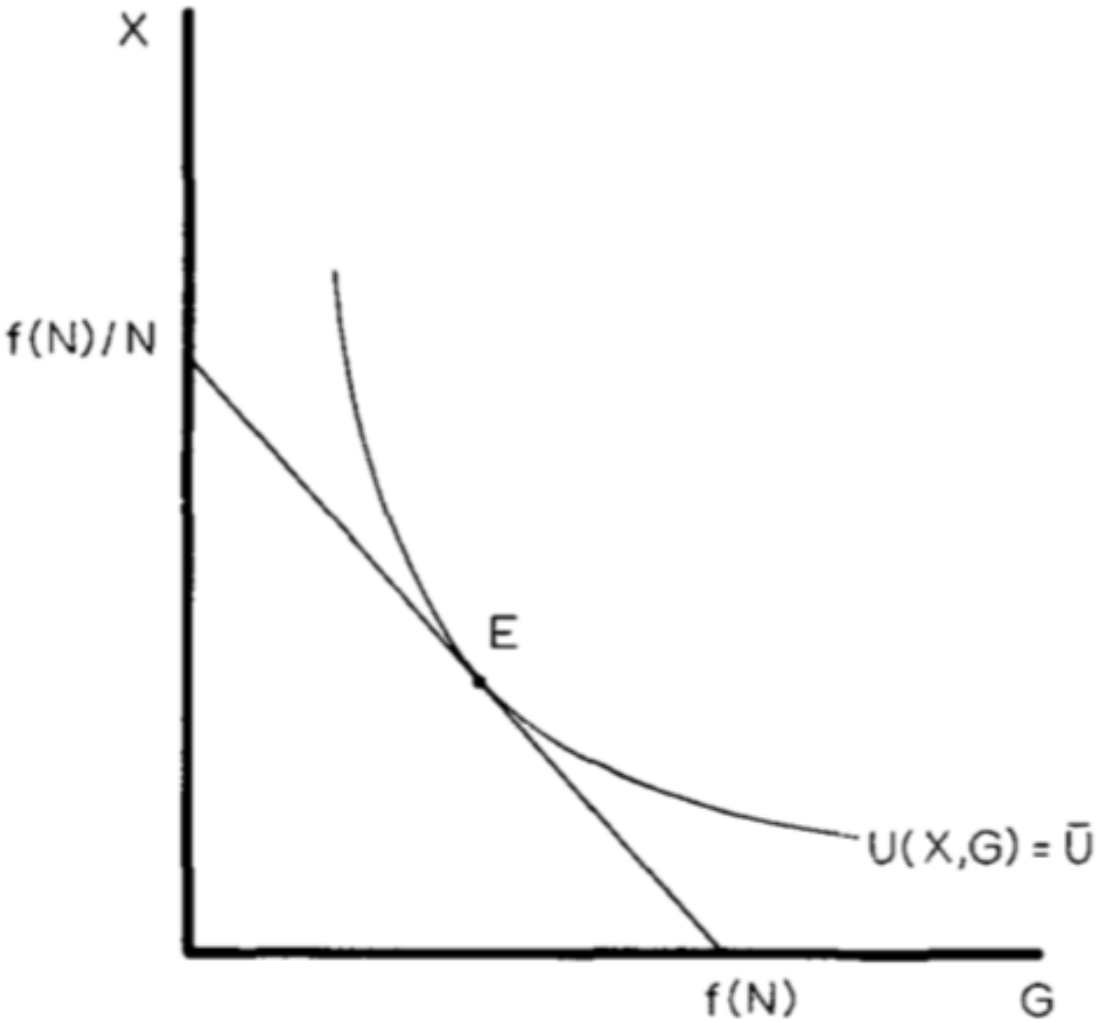
$$\max_{X,G} U(X, G) - \lambda(XN + G - f(N))$$

- FOCs:

$$\frac{\partial U}{\partial X} - \lambda N = 0$$
$$\frac{\partial U}{\partial G} - \lambda = 0$$

- Combining FOCs gives the Samuelson condition, $N\frac{\frac{\partial U}{\partial G}}{\frac{\partial U}{\partial X}} = 1$,
  - LHS sum of MRS, i.e., $N\frac{\frac{\partial U}{\partial G}}{\frac{\partial U}{\partial X}}$
  - RHS is MRT, i.e., the marginal cost in terms of forgone units of X from producing another unit of G, which is 1

Opportunity Set for a fixed population



Source: Rubinfeld (Hbook of Public Economics, 1987) based on (Atkinson and Stiglitz, 1980)

Optimal provision for a variable population (for a given G)

For a given level of G,

- From the production function and resource constraint, $X = \frac{f(N)-G}{N}$
- Maximizing X wrt N gives: $f'(N) = X$
- Equates MC and MB of higher population
  - MC: less private good available because with higher N, $f(N)$ increases but $f(N)/N$ decreases (from greater congestion and other externalities in a more realistic model)
  - MB: public good costs less per person (i.e., G/N) decreases with N
- We can re-express the FOC as $G = f(N) - Nf'$
  - Since f' is the MPL, $f(N) - Nf'$ is output minus wage payments
  - Thus, when G is fixed and N is variable, N^* that maximizes per capita consumption is such that rents equal public good expenditure
  - Stiglitz (1977) calls this the "Henry George Theorem" since not only is the land tax non-distortionary, but it is also the "single tax" required to finance the public good

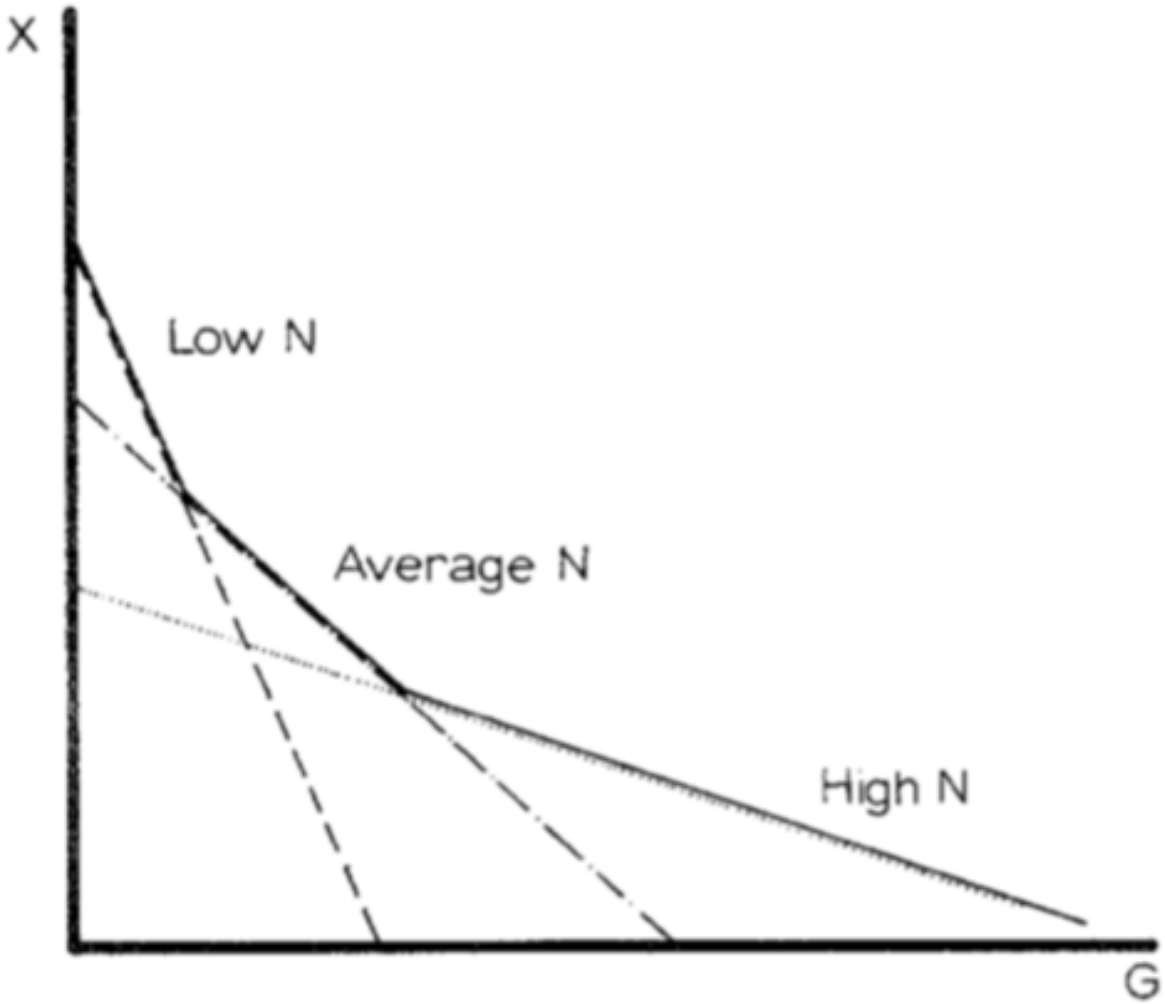
Optimal provision for a variable population and variable G

When N and G can both vary, the full club model analyzed

- Higher $N \rightarrow$ aggregate income and G increase, but per capita private consumption decreases b/c MPL decreases (i.e., $f(N) \uparrow$ but $\frac{f(N)}{N} \downarrow$)
- The following figure shows how opportunity sets change with N
- The next figure shows that optimal size may be zero, the entire population, or somewhere in between depending on the share of the opportunity locus and indifference curves

See (Buchanan, 1965) for the original formulation of this optimal "club" problem.

Opportunity Set for variable population



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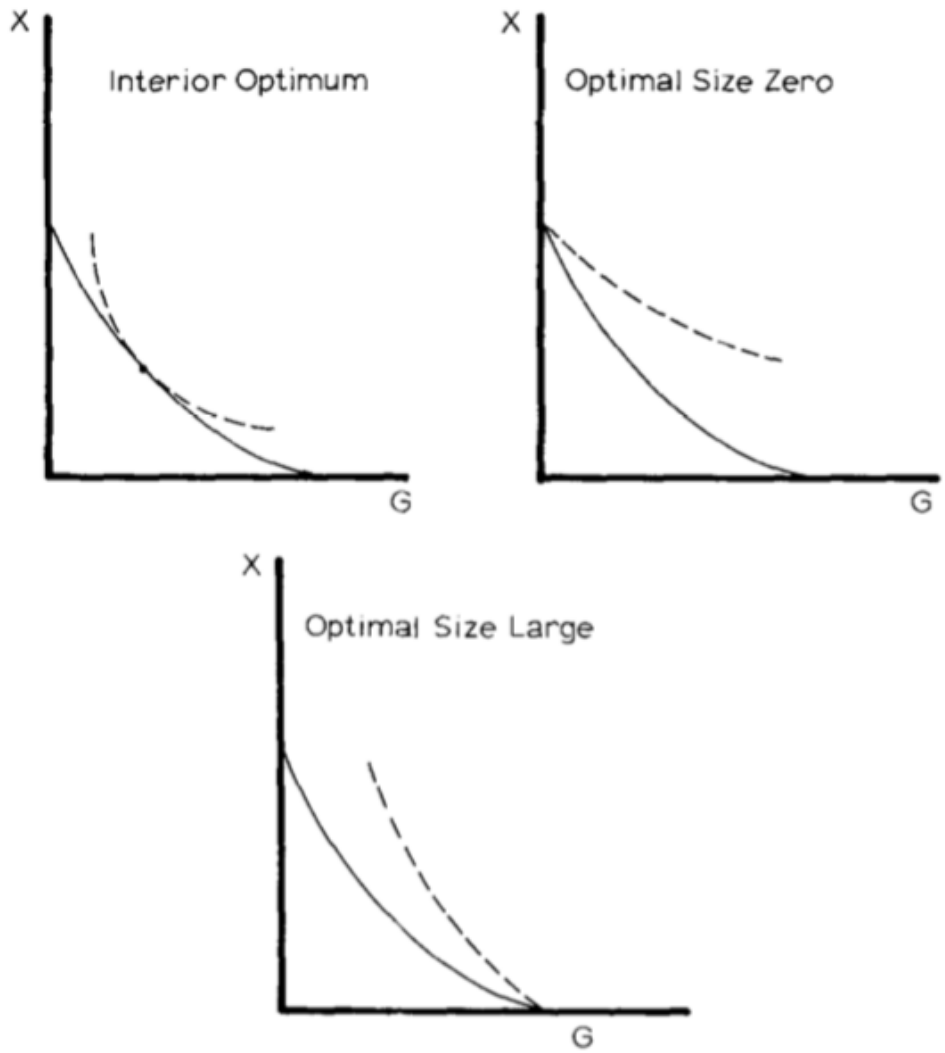
Optimal population size



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Modeling quality vs. quantity problem

Why do people increase quality as income goes up (rather than quantity)?

There are physical constraints – stomach capacity, time in the day, etc.

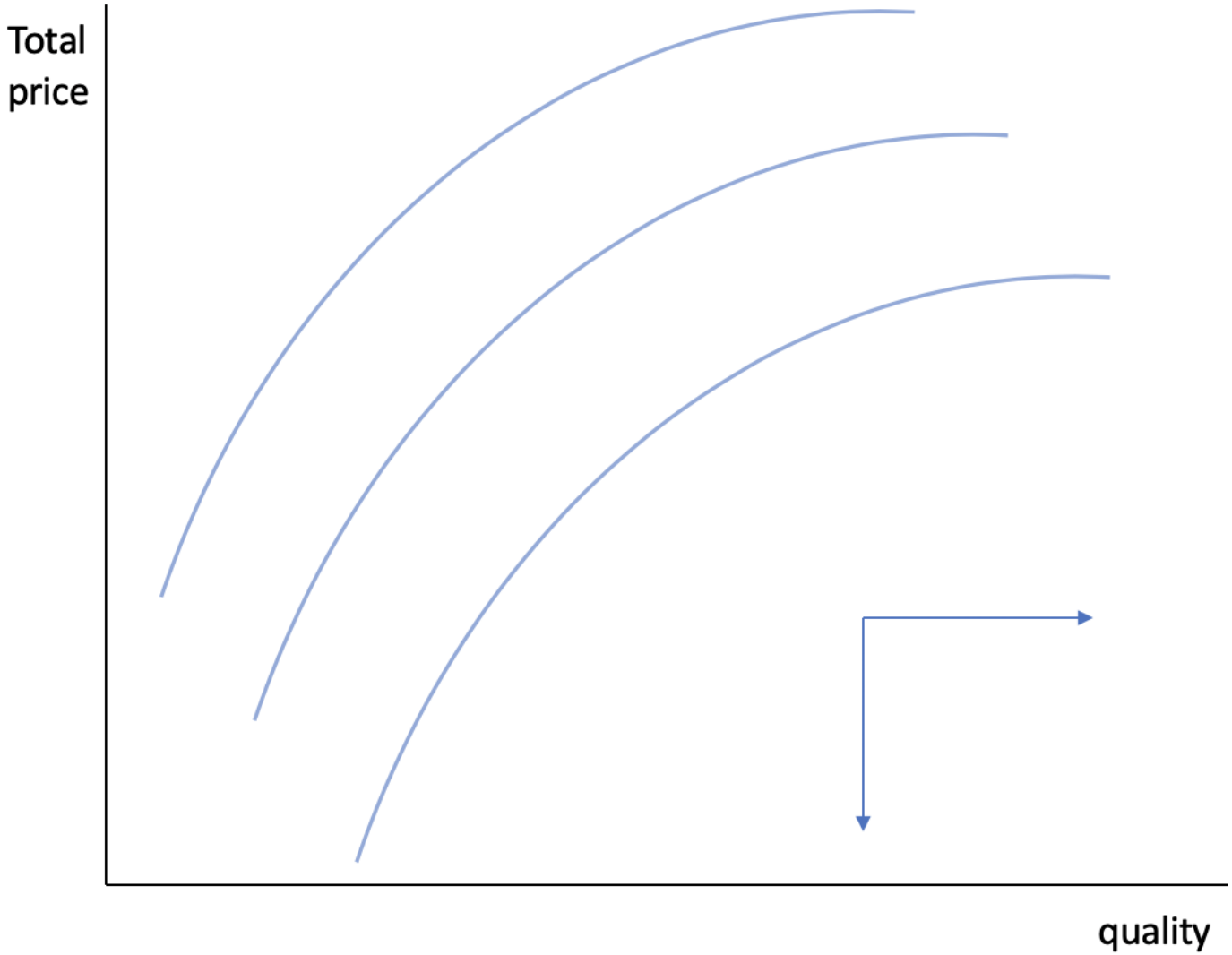
$$U(x, NV(q)) + \lambda[M - x - NP(q)]$$
$$\equiv U(x, Z) + \lambda\left[M - x - Z\frac{P(q)}{V(q)}\right]$$

- x: other goods that have price of 1
- N: quantity of main good
- q: quality of main good with price $P(q)$
- $Z = NV(q)$: "effective consumption" as it combines N and q
- $\frac{P(q)}{V(q)}$: cost per unit enjoyment

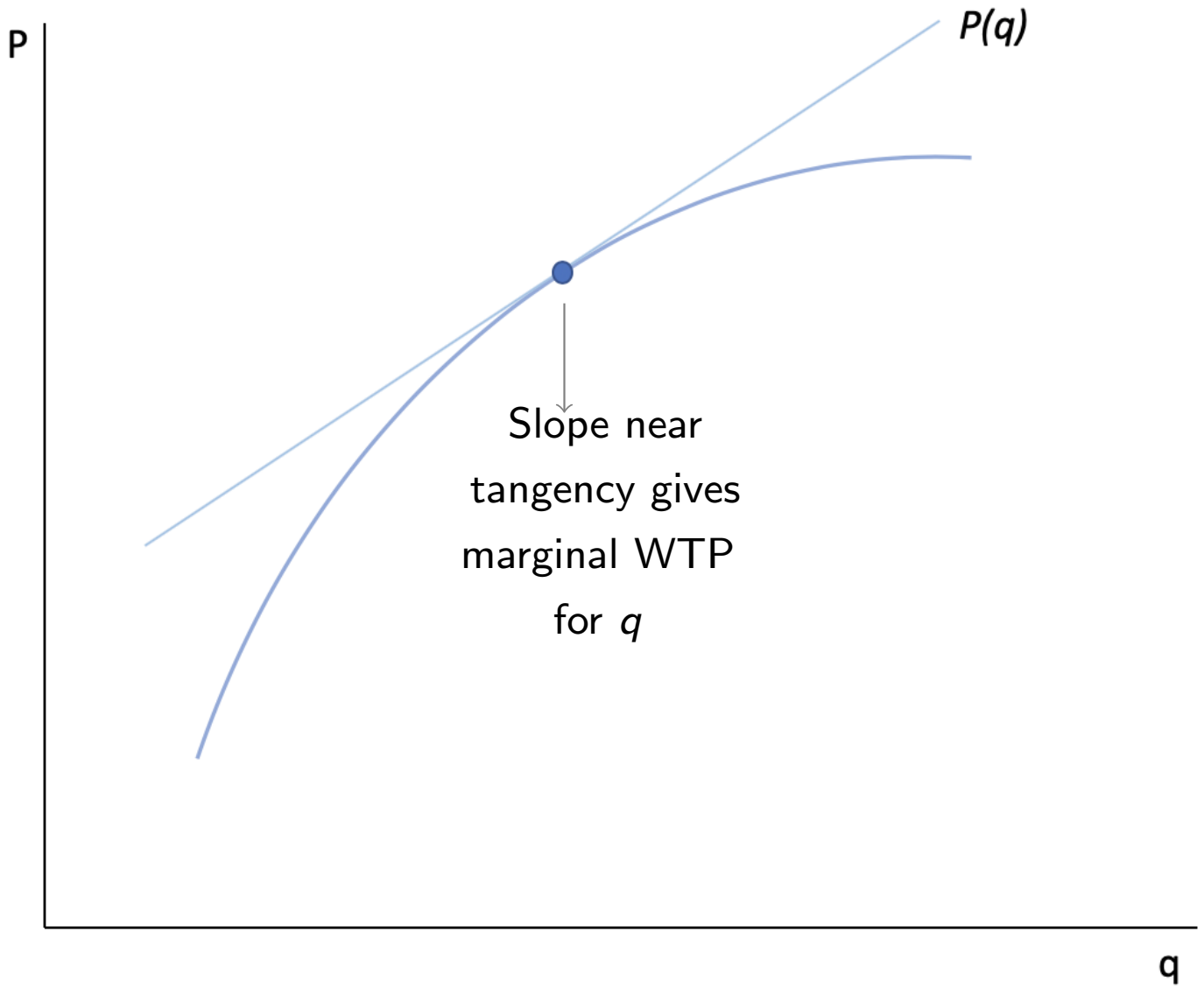
In general, people prefer lower prices and higher quality

Consumers prefer higher quality and lower price

Suppose Indifference Curves are Concave



Consumer Chooses q s.t. Indiff Curve is Tangent to $P(q)$



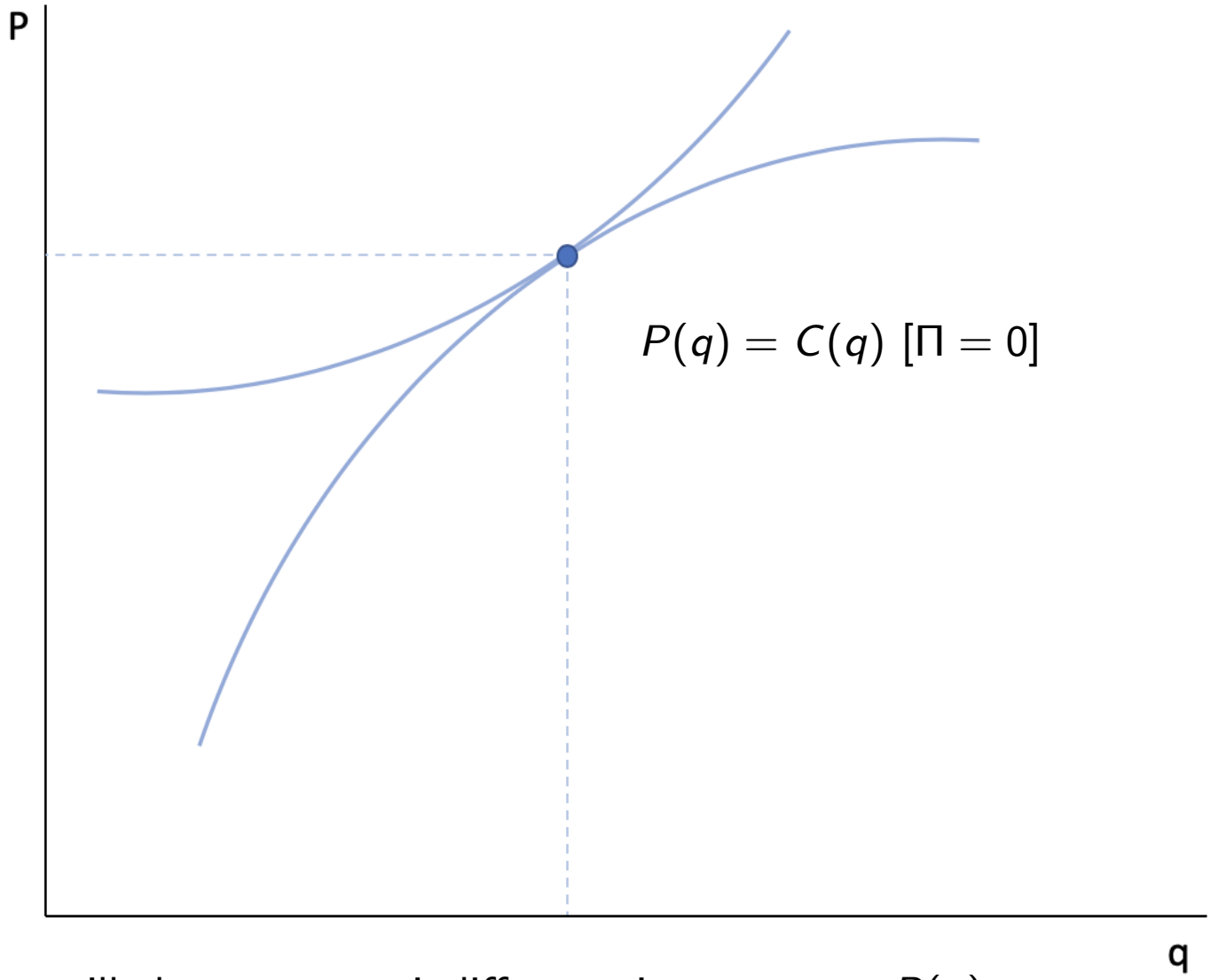
Producer Problem: Homogeneous Firms

- Assume a large number M of producers
- Each produces 1 unit of good at some quality level
- $C(q)$: cost of production
- Assume $M > N$
  - N: number of consumers

$\Rightarrow$ Some producers don't produce in equilibrium

$\Rightarrow$ $\Pi = 0$ and $P(q) = C(q)$

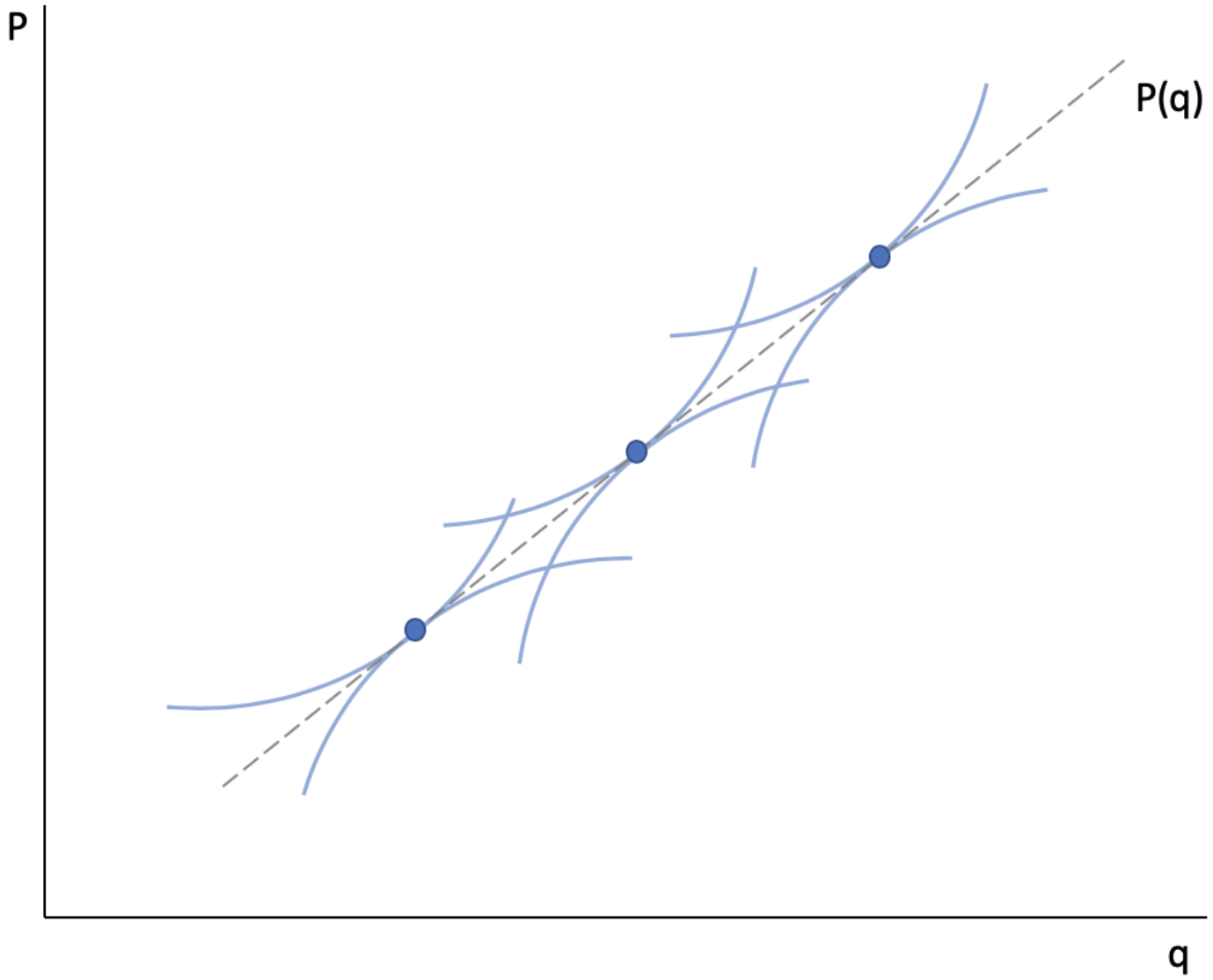
Equilibrium



Note: Consumer still chooses q s.t. indiff curve is tangent to $P(q)$

What happens if someone's income increases?

Continuum of Firm and Consumer Types



Hedonics

Hedonics Introduction

- Hedonics is fundamentally a model of sorting (i.e., individuals sort over houses, neighborhoods, cities, employment sectors), trading something pecuniary (i.e., housing price/rent, wage, commute time) for something non-pecuniary (air quality, fatality risk)
- Sorting is an inherently equilibrium phenomenon - Individuals' behavior will depend upon what other individuals are doing and vice-vera. Hedonics just uses the equilibrium outcome of the sorting process
  - Creates a variety of econometric problems
  - Sorting models deal with these problems by modeling the sorting process itself, not just the equilibrium outcome

"Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition" (Rosen, 1974)

Consider a single relevant dimension z_i on which houses differ:

$$\max_{x,z} u(x, z_i) \text{ s.t. } x + p(z_i) = I$$

Choosing a level of z_i is the equivalent of choosing a house. Makes it easier to draw pictures.

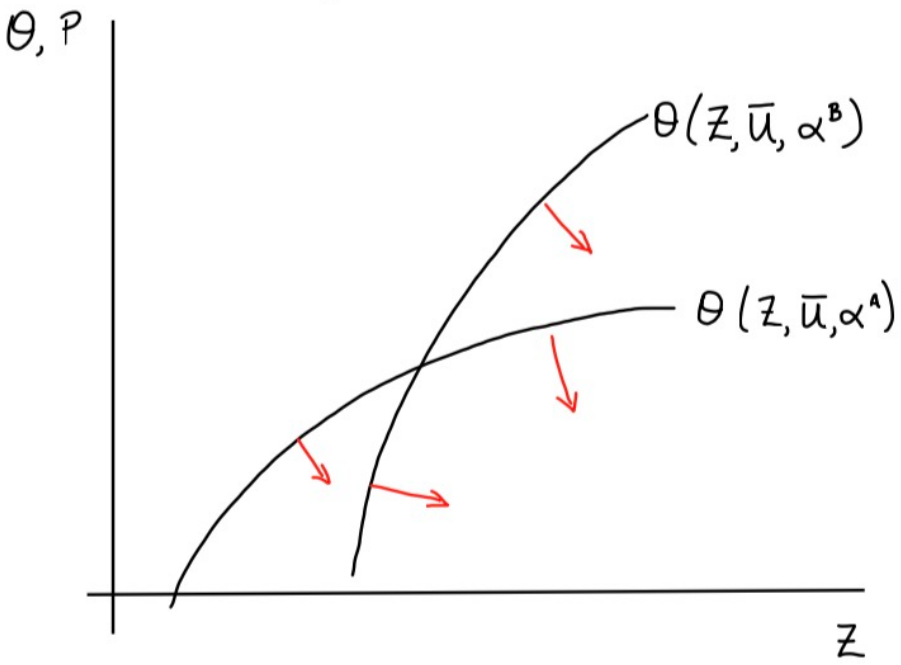
We can combing utility and budget constraint to yield a bid curve, $\theta(z, \overline{u})$, defined implicitly by

$$u(I - \theta(z, \overline{u}), z) = \overline{u}$$

"Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition" (Rosen, 1974)

$\theta(z, \overline{u})$ tells us how much the individual would be willing to pay for a house with z and get utility $\overline{u}$

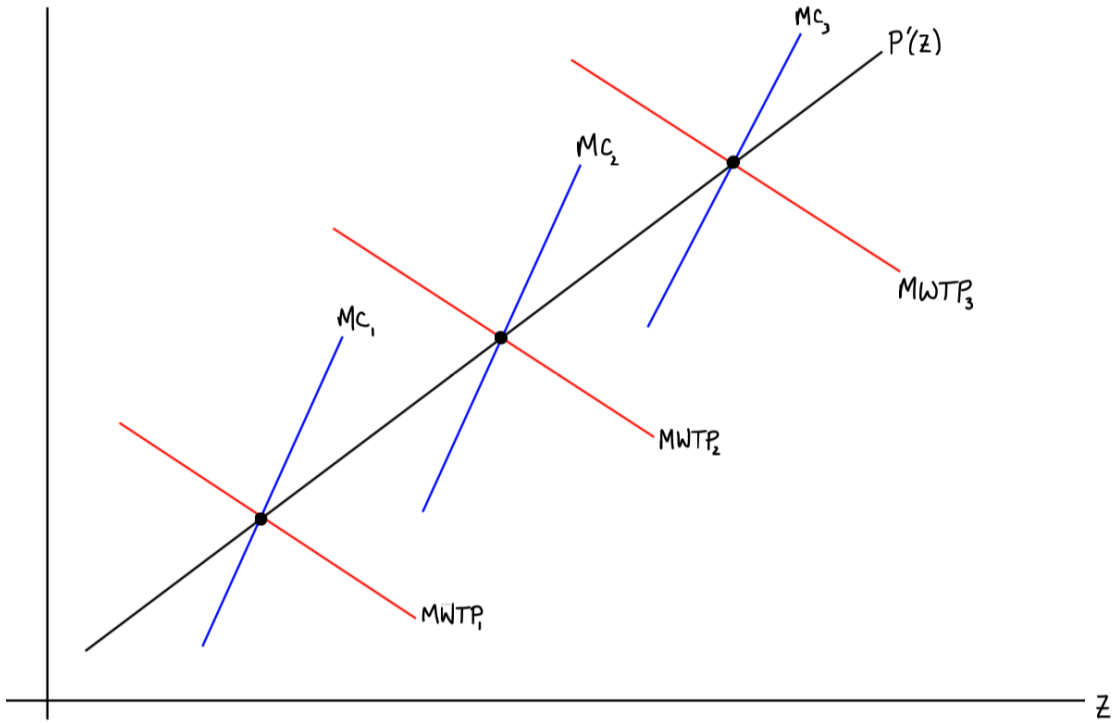
- Lower curves yield higher utility (lower price and/or more z)
- Heterogeneous individuals will have different bid curves (B has a stronger preference for z)



If α is a function of an observable attribute (education, income) we will see this attribute correlated with z in equilibrium (e.g., higher income individuals live in houses with better air quality).

Hedonic Equilibrium

At any particular point, the MWTP of the person living there is just equal to the builder's MC of supplying z, which is just equal to the hedonic price of z, $P'(z)$



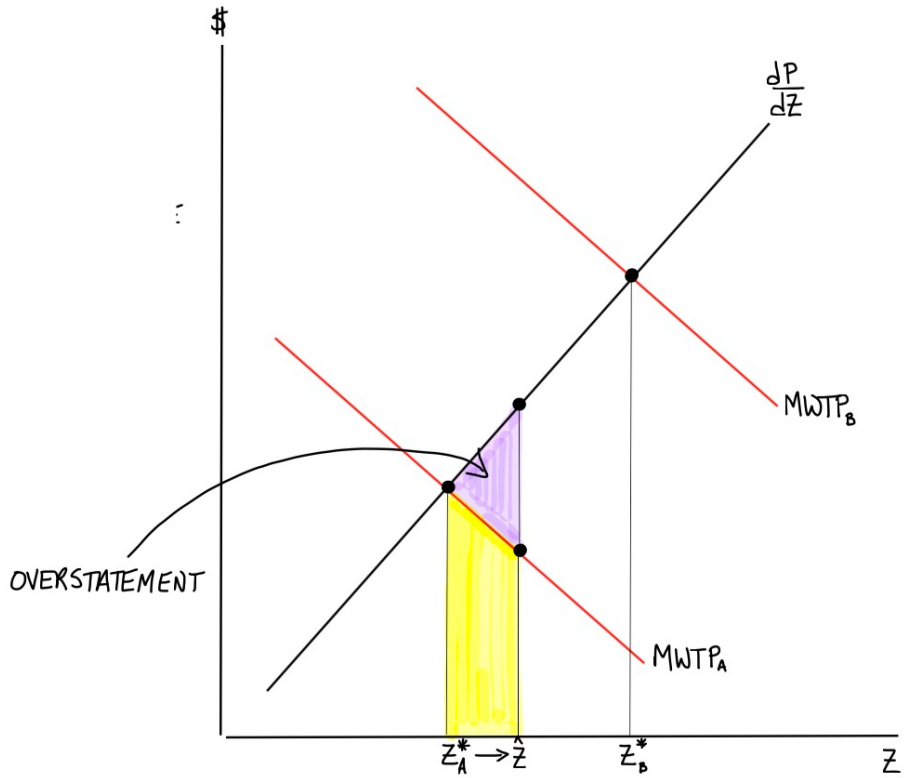
At any point away from the chosen house, $P'(z)$ doesn't tell us anything about MWTP or MC

Segmentation and Welfare

The problem is that the hedonic gradient ($\frac{\delta P}{\delta z}$) only tells us one point on each of these lines

Using the hedonic gradient ($\frac{\delta P}{\delta z}$) as an approximation will therefore not give us an accurate representation of the individual's total WTP for a change in z

$\frac{\delta P}{\delta z}$ works okay for a small change



Hedonic Model Example: Travel time and Rent Gradients

Setup

Q: how do rental costs vary with distance from the city center?

- All city residents work at a Central Business District (CBD)
- Utility function $U(C, L)$
- Budget constraint: $C = (24 - L - t)w - R(t)$
  - t: travel time to CBD from location t
  - $R(t)$: rent for living at t
  - Individual works constant $24 - L - t$ hours

Worker Problem

The Lagrangian is

$$\mathcal{L} = U(C, L) + \lambda[(24 - L - t)w - R(t) - C(t)]$$

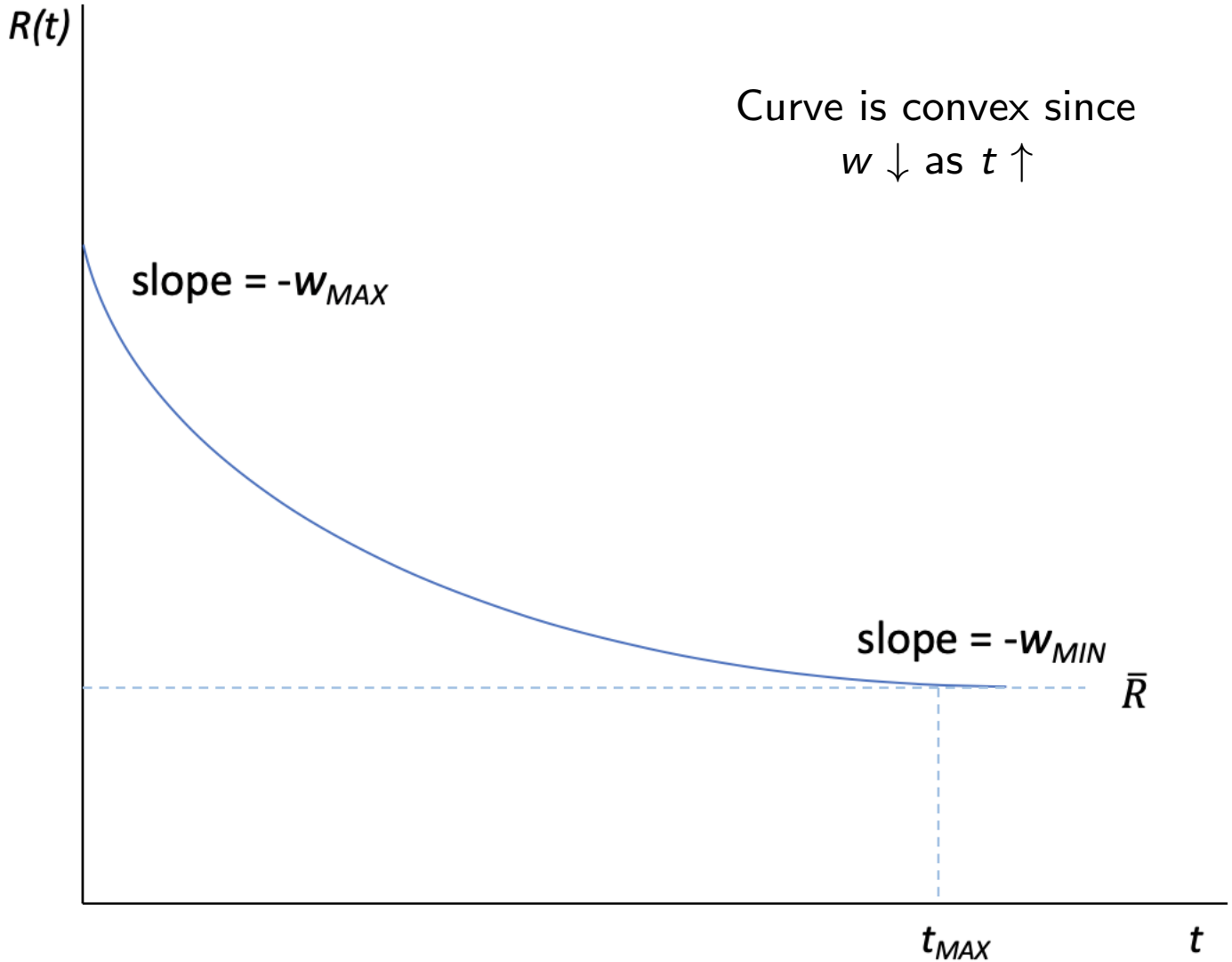
FOCs:

$$\frac{\partial U}{\partial C} = \lambda$$
$$\frac{\partial U}{\partial L} = \lambda w$$
$$-R'(t) = w$$

- I choose to work where the savings I get in rent from living another hour further away is equal to the wage rate

Rent Curve

Not only downward sloping, but also convex b/c people's wages are decreasing as we move along the curve (i.e., slope gets flatter)



Solving for $R(0)$

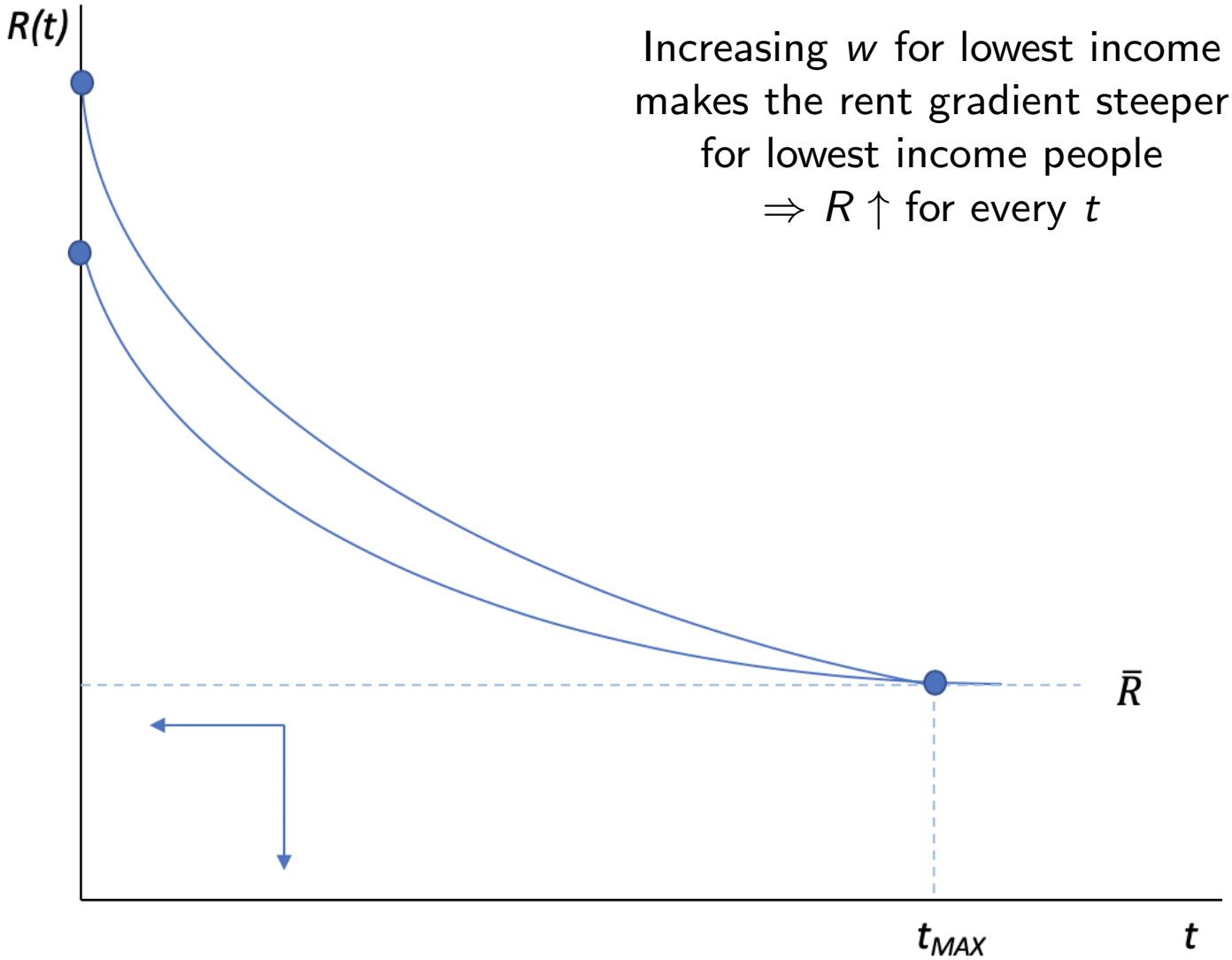
We know the *slope* but not the *level* at $R(0)$:

- Suppose at t_{MAX}, no workers are willing to drive to the CBD
- Let $\bar{R}$ be the "reservation rent"
- Then $R(t_{MAX}) = \bar{R}$
- Since we know $-R'(t) = w$, we can back out $R(0)$

What would happen if we raised incomes of just the top half of the distribution?

- There would be no effect on the lower half of the income distribution, but the rent gradient for the upper half would get steeper, and rents would rise. (Assuming no supply side response)

Suppose w Increases for Lowest Income Workers



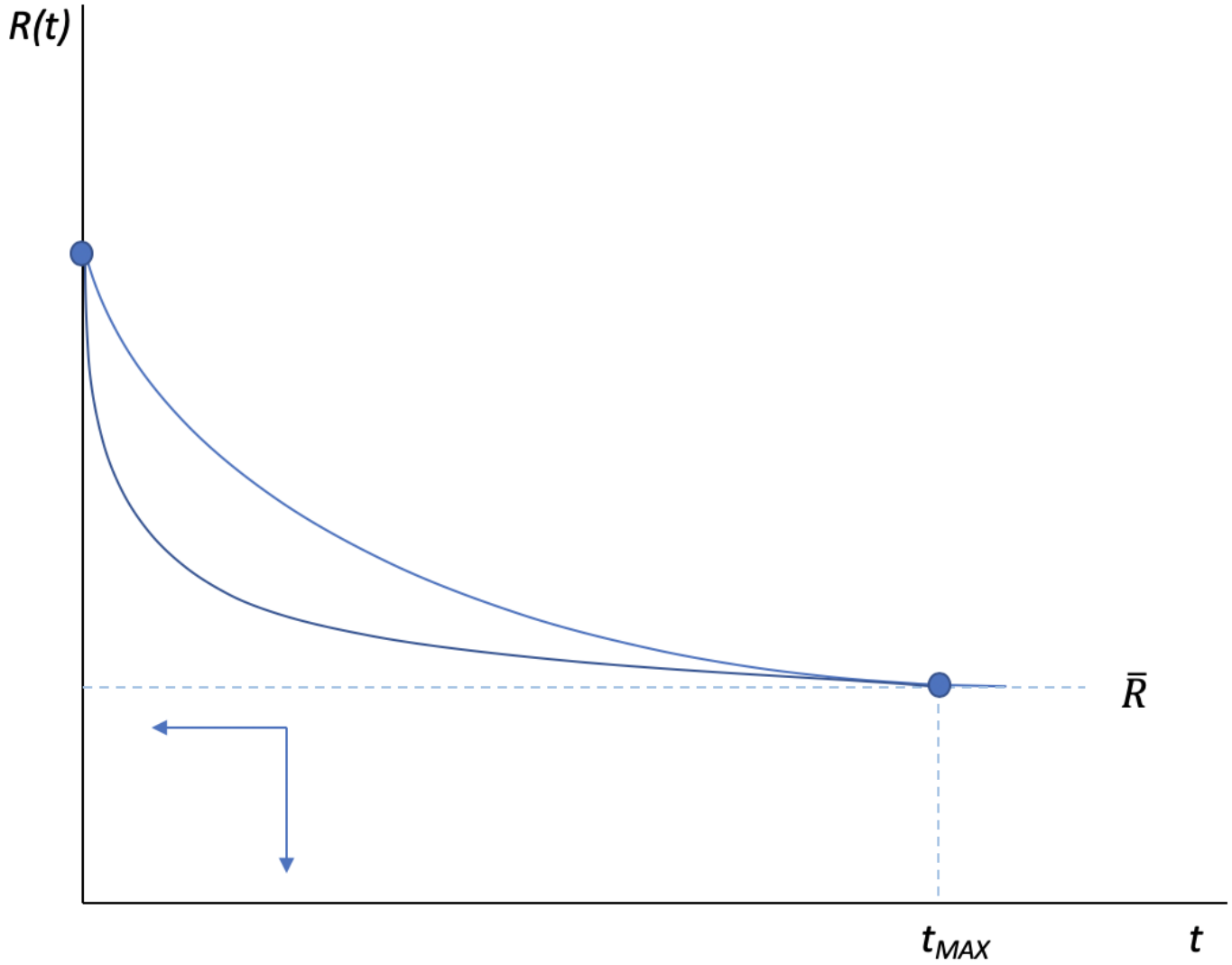
Increasing w for lowest income makes the rent gradient steeper for lowest income people

$\Rightarrow R \uparrow$ for every t

Suppose Inequality of w Increases

- Assume average wage $\bar{w}$ stays constant, but wage inequality increases
- same $\bar{w} \Rightarrow$ new rent gradient has same end points
- Recall that a worker's rent is determined by the wages of people who live further away from CBD
- For any given worker not at endpoints, wages of those closer to CBD have increased and of those further have decreased, on average
- So rents decrease across the board

Effect of Increase in Wage Inequality



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Tiebout (JPE, 1956)
A Pure Theory of Local Expenditures

Tiebout's insight

What is it about the private market that guarantees optimal provision of private goods that is missing in the case of public goods?

- Tiebout's insight was that the factors missing from the market for public goods were shopping and competition
- The situation is different when public goods are provided at the local level by cities and towns
- Competition will naturally arise because individuals can vote with their feet: if they don't like the level or quality of public goods provision in one town, they can move to the next town
- This threat of exit can induce efficiency in local public goods production

A simple stylized model

Suppose

- Local government j provides a non-rival local public good that may be limited (e.g., public park or police protection)
- Avg cost of provision across individuals is u-shaped
- Good is non-rival but excludable (i.e., residents of $j' \neq j$ cannot consume in j)
- There are no externalities across jurisdictions
- Individuals are perfectly mobile
- Governments cover the cost of spending through uniform, jurisdiction-based lump-sum taxes t_j on residents
- There is a large # of jurisdictions relative to # of individuals with different preferences for gov spending

Tiebout hypothesis

Tiebout hypothesis: outcome of local government provision is efficient, with individuals sorting into jurisdictions based on their preferences for the level and mix of public goods

- Local governments provide different level and mix of public goods
- Individuals choose among locations (i.e., **"vote with their feet"**)
- In equilibrium, competition ensures efficient public good production
- Intuition: local governments will provide a bundle of goods, for which the lump-sum tax paid by residents serves as a price

Relaxing assumptions from the stylized model

The Tiebout hypothesis may not hold if

1. Spending is financed through distortionary (i.e., not lump-sum) tax instruments because benefit-tax link can be broken
2. There are fiscal externalities
3. Individuals' mobility is constrained
4. There are economies of scale in public good provision
5. Goods are not locally excludable
6. There are not enough jurisdictions relative to preferences for spending

We'll focus on (1) and (2). See Bewley (1981) for more analysis

1. Spending is financed through distortionary taxes

- Suppose spending is now financed through property taxes
- Sources of distortion added:
  1. Once in a jurisdiction j, individuals don't buy more housing because property taxes $\uparrow$ without $\uparrow$ in public good consumption
  2. Individuals pay different absolute amounts for the same level of public goods in j, so can have different valuation of public good in a given jurisdiction. Wealthy may seek to exclude poor
  3. Heterogeneous valuation of public goods $\rightarrow$ unlikely that provision level set by majority will be efficient
- Can potentially resolve the Tiebout hypothesis in this case by adding *residential zoning* (Hamilton, 1975)

Residential Zoning

Can resolve the Tiebout hypothesis in case (1) by adding *residential zoning* (Hamilton, 1975)

- Community can set minimum level of housing such that sorting into j produces the same outcome as lump sum taxation
- Jurisdictions will not have individuals who want to purchase less than the min level of housing

$\Rightarrow$ Zoning can induce efficient allocation if public goods are funded with property taxes

- Note: If there's a minimum level of housing, then preferences for public goods and housing must be homogeneous in j

Aside: Allen, Arkolakis, Li have a recent paper on zoning in Chicago called optimal city structure

2. Fiscal spillovers

- Allow spending in j to affect spending in $j' \neq j$
  - E.g., If j increases sales tax, the sales tax base increases in neighboring jurisdictions due to fleeing shoppers
- In the presence of fiscal externalities, local policy may not be *nationally* efficient
- Federal government can implement a Pigouvian policy, such as matching grants or state and local tax deductions

Will discuss this in more depth at the end of the lecture

Evidence on the Tiebout Model: Hoxby (2000)

Hoxby (2000) considers public school districts in the US. She compares cities where:

- There are few large school districts and hence little choice for residents (such as Miami)
- There are many small school districts and hence a lot of choice for residents (such as Boston)
- **Finding #1**: Cities with few districts have less sorting across neighborhood (in terms of school quality) than cities with many districts (this result is well established)
- **Finding #2**: Cities with many districts have **higher** test scores on average: this result is controversial (see Rothstein, 2007 critique)

Many other papers on evidence or lack thereof on Tiebout model (see, e.g., J. Donahue (JEP, 1997) and Rhode Strumpf (AER, 2003).

Ellickson (AER, 1971)

Ellickson (AER, 1971)

"Jurisdictional Fragmentation and Residential Choice"

Model to operationalize the idea of "voting with one's feet." Provides a modeling structure for the first empirical sorting models

$$\Phi^i(p_c, \overline{p}^j_d, g^j, w^i) \tag{1}$$

- p_c = Price of consumption goods (same everywhere)
- $\overline{p}^j_d$ = After-tax price of housing in j

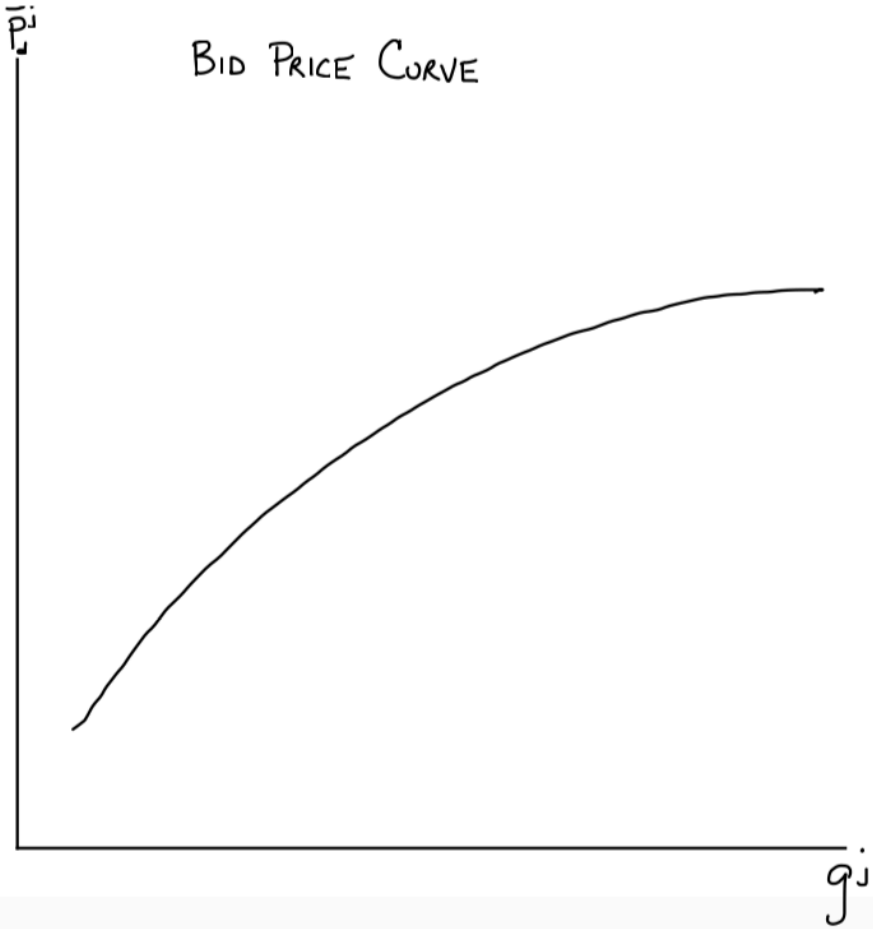
$$\overline{p}^j_d = p^j_d(1 + \tau^j)$$

- p^j_d = Price of constructing a house in j
- g^j = Public services quality in j
- w^i = Household i's wealth

Bid Price Curve

Bid Price Curve: the set of $(\overline{p}^j_d, g^j)$ that yield the same level of utility, $\hat{u}$, implicitly defined by $\Phi^i(p_c, \overline{p}^j_d, g^j, w^i) - \hat{u} = 0$

Holding all else equal, a higher g^j will require a higher p^j_d to keep utility constant



Feasibility Set

Cost of providing government services quality g^j to population N^j (g^j is a congestable public good)

- $G^j = G(N^j, g^j) = \overline{G}(g^j)N^j$ (Constant returns to scale)
- $T^j = \tau^j p_d^j D^j$ Tax Revenue (Given residential land D^j)

Budget Balance reveals what's feasible

1. $\overline{G}(g^j)N^j = \tau^j p_d^j D^j$
2. $\overline{p}_d^j = p_d^j(1+\tau^j) = p_d^j + \tau^j p_d^j$

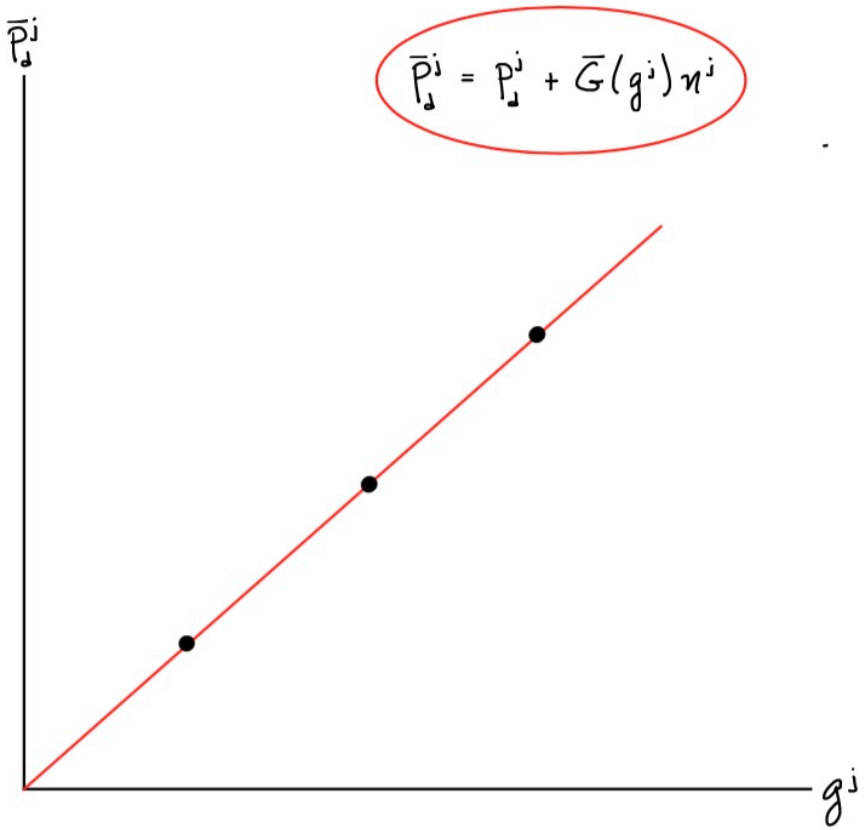
Rearranging 1, we get:

$$\tau^j p_d^j = \frac{\overline{G}(g^j)N^j}{D^j} = \overline{G}(g^j)\eta^j \tag{2}$$

where η^j = population density

Thus, $\overline{p}_d^j = p_d^j + \overline{G}(g^j)\eta^j$

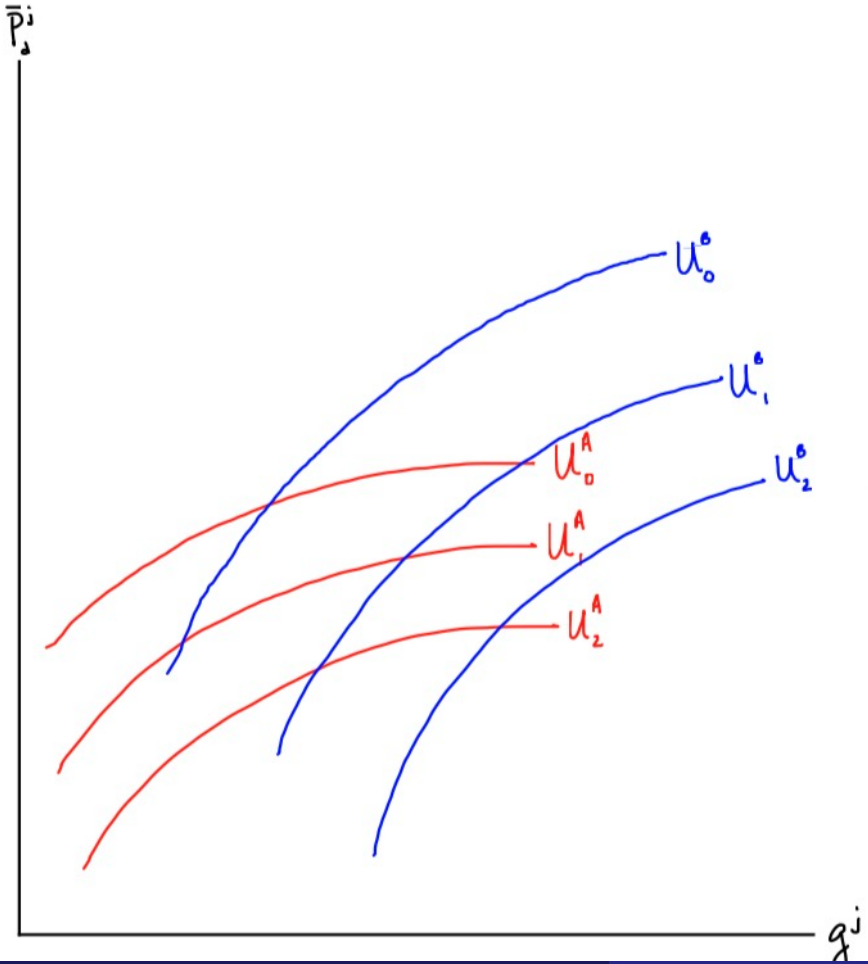
Budget Balance



Equation defintes a set of $(\overline{p}^j_d, g^j)$ that could be made available by local governments (Higher g^j requires higher $\overline{p}^j_d$)

Stratification by Wealth

Which Community people will choose to live in is a very complicated problem without further restrictions on the model. We assume preferences take a shape that ensures perfect stratification by wealth

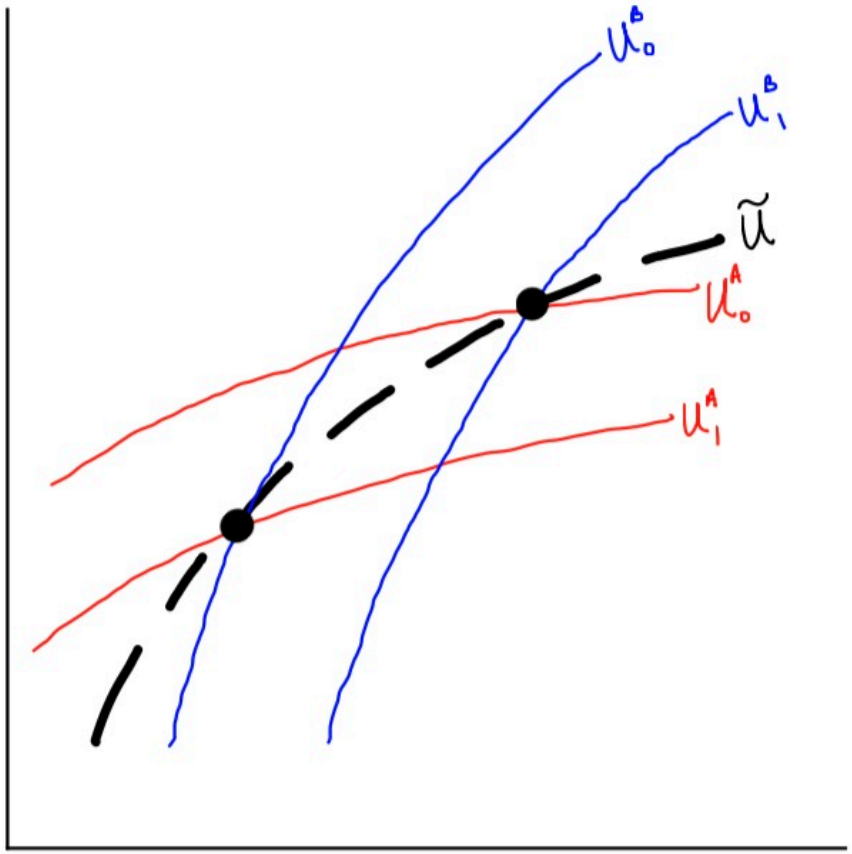


As w increases, bid function in $(\bar{p}^j_d, g^j)$ space gets steep

$\leftarrow$ "Single Crossing" property

Stratification by Wealth

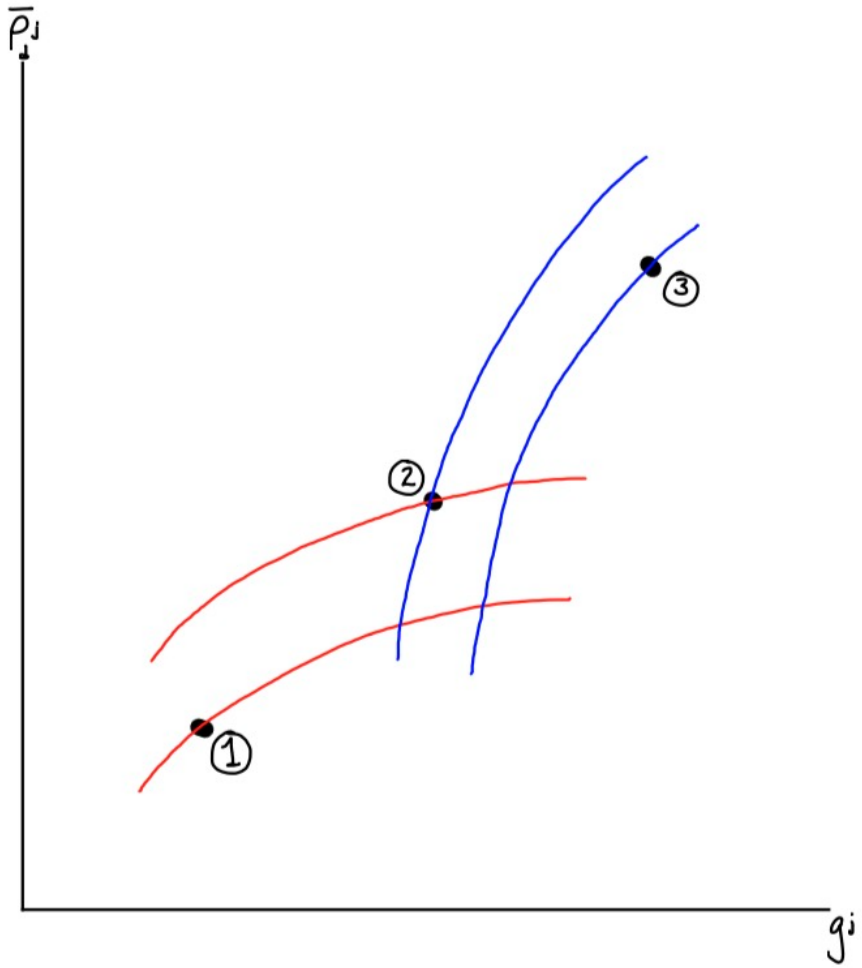
High wealth individuals will maximize utility by choosing to locate in community B



Low wealth individuals ma maximize utility by locating in community A

There is an intermediate individual with indifference curve $\tilde{u}$ who is indifferent between the two locations

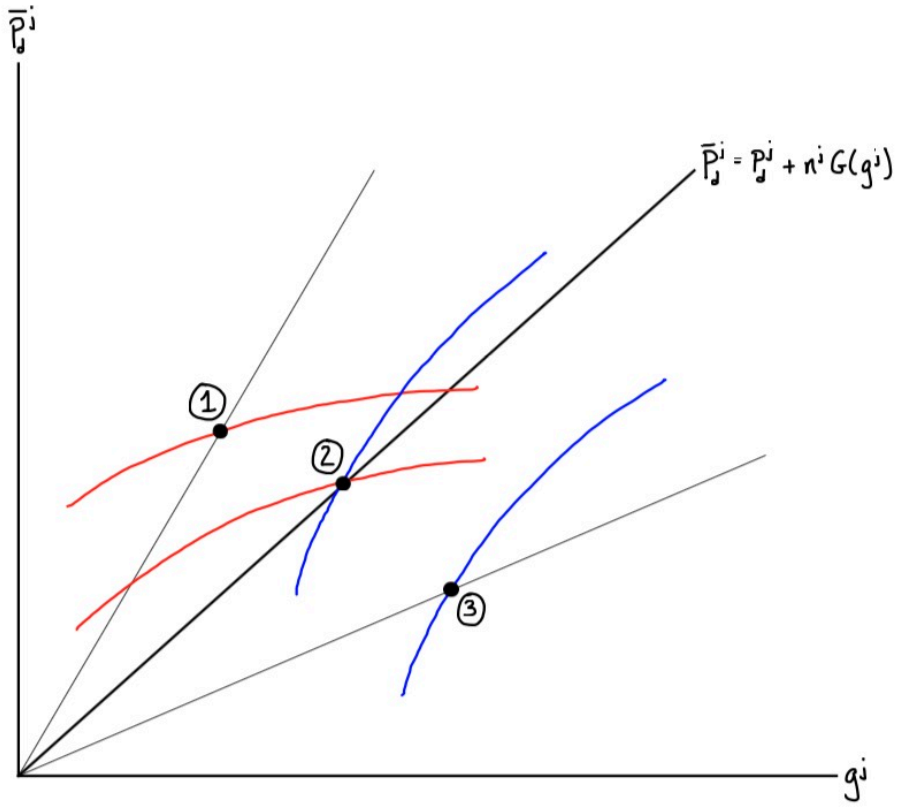
Decentralization



In general, decentralizing gov't provisions of public goods improves welfare as it lets individuals find $(\overline{p}_d^j, g^j)$ combinations that better match their preferences

Starting with both types of individuals in (2), they are both made better off when (2) splits into a low g^j low tax community (1) and a high g^j, high tax community (3)

Things get more complicated if the tax base changes along with the congestion of the public good



Suppose higher wealth indivuals consume more land. When the split occurs, $\eta_1 > \eta_3$ (i.e. higher population density in the poor community) This raises the cost of providing any level of g Poor now

face a worse option in (1). Poor would prefer to stay in a community with the rich, vote against decentralization. Rich vote for zoning requiring big plots to keep poor out

Bayer Ferreira McMillan (JPE, 2007)

"A Unified Framework for Measuring Preferences for Schools & Neighborhoods"

Embeds boundary discontinuity design in discrete choice residential sorting model. Addresses endogeneity of school and neighborhood characteristics

Summary of Results:

- Households are willing to pay less than previously thought for improvements in school quality. May instead reflect WTP for neighborhood attributes that form b/c of sorting in response to school quality differences
- Willingness to pay for more educated, wealthier neighbors is really explained by correlation between these attributes and neighborhood unobservables
- Negative correlation between % black & house price is driven by blacks living in lower quality neighborhoods
- Lots of heterogeneity in preferences. Demonstrates how sorting model nests hedonic model, with adjustment for preference heterogeneity.

Boundary Discontinuity Design (BDD) - Black (1999)

- Want limited geographic space to limit unobservables, but still want variation in school quality
- Rely on fact that school quality changes discretely at catchment zone boundary, but other neighborhood unobservables will be the same of both sides
- Use fixed effects for small neighborhoods defined around the boundary. Exploits "within" variation.

Use to deal with endogeneity of race variable (i.e., sociodemographics correlated with unobserved neighborhood quality)

Sorting across boundary based on (observable) school quality creates an exogenous source of variation in neighbors' race that can be used to identify households' preferences for these social interactions

Data (1/2)

- 1990 restricted access census (15% of pop long-form)
- Block-level (approx. 100 individuals)
- SF Bay Area
  - Alameda
  - Contra Costa
  - Marin
  - San Mateo
  - San Francisco
  - Santa Clara
- 1,100 census tracts
- 39,500 blocks

Data (2/2)

- Add information about:
  - Crime Rates
  - Land Use/Topography
  - Urban Density
  - Local Schools
- School Quality = Average of 4^{th} grade math and reading scores, averaged over two years
- Only have school attendance zones for 1/3 of the elementary schools in the bay area. Mostly lose San Francisco - Leads to lower housing prices and income in boundary sample
- Back-up with data describing housing transactions between 1992-1996 (dataquick). Merge with HMDA data on race and income

Analysis of Boundary Effects

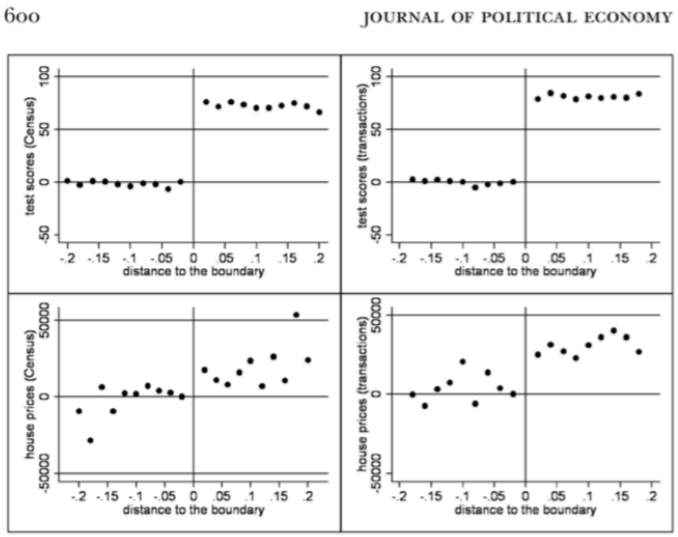


FIG. 1.—Test scores and house prices around the boundary. Each panel is constructed using the following procedure: (i) regress the variable in question on boundary fixed effects and on 0.02-mile band distance to the boundary dummy variables; (ii) plot the coefficients on these distance dummies. Thus a given point in each panel represents this conditional average at a given distance to the boundary, where negative distances indicate the low test score side.

- Regress each variable on boundary fixed effects and dummies for distance to the boundary. Census and transaction data.
- Clear discontinuity in test scores at the boundary. Similar jumps seen in housing price
- If all other neighborhood attributes are continuous at the boundary difference in price will reveal value of difference in test scores

Analysis of Boundary Effects

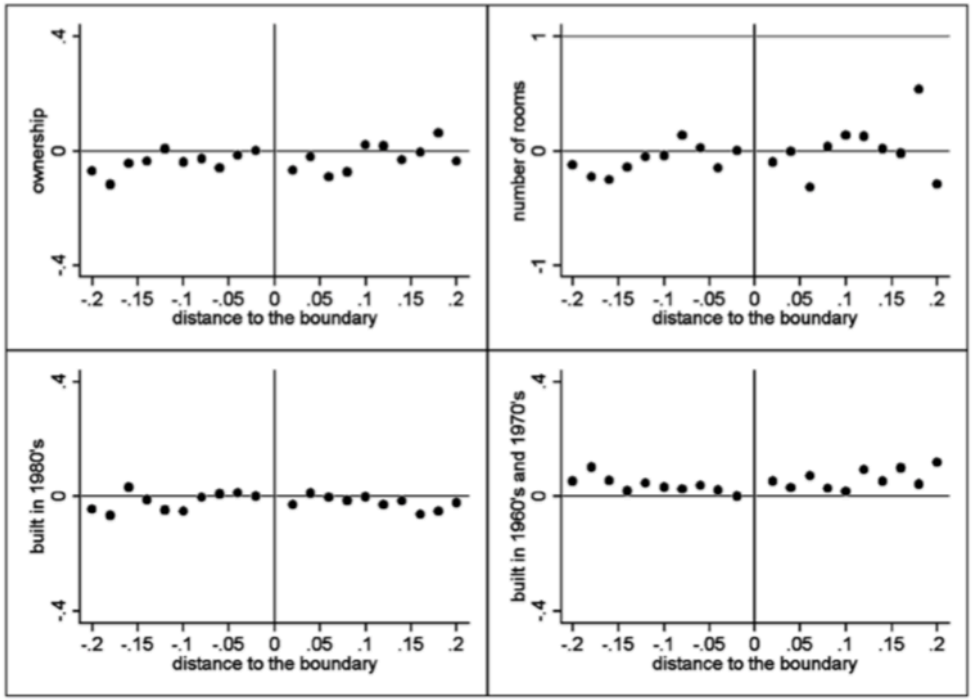


FIG. 2.—Census housing characteristics around the boundary. Each panel is constructed using the following procedure: (i) regress the variable in question on boundary fixed effects and on 0.02-mile band distance to the boundary dummy variables; (ii) plot the coefficients on these distance dummies. Thus a given point in each panel represents this conditional average at a given distance to the boundary, where negative distances indicate the low test score side.

Housing variables are continuous across the boundary (i.e., we don't think price reflects the influence of these things).

Analysis of Boundary Effects

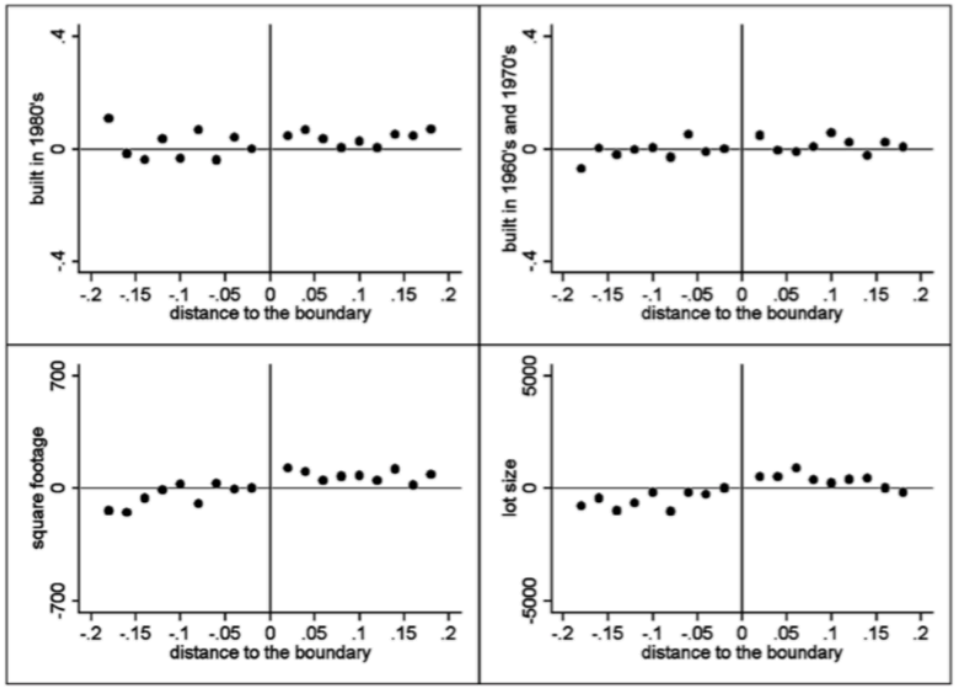


FIG. 3.—Transactions data housing characteristics around the boundary. Each panel is constructed using the following procedure: (i) regress the variable in question on boundary fixed effects and on 0.02-mile band distance to the boundary dummy variables; (ii) plot the coefficients on these distance dummies. Thus a given point in each panel represents this conditional average at a given distance to the boundary, where negative distances indicate the low test score side.

Same for these housing attributes . . .

Analysis of Boundary Effects

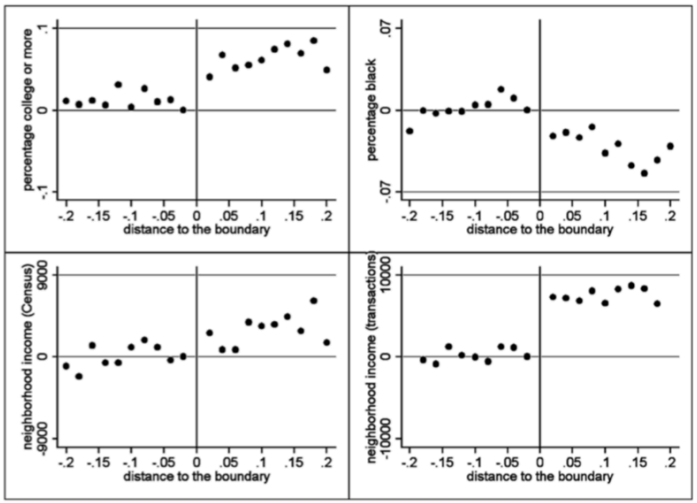


FIG. 4.—Neighborhood sociodemographics around the boundary. Each panel is constructed using the following procedure: (i) regress the variable in question on boundary fixed effects and on 0.02-mile band distance to the boundary dummy variables; (ii) plot the coefficients on these distance dummies. Thus a given point in each panel represents this conditional average at a given distance to the boundary, where negative distances indicate the low test score side.

- Things are very different when we look at the attributes of the people who have chosen to live on each side of the boundary
- High-side individuals have more income and education and are less likely to be black
- Ignoring attributes of neighbors is likely to yield biased estimates of value in school quality

Hedonic Regressions

$$p_h = \beta x_h + \theta_{bh} + \xi_h \tag{3}$$

- x_h = housing and neighborhood characteristics
  - Owner occupied
  - Number of bedrooms
  - Year built
  - Population density
  - Crime
  - Land use (% Commercial, etc.)
  - Avg. Test Score
  - % College degree
  - Average block income
- θ_{bh} = boundary fixed effects

Hedonic Regression Results (1/4)

TABLE 3
KEY COEFFICIENTS FROM BASELINE HEDONIC PRICE REGRESSIONS

	SAMPLE			
	Within 0.20 Mile of Boundary (N = 27,548)		Within 0.10 Mile of Boundary (N = 15,122)	
Boundary fixed effects included	No	Yes	No	Yes
	A. Excluding Neighborhood Sociodemographic Characteristics			
	(1)	(2)	(5)	(6)
Average test score (in standard deviations)	123.7	33.1	126.5	26.1
	(13.2)	(7.6)	(12.4)	(6.6)
R^2	.54	.62	.54	.62
	B. Including Neighborhood Sociodemographic Characteristics			
	(3)	(4)	(7)	(8)
Average test score (in standard deviations)	34.8	17.3	44.1	14.6
	(8.1)	(5.9)	(8.5)	(6.3)
% census block group black	−99.8	1.5	−123.1	4.3
	(33.4)	(38.9)	(32.5)	(39.1)
% block group with college degree or more	220.1	89.9	204.4	80.8
	(39.9)	(32.3)	(40.8)	(39.7)
Average block group income (/10,000)	60.0	45.0	55.6	42.9
	(4.0)	(4.6)	(4.3)	(6.1)
R^2	.59	.64	.59	.63

NOTE.—All regressions shown in the table also include controls for whether the house is owner-occupied, the number of rooms, year built (1980s, 1960–79, pre-1960), elevation, population density, crime, and land use (% industrial, % residential, % commercial, % open space, % other) in 1-, 2-, and 3-mile rings around each location. The dependent variable is the monthly user cost of housing, which equals monthly rent for renter-occupied units and a monthly user cost for owner-occupied housing, calculated as described in the text. Standard errors corrected for clustering at the school level are reported in parentheses.

Adding BFE's dramatically lowers estimated WTP for test score improvements. This implies test scores are correlated with neighborhood unobservables (geographically restricting variation to a small area around the boundary reduces role of unobservables)

Hedonic Regression Results (2/4)

TABLE 3
KEY COEFFICIENTS FROM BASELINE HEDONIC PRICE REGRESSIONS

	SAMPLE			
	Within 0.20 Mile of Boundary (N = 27,548)		Within 0.10 Mile of Boundary (N = 15,122)	
Boundary fixed effects included	No	Yes	No	Yes
	A. Excluding Neighborhood Sociodemographic Characteristics			
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WTP for school quality drops even further once neighborhood sociodemographics are included

BFE's alone can't deal with bias imposed by sorting and individuals having a preference for the attributes of their neighbors

\$17 per month = 1.8% of average monthly user cost of housing

Hedonic Regression Results (3/4)

TABLE 3
KEY COEFFICIENTS FROM BASELINE HEDONIC PRICE REGRESSIONS

	SAMPLE			
	Within 0.20 Mile of Boundary (N = 27,548)		Within 0.10 Mile of Boundary (N = 15,122)	
Boundary fixed effects included	No	Yes	No	Yes
	A. Excluding Neighborhood Sociodemographic Characteristics			
	(1)	(2)	(5)	(6)
Average test score (in standard deviations)	123.7	33.1	126.5	26.1
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Look at the effect of BFE's on sociodemographic coefficients. Boundary provides an exogenous source of variation in race (B/C of sorting) as long as we control for the things that differ across the boundary (i.e., school quality)

Adding the BFE's changes the coefficient on % black from -99.8 to 1.5. Similar impacts for education and income of neighbors

Hedonic Regression Results (4/4)

TABLE 3
KEY COEFFICIENTS FROM BASELINE HEDONIC PRICE REGRESSIONS

	SAMPLE			
	Within 0.20 Mile of Boundary (N = 27,548)		Within 0.10 Mile of Boundary (N = 15,122)	
Boundary fixed effects included	No	Yes	No	Yes
	A. Excluding Neighborhood Sociodemographic Characteristics			
	(1)	(2)	(5)	(6)
Average test score (in standard deviations)	123.7	33.1	126.5	26.1
	(13.2)	(7.6)	(12.4)	(6.6)
R^2	.54	.62	.54	.62
	B. Including Neighborhood Sociodemographic Characteristics			
	(3)	(4)	(7)	(8)
Average test score (in standard deviations)	34.8	17.3	44.1	14.6
	(8.1)	(5.9)	(8.5)	(6.3)
% census block group black	−99.8	1.5	−123.1	4.3
	(33.4)	(38.9)	(32.5)	(39.1)
% block group with college degree or more	220.1	89.9	204.4	80.8
	(39.9)	(32.3)	(40.8)	(39.7)
Average block group income (/10,000)	60.0	45.0	55.6	42.9
	(4.0)	(4.6)	(4.3)	(6.1)
R^2	.59	.64	.59	.63

NOTE.—All regressions shown in the table also include controls for whether the house is owner-occupied, the number of rooms, year built (1980s, 1960–79, pre-1960), elevation, population density, crime, and land use (% industrial, % residential, % commercial, % open space, % other) in 1-, 2-, and 3-mile rings around each location. The dependent variable is the monthly user cost of housing, which equals monthly rent for renter-occupied units and a monthly user cost for owner-occupied housing, calculated as described in the text. Standard errors corrected for clustering at the school level are reported in parentheses.

Analyses that fail to control for correlation of neighborhood sociodemographics and unobserved neighborhood quality will overstate the capitalization of the former into housing prices

* Assumption: controlling for school quality wipes out impact of anything else that might have been correlated with race

Sorting Model

Goal

- Use to clarify the relationship between the true distribution of preferences and the hedonice price function coefficients
- When do the hedonic price function coefficients provide a reasonable estimate of the mean marginal willingness to pay?

Sorting Model

$$\max_h V_h^i = \alpha_x^i x_h - \alpha_p^i p_h - \alpha_d^i d_h^i + \theta_{bh} + \xi_h + \epsilon_h^i \quad (4)$$

- x_h = observable attributes of house h
- p_h = price of house h
- d_h^i = distance of house h to place of work of household i
- ξ_h = unobservable attribute of house h (valued the same by all households)
- ϵ_h^i = idiosyncratic utility of house h for household i

Each household's marginal utility of each attribute is allowed to vary with its observable attributes

$$\alpha_j^i = \alpha_{0j} + \sum_{k=1}^{K} \alpha_{kj} z_h^i$$

Estimation

$$V_h^i = \delta_h + \lambda_h^i + \epsilon_h^i$$

$$\delta_h = \alpha_{0x} x_h - \alpha_{0p} p_h + \theta_{bh} + \xi_h \text{ Baseline utilitiy}$$

$$\lambda_h^i = (\sum_{k=1}^{k} \alpha_{kx} z_k^i) x_h - (\sum_{k=1}^{k} \alpha_{kp} z_k^i) p_h - (\sum_{k=1}^{k} \alpha_{kd} z_k^i) d_h^i \quad (5)$$

Estimation: Step #1

Maximum likelihood returns estimates of δ_h's and parameters in λ_h

$$P_h^i = \frac{EXPd_h + \lambda_h^i}{\sum_l EXPd_l + \lambda_l^i} \tag{6}$$

$$L = \sum_i \sum_h I_h^i \log(P_h^i) \tag{7}$$

Maximize the likelihood of seeing the households choose the houses that they actually pick

- Vector of δ_h's should be that which makes the predicted share of the population choosing each house equal the actual share (1/N)
- Predicted share is just the sum of the probabilities that each household picks the house

Estimation: Step #2

Decompose δ_h into its component parts

$$\delta_h = \alpha_{0x} x_h - \alpha_{0p} p_h + \theta_{bh} + \xi_h$$

This equation can be re-arranged to look a lot like the hedonic regression equation

$$P_h + \frac{1}{\alpha_{0p}} \delta_h = \frac{\alpha_{0x}}{\alpha_{0p}} x_h + \frac{1}{\alpha_{0p}} \theta_{bh} + \frac{1}{\alpha_{0p}} \xi_h$$

Estimation: Step #2

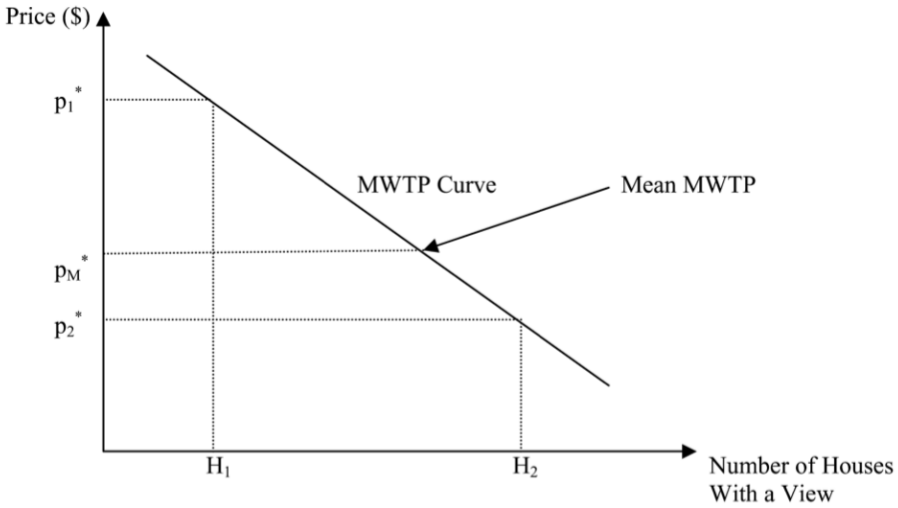


FIG. 5.—Demand for a view of the Golden Gate Bridge

δ_h provides an adjustment to the hedonic price function when households have heterogeneous preferences. MWTP estimate reflects preferences of marginal household who consumes attribute.

Interpretation

- The hedonic price will be determined by the marginal household.
  - This will only equal the mean preference if all households are identical (MWTP is a horizontal line)
  - δ_h "corrects" for the first-stage heterogeneity in preferences (i.e., it formally represents mean utility).
  - When everyone is identical, $\delta_h = k \forall h$ and the correction is absorbed into the constant

- If a small share of households purchase a particular amenity, the WTP of the marginal household may be quite high.
  - This would get reflected in the hedonic estimate, even though the mean MWTP is much lower
  - In this case, δ_h will be low for houses with this attribute to explain why so few households want them. This will pull down the estimates in the adjusted regression

IV

- Price is likely correlated with unobserved neighborhood attributes. Use attributes of houses more than 3 mi. away as IV's, as these are only likely to affect the price by determining the availability of subsitutes, but are otherwise excluded from utility
- Use BFE's in stage 2 as well to account for neighborhood unobservables that may be correlated with race, average income, school quality, etc.

Estimation Results (1/3)

TABLE 7
DELTA REGRESSIONS: IMPLIED MEAN WILLINGNESS TO PAY
SAMPLE: WITHIN 0.20 MILE OF BOUNDARY (N = 27,458)

Boundary fixed effects included	No	Yes
	A. Excluding Neighborhood Sociodemographic Characteristics	
	(1)	(2)
Average test score (in standard deviations)	97.3	40.8
	(14.0)	(5.5)
	B. Including Neighborhood Sociodemographic Characteristics	
	(3)	(4)
Average test score (in standard deviations)	18.0	19.7
	(8.3)	(7.4)
% block group black	−404.8	−104.8
	(41.4)	(36.9)
% census block group Hispanic	−88.4	−3.5
% block group with college degree or more	183.5	104.6
	(26.4)	(31.8)
Average block group income (/10,000)	30.7	36.3
	(3.7)	(6.6)

NOTE.—All regressions shown in the table also include controls for whether the house is owner-occupied, the number of rooms, year built (1980s, 1960–79, pre-1960), elevation, population density, crime, and land use (% industrial, % residential, % commercial, % open space, % other) in 1-, 2-, and 3-mile rings around each location. The dependent variable is the monthly user cost of housing, which equals monthly rent for renter-occupied units and a monthly user cost for owner-occupied housing, calculated as described in the text. Standard errors corrected for clustering at the school level are reported in parentheses.

With BFE's and sociodemographics, MWTP for school quality ($19.70) is similar to the hedonic estimate. This is because the attribute varies continuously (i.e., MWTP not determined by marginal consumer consuming the attribute)

Estimation Results (2/3)

- Adding BFE's reduces magnitude of coefficients on sociodemographics, but MWTP for % black is still negative and significant
- Suggests that households can self-segregate based on race without requiring equilibrium price differentials
  - Mean preference = White (Majority)
  - B/C there are so many white neighborhoods, the marginal white household (reflected in hedonic estimates) doesn't care very much about % black

Estimation Results (3/3)

TABLE 8
HETEROGENEITY IN MARGINAL WILLINGNESS TO PAY FOR AVERAGE TEST SCORE AND NEIGHBORHOOD SOCIODEMOGRAPHIC CHARACTERISTICS

		NEIGHBORHOOD SOCIODEMOGRAPHICS		
	AVERAGE TEST SCORE +1 SD	+10% Black vs. White	+10% College-Educated	Block Group Average Income +$10,000
Mean MWTP	19.69	−10.50	10.46	36.3
	(7.41)	(3.69)	(3.18)	(6.60)
Household income (+$10,000)	1.38	−1.23	1.41	.86
	(.33)	(.37)	(.21)	(.12)
Children under 18 vs. no children	7.41	11.86	−16.07	2.37
	(3.58)	(3.03)	(2.25)	(1.17)
Black vs. white	−14.31	98.34	18.45	−1.16
	(7.36)	(3.93)	(4.52)	(2.24)
College degree or more vs. some college or less	13.03	9.19	58.05	.31
	(3.57)	(3.14)	(2.33)	(1.40)

NOTE.—The first row of the table reports the mean marginal willingness to pay for the change reported in the column heading. The remaining rows report the difference in willingness to pay associated with the change listed in the row heading, holding all other factors equal. The full heterogeneous choice model includes 135 interactions between nine household characteristics and 15 housing and neighborhood characteristics. The included household characteristics are household income, the presence of children under 18, and the race/ethnicity (Asian, black, Hispanic, white), educational attainment (some college, college degree or more), work status, and age of the household head. The housing and neighborhood characteristics are the monthly user cost of housing, distance to work, average test score, whether the house is owner-occupied, number of rooms, year built (1980s, 1960–79, pre-1960), elevation, population density, crime, and the racial composition (% Asian, % black, % Hispanic, % white) and average education (% college degree) and household income for the corresponding census block group. Standard errors are reported in parentheses.

Lots of asymmetry in preferences. Those with college degree willing to pay a lot more to live in a high education neighborhood. Same for average income and % black $\rightarrow$ **Self-Segregation**

Conclusions

- Discontinuous amenities induce sorting along boundaries. Because households care about neighbor sociodemographics, BFE analysis will yield biased results if these factors aren't controlled for
- Use boundary variation to measure value of sociodemographics (as long as you can control for differences across boundary with observables. Normally, it would be hard to find exogenous variation in neighbor attributes)

Social Interactions, Sorting, and Peer Effects

Social interactions/ peer effects are important in local PF

Sorting + human capital spillovers from neighbors $\rightarrow$ interesting issues

- Benabou (QJE, 1993) explores a steady state model where local complementarities in human capital investment, or peer effects, generate occupational segregation and studies its efficiency properties
- Benabou (Restud, 1996) shows minor differences in preferences can create a "tipping" effect that leads to severe stratification by income
- Fernandez and Rogerson (QJE, 1996) show how sorting, community formation, and spillovers manifesting through the tax base and determine local education spending in GE
- Fogli and Guerrieri (2018) build calibrated OLG model where parents choose the neighborhood where to raise their kids/invest in their human capital. Segregation and inequality amplify each other b/c of a local spillover that affects the returns to education.

See Kuminoff Smith Timmins (JEL, 2013) "The New Economics of Equilibrium Sorting and Policy Evaluation Using Housing Markets"

Outline

1. Overview
   - Key questions in local public finance
   - Club model of local provision of public goods
2. Preliminaries
   - Quality Differences
   - Hedonics
   - Hedonic Model Example: Travel time and Rent Gradients
3. Tiebout and Sorting
   - Tiebout (JPE, 1956)
   - Ellickson (AER, 1971)
   - Bayer Ferreira McMillan (JPE, 2007)
   - Social Interactions, Sorting, and Peer Effects
4. Fiscal Federalism
   - Oates (1972) and Oates (JEL, 1999)
   - Intergovernmental Grants
   - Tax Harmonization - FMSZ (Restud, 2018)

Oates (1972)

Question: what form of government is best for resolving allocation, distribution, and stabilization problems?

- Musgrave (1959): Three roles of government
  - Ensure an efficient use of resources
  - Establish an equitable distribution of income
  - Maintain stable employment and prices
- Case for centralized government
  - A central agency should manage monetary policy, so **stabilization** at local levels depends on fiscal policy which may have spillovers, have small effects, and encourage debt financing and affect financial flows. Also shocks are likely correlated across locations.
  - Local **redistribution** would create strong incentives for wealthy to flee and for the poor to migrate into the community (e.g., Stigler (1957), Epple and Romer (1991), Feldstein and Wrobel (1998))
  - Central gov must provide certain "national" public goods (like national defense) that provide services to the entire population of the country.
  - Risk and income can be more easily spread and distributed
  - Central governments consolidate bargaining power against external agents

Oates (1972): case for a decentralized government

Question: what form of government is best for resolving allocation, distribution, and stabilization problems?

- There a local public goods whose consumption is limited to their own jurisdictions
- Uniform levels of consumption may not be efficient if **preferences and local technologies are heterogeneous**. Tiebout sorting can restore efficiency with local provision.
- Local governments do not do any redistribution: individuals receive in local public goods exactly what they are paying in taxes (= benefit principle of taxation)
- Decentralization may result in greater experimentation and innovation due to **competitive pressures** across governments
- Local gov't may provide a **better institutional setting** that promotes better decision making by compelling more explicit recognition of the costs of public programs and having better information about local performance and preferences (see, e.g., Besley and Coate (2003))

See Oates (JEL, 1999) for more details

Oates (1972): The allocative role

Question: what form of government is best for resolving allocation, distribution, and stabilization problems?

Considerations re centralized vs decentralized allocative role

- Optimal size of jurisdiction (clubs) can vary
- Inter-jurisdictional externalities exist
  - A fiscal externality is one where the tax base of one community is affected by the tax policy of another.
  - E.g,. one location increasing spending on police enforcement might increase crime in a neighboring community.
  - E.g., if a place increases sales tax, the sales tax base increases in neighboring jurisdictions due to fleeing shoppers
- Costs of decision making may be lower for small groups
- Costs of congestion resulting from mobility
- See Gordon (QJE, 1983) for a classic analysis of some of these issues

Intergovernmental grants can help address issues related to broadening responsibility beyond the local population

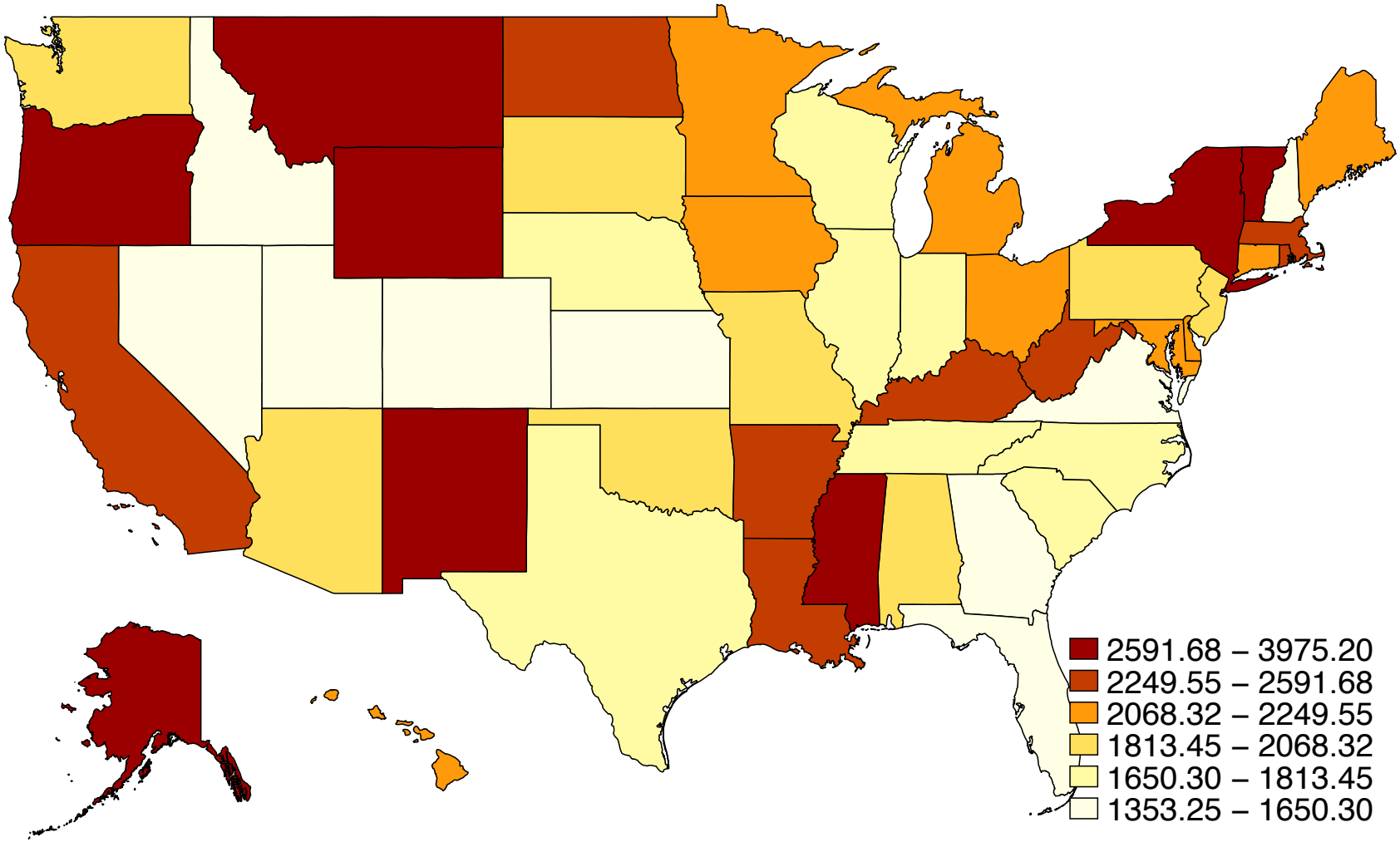
Intergovernmental Grants

Background on grants

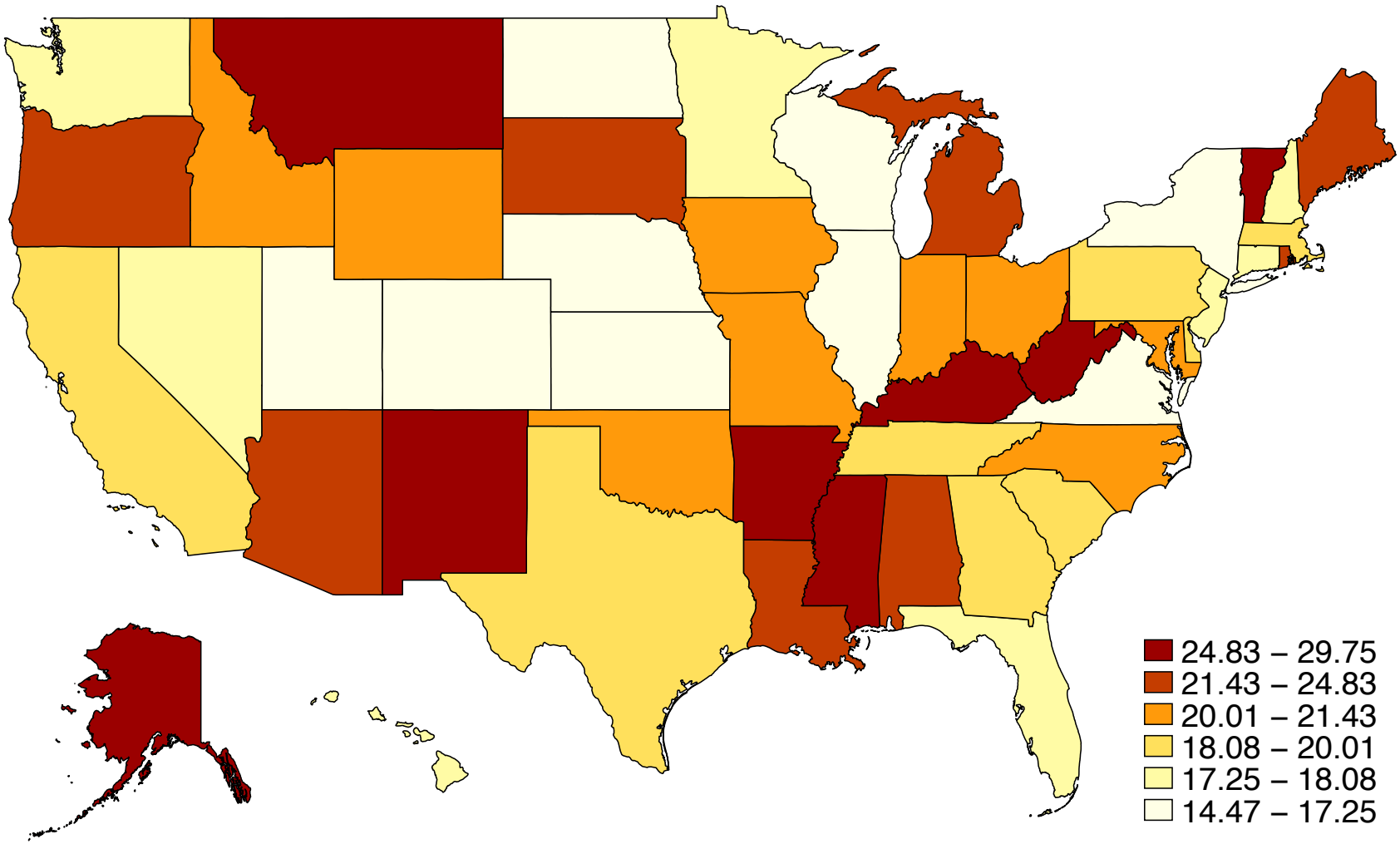
- In the US, federal gov provides grants to state and local govs
  - Similarly, state govs provide grants to local govs
- Why grants?
  1. Fiscal externalities
  2. Economies of scale in tax collection (e.g., fixed cost to administering the tax collection)
  3. Redistribution/Medicaid spending could have positive externalities for other jurisdictions
  4. Address discrepancies (e.g., school funding) between rich and poor locations
- Trade-off between federal provision of a public good and a grant to states
  - Federal gov might be better at internalizing externalities
  - but local gov can better adapt to local conditions and tastes

Federal transfers per capita (2015)

Federal IG transfers to state+local governments. 2015 USD.

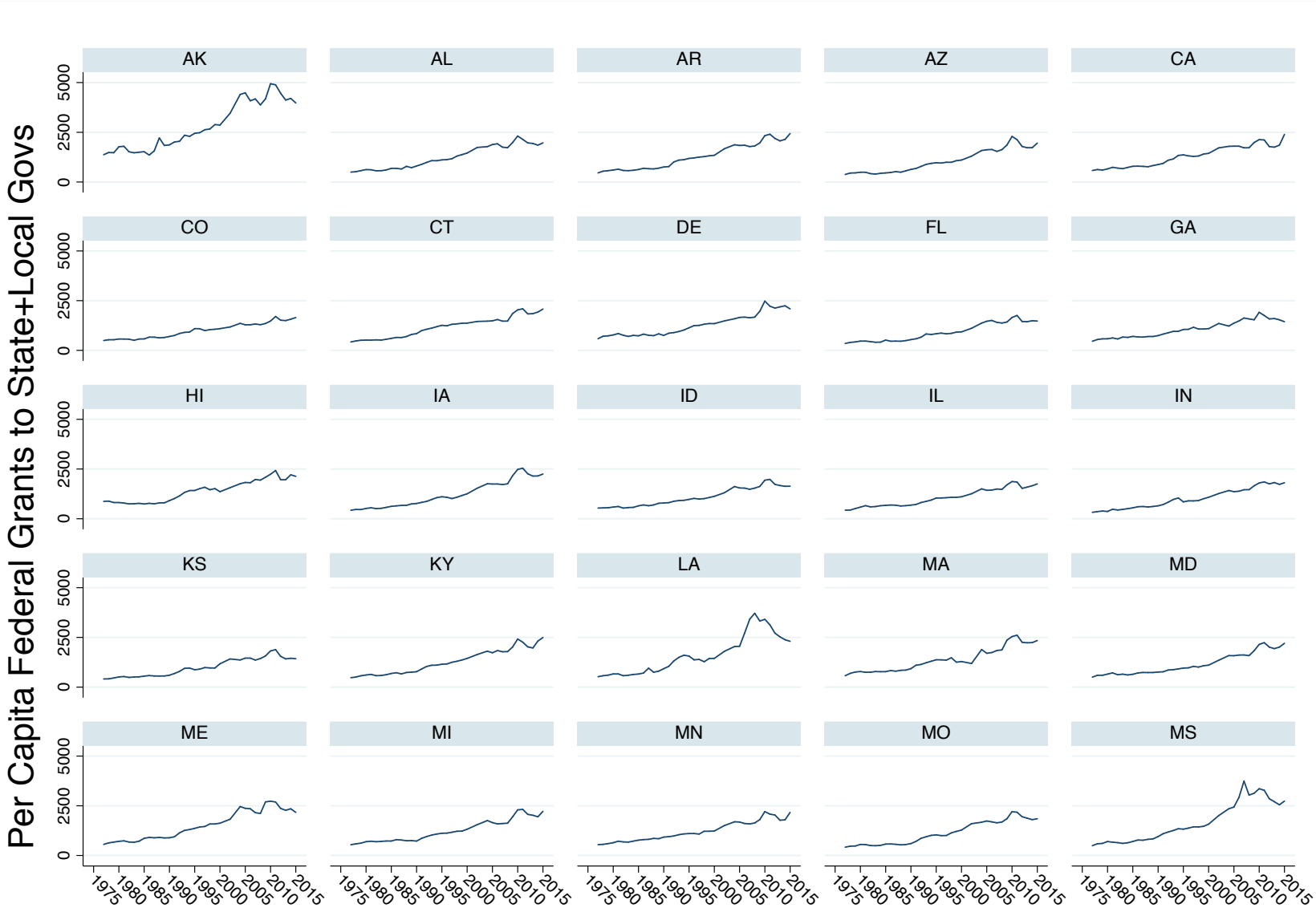


Federal transfers' share of total state+local revenue (2015)



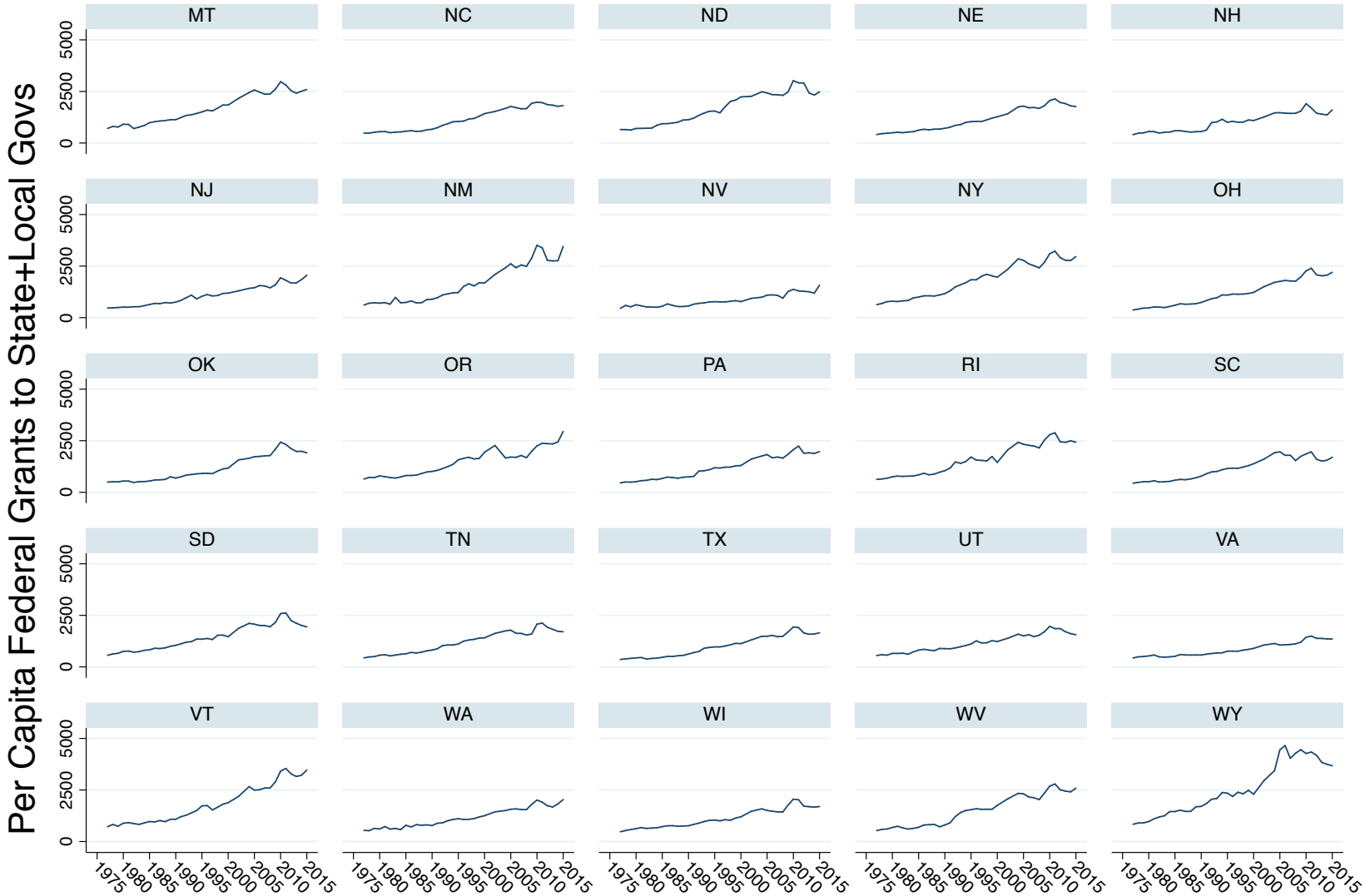
State and local revenue from federal grants per capita (1)

2015 USD



State and local revenue from federal grants per capita (2)

2015 USD



Types of grants

1. Block grants: unrestricted, fixed amount
2. Matching grants:
   - Amount is tied to the amount of public good spending by the local community
   - Higher level of gov pays for a fraction of costs at the margin (e.g., Medicaid)
3. Categorical grants:
   - Provided for a specific *expenditure*
   - Goal is to shift budget constraint, inducing substitution into other spending categories
     - Some evidence of a *flypaper effect*, where spending on specific expenditure actually increases after grant
     - Knight (2002) suggests that evidence of flypaper effect is actually due to endogeneity in allocation of grants

Education finance

- Education finance is a large share of local spending in the US
- Largely financed through local property taxes $\rightarrow$ can lead to large differences in spending per student across districts
- State gov can mitigate spending inequality through alternative funding formulas
  1. Foundation level funding
  2. Power equalization funding

See Hanushek (2002) handbook chapter on publicly provided education for details

Education finance

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- State gov can mitigate spending inequality through alternative funding formulas
  1. Foundation level funding
     - B_j: tax base per pupil
     - N_j: number of students
     - r_0: "normal" property tax rate
     - Higher level of gov wants foundation level of funding F per pupil
     - So provides a grant $G_j = N(F - r_0 B_j)$
  2. Power equalization funding

See Hanushek (2002) handbook chapter on publicly provided education for details

Education finance

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- State gov can mitigate spending inequality through alternative funding formulas
  1. Foundation level funding
  2. Power equalization funding
     - State compensates tax base differences from some "normal" level B_0
     - So provides a grant $G_j = Nr(B_0 - B)$

See Hanushek (2002) handbook chapter on publicly provided education for details

Incentives associated with funding formulas

1. Foundation level funding
   - $dG/dr = 0 \Rightarrow$ only income effect
2. Power equalization funding
   - $dG/dr = N(B_0 - B) \Rightarrow$ income and substitution effect

So for a given G, expect a stronger impact on spending by poorer districts and greater equalization under *power equalization formula*

CALIFORNIA SCHOOL EQUALIZATION

In 1960s-1970s, California used to have one of the best K-12 public school systems in the nation, now it has one of the worst

California used to have no school finance equalization and hence big disparities across areas

1976: Serrano vs. Priest case: Supreme court ruled that disparities above a threshold were unconstitutional

$\Rightarrow$ Wealthy districts forced to give all their tax revenue above the threshold to the common pool to fund poor districts

$\Rightarrow$ local government has no incentive to raise taxes $\Rightarrow$ taxes and school funding fall in rich districts

$\Rightarrow$ Property taxes no longer able to fund schools adequately

FMSZ (Restud, 2018):Tax Harmonization

FMSZ (Restud, 2018):Tax Harmonization

Question: what are aggregate effects of dispersion in tax rates across U.S. states?

1. Quantitative Geography Model with U.S. State Tax System
   - States with heterogeneous fundamentals (productivity, amenities, trade costs, factor shares, fixed factors, ownership rates)
   - Workers and firms sort across states according to idiosyncratic draws
   - Firms are monopolistically competitive
   - 3 major state taxes and federal transfers, which finance state spending which may be valued by workers and firms
2. Estimation
   - Elasticities of worker and firm location with respect to taxes
   - Fundamentals match distribution of employment, wages, and trade
3. Counterfactuals
   - Vary or eliminate tax dispersion keeping government spending constant
   - Also analyze GE impact of the North Carolina income tax cuts, rolling back tax system to 1980, and eliminating state and local tax deduction
4. Results: heterogeneity in state tax rates leads to aggregate losses
   - Harmonizing state taxes increases worker welfare by 0.6% with fixed G, 1.2% if government spending responds endogenously
   - Harmonization within Census regions achieves most of these gains