Economics and the City

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Bojos per l'Economia
31 January, 2015

Cities

Cities

Labor markets

Local Labor markets

Cities

mobility

Local Labor markets

Cities

mobility

Local Labor markets

population dynamics

Cities

mobility

Local Labor markets

population dynamics

Zipf's Law

CITIES

mobility

Local Labor markets

population dynamics

Gibrat's Law Zipf's Law

Cities

wages

mobility

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population dynamics

Gibrat's Law

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productivity differences
geographical: mountains and waterways mobility
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Alfred Marshall

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Optimal Spatial Taxation

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Three Questions

1. Zipf's and Gibrat's law: where does it come from?

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2. Is there Spatial Sorting?
    - Who works in big cities?
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3. Does Federal Income Taxation affect local labor markets?
    - Effect on location decisions
    - Optimal taxation policy

Introduction

- Why are there cities of sizes? Why are there cities?
  - Geographical determinants? Rivers, weather,...
  - Consumer demand: amenities from size? Opera,...
  - Labor markets?
- What are the technological determinants of productivity across different size cities?

Introduction

- Why are there cities of sizes? Why are there cities?
  - Geographical determinants? Rivers, weather,...
  - Consumer demand: amenities from size? Opera,...
  - Labor markets?
- What are the technological determinants of productivity across different size cities?
- Address two puzzles + policy implications:
  1. Proportionate growth and Zipf's law
  2. Urban Wage Premium
  3. Taxation
- Exploit the relation: wages – population – housing prices

Outline

I. Population and Labor Market Dynamics

Zipf's law

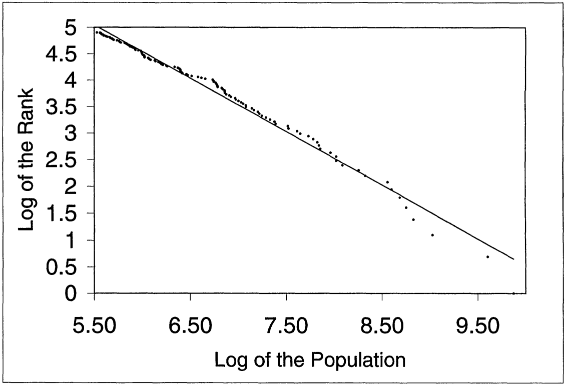

Figure I
Log Size versus Log Rank of the 135 largest U. S. Metropolitan Areas in 1991
Source: Statistical Abstract of the United States [1993].

$$\ln \text{Rank} = 10.53 - \underset{(.010)}{1.005} \ln \text{Size}, \tag{1}$$

Zipf's Law

- The largest city is N times larger than the N-th city

$$S \approx \frac{e^a}{Rank} \qquad (a = 10.53)$$

- First observed by Zipf (1949)
- Early systematic pattern: Le Maître (1648), Auerbach (1913)
- Robust across time and space

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- Early systematic pattern: Le Maître (1648), Auerbach (1913)
- Robust across time and space
- Remarkably systematic relationship

⇒ Krugman (1995): *"We have to say that the rank-size rule is a major embarrassment for economic theory: one of the strongest statistical relationships we know, lacking any clear basis in theory."*

TABLE 2—TEN LARGEST METROPOLITAN AREAS IN THE UNITED STATES

Rank	MA	Population S	S_{NY}/S
1	New York-Northern New Jersey-Long Island, NY-NJ-CT-PA	21,199,865	1.000
2	Los Angeles-Riverside-Orange County, CA	16,373,645	1.295
3	Chicago-Gary-Kenosha, IL-IN-WI	9,157,540	2.315
4	Washington-Baltimore, DC-MD-VA-WV	7,608,070	2.787
5	San Francisco-Oakland-San Jose, CA	7,039,362	3.012
6	Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	6,188,463	3.426
7	Boston-Worcester-Lawrence, MA-NH-ME-CT	5,819,100	3.643
8	Detroit-Ann Arbor-Flint, MI	5,456,428	3.885
9	Dallas-Fort Worth, TX	5,221,801	4.060
10	Houston-Galveston-Brazoria, TX	4,669,571	4.540

Note: S_{NY}/S denotes the ratio of population size relative to New York.
Source: Census Bureau, 2000.

Zipf's Law

Two open questions:

1. Why Pareto distribution?
   - Pareto vs. other distributions?
   - Why so robust?
2. What are the economic forces behind this?

Zipf's Law

- Zipf's law: size distribution is Pareto with scale coefficient 1
- Pareto distribution ($\forall S \geq \underline{S}$):

$$p(S) = \frac{a\underline{S}^a}{S^{a+1}}$$
$$P(S) = 1 - \left(\frac{\underline{S}}{S}\right)^a$$

- If we denote rank by r, then (where $\underline{N}$ is # cities above cutoff):

$$r = \underline{N}(1 - P(S)) = \underline{N}\left(\frac{\underline{S}}{S}\right)^a$$

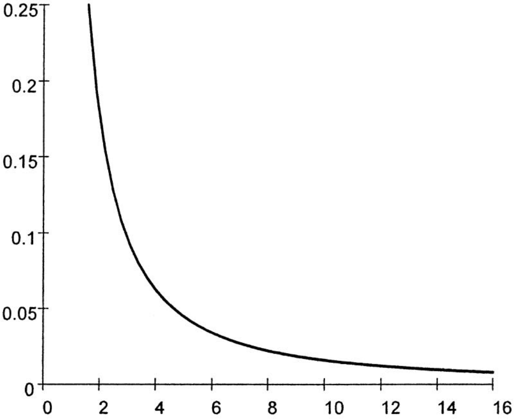
and therefore

$$\ln r = K - a \ln S$$

(where $K = \ln \underline{N} + a \ln \underline{S}$).

Zipf's law

Pareto Distribution



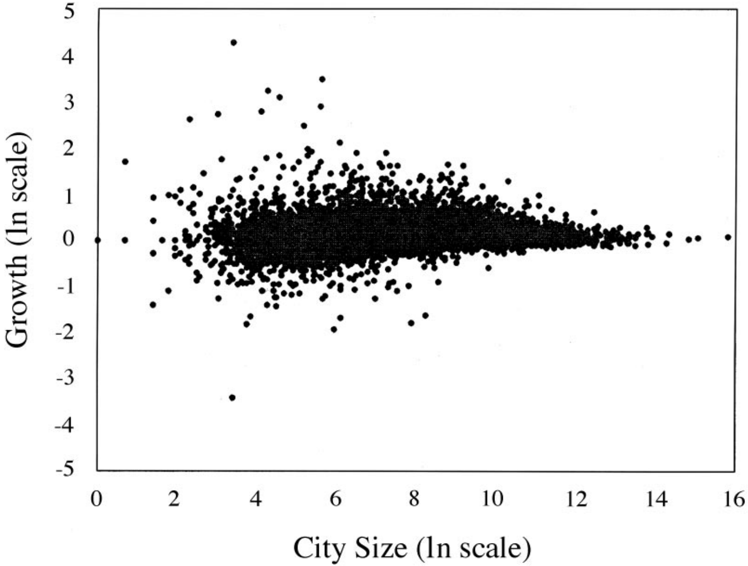
A Second Regularity

Proportionate Growth

- Cities grow at different rates
- Growth is stochastic
- But: the average growth rate is independent of size

A Second Regularity

Proportionate Growth



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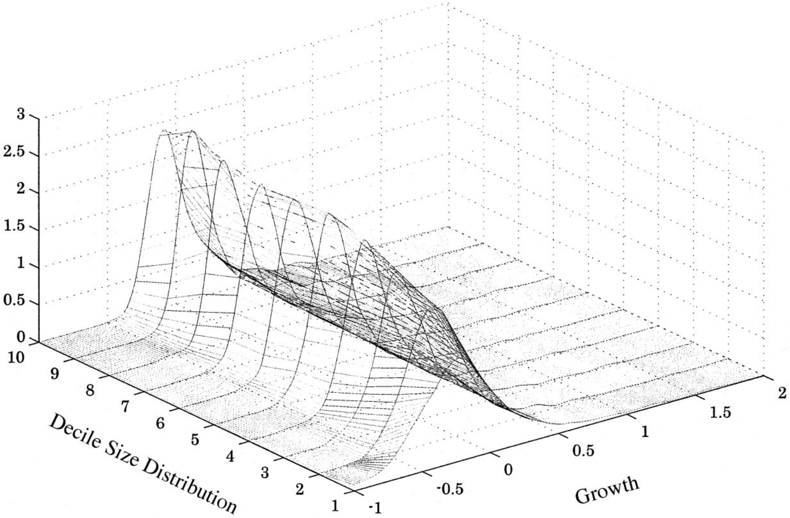

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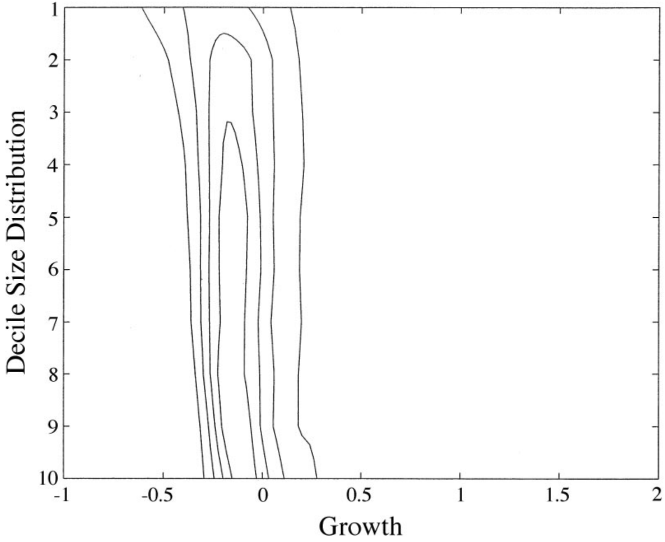

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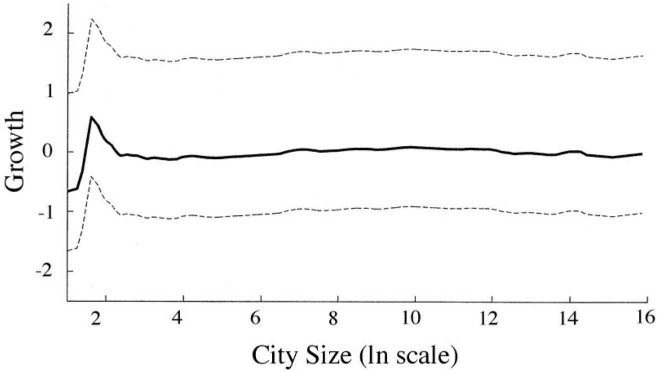


Proportionate Growth

Parametric growth regressions:

$$\frac{S_{00}}{S_{90}} = \underset{(0.005)}{1.102} - \underset{(7E(-08))}{3.75E(-08)} \frac{S_{90} + S_{00}}{2}$$

$$\frac{S_{00}}{S_{90}} = \underset{(0.005)}{1.103} + \underset{(7.3E(-08))}{2.3E(-09)} S_{90}$$

A Puzzle

- How can we reconcile
  1. Zipf's law, and
  2. proportionate growth?

A Puzzle

- How can we reconcile
  1. Zipf's law, and
  2. proportionate growth?
- Reason: Gibrat's Law: proportionate growth
  - ⇒ log-normal distribution of city sizes, not Pareto
- Proportionate growth

$$S_{i,t} = (1 + \varepsilon_{i,t}) S_{i,t-1}$$

$$\sum_{t=1}^{T} \frac{S_{i,t} - S_{i,t-1}}{S_{i,t-1}} = \sum_{t=1}^{T} \varepsilon_{i,t}$$

$$\sum_{t=1}^{T} \frac{S_{i,t} - S_{i,t-1}}{S_{i,t-1}} \approx \int_{S_{i,0}}^{S_{i,T}} \frac{dS_i}{S_i} = \ln S_{i,t} - \ln S_{i,0}$$

A Puzzle

- Between any two periods t:

$$\ln S_{i,t} = \ln S_{i,t-1} + \varepsilon_{i,t}$$

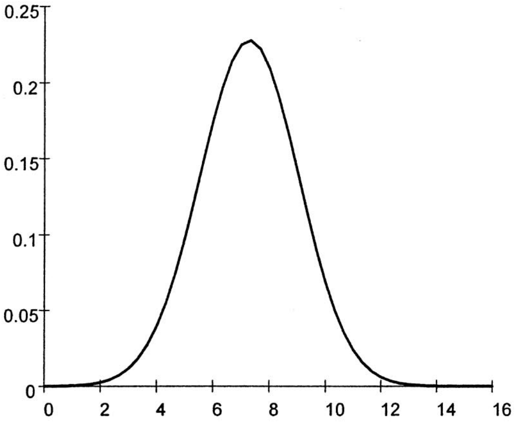
and therefore:

$$\ln S_{i,T} = \ln S_{i,0} + \varepsilon_{i,1} + \cdots + +\varepsilon_{i,T}.$$

- From the central limit theorem, $\ln S_{i,T}$ is asymptotically normal, and therefore $S_{i,T}$ is asymptotically log-normal (Gibrat 1931)

⇒ Proportionate growth ⇒ lognormal distribution (not Pareto)

A Puzzle



Reconciling Evidence

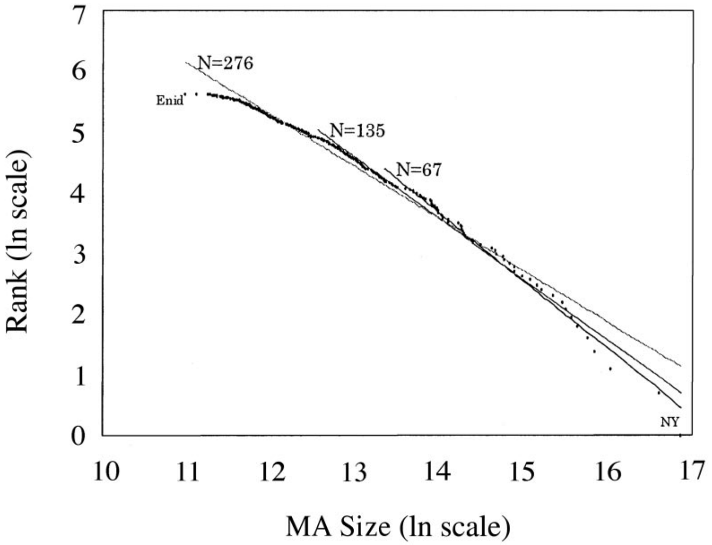
- Gabaix (1999): a process with entry and exit at high truncation
- The fit of the Pareto tail (Zipf's law) is for 135 cities only

⇒ Something going on outside tail

⇒ Need to consider entire distribution, not just the truncation

Evidence

Zipf's law for (All) MSA's?



Evidence

Places

- By definition, MSA is truncated (at least one city with population $> 50,000$)
- Use a different definition: incorporated places
  - Largest: five boroughs of NYC
  - But not New Jersey, Connecticut,...
  - Based on the legal definition (mayor,...)
  - Some are extremely small (zero population!)
  - 25,359 places; median size = 1,338
  - Only 73% of population

Evidence

Places

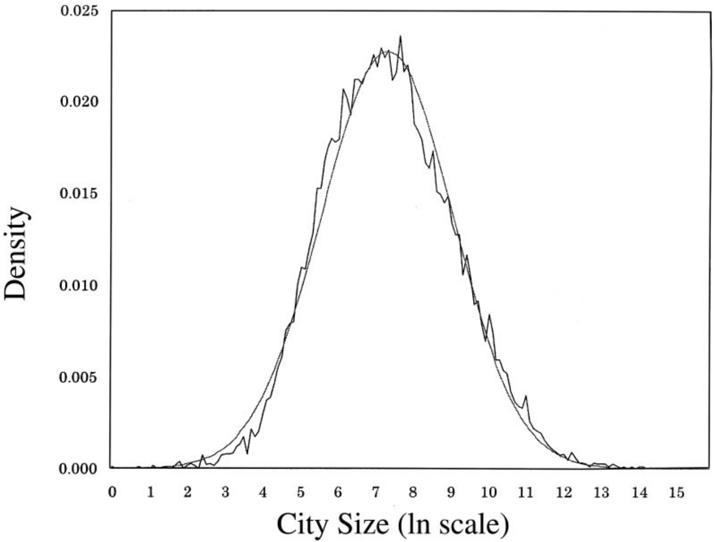
Table 1—Ten Largest Cities in the United States

Rank	City	Population S	S_{NY}/S
1	New York, NY	8,008,278	1.000
2	Los Angeles, CA	3,694,820	2.167
3	Chicago, IL	2,896,016	2.753
4	Houston, TX	1,953,631	4.099
5	Philadelphia, PA	1,517,550	5.277
6	Phoenix, AZ	1,321,045	6.062
7	San Diego, CA	1,223,400	6.546
8	Dallas, TX	1,188,580	6.738
9	San Antonio, TX	1,144,646	6.996
10	Detroit, MI	951,270	8.419

Note: S_{NY}/S denotes the ratio of population size relative to New York.
Source: Census Bureau, 2000.

Evidence

All Cities



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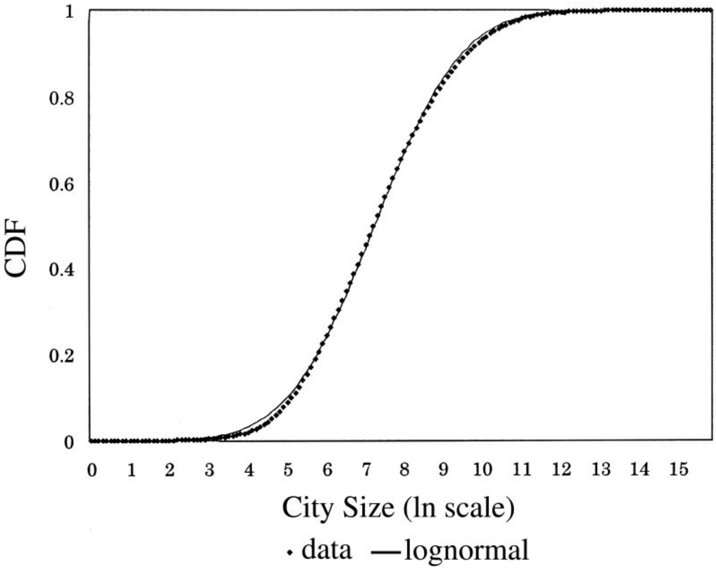

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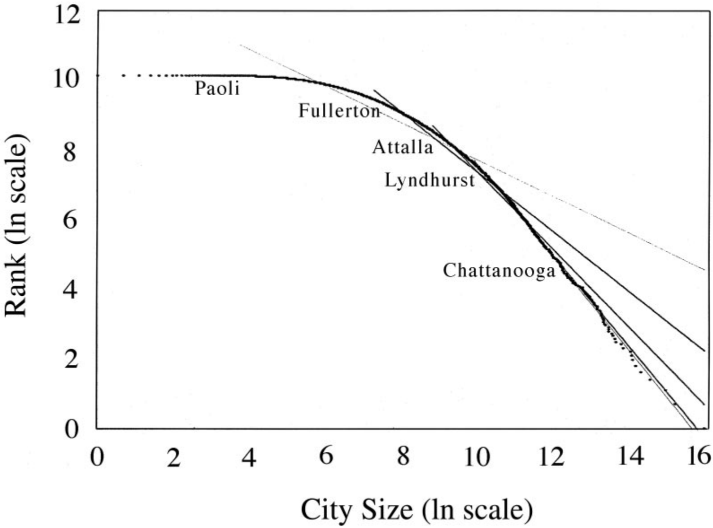

Table 3—Pareto Coefficient Regressions

Truncation point			Estimates		
$\underline{N}$	$\underline{S}$	City	$\hat{K}$ (s.e.)	$\hat{a}$ (s.e.) (GI s.e.)	R^2
135	155,554	Chattanooga (city), TN	21.099 (0.144)	1.354 (0.011) (0.165)	0.99
2,000	19,383	Lyndhurst (CDP), NJ	20.648 (0.017)	1.314 (0.002) (0.042)	0.997
5,000	6,592	Attalla (city), AL	18.588 (0.019)	1.125 (0.002) (0.023)	0.985
12,500	1,378	Fullerton (city), NE	15.944 (0.014)	0.863 (0.002) (0.011)	0.961
25,000	42	Paoli (town), CO	13.029 (0.010)	0.534 (0.001) (0.005)	0.860

Notes: Dependent variable: Rank (ln). s.e. standard error; GI s.e. Gabaix-Ioannides (2003) corrected standard error ($\hat{a}(2/N)^{1/2}$).
Source: Census Bureau, 2000.

From Population to Economics

- What drives population mobility?
  1. Geography: rivers, coasts, mountains, weather
  2. Amenities: Opera, externalities (+/-, (non-)pecuniary), ...
  3. Productivity Changes
- Citizen mobility in response to changes in prices: wages, housing prices, consumption prices,...
- Prices are determined in equilibrium

→ A general equilibrium theory of production across locations

∴ Objective: understand economic mechanisms (technology, preferences,...) from observing the population dynamics

From Population to Economics

- Local TFP $A_{i,t}$; law of motion: $A_{i,t} = A_{i,t-1}(1 + \sigma_{i,t})$ where $\sigma_{i,t}$ is zero mean i.i.d.
- Local externalities:
  - positive in production $a_+(S_{i,t})$ $(a'_+(S_{i,t}) > 0)$
  - negative (commuting) $a_-(S_{i,t})$ $(a'_-(S_{i,t}) < 0)$
- Identical firms in a competitive local labor market produce $y_{i,t} = A_{i,t}a_+(S_{i,t}) \Rightarrow$ wage is equal to marginal product
- Stock of land in each city is H; unit price of land is $p_{i,t}$ and individual consumption is $h_{i,t}$
- Preferences: $u(c, h, l) = c^\alpha h^\beta (1 - l)^{1-\alpha-\beta}$
- Perfect mobility across cities (no moving cost)

Proposition

Under general conditions, city size satisfies Gibrat's law: population growth is proportionate and the asymptotic size distribution is lognormal.

What is a City?

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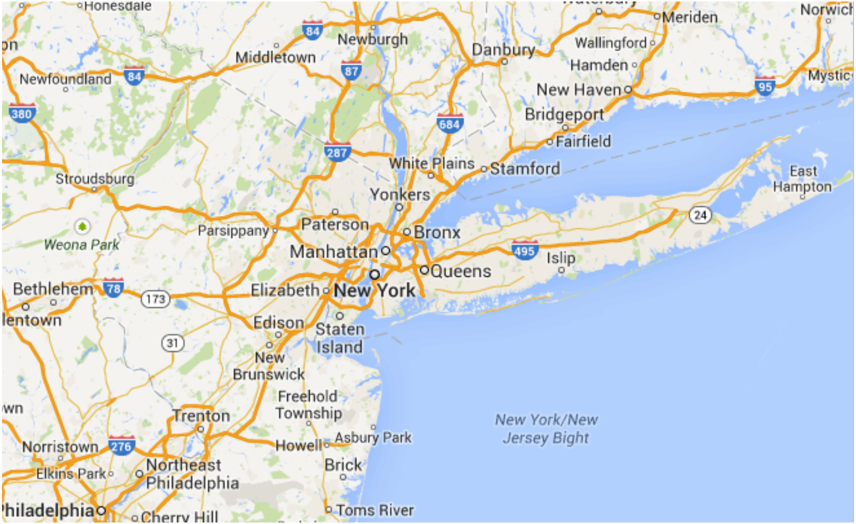
Àrea Metropolitana de Barcelona

What is a City?



MSA, Place, County,...

What is a City?

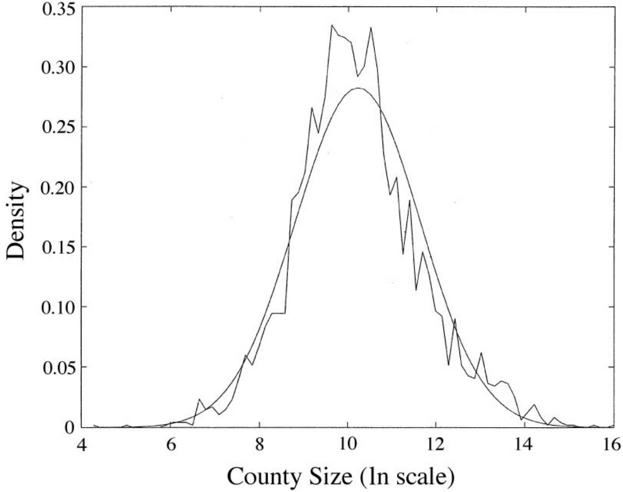
Counties

Rank	City	Population S	S_{LA}/S
1	Los Angeles County, CA	9,519,338	1.000
2	Cook County, IL	5,376,741	1.770
3	Harris County, TX	3,400,578	2.799
4	Maricopa County, AZ	3,072,149	3.099
5	Orange County, CA	2,846,289	3.344
6	San Diego County, CA	2,813,833	3.383
7	Kings County, NY	2,465,326	3.861
8	Miami-Dade County, FL	2,253,362	4.225
9	Queens County, NY	2,229,379	4.269
10	Dallas County, TX	2,218,899	4.290

Note: S_{LA}/S denotes the ratio of population size relative to Los Angeles.
Source: Census Bureau, 2000.

What is a City?

Counties



What is a City?

Constructing cities

Holmes and Lee: a unit consists of a 6×6 miles area

Fig. 3.1 Map of grid lines for six-by-six squares in the vicinity of New York City

Outline

I Zipf's and Gibrat's law

II Spatial Sorting

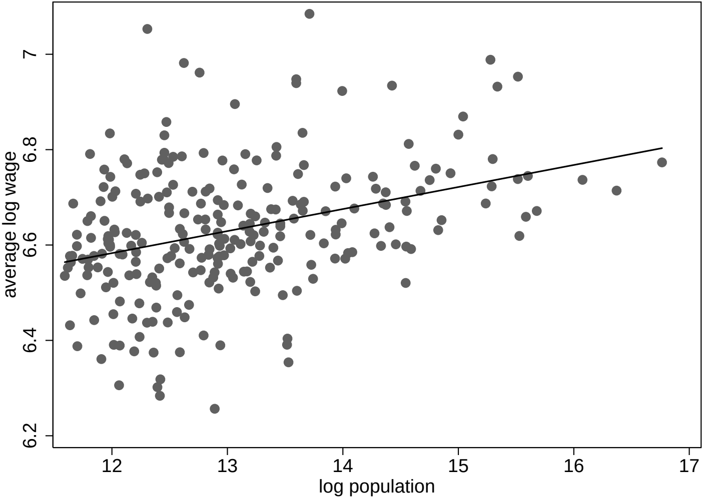
III Taxation

Spatial Sorting

The Urban Wage Premium

Spatial Sorting

The Urban Wage Premium



Spatial Sorting
The Urban Wage Premium

- The elasticity of average wage with respect to city size is 4.2%
- Big differences:

	Population	Wage	Wage Ratio
New York	19 million	897	1.22
Janesville, WI	160,000	735	1.00

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$\Rightarrow$ Explanations?

1. Amenities
2. Cost of Living
3. Sorting

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⇒ Explanations?

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2. Cost of Living
3. Sorting

Sorting in Teams

Production and Complementarities

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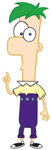
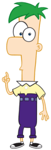
Production and Complementarities



Sorting in Teams

Production and Complementarities



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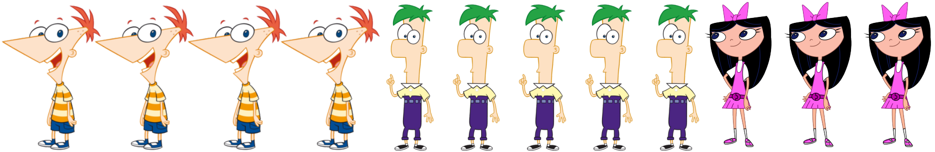

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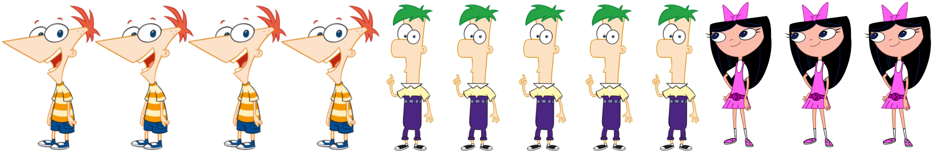

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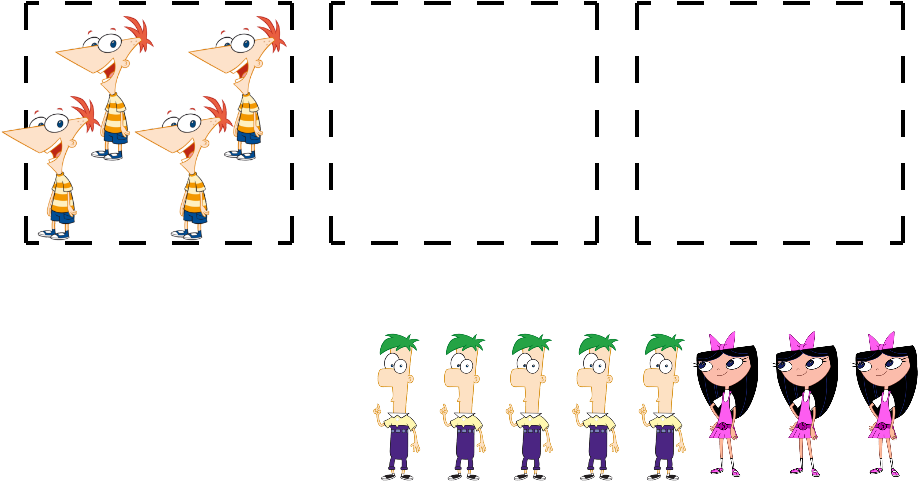

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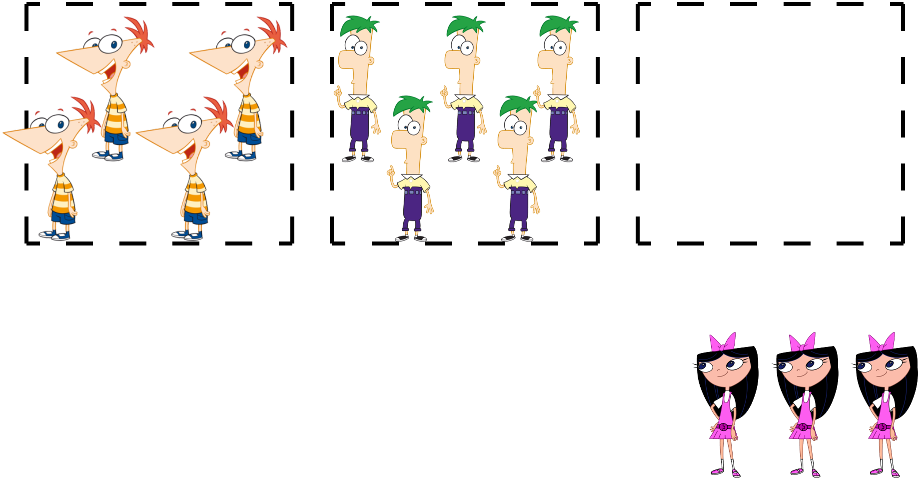

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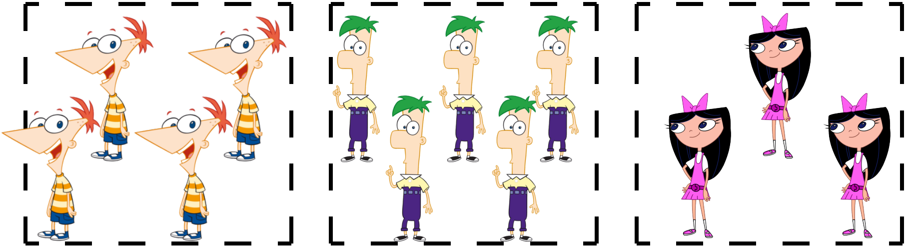

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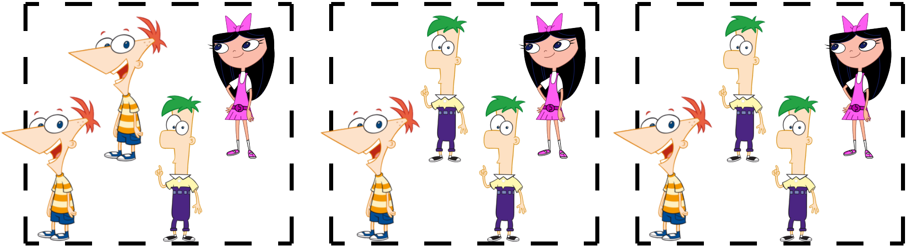
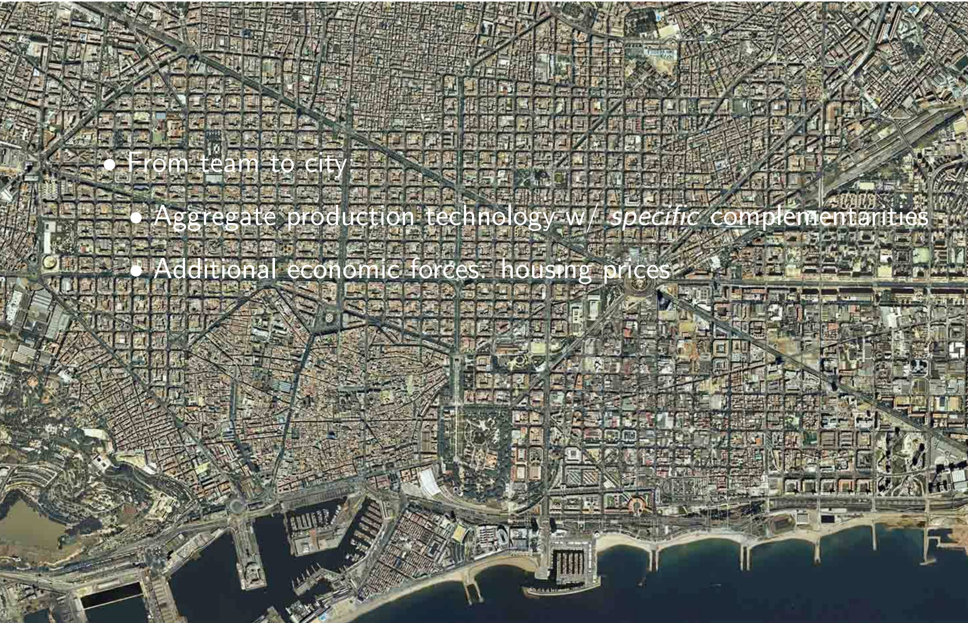


City as a team

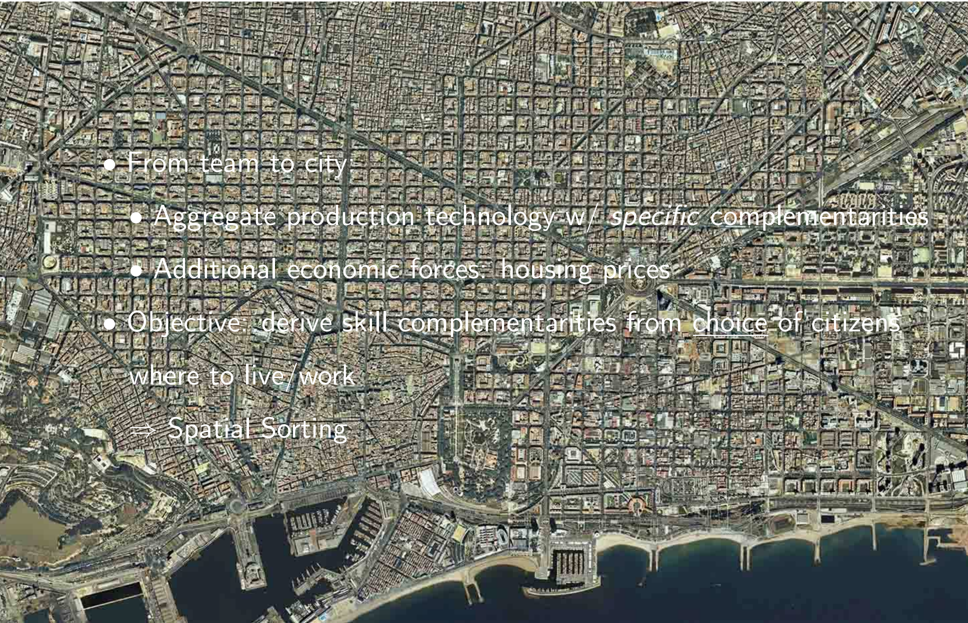
Production and Complementarities



- From team to city:
  - Aggregate production technology w/ *specific* complementarities
  - Additional economic forces: housing prices

City as a team

Production and Complementarities



- From team to city:
  - Aggregate production technology w/ *specific* complementarities
  - Additional economic forces: housing prices
- Objective: derive skill complementarities from choice of citizens where to live/work

  ⇒ Spatial Sorting

City as a team

Spatial Sorting

The model

- J locations (cities) $j \in \mathcal{J} = \{1, ..., J\}$
- Fixed amount of land (housing) H_j

Citizens

- Citizens (workers) with heterogenous skills x_i
- Preferences over consumption and housing (price p):

$$u(c, h) = c^{1-\alpha} h^{\alpha}$$

- Worker mobility $\Rightarrow$ utility equalization across cities:

$$u(c_{ij}, h_{ij}) = u(c_{ij'}, h_{ij'}), \quad \forall j' \neq j$$

Technology

- Cities differ exogenously in TFP A_j
- Representative firm in city j produces

$$A_j F(m_{1j}, ..., m_{Ij})$$

m_{ij}: employment level of skill i; given wages w_{ij}

Technology: Nested CES

3 skill types ⇒ 5 configurations

0. Benchmark CES:

$$A_j F = A_j \left(m_{1j}^{\gamma} y_1 + m_{2j}^{\gamma} y_2 + m_{3j}^{\gamma} y_3 \right)^{\beta} \quad \gamma \in [0,1], \beta > 0$$

Technology: Nested CES

3 skill types $\Rightarrow$ 5 configurations

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$$A_j F = A_j \left(m_{1j}^{\gamma} y_1 + m_{2j}^{\gamma} y_2 + m_{3j}^{\gamma} y_3 \right)^{\beta} \;\; \gamma \in [0,1], \beta > 0$$

1. Extreme-Skill Complementarity

$$A_j F = A_j \left[m_{2j}^{\gamma} y_2 + ({m_{1j}}^{\gamma} y_1 + {m_{3j}}^{\gamma} y_3)^{\lambda} \right]^{\beta}$$

   A. $\lambda > 1$: skills 1 and 3 are (relative) complements;
   B. $\lambda < 1$: skills 1 and 3 are (relative) substitutes;
   C. $\lambda = 1$: CES

Technology: Nested CES

3 skill types ⇒ 5 configurations

0. Benchmark CES:

$$A_j F = A_j \left(m_{1j}^{\gamma} y_1 + m_{2j}^{\gamma} y_2 + m_{3j}^{\gamma} y_3 \right)^{\beta} \;\; \gamma \in [0,1], \beta > 0$$

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   B. $\lambda < 1$: skills 1 and 3 are (relative) substitutes;
   C. $\lambda = 1$: CES

2. Top-Skill Complementarity

$$A_j F = A_j \left[m_{1j}^{\gamma} y_1 + ({m_{2j}}^{\gamma} y_2 + {m_{3j}}^{\gamma} y_3)^{\lambda} \right]^{\beta}$$

Market clearing

- Housing market: $\sum_{i=1}^{I} h_{ij} m_{ij} = H_j$
- Labour market: $\sum_{j=1}^{J} m_{ij} = M_i$ (M_i: total # of skill i)
- City population: $S_j = \sum_{i=1}^{I} m_{ij}$
- Two types of cities, C_1, C_2 of each type

Citizen's problem

- Optimal consumption

$$c_{ij}^{\star} = (1-\alpha) w_{ij} \quad \text{and} \quad h_{ij}^{\star} = \alpha \frac{w_{ij}}{p_j}$$

- Indirect utility function

$$U_i = \alpha^{\alpha} (1-\alpha)^{1-\alpha} \frac{w_{ij}}{p_j^{\alpha}}$$

⇒ From mobility, utility equalization:

$$\frac{w_{i1}}{p_1^{\alpha}} = \frac{w_{i2}}{p_2^{\alpha}}$$

Main Results

Theorem 1. City Size and TFP

The more productive city is larger, $S_1 > S_2$

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Theorem 3. Top-Skill Complementarity and FOSD

The skill distribution in the larger city first-order stoch. dominates

Main Results

Mechanism: skill complementarity also in small cities, but demand for extreme skills is higher in big cities due to TFP (A_j)

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Corollary 1. CES technology

If $\lambda = 1$, then the skill distribution across cities is identical

Corollary 2. Extreme-Skill Substitutability and Thin Tails

The skill distribution in the larger city has thinner tails

Main Results

5 technologies → 5 distributions

1. Extreme-Skill Complementarity ⇒ thick tails
2. Extreme-Skill Substitutability ⇒ thin tails
3. Top-Skill Complementarity ⇒ FOSD of big cities
4. Top-Skill Substitutability ⇒ FOSD of small cities
5. Constant Elasticity (CES) ⇒ identical distributions

Empirical evidence

Empirical evidence

- Use theory to obtain a measure for skills

$$U_i = \alpha^{\alpha}(1-\alpha)^{1-\alpha}\frac{w_{ij}}{p_j^{\alpha}}$$

- Need to observe:
  - wage distribution w_{ij} by city
  - housing price level p_j
  - budget share of housing α
    $\widehat{\alpha} = 0.24$ from Davis and Ortalo-Magné (RED 2010)

Wages

CPS 2009

10th percentile: pop < 1m = 5.93, pop > 2.5m = 5.99, diff = 0.065*** (0.007)
90th percentile: pop < 1m = 7.36, pop > 2.5m = 7.56, diff = 0.198*** (0.007)

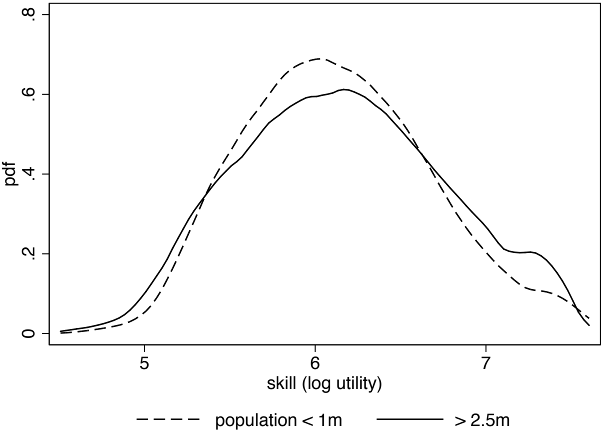
Housing prices

- American Community Survey (ACS) 2009
- Rental prices (robust: sales)
- Hedonic price schedule: to obtain housing price index

⇒ Skill measure: $\frac{w_i}{p_i^{\alpha}}$

Skills and city size

Skill measure: $\frac{w_i}{p_i^{\alpha}}$



10th percentile: pop < 1m = 5.44, pop > 2.5m = 5.36, diff = -0.074*** (0.006)
90th percentile: pop < 1m = 6.86, pop > 2.5m = 6.99, diff = 0.132*** (0.009)

Skills and city size

1. Constant mean: housing cost increases 4 × faster than wages
   $\Rightarrow 1.169^{0.24} = 1.038 \approx 1.042$
2. Variance increases in city size

∴ Urban Wage Premium: not spatial sorting, but housing prices

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→ high skilled workers need low-skilled services for production

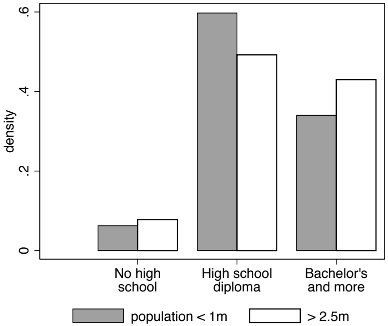
- administrative/sales help
- household help and child care
- food services, restaurants,...

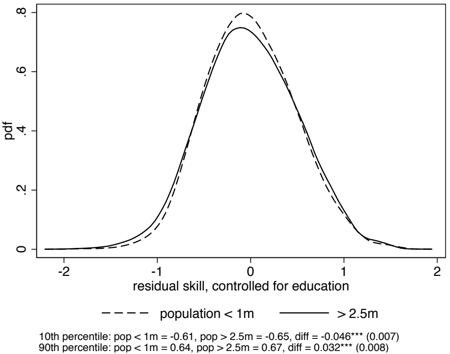
Robustness: Observables

- Our measure of skills: price based (wages and housing price)
- Includes everything: observables and unobservables
- 2/3 of wages: unobservables (non-cognitive skills,...)

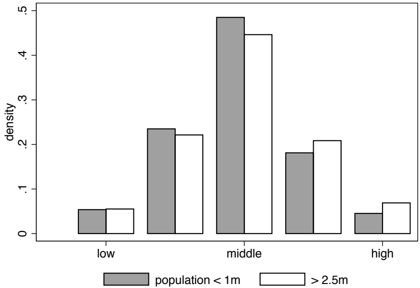
→ Thick tails also for observables?

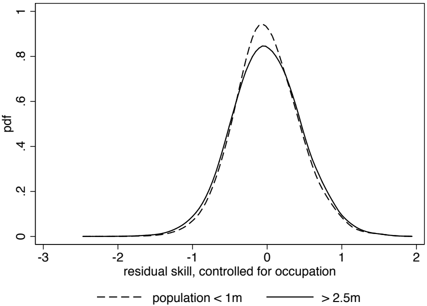
Education: A Direct Measure of Skill





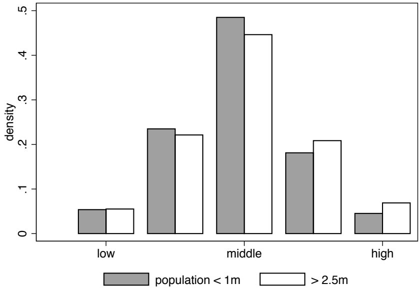
Occupation

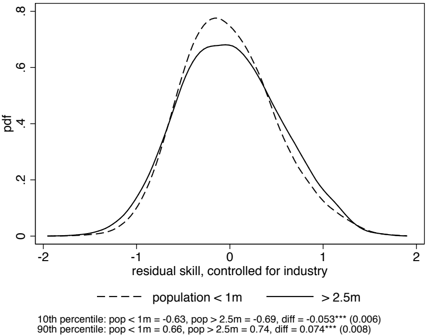




10th percentile: pop < 1m = -0.55, pop > 2.5m = -0.59, diff = -0.042*** (0.006)
90th percentile: pop < 1m = 0.56, pop > 2.5m = 0.60, diff = 0.040*** (0.007)

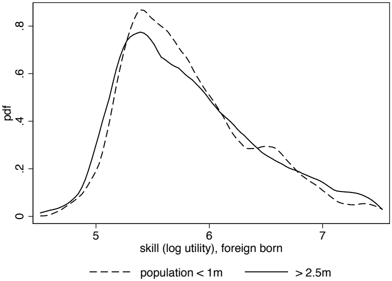
Industrial Composition





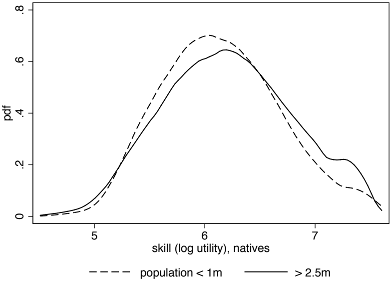
Migration

Foreign Born



10th percentile: pop < 1m = 5.23, pop > 2.5m = 5.14, diff = -0.085*** (0.017)
90th percentile: pop < 1m = 6.61, pop > 2.5m = 6.70, diff = 0.083** (0.046)

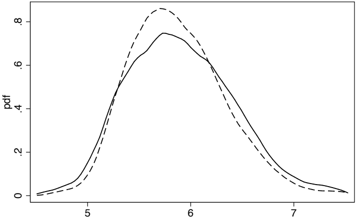
Natives



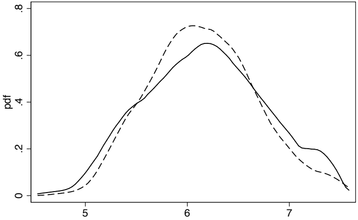
10th percentile: pop < 1m = 5.47, pop > 2.5m = 5.45, diff = -0.014** (0.007)
90th percentile: pop < 1m = 6.87, pop > 2.5m = 7.02, diff = 0.151*** (0.010)

Age

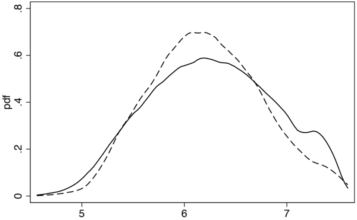
20-29 year old



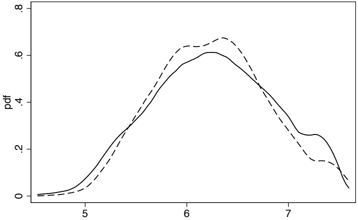
30-39 year old



40-49 year old



50-59 year old



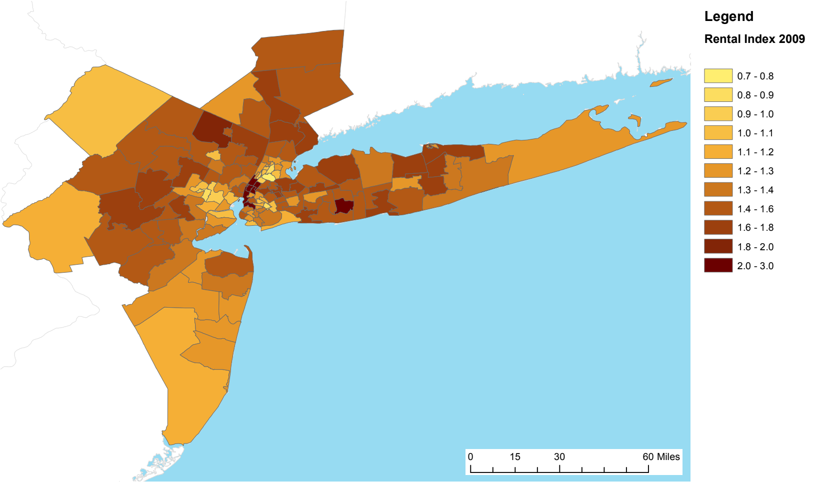
Decomposing the skill distributions

Small vs. big cities

	10% Quantile			90% Quantile		
Observed Quantiles:						
- Large cities	5.365	(0.004)	***	6.994	(0.006)	***
- Small cities	5.439	(0.005)	***	6.862	(0.007)	***
- Difference	-0.074	(0.006)	***	0.132	(0.009)	***
Firpo, Fortin, Lemieux (2009)						
Predicted Quantiles:						
- Large cities	5.387	(0.005)	***	7.022	(0.005)	***
- Small cities	5.454	(0.004)	***	6.878	(0.008)	***
- Difference	-0.068	(0.007)	***	0.144	(0.009)	***
Explained by observables:						
- Education (16 categories)	0.003	(0.002)	**	0.052	(0.002)	***
- Occupation (22 categories)	0.004	(0.002)	*	0.025	(0.003)	***
- Industry (51 categories)	-0.001	(0.002)		0.013	(0.002)	***
- Race (4 groups)	-0.004	(0.001)	***	-0.015	(0.001)	***
- Sex	-0.001	(0.001)	*	-0.002	(0.001)	*
- Foreign born	-0.020	(0.002)	***	-0.004	(0.001)	***
- Age (2nd order polynomial)	0.000	(0.001)		-0.002	(0.001)	*
Total explained by observables	-0.018	(0.004)	***	0.067	(0.005)	***
Not explained by observables	-0.049	(0.006)	***	0.077	(0.008)	***
Chernozhukov, Fernández-Val, Melly (2012)						
Predicted Quantile difference	-0.068	(0.006)		0.113	(0.009)	
Explained by observables	-0.019	(0.004)		0.064	(0.005)	
Not explained by observables	-0.050	(0.007)		0.049	(0.007)	

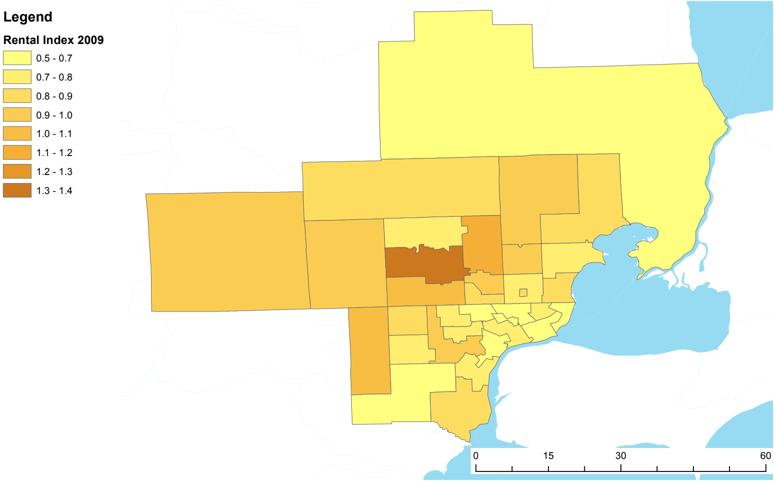
Sorting within Cities

New York City



Sorting within Cities

Detroit



Outline

I Zipf's and Gibrat's law

II Spatial Sorting

III Taxation

Income Taxation in Local Labor Markets

- Federal Taxes affect same skill workers differentially in cities:
    - Urban Wage Premium
    - Progressive Taxation

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- Average tax rate: 3% points difference *at median*:

	Population	Wage level	Avg. Tax Rate
New York	19 million	1.22	26.5%
Janesville, WI	160,000	1.00	23.5%

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	Population	Wage level	Avg. Tax Rate
New York	19 million	1.22	26.5%
Janesville, WI	160,000	1.00	23.5%

- Due to mobility: no redistribution! Same skills, same utility
- Policy Question: what is optimal spatial taxation policy?

Model

- J cities, with TFP A_j; Identical agents; Output: $A_j l_j^{\gamma}$
- Amenities: $\varepsilon_j \to u(c,h) = (1+\varepsilon_j)c^{1-\alpha}h^{\alpha}$
- Mobility: $u(c_j, h_j) = u(c_{j'}, h_{j'}), \quad \forall j, j'$
- Tax schedule

$$\tilde{w}_j = \lambda w_j^{1-\tau}$$

  - average tax rate: $\lambda w_j^{-\tau}$;
  - marginal tax rate $\lambda(1-\tau)w_j^{-\tau}$
  - $\tau = 0$: proportional; $\tau > 0$: progressive; $\tau < 0$: regressive
  - US, estimated $\tau \approx 0.12$

Empirical Results

Parametrization

- Production: $\gamma = 1$ output $A_j l_j$
- Tax schedule: $\tau = 0.12, \lambda = 0.752$ (OECD calculator)
- Housing Exp. 24% (Davis,Ortalo-Magné, 2009)
  $\Rightarrow \alpha = \frac{0.24}{\lambda} = 0.319$

Optimal Tax Schedule?

- TFP from average wages and labor force:

$$A_j = \frac{w_j l_j^{1-\gamma}}{\gamma}, \quad \forall j.$$

- Amenities from mobility (utility equalization):

$$1 + \varepsilon_j = \frac{l_j^{\alpha} w_1^{(1-\alpha)(1-\tau^{US})}}{l_1^{\alpha} w_j^{(1-\alpha)(1-\tau^{US})}}$$

- Revenue neutrality $\rightarrow$ fixes λ

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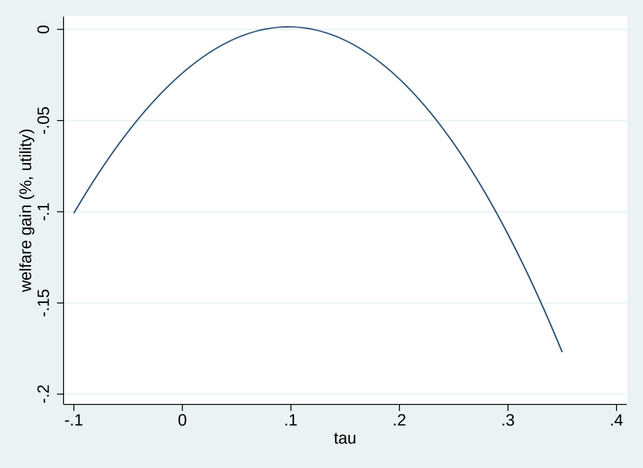
- Revenue neutrality $\rightarrow$ fixes λ

$\Rightarrow$ $\forall \tau$, new l_j, u_j: search grid for τ that maximizes u

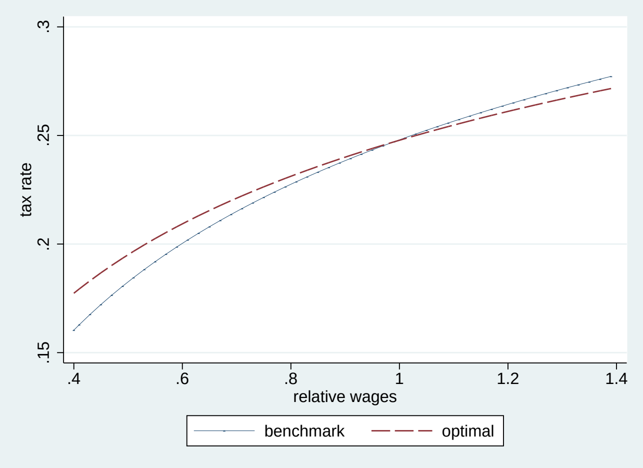
Optimal Tax Schedule

$\tau^{\star} = 9\%$



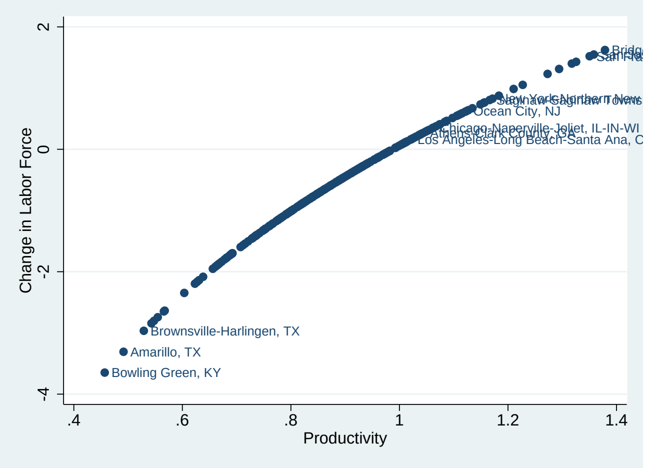
Tax Schedules

Actual vs. Optimal



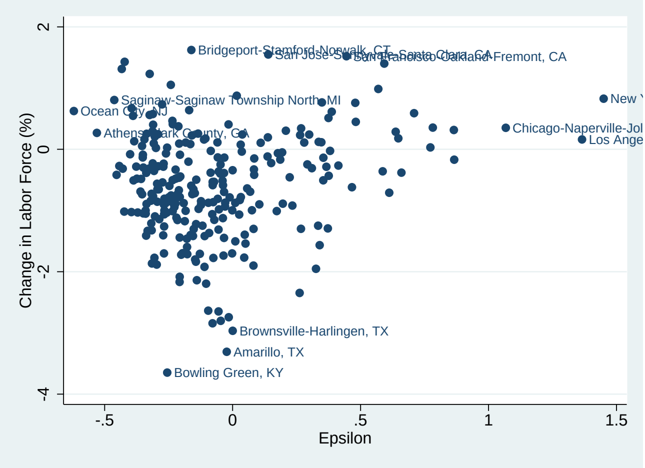
Simulation

Change in Labor Force – Productivity



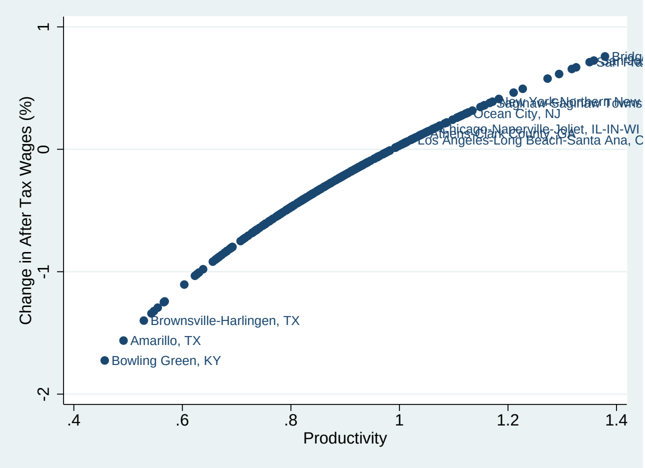
Simulation

Change in Labor Force – Amenities



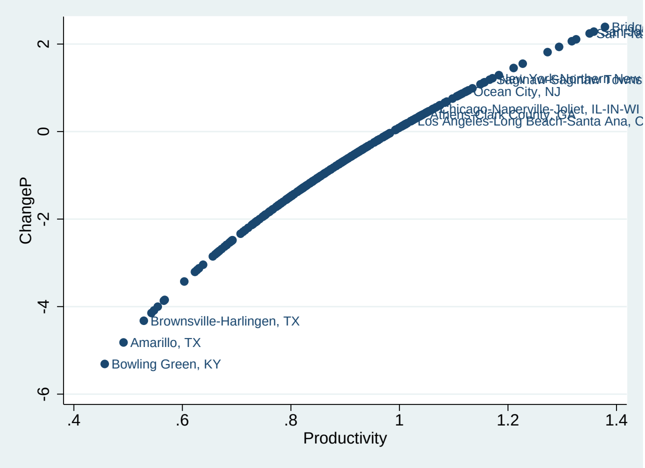
Simulation

Change in After-tax Wages



Simulation

Change in Housing Prices



Outcomes for Selected Cities

MSA	A	ε	Δl	$\%\Delta p$	$\%\Delta c$	$\%\Delta h$
Highest A						
Bridgeport-Stamford-Norwalk, CT	1.38	-0.16	1.62	2.39	0.76	-1.60
San Jose-Sunnyvale-Santa Clara, CA	1.36	0.14	1.55	2.28	0.72	-1.52
San Francisco-Oakland-Fremont, CA	1.35	0.44	1.52	2.24	0.71	-1.50
Lowest A						
Brownsville-Harlingen, TX	0.53	0.00	-2.97	-4.32	-1.40	3.06
Amarillo, TX	0.49	-0.02	-3.31	-4.82	-1.56	3.42
Bowling Green, KY	0.46	-0.26	-3.65	-5.31	-1.72	3.79
Highest ε						
New York-Northern New Jersey-Long Island	1.17	1.45	0.83	1.22	0.39	-0.82
Los Angeles-Long Beach-Santa Ana, CA	1.02	1.37	0.16	0.24	0.08	-0.16
Chicago-Naperville-Joliet, IL-IN-WI	1.06	1.07	0.35	0.52	0.17	-0.35
Lowest ε						
Saginaw-Saginaw Township North, MI	1.17	-0.46	0.81	1.19	0.38	-0.80
Athens-Clark County, GA	1.04	-0.53	0.27	0.40	0.13	-0.27
Ocean City, NJ	1.12	-0.63	0.62	0.92	0.29	-0.62

Simulation

c/h substitution

Aggregate Outcomes

$\alpha = 0.319, \gamma = 1, \tau^{\star} = 0.067$

Outcomes	$\%\Delta$
Output gain	1.02
Population in 5 largest cities	0.59
Average housing prices	1.25

Sensitivity

	$\alpha = 0.24$, $\gamma = 1$	$\alpha = 0.3191$, $\gamma = 1.2$
	$\tau^\star = -0.0082$	$\tau^\star = -0.0834$
Outcomes	$\%\Delta$	$\%\Delta$
Output gain	8.86	20.30
Population in 5 largest cities	4.91	9.63
Average housing prices	10.36	23.39

Concluding Remarks

Economics and the City

1. Zipf's law and Gibrat's law
   - Puzzle resolved

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Economics and the City

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2. There is Spatial Sorting
   - Thick tails $\rightarrow$ bigger inequality in big cities
   - Extreme-skill compl.: Urban wage premium not due to skills

   $\rightarrow$ increasing over time + urbanization $\uparrow$ $\Rightarrow$ inequality $\uparrow$

Concluding Remarks

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2. There is Spatial Sorting
   - Thick tails $\rightarrow$ bigger inequality in big cities
   - Extreme-skill compl.: Urban wage premium not due to skills

   $\rightarrow$ increasing over time + urbanization $\uparrow \Rightarrow$ inequality $\uparrow$
3. Federal Income Taxation does affect local labor markets
   - Effect on location decisions: big cities are too small
   - Optimal level of taxation: progressive, but city-specific

Economics and the City

Jan Eeckhout[†]

[†]Barcelona GSE-UPF

Bojos per l'Economia
31 January, 2015

Green Growth in Cities

- Cities: dense, dirty, and polluted,...

Green Growth in Cities

- Cities: dense, dirty, and polluted,...
- Yet, green

Green Growth in Cities

- Cities: dense, dirty, and polluted,...
- Yet, green
- Large cities are more productive: urban wage premium = productivity premium
  Double city size and output grows by 4%
- But more expensive to live: elasticity wrt housing prices: 16%
- Large cities are more dense: more people in same space
  - Less consumption of energy
  - Less production of waste

Kleiber's law

Kleiber (1947)

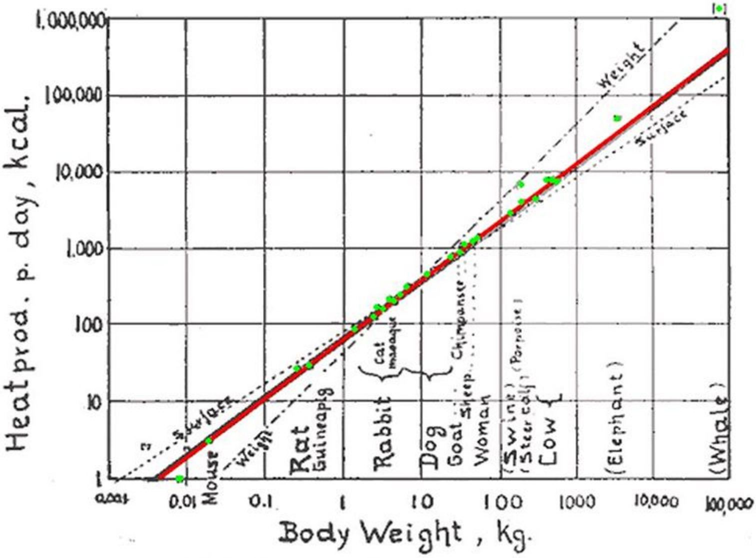


Fig. 1. Log. metabol. rate/log body weight

Kleiber's law

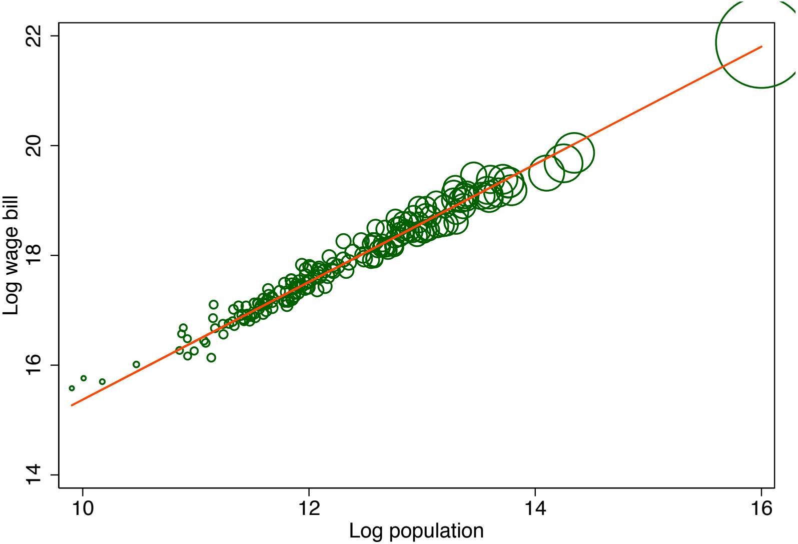
- Energy consumption (metabolic rate) of animals and plants relates to their mass
$$q \sim M^{\frac{3}{4}}$$
  q: metabolic rate; M body mass
- Log-linear relationship
- Cat 100 heavier than mouse, would use 31 times energy
- For plants the exponent is close to 1

From Biology to economics

- Energy efficiency: consumption of energy; production of waste
- But: mass is not size of the city, but economic productivity
- Economic productivity is correlated with size (Urban Wage Premium)

Urban Wage Premium

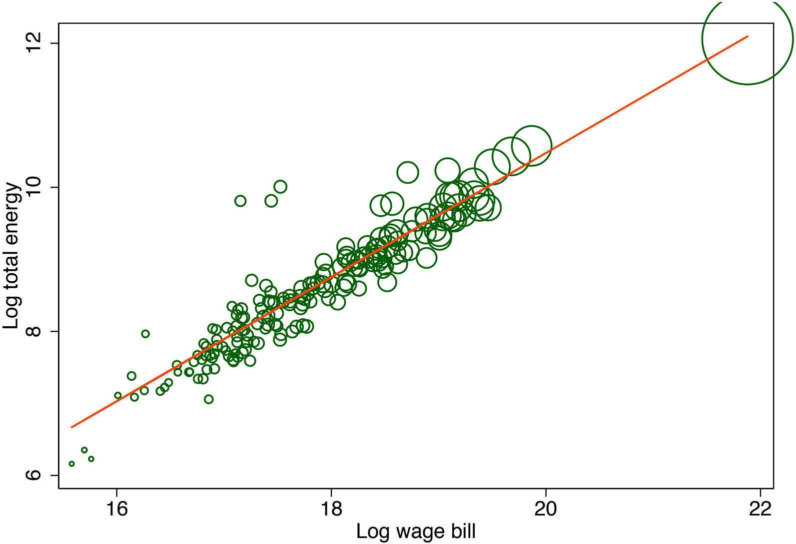
UK Data



Coeff: 1.072 (.009), R2: .987, N: 178

Urban Energy Premium

14%



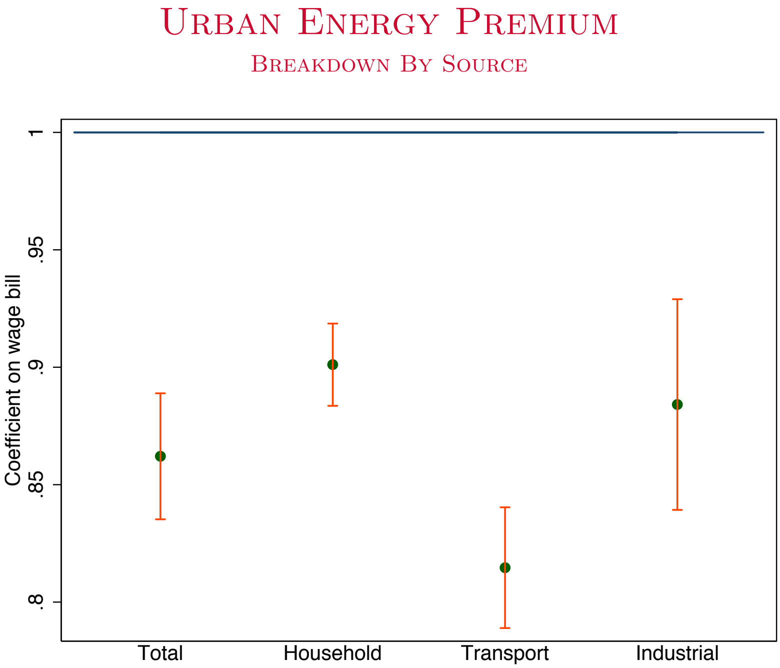
Coeff: .862 (.014), R2: .957, N: 178

Urban Energy Premium

Breakdown By Source

Table: Energy Demand by Source

Household	Transport	Industrial	Total
33.9%	28.0%	38.1%	100%



Urban Energy Premium
Breakdown By Source
Coefficient on wage bill
1
.95
.9
.85
.8
Total
Household
Transport
Industrial

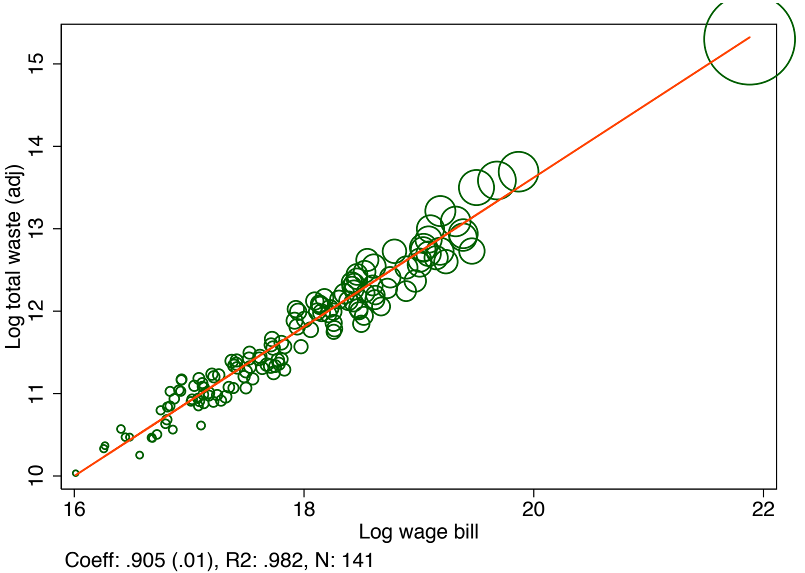
Urban Energy Premium

Why?

- Owen, David, *Green Metropolis: Why Living Smaller, Living Closer, and Driving Less Are the Keys to Sustainability*, 2009.
- Glaeser, Edward, *Triumph of the City*, 2011
- Energy Savings:
    1. Live in smaller space: less energy
    2. Apartments (vs. stand-alone buildings): more energy efficient
    3. Transportation: more efficient mass transportation (vs. car), walking, bike,...

Urban Waste Premium

10%



Urban Waste Premium

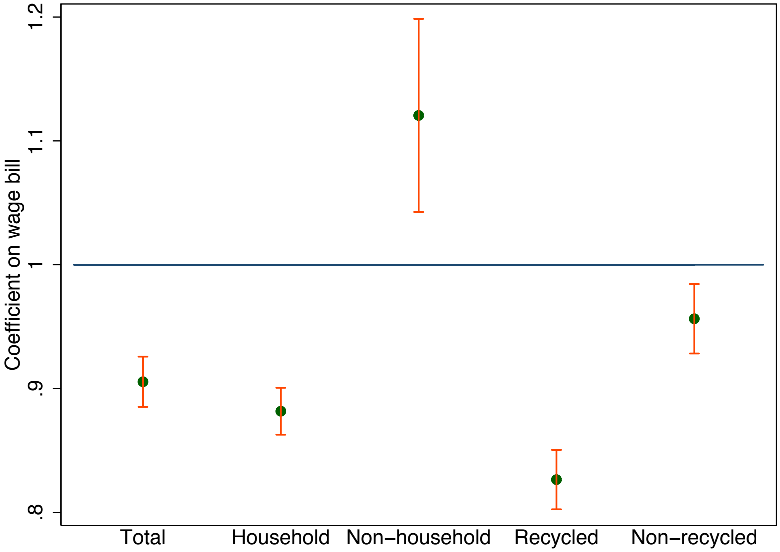
Breakdown By Source

Table: Waste Supply by Source

	Household	Non-household	Total
Recycled	35.1%	3.3%	38.4%
Non-recycled	54.1%	7.5%	61.6%
Total	89.2%	10.8%	100%

Urban Waste Premium

Breakdown By Source

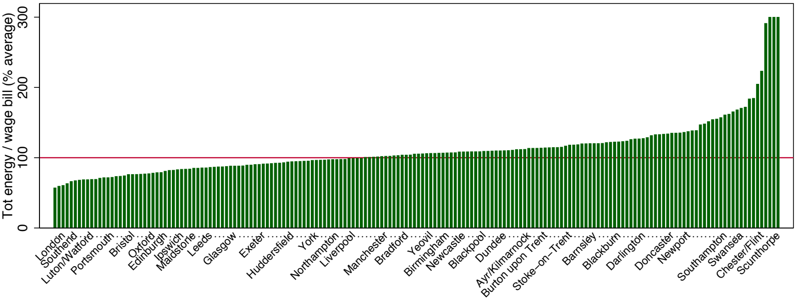


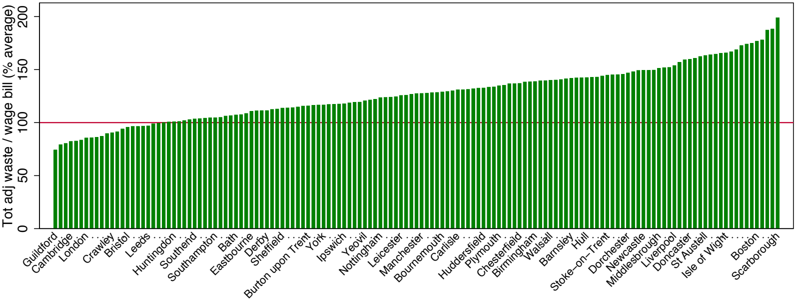
Urban Waste Premium

Why?

- Housing: small space (no garages):
  - do not collect junk
  - buy less durables (furniture,...)
  - do not buy outdoors durables

Ranking Cities





A Policy Experiment

City-Specific Taxation

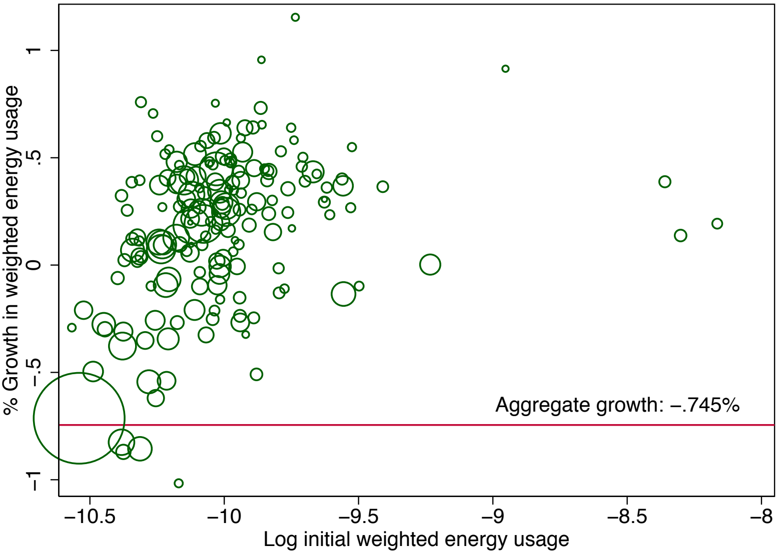
- From analysis on taxation results:
- Progressive taxation keeps workers from productive cities
- Productive cities are also clean

$\Rightarrow$ City-specific tax will:

1. Increase population of big cities
2. Increase productivity
3. Shift people to cleaner living

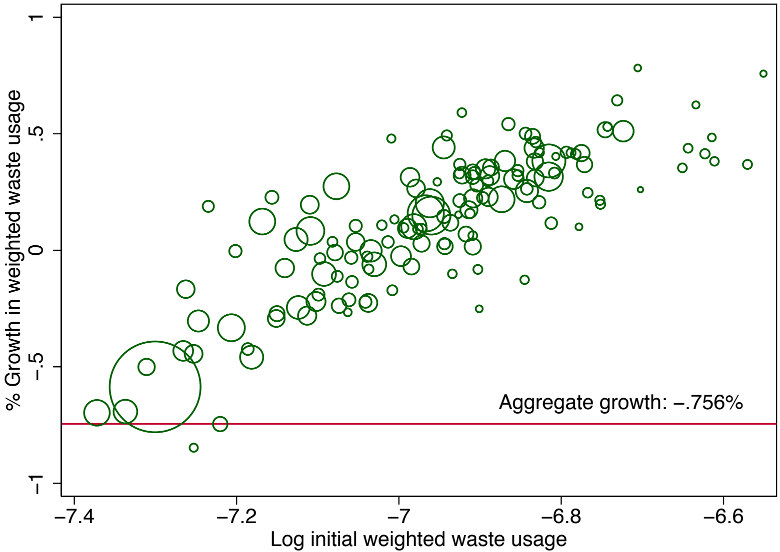
A Policy Experiment

City-Specific Taxation



A Policy Experiment

City-Specific Taxation



Economics and the City

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Bojos per l'Economia
31 January, 2015