Two-Sided Sorting and Spatial Inequality in Cities

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- Cities highly unequal
  - Segregation by income, education, race
  - Spatial inequality in opportunity/access: jobs, consumption, amenities
  - Endogenous provision of opportunities, gentrification

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$\Rightarrow$ This Paper: Sorting of heterogeneous households and firms (*Two-Sided Sorting*)

  - Amplification of sorting patterns, externalities
  - Interaction of place-based policies with sorting (efficacy, welfare)

This Paper

1. Quantitative spatial GE model with two-sided sorting
   - Heterogeneity: Households by skill, sectors by income elasticity and cost
   - Mobility: Households (residence, workplace, consumption), firms (location, labor)
   - Non-homothetic preferences across sectors
   - Key: Endogenous price index, dependent on local skill composition

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2. Estimation/Calibration with microdata on HHs and firms from Los Angeles
3. Model validation against *Federal Empowerment Zones* (tax incentives to firms)
   - Empirical evaluation of EZ program
   - Policy counterfactuals under various model assumptions
   - Welfare effects of policy
   - Alternative policy designs (target specific sectors = target people)

Preview of Results

1. Empowerment Zone program causes to gentrification of targeted tracts.
   - 27% increase in the share of high-skilled
   - Large inflow of firms, more so in non-local, income-elastic sectors
   - Rent hikes, fall in price index of services biased towards high-skill
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   - Models with homothetic preferences, free shopping rejected
   - Policy inefficient, benefits high-skilled
3. Treating specific sectors (income elasticity, skill intensity, tradability) targets specific populations

Related Literature

- **Endogenous access to services and residential sorting:** Almagro & Dominguez-Iino (2022), Miyauchi *et al.* (2021), Couture *et al.* (2019)
- **Access to goods and services associated with local population:** Handbury (2013), Waldfogel (2008), Schiff (2014), Couture (2016), Davis *et al.* (2019)
- **Firm sorting:** Behrens *et al.* (2014), Gaubert (2018), Brinkman *et al.* (2015), Ziv (2015)
- **Quantitative spatial models of the city:** Ahlfeldt *et al.* (2015), Allen *et al.* (2015), Tsivanidis (2021), Severen (2021)
- **Placed-based firm subsidies:** Busso *et al.* (2013), Reynolds & Rohlin (2015), Ham *et al.* (2011), Neumark & Young (2019), Hanson (2009), Freedman *et al.* (2021)

Key Model Ingredients

1. Endogenous skill premium (local skill demand and supply, commuting frictions)

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6. Further amplification through amenity spillovers

Detail

Two-Sided Sorting

- Residents of skill k in neighborhood n

$$L_{kn}^{R} = \frac{B_{kn}\left(I_{kn}P_{kn}^{-1}\right)^{\kappa}}{\Phi_{k}^{R}}L_{k}$$

B_{kn}: amenities; L_k: mass of skill k in city; Φ_k^R: expected utility of k

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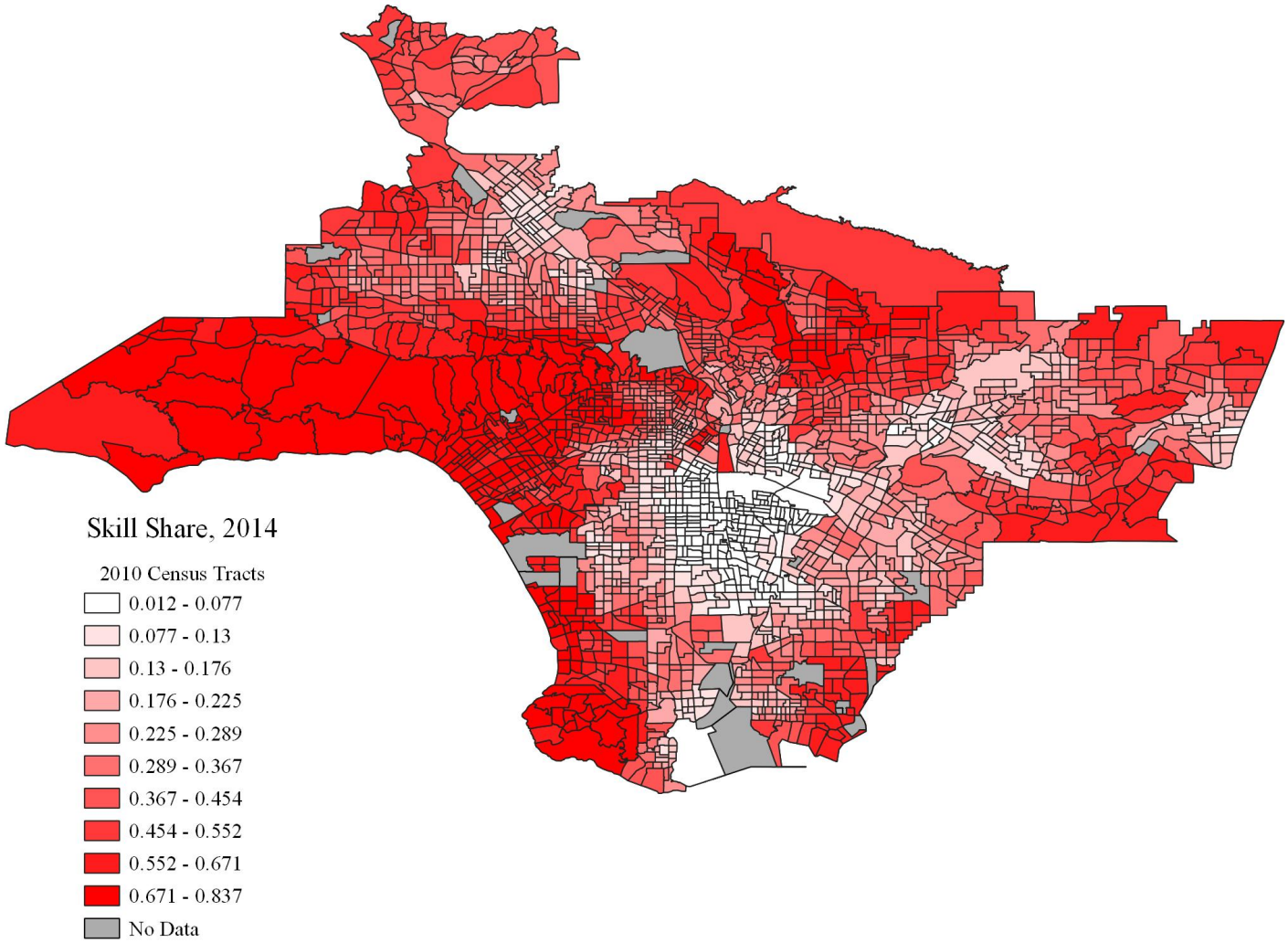
1. *Factor Access*: Supply of skill, housing
2. *Consumer Access*: Non-homothetic demand of nearby skill composition

Data

Los Angeles: urban census tracts of LA County

1. NHGIS and IPUMS, Census 1990, 2000 and 5-year ACS 2012-2016, 2007-2011
   - Tract-level HH info by skill, e.g., population, income, housing expenditure share
   - Individual-level data at PUMA-level
   - Skilled HH: Head with at least BA
2. National Establishments Time-Series Database (NETS), 1990-2014
   - Geo-coded universe of establishments, annual, CA only
   - Industry code, employment, sales, business characteristics
3. Household expenditure data from CEX 1990 and 2010-2016
   - Expenditure across 29 local service and retail sectors + non-local sector
4. Manual crosswalks of sectors with NAICS, CEX, Census industries

Skill Share, Los Angeles 2014

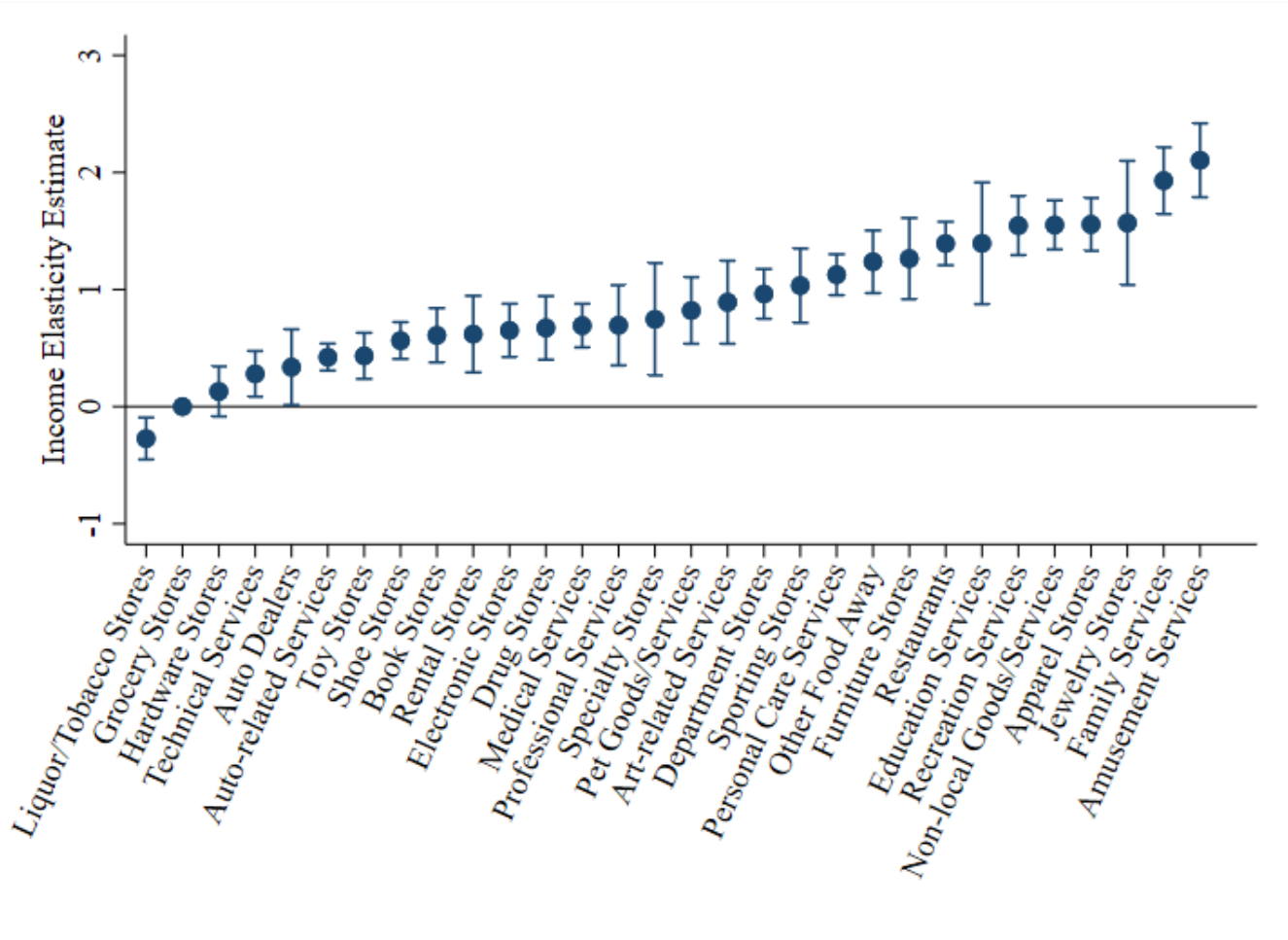


Bringing the Model to the Data

1. Model-based statistic for the price index Details
2. Estimate sector-level Engel curves
3. Estimate resident supply elasticity κ and external spillovers δ's Details
4. Estimate firm supply elasticity θ Details
5. Calibrate subset of parameters from data and literature
6. Using data to invert calibrated model and recover fundamentals Details
7. Evaluate model fit along non-targeted moments

Sector Engel Curves

Point Estimates of $\nu_j - \nu_{j*}$, 95% CI



Details

Model Parameters

Parameter	Description	Value	Source
κ	Resident supply elasticity	2.8	Estimated
ν_j	Income elasticities by sector		Estimated
η	EoS housing vs goods	.493	Albouy et al (2016)
γ	EoS across sectors	1.6	Literature
σ	EoS across varities	3	Literature
ρ	Commuter supply elasticity	6	Literature
θ	Firm supply elasticity	16	Estimated
ψ	Commuter demand elasticity	20	Assumed
$\mu/(1-\mu)$	Housing supply elasticity	.43	Severen (2021)
β^C	Housing share in production	.2	Retail Survey 2012
β_j^k	Labor share of k in sector j		Census/ACS
δ^{HS}	Spillover elasticity LS	-.5	Estimated
δ^{LS}	Spillover elasticity HS	.5	Estimated
$\phi^{\mathcal{L}}$	Distance decay spillover	-3.5	Ahlfeldt et al (2015)
ϕ^S	Distance elasticity shopping	.9	Redding et al (2021)
ϕ^W	Distance elasticity commuting	.263	Estimated

Model Fit

Compare model-implied moments with **non-targeted data moments**

- Non-homotheticity between goods and housing Go
- Non-homotheticity across sectors Go
- Skill premium Go
- Relative goods price indices Go
- Rents Go
- Housing stock, commercial vs residential Go
- Commuting flows Go
- Employment by skill and tract Go

Federal Empowerment Zones (EZ)

- Enacted in 1993, tax incentives to firms and block grants in designated tracts
- Awarded by HUD, applications by municipalities
- Eligibility based on population, poverty rate and unemployment rate
- Los Angeles receives “Supplemental Empowerment Zone", full benefits in 2000
- $3000 tax credit for employee from EZ (tilted towards low-income)
- $100M in block grants (business assistance, credit access, social spending)
- Time frame 1994-2011

Mixed Evidence in the literature

- Busso *et al.* (2013), Reynolds & Rohlin (2015), Ham *et al.* (2011) find increase on skill/income composition, increase in income, number of establishments
- Neumark & Young (2019), Hanson (2009), Freedman *et al.* (2021) find limited effects

Empirical Strategy

- Follows Busso *et al.* (2013) and Reynolds & Rohlin (2015)
- Treatment group: 8 EZ zones (incl LA) awarded in first round (1994)
- Control group: all ever rejected zones
- California sample: LA EZ, Fresno, Sacramento, San Diego (rejected)
- *Propensity-score reweighting* to further balance sample
  1. Predict participation probability $\hat{P}$ using pre-treatment covariates with Logit
  2. Use $\hat{P}/\left(1-\hat{P}\right)$ as regression weights for control and $1/N(treated)$ for treated in

$$\Delta y_{n,t} = \alpha + \beta T_n + \epsilon_{n,t}$$

  where $\Delta y_{n,t}$ is a change in outcome
- Standard errors block-bootstrapped with 1000 repetitions
- Data from Census 1980, 1990, 2000 and 5-year ACS 2007-2011

Impact of EZ Program

	(1)	(2)	(3)	(4)
	All EZ	Obs	All EZ	Obs
Tract-Level Changes	*1990-2000*		*1990-2009*	
Log Skill Share	0.270	847	0.269	843
	(0.153)*		(0.128)**	
Log HH Income HS	0.145	847	0.103	843
	(0.126)		(0.093)	
Log HH Income LS	0.086	848	0.109	843
	(0.043)*		(0.050)**	
Log Rent	0.006	848	0.147	690
	(0.050)		(0.041)***	
Log Housing Share HS	0.039	847	0.072	840
	(0.031)		(0.035)**	
Log Housing Share LS	-0.037	848	0.009	840
	(0.024)		(0.023)	
Log Firms			0.499	71
			(0.265)**	
Log Firms Local			0.365	71
			(0.388)	
Log Firms Non-Local			0.624	71
			(0.204)***	
Share Income-elastic			0.115	71
			(0.038)***	

Balance More Outcomes

Impact of EZ Program

- Significant increase in the skill share by 27%
- Incomes by around 10%
- Counteracted by higher rents (15%)
- Larger increase in housing share for the high-skilled

$\Rightarrow$ larger improvement in consumption access for the high-skilled

- Significant increase in the number of firms (50%)
- More so in non-local sector and in income-elastic sectors

EZ program leads to gentrification of disadvantaged tracts

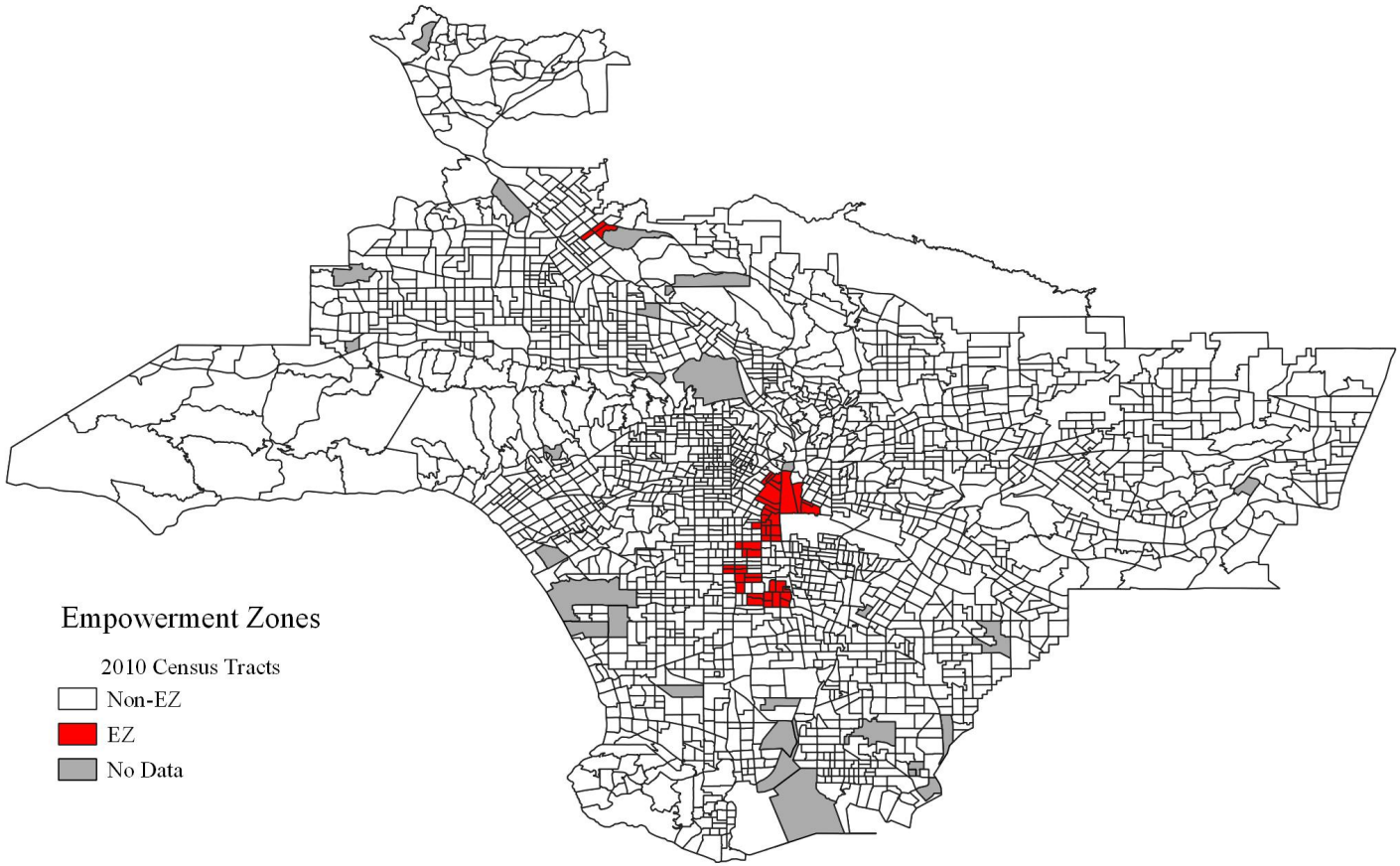
EZ Program Counterfactual

- Implement only firm-level subsidies in model
  1. Wage subsidy $w_{kin} - subsidy_j/e_{kin}$ for i and n inside Zone
  2. Profit subsidy of 30% (block grant, LA Community Development Bank)
  3. Amenity shock tilted towards high-skilled Detail
- Cost financed by Federal Government; report costs and benefit
- Model calibrated to 1990

Set up model variants

1. Baseline Model: non-homothetic pref, local demand, local labor supply (two-sided sorting)
2. Homothetic Model: remove sector differences in income elasticity
3. No Shopping Frictions: demand citywide
4. No Commuting Frictions: labor supply citywide

Los Angeles EZ



Impact of EZ Program in Data and Model

	(1)	(2)	(3)	(4)	(5)
	Data	Counterfactual			
Model Version	Data	Baseline	Homothetic Preferences	No Shopping Frictions	No Commuting Frictions
Log Skill Share	0.269	0.248	0.088	0.232	0.253
	(0.128)**	(0.005)	(0.005)	(0.005)	(0.007)
Log HH Income HS	0.103	0.013	0.016	0.014	-0.004
	(0.093)	(0.001)	(0.001)	(0.001)	(0.000)
Log HH Income LS	0.109	0.026	0.024	0.027	0.007
	(0.050)**	(0.002)	(0.002)	(0.002)	(0.000)
Log Rent	0.147	0.122	0.142	0.125	0.104
	(0.041)***	(0.009)	(0.008)	(0.009)	(0.009)
Log Housing Share HS	0.072	0.052	0.053	0.050	0.048
	(0.035)**	(0.004)	(0.003)	(0.004)	(0.004)
Log Housing Share LS	0.009	0.047	0.053	0.045	0.044
	(0.023)	(0.003)	(0.003)	(0.003)	(0.004)
Log Firms	0.499	0.565	0.556	0.580	0.551
	(0.265)**	(0.010)	(0.009)	(0.011)	(0.008)
Log Firms Local	0.365	0.482	0.505	0.586	0.441
	(0.388)	(0.009)	(0.008)	(0.011)	(0.009)
Log Firms Non-Local	0.624	0.657	0.615	0.572	0.667
	(0.204)***	(0.015)	(0.012)	(0.010)	(0.014)
Share Income-elastic	0.115	0.027	0.016	-0.002	0.034
	(0.038)***	(0.002)	(0.001)	(0.000)	(0.002)

By policy instrument Spillovers

Welfare Impact of EZ Program

	(1)	(2)	(3)	(4)
Model Version	Baseline	Homothetic Preferences	No Shopping Frictions	No Commuting Frictions
Welfare HS (x100)	0.298	0.702	0.309	0.280
Welfare LS (x100)	0.275	0.730	0.290	0.281
CV HS ($)	175	410	181	164
CV LS ($)	99	260	104	101
CV weighted ($)	120	302	125	118
Cost per HH ($)	204	205	207	195

Alternative EZ Designs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All Sectors Treated	Income-elastic Sectors	Income-inelastic Sectors	High-skill Sectors	Low-skill Sectors	Local Sectors	Non-local Sector
Log Skill Share	0.037	0.097	-0.105	0.068	-0.069	0.013	0.011
Welfare HS (x100)	0.333	0.329	0.045	0.366	0.020	0.050	0.366
Welfare LS (x100)	0.316	0.243	0.150	0.226	0.182	0.126	0.271
CV HS ($)	195	193	26	215	12	29	215
CV LS ($)	113	87	53	81	65	45	97
CV weighted ($)	136	116	46	118	50	41	130
Cost per HH ($)	175	157	80	148	103	120	138
Benefit-Cost Ratio	0.776	0.739	0.576	0.799	0.488	0.339	0.937

- Alternative EZ designs more targeted
- Treatment by income-elasticity strongest effects
- Policies remain inefficient

Policy Implications & Conclusion

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   - Rich interactions between heterogeneous households and firm
   - Two-Sided Sorting amplifies segregation
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   - Rich interactions between heterogeneous households and firm
   - Two-Sided Sorting amplifies segregation
   - Predicts policy impact on gentrification
2. Evaluate Federal Empowerment Zone using data and model
   - EZ program costly, benefits the rich (unintended?)
   - Alternative subsidy schemes more effective in targeting specific populations

BACKUP

Residence Choice

- K skill-types with fixed mass L_k: high-skilled ($k = HS$), low-skilled ($k = LS$)
- N neighborhoods: residence and/or workplace

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- Utility for household ι of type k in n: $\mathcal{U}_{kn}(\iota) = I_{kn} P_{kn}^{-1} b_{kn}(\iota)$
- Idiosyncratic preference draw for each n, $b_{kn}(\iota) \sim$ Fréchet(κ,B_{kn})
- Residents of skill-type k in neighborhood n

$$L_{kn}^R = \frac{B_{kn} \left(I_{kn} P_{kn}^{-1}\right)^{\kappa}}{\sum_{n'} B_{kn'} I_{kn}^{\kappa} P_{kn'}^{-\kappa}} L_k$$

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1. I_{kn}: Expected income of k in n (*Labor Market Access*)
2. P_{kn}^{-1}: Expected price index of consumption of k in n (*Consumption Access*)

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3. B_{kn}: Amenities for k in n, spillovers

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- Mass of households of type k living in n commuting to i:

$$L^W_{ki|n} = \frac{w^\rho_{kni} \left(\tau^W_{kni}\right)^{-\rho}}{\sum_{i'} w^\rho_{kni'} \left(\tau^W_{kni'}\right)^{-\rho}} L^R_{kn} = \frac{w^\rho_{kni} \left(\tau^W_{kni}\right)^{-\rho}}{\Phi^W_{kn}} L^R_{kn}.$$

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$$I_{kn}(\iota) \equiv \max_i \left(\frac{e_{ki|n}(\iota) w_{kni}}{\tau^W_{kni}} \right).$$

- Mass of households of type k living in n commuting to i:

$$L^W_{ki|n} = \frac{w^\rho_{kni} \left(\tau^W_{kni}\right)^{-\rho}}{\sum_{i'} w^\rho_{kni'} \left(\tau^W_{kni'}\right)^{-\rho}} L^R_{kn} = \frac{w^\rho_{kni} \left(\tau^W_{kni}\right)^{-\rho}}{\Phi^W_{kn}} L^R_{kn}.$$

- Expected labor income:

$$\tilde{I}_{kn} = \gamma^W \left(\Phi^W_{kn}\right)^{1/\rho},$$

- Expected income: $I_{kn} = \tilde{I}_{kn} + t_k$, lump-sum transfer t_k

Back

Consumption Choices

- Housing rents r_n and goods price index P_{kng}

$$P_{kn} = \left(a_h r_n^{1-\eta} + a_g P_{kng}^{1-\eta}\right)^{\frac{1}{1-\eta}}$$

Preferences
Back

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- Goods price index across J sectors, **non-homothetic CES**

$$P_{kng} = \left(\sum_{j=1}^{J} \alpha_j U_{kn}^{\nu_j} p_{knj}^{1-\gamma}\right)^{\frac{1}{1-\gamma}}$$

$U_{kn} = I_{kn} P_{kn}^{-1}$: real consumption of k in n; ν_j: income elasticity for sector j

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- Price index of sector $j \in J$ in n with shopping frictions $\tau_{knn'}^S$

$$p_{knj} = \left(\sum_{n'=1}^{N} \left(\int_{\Omega_{n'j}} \left(\tau_{knn'}^S\right)^{1-\sigma} p_{n'j}(\omega)^{1-\sigma} d\omega\right)\right)^{\frac{1}{1-\sigma}}$$

Preferences
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- $\Omega_{n'j}$: endogenous set of varieties in $n' \Rightarrow$ **Firm Sorting**

Preferences

Back

Firm Sorting

- Infinite Mass Ω_j of potential varieties in each sector j (ω)
- Free Entry: fixed cost f_j^e to enter city $\Rightarrow$ mass M_j

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- Labor input of each skill-type from origins i':

$$\tilde{l}_{knj}(\omega) = \left(\sum_{i'} \left(\tilde{l}_{ki'nj}(\omega) \right)^{\frac{\psi-1}{\psi}} \right)^{\frac{\psi}{\psi-1}}$$

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- Unit cost with commercial rent r_n^C and wage indices W_{kn}

$$\mathcal{C}_{nj}(\omega) = z_{nj}(\omega)^{-1} \mathcal{C}_{nj} = z_{nj}(\omega)^{-1} \left(r_n^C \right)^{\beta_j^h} \prod_k W_{kn}^{\beta_j^k}$$

- Monopolistic competition:

$$p_{nj}(\omega) = \frac{\sigma}{\sigma - 1} \mathcal{C}_{nj}(\omega)$$

Firm Sorting

- Profits of ω in n and j:

$$\pi_{nj}(\omega) = \frac{1}{\sigma - 1} z_{nj}(\omega)^{\sigma-1} \underbrace{\mathcal{C}_{nj}^{1-\sigma}}_{\text{Factor Access } FA_{nj}} \underbrace{\sum_{n'} \sum_{k} \left(\frac{\tau_{kn'n}^{S}}{p_{kn'j}} \right)^{1-\sigma} \tilde{s}_{kn'j} s_{kn'g} I_{kn'} L_{kn'}^{R}}_{\text{Consumer Access } CA_{nj}}$$

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- $\tilde{\pi}_{nj} = FA_{nj} \times CA_{nj}$
- Mass of varieties in sector j in n:

$$M_{nj} = \int_{\Omega_{nj}} 1 d\omega = \frac{A_{nj} \tilde{\pi}_{nj}^{\frac{\theta}{\sigma-1}}}{\sum_{n'}^{N} A_{n'j} \tilde{\pi}_{n'j}^{\frac{\theta}{\sigma-1}}} M_j$$

Back

Firm Sorting

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- Variation in expenditure shares $\tilde{s}_{kn'j} s_{kn'g}$ due to prices and non-homotheticity

Back

Amenity Spillovers

- B_{kn}: exogenous amenities and *endogenous spillovers*
- Spillovers capture other endogenous amenities (schooling, crime,...)
- Define

$$B_{kn} = \bar{B}_{kn}\mathcal{L}_{kn} = \bar{B}_{kn}\prod_{n'}\prod_{k'}\left(L^{R}_{k'n'}\right)^{\delta_{k'n',kn}}$$

- Spillovers $\mathcal{L}_{kn}$ function of household distribution in city and set of elasticities δ

Back

Housing Supply, Closing the Model

- Floorspace supplied by competitive construction sector with productivity A_{nH}, outside capital Q_n at price P_Q, land Z_n:

$$H_n = A_{nH} Q_n^{\mu} Z_n^{1-\mu}$$

- Arbitrage between residential and commercial floorspace: $r_n^C = r_n^R = r_n$

- Landlords and capital owners fully taxed, rebated lump-sum to households according to citywide skill premium (t_k)

Competitive Equilibrium:
HHs and firms take prices as given + all markets clear

Back

Model - Preferences

- Housing C_{knh} and goods consumption C_{kng}

$$U_{kn} = \left(a_h^{\frac{1}{\eta}} C_{knh}^{\frac{\eta-1}{\eta}} + a_g^{\frac{1}{\eta}} C_{kng}^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}}.$$

- Goods consumption across J sectors: Non-homothetic CES

$$C_{kng} = \left(\sum_{j=1}^{J} \left(\alpha_j U_{kn}^{\upsilon_j} \right)^{\frac{1}{\gamma}} c_{knj}^{\frac{\gamma-1}{\gamma}} \right)^{\frac{\gamma}{\gamma-1}}.$$

  U_{kn}: Real consumption of k in$n$; ν_j: income elasticity for sector j

- Consumption of sector $j \in J$ across varieties ω

$$c_{knj} = \left(\sum_{n'=1}^{N} \left(\int_{\Omega_{n'j}} c_{knn'j}(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right) \right)^{\frac{\sigma}{\sigma-1}}.$$

- $\Omega_{n'j}$: endogenous set of varieties in $n' \Rightarrow$ Firm Sorting

Price Indices

Model-based Statistic for the Price Index

- Constructing a skill-tract-level price index challenging
- Requires detailed prices, varieties, expenditure shares at fine geographic scale

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- Requires detailed prices, varieties, expenditure shares at fine geographic scale
- Use model-based sufficient statistic for P_{kng} and P_{kn} (Atkin *et al.*, 2023)

$$P_{kn} = a_h^{\frac{1}{1-\eta}} r_n^R s_{knh}^{\frac{1}{\eta-1}} \quad \text{and} \quad P_{kng} = \left(\frac{a_h}{a_g}\right)^{\frac{1}{1-\eta}} r_n^R \left(\frac{s_{knh}}{1-s_{knh}}\right)^{\frac{1}{\eta-1}}$$

- Assuming a single housing market and constant relative tastes for housing
- Housing expenditure shares s_{knh} and rents r_n^R are observable

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- Assuming a single housing market and constant relative tastes for housing
- Housing expenditure shares s_{knh} and rents r_n^R are observable
- Real consumption

$$U_{kn} = \frac{I_{kn}}{a_h^{\frac{1}{1-\eta}} r_n^R s_{knh}^{\frac{1}{\eta-1}}}$$

- Extremely helpful for estimation

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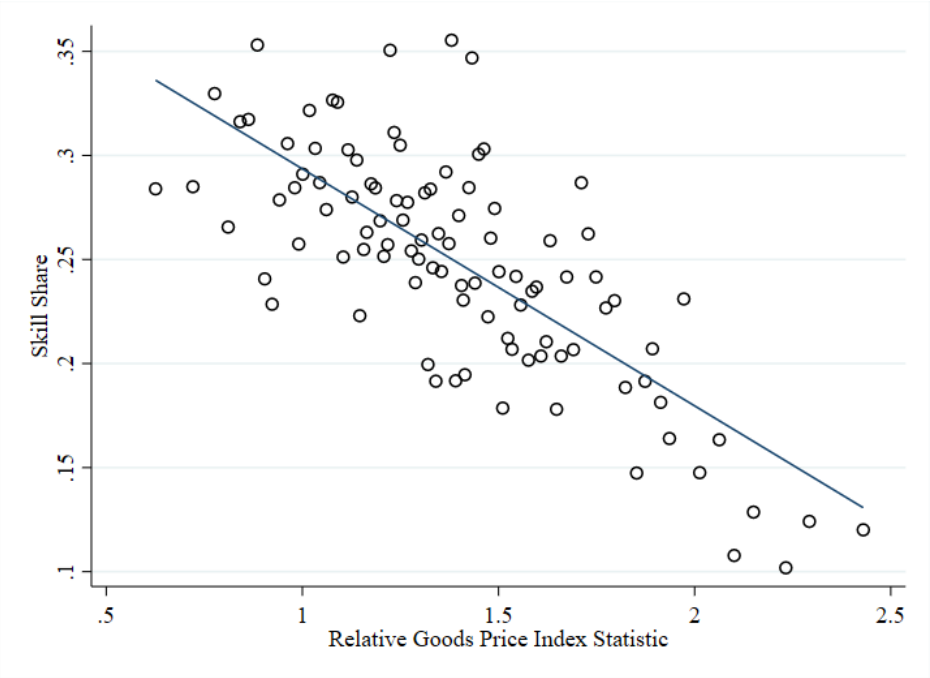
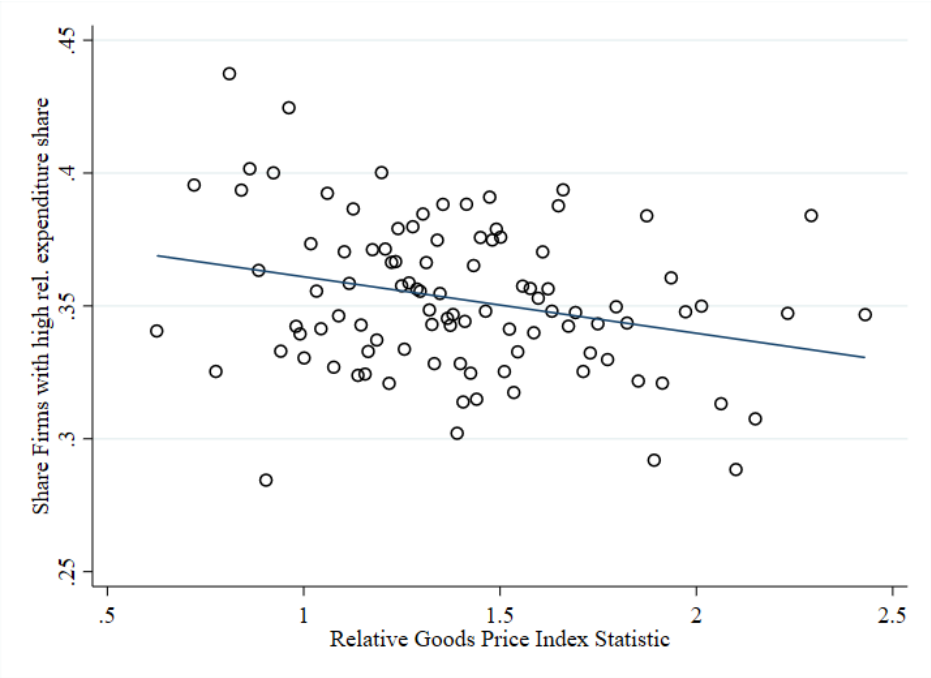
Model-based Statistic for the Price Index





- Relative goods price index statistic (horizontal): $\frac{P_{HS,ng}}{P_{LS,ng}}$
- Share of households with skilled head (left)
- Share of firms with $\tilde{s}_{HS,j}^{CEX90} > \tilde{s}_{LS,j}^{CEX90}$ (right)

Back

Sector Engel Curves

- Expenditure of HH i in location n on sector j at time t, reference sector j^*

$$\log\left(\frac{p_{nj,t}c_{i,nj,t}}{p_{nj^*,t}c_{i,nj^*,t}}\right) = \log\left(\frac{\alpha_{i,j,t}}{\alpha_{i,j^*,t}}\right) + (1-\gamma)\log\left(\frac{p_{nj,t}}{p_{nj^*,t}}\right) + (\nu_j - \nu_{j^*})\log U_{i,n,t},$$

Back

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- With sufficient statistic for $U_{i,n,t}$

$$\log\left(\frac{p_{n,t}(j)c_{i,n,t}(j)}{p_{n,t}(j^*)c_{i,n,t}(j^*)}\right) = \iota_{nj,t} + (\nu_j - \nu_{j^*})\log\left(\frac{I_{i,n,t}}{r^R_{i,n,t}s^{\frac{1}{\eta-1}}_{i,n,t}}\right) + u_{i,nj,t},$$

  - $u_{i,nj,t} = \log\left(\frac{\alpha_{i,j,t}}{\alpha_{i,j^*,t}}\right) + \frac{\nu_j - \nu_{j^*}}{\eta-1}\log a_{i,h,t}$
  - Sector-MSA-Time FX, dummies for HH size, age of HH head, # earners interacted with sector FX
  - IV for $U_{i,n,t}$: after-tax income in previous year

Back

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  - Sector-MSA-Time FX, dummies for HH size, age of HH head, # earners interacted with sector FX
  - IV for $U_{i,n,t}$: after-tax income in previous year

Data

- Urban HHs in MSAs, HH head aged 25-64, 2012-2016
- Reference Sector: Groceries
- Quarterly expenditure $I_{i,n,t}$, rent per room $r^R_{i,n,t}$, housing share $s_{i,n,t}$
- $\eta = .493$

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Sector Engel Curves

$J-1$ income elasticities, $\nu_j - \nu_{j^*}$ $\Rightarrow$ Find ν_{j^*} (groceries) and overall degree of non-homotheticity

Elasticity of relative expenditure on housing and goods with respect to real consumption follows:

$$\frac{\partial \log \frac{s_{knh}}{s_{kng}}}{\partial \log U_{kn}} = (\eta - 1)\frac{\bar{\nu}_{kn}}{1-\gamma},$$

where $\bar{\nu}_{kn} = \sum_j \tilde{s}_{knj}\nu_j$.

- Albouy *et al.* (2016) estimate this to be around .76 with $\eta = .493$.
- Rescale ν_j accordingly and recover $\nu_{grocery}$.
- Implies concave marginal utility from income, around .5 on average at baseline.

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Resident Supply Elasticity κ & Spillovers δ's

$$\log \hat{L}^R_{kn,t} = \kappa \log \left(\frac{\widehat{I_{kn,t}}}{r^R_{n,t} s^{\frac{1}{\eta-1}}_{knh,t}} \right) + \delta_k \log \left(\prod_{n'} \left(\frac{\widehat{L^R_{HS,n',t}}}{L^R_{LS,n',t}} \right)^{\omega_{nn'}} \right) + \hat{X}_{kn,t}\beta + \iota_{kn,t} + u_{kn,t}$$

- Log change in population of skill-type k in n between t and $t-1$ (in hats)
- Error term: $u_{kn,t} = \frac{\kappa}{\eta-1} \log \hat{a}_{h,t} + \log \hat{\tilde{B}}_{kn,t}$
- $\hat{X}_{kn,t}$ controls, $\iota_{kn,t}$ skill-type-time FX
- Construct both independent variables from data

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Resident Supply Elasticity κ & Spillovers δ's

Identification

1. Average Price Instrument

$$P_{n,t}^{IV} = \sum_j \left(\sum_{n'} \frac{M_{n'j,t_0} \mathbf{1}(d_{nn'} < b)}{M_{j,t_0}} \right) \log \hat{M}_{j,t}^{O}$$

2. Relative Price Instrument

$$\Delta P_{n,t}^{IV} = \sum_j \left(\tilde{s}_{HS,j,t_0}^{CEX} - \tilde{s}_{LS,j,t_0}^{CEX} \right) \left(\sum_{n'} \frac{M_{n'j,t_0} \mathbf{1}(d_{nn'} < b)}{M_{j,t_0}} \right) \log \hat{M}_{j,t}^{O}.$$

3. Bartik Wage Instrument

$$I_{kn,t}^{IV} = \sum_{n'} \frac{\left(\tau_{nn'}^{W}\right)^{\frac{\rho(\psi-1)}{1-\rho-\psi}}}{\sum_{n''} \left(\tau_{nn''}^{W}\right)^{\frac{\rho(\psi-1)}{1-\rho-\psi}}} \sum_i \frac{L_{kn'i,t_0}^{W}}{L_{kn,t_0}^{W}} \log \hat{W}_{ki,t}^{O}.$$

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Resident Supply Elasticity κ & Spillovers δ's

Estimation Results for κ and δ_k

	(1) Non-Homothetic	(2) Homothetic	(3) Non-Homothetic	(4) Non-Homothetic	(5) Non-Homothetic	(6) Non-Homothetic
$\hat{\kappa}$	0.038**	1.472***	2.734***	2.833***	2.629***	3.419**
	(0.019)	(0.106)	(0.318)	(0.337)	(0.326)	(1.369)
$\hat{\delta}^{LS}$	-0.154***	-0.305***	-0.879***	-0.964***	-0.970***	-0.525
	(0.017)	(0.118)	(0.184)	(0.199)	(0.191)	(0.324)
$\hat{\delta}^{HS}$	1.046***	0.930***	0.712***	0.760***	0.700***	-0.012
	(0.020)	(0.118)	(0.201)	(0.205)	(0.197)	(0.531)
Observations	8,343	8,343	8,343	8,343	8,343	8,343
Instruments	None	All	All	No Wage IV	No Avg Price IV	No Rel Price IV
R^2	0.567					
K-P F-Stat		50.56	24.05	31.14	27.58	2.288
Hansen J p-val		7.09e-05	0.269			

Notes: Standard errors clustered at tract level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

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Firm Supply Elasticity θ

Employment of firm ω at time t in n

$$l_{nj,t}(\omega) = \sum_k l_{knj,t}(\omega) = \left(\sum_k \sum_i \frac{\beta_j^k}{\bar{e}_{kin,t}} \frac{w_{kin,t}^{-\psi}}{W_{kn,t}^{1-\psi}} \right) (\sigma - 1) \tilde{\pi}_{nj,t}(\omega) z_{nj,t}(\omega)^{\sigma-1}.$$

Share of employment of firm ω in total employment in sector j in n

$$\log \frac{l_{nj,t}(\omega)}{L_{nj,t}^W} = \alpha + \left(\frac{\sigma - 1}{\theta} - 1 \right) \log M_{nj,t} + \iota_{j,t} + \upsilon_{nj,t}(\omega),$$

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Identification

- $v_{nj,t}(\omega) = \frac{1-\sigma}{\theta} \log A_{nj,t} + (\sigma - 1) \log z_{nj,t}(\omega)$
- IV: Average slope in tract, distance to shore
- Interacted with $\tilde{s}_{HS,j,t_0}^{CEX90} - \tilde{s}_{LS,j,t_0}^{CEX90}$
- Chain firms m: Assume $z_{nj,t}^m(\omega^m) = z_{j,t}^m(\omega^m)$
- Tract-time FX: rents, labor market access, slope, distances...
- Chain-time FX: common productivity...

Back

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- Tract-time FX: rents, labor market access, slope, distances...
- Chain-time FX: common productivity...

Data

- Private, for-profit establishments in 28 local sectors, 1992-2014
- Restricted to chain firms (excluding headquarters),

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Firm Supply Elasticity θ

Estimation Results for θ

	(1) OLS	(2) IV Slope	(3) IV Slope	(4) IV Slope	(5) IV Slope	(6) IV Slope & Distance
2SLS						
log $M_{nj,t}$	-0.903***	-0.867***	-0.886***	-0.846***	-0.876***	-0.857***
	(0.005)	(0.078)	(0.111)	(0.109)	(0.082)	(0.082)
Implied $\hat{\theta}$ ($\sigma = 3$)	20.574***	15.083*	17.533	12.990	16.111	14.001*
	(1.001)	(8.876)	(17.106)	(9.221)	(10.695)	(8.000)
1st Stage						
Avg Slope X rel Exp Share		0.259***	0.252***	0.268***	0.249***	0.254***
		(0.020)	(0.027)	(0.031)	(0.020)	(0.021)
Dist to Shore X rel Exp Share						-0.025***
						(0.008)
Observations	178,809	178,809	93,841	84,968	174,191	174,191
Sample	all	all	2004-2014	1990-2003	excl Amusement & Recreation	excl Amusement & Recreation
K-P F-Stat		164.5	89.18	74.61	147.4	76.57
Hansen J p-val						0.339

Notes: Standard errors clustered at zipcode-year level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Back

Model Inversion

With all parameters and data on

1. Residential household distribution L_{kn}^R
2. Firm distribution M_{nj}
3. Citywide revenue shares by sector rs_{cj}
4. Citywide and tract-level expenditure share on housing, s_{ch} and s_{nh}
5. Land endowment Z_n
6. Distances between all tracts

Back

Model Inversion

With all parameters and data on

1. Residential household distribution L^R_{kn}
2. Firm distribution M_{nj}
3. Citywide revenue shares by sector rs_{cj}
4. Citywide and tract-level expenditure share on housing, s_{ch} and s_{nh}
5. Land endowment Z_n
6. Distances between all tracts

uniquely recover fundamentals

1. Fixed amenities $\bar{B}_{kn}$
2. Composite demand and productivity shifters $\bar{A}_{nj} = A_{nj} a_g^{\frac{\theta}{\eta-1}} \alpha_j^{\frac{\theta}{\gamma-1}}$
3. Housing supply productivity $\bar{A}_{nH} = A_{nH}^{-\frac{1}{\mu}} P_Q$
4. Fixed cost of entry $f^e(j)$
5. Transfers t_k

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Model Fit - Goods vs Housing

	(1) Census 1990	(2) ACS 2014	(3) Census 1990	(4) ACS 2014	(5) Model 1990	(6) Model 2014
Skill	-0.024***	-0.057***	-0.031***	-0.064***	-0.040***	-0.067***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Observations	133,433	122,837	4,412	4,412	4,412	4,412
R-squared	0.148	0.129	0.927	0.955	0.998	0.997
Individual controls	X	X				
Location FE	Puma	Puma	Tract	Tract	Tract	Tract
Sample	LA HH	LA HH	LA Tracts	LA Tracts	LA Tracts	LA Tracts

Notes: Individual controls include dummies for sex, race, age (24-44, 45-64), household size and home-ownership. Observations weighed with survey weights in (1) and (2). Tracts weighted with population in (3)-(6). Robust standard errors. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

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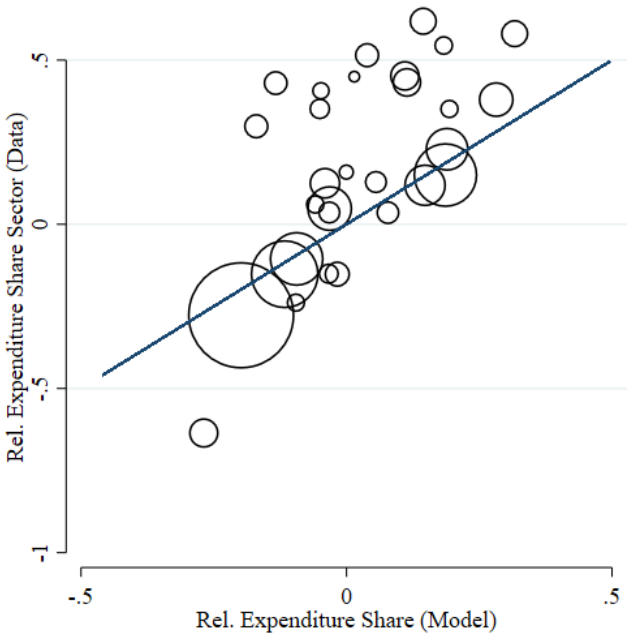
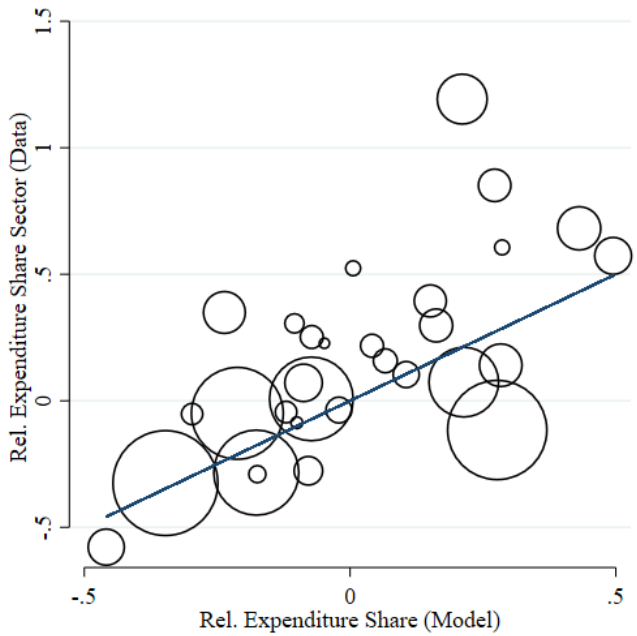
Model Fit - Sectors

Expenditure share differences by skill across sectors implied by model and data for 1990 and 2014





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Model Fit - Skill Premium

	(1) Census 1990	(2) ACS 2014	(3) Census 1990	(4) ACS 2014	(5) Model 1990	(6) Model 2014
Skill	0.484***	0.616***	0.489***	0.587***	0.495***	0.781***
	(0.005)	(0.006)	(0.011)	(0.011)	(0.002)	(0.001)
Observations	140,887	133,982	4,412	4,412	4,412	4,412
R-squared	0.240	0.256	0.339	0.443	0.972	0.993
Individual controls	X	X				
Sample	LA HH	LA HH	LA Tracts	LA Tracts	LA Tracts	LA Tracts

Notes: Individual controls include dummies for sex, race, age (24-44, 45-64) and household size. Observations weighed with survey weights in (1) and (2). Tracts weighted with population in (3)-(6). Robust standard errors. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

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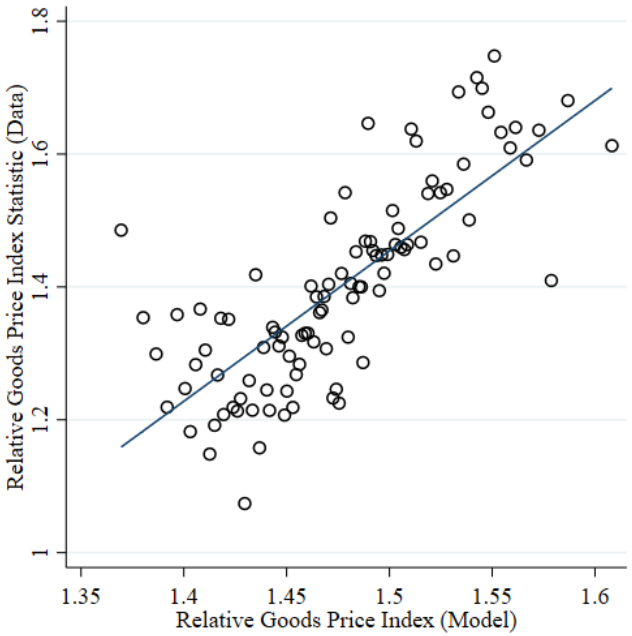
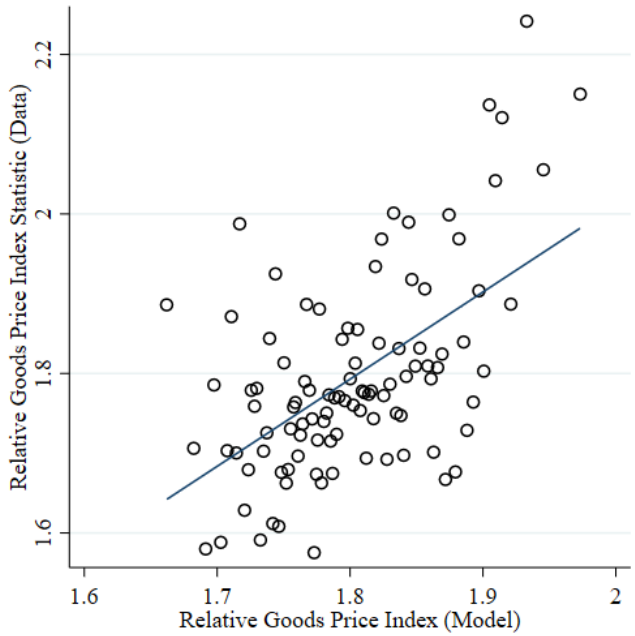
Model Fit - Relative Goods Prices

Relative Goods Price Index Statistic and Model-implied Relative Goods Prices for 1990 and 2014





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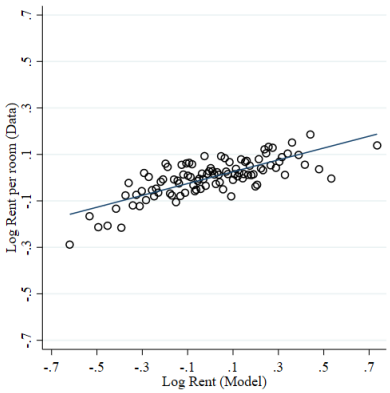
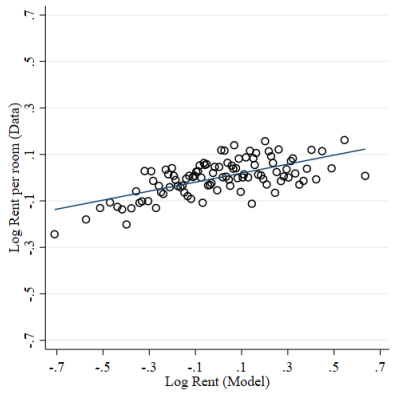
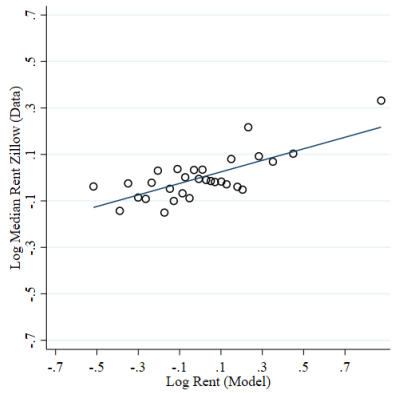
Model Fit - Rents

Model-implied rents and data from Census 1990, ACS 2014 and Zillow 2014







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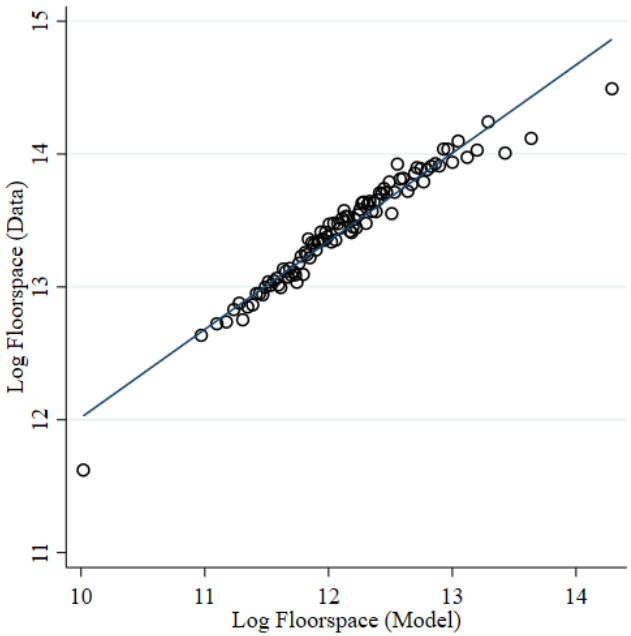
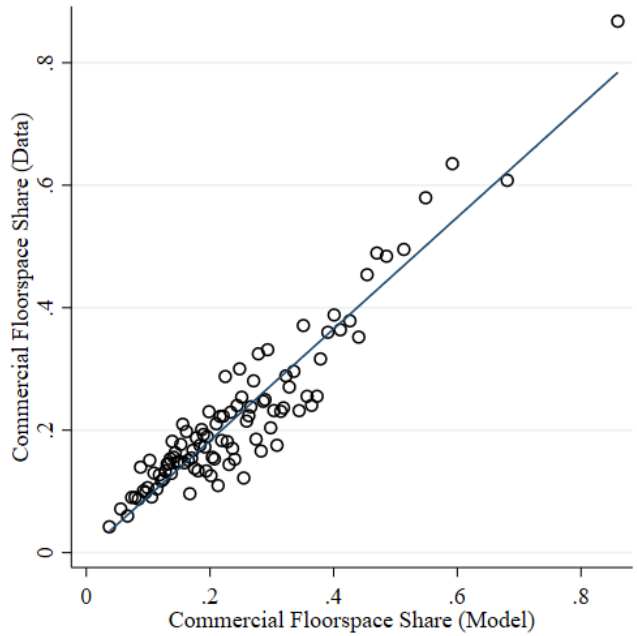
Model Fit - Housing Stock

Floorspace and share of commercial space in model and data from Los Angeles County Tax Assessor, 2014





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Model Fit - Commuting Flows

Commuter Flows in Baseline Model and LODES data, 2014

	(1)	(2)	(3)	(4)
Log Commuters, Model	1.006***	0.960***	1.018***	1.002***
	(0.009)	(0.017)	(0.020)	(0.018)
Observations	4,864,230	4,864,230	4,864,230	4,864,230
Residence FE	X		X	
Workplace FE	X	X		

Notes: Regression compares the number of workers commuting between two tracts in the model with data from LODES for 2014 (including zero flows). Regressions use Pseudo Poisson Maximum Likelihood (PPML). Standard errors clustered at residence and workplace. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

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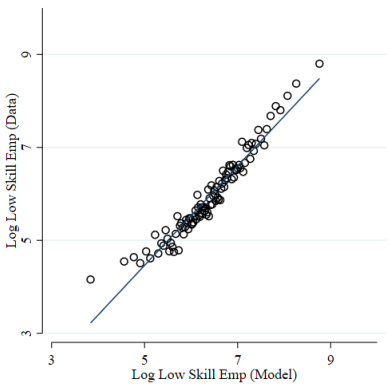
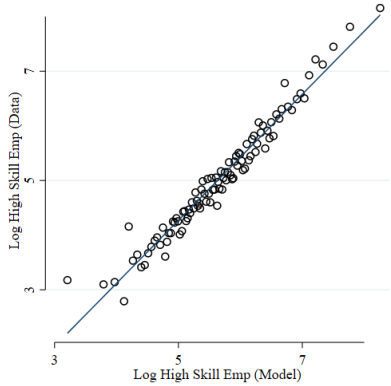
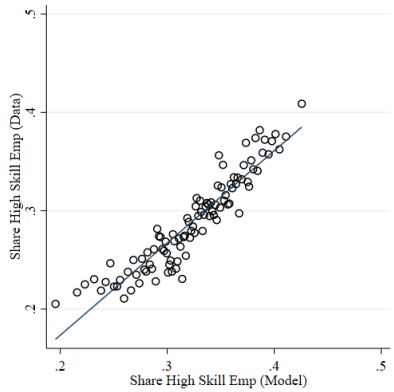
Model Fit - Employment

Employment by tract & skill in model and LODES data, 2014







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Balance

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Difference	Control Mean	p-value	Obs	Difference	Control Mean	p-value	Obs
Levels, 1990	*All EZs*				*LA EZ*			
UE Rate	-0.012	0.234	0.617	849	-0.233	0.426	0.037	71
Poverty Rate	-0.005	0.458	0.901	849	-0.052	0.458	0.733	71
Emp-Pop Ratio	0.030	0.415	0.277	849	0.175	0.286	0.044	71
Minority Share	0.042	0.813	0.260	849	0.257	0.566	0.001	71
Housing Share	0.010	0.212	0.123	849	0.073	0.185	0.001	71
Vacant Share	0.032	0.111	0.006	849	-0.024	0.083	0.463	71
Homeowner Share	-0.002	0.237	0.960	849	0.083	0.202	0.608	71
Skill Share	0.009	0.053	0.203	849	-0.059	0.096	0.046	71
Changes, 1980-90								
UE Rate	-0.011	0.054	0.616	849	-0.182	0.218	0.317	71
Poverty Rate	0.002	0.035	0.915	849	-0.014	0.028	0.821	71
Emp-Pop Ratio	0.009	0.006	0.675	849	0.137	-0.116	0.360	71
Minority Share	-0.012	0.035	0.183	849	-0.023	-0.009	0.464	71
Housing Share	0.003	0.029	0.595	849	0.056	0.007	0.091	71
Vacant Share	0.018	0.006	0.173	849	-0.009	0.013	0.872	71
Homeowner Share	-0.005	0.009	0.374	849	-0.005	-0.005	0.845	71
Skill Share	0.002	0.021	0.697	849	-0.067	0.072	0.036	71
Log HH Income	-0.001	0.542	0.986	849	0.065	0.635	0.536	71
Log Home Value	-0.037	0.816	0.693	849	-0.152	1.148	0.349	71
Log Rent	0.032	0.814	0.465	849	0.366	0.817	0.000	71
Firms, 1990								
Log Firms					-1.318	5.359	0.003	71
Log Firms Local					-0.964	4.242	0.054	71
Log Firms Non-Local					-1.604	4.894	0.004	71
Log Employment					-2.006	8.395	0.006	71
Share Income-elastic					-0.006	0.382	0.882	71

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Impact of EZ Program

	(1)	(2)	(3)	(4)	(5)	(6)
	All EZ	Obs	All EZ	Obs	LA EZ	Obs
Tract-Level Changes	*1990-2000*		*1990-2009*		*1990-2009*	
UE Rate	0.009	848	-0.025	843	0.039	71
	(0.026)		(0.024)		(0.056)	
Poverty Rate	-0.029	848	-0.079	843	-0.020	71
	(0.022)		(0.036)**		(0.020)	
Emp-Pop Ratio	0.004	849	0.049	844	-0.004	71
	(0.020)		(0.037)		(0.023)	
Log Households	-0.055	849	-0.036	843	0.011	71
	(0.051)		(0.073)		(0.106)	
Log Skill Share	0.270	847	0.269	843	0.238	71
	(0.153)*		(0.128)**		(0.339)	
Log HH Income	0.155	848	0.157	842	0.154	71
	(0.057)**		(0.073)**		(0.144)	
Log HH Income HS	0.145	847	0.103	843	0.222	71
	(0.126)		(0.093)		(0.202)	
Log HH Income LS	0.086	848	0.109	843	-0.069	71
	(0.043)*		(0.050)**		(0.047)	
Log Home Value	0.352	820	0.693	709	0.246	56
	(0.100)***		(0.157)***		(0.117)**	
Log Rent	0.006	848	0.147	690	0.107	55
	(0.050)		(0.041)***		(0.050)**	
Log Housing Share HS	0.039	847	0.072	840	0.132	71
	(0.031)		(0.035)**		(0.044)***	
Log Housing Share LS	-0.037	848	0.009	840	-0.029	71
	(0.024)		(0.023)		(0.065)	
Share Commute u10min	0.013	848	0.024	843	0.181	71
	(0.020)		(0.025)		(0.055)***	
Log Firms					0.499	71
					(0.265)**	
Log Firms Local					0.365	71
					(0.388)	
Log Firms Non-Local					0.624	71
					(0.204)***	
Log Employment					0.298	71
					(0.245)	
Share Income-elastic					0.115	71
					(0.038)***	

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Impact of EZ Program

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Less 1km from EZ	Obs	Less 5km from EZ	Obs	Less 15km from EZ	Obs	All tracts	Obs
$\Delta \log \bar{B}_{HS}$	0.106	152	0.282	564	0.539	1559	0.624	2206
	(0.114)		(0.102)***		(0.101)***		(0.101)***	
$\Delta \log \bar{B}_{LS}$	0.083	152	0.250	564	0.502	1559	0.588	2206
	(0.088)		(0.079)***		(0.078)***		(0.078)***	
Difference	0.023	152	0.032	564	0.037	1559	0.035	2206
	(0.054)		(0.050)		(0.050)		(0.050)	

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Impact of EZ Program in Data and Model

	(1)	(2)	(3)	(4)	(5)	(6)
	Data	Policy Instrument				
Policy Version		Subsidies & Amenity Shock	Subsidies	Wage Subsidy	Profit Subsidy	Amenity Shock
Log Skill Share	0.269	0.248	0.037	-0.030	0.084	0.213
	(0.128)**	(0.005)	(0.002)	(0.003)	(0.004)	(0.006)
Log HH Income HS	0.103	0.013	0.019	0.008	0.008	-0.006
	(0.093)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
Log HH Income LS	0.109	0.026	0.025	0.012	0.009	0.001
	(0.050)**	(0.002)	(0.002)	(0.001)	(0.001)	(0.000)
Log Rent	0.147	0.122	0.129	0.024	0.100	-0.007
	(0.041)***	(0.009)	(0.008)	(0.001)	(0.008)	(0.001)
Log Housing Share HS	0.072	0.052	0.054	0.009	0.043	-0.002
	(0.035)**	(0.004)	(0.003)	(0.000)	(0.004)	(0.000)
Log Housing Share LS	0.009	0.047	0.050	0.008	0.041	-0.003
	(0.023)	(0.003)	(0.003)	(0.000)	(0.003)	(0.001)
Log Firms	0.499	0.565	0.563	0.039	0.537	0.002
	(0.265)**	(0.010)	(0.009)	(0.002)	(0.008)	(0.001)
Log Firms Local	0.365	0.482	0.496	0.058	0.442	-0.014
	(0.388)	(0.009)	(0.009)	(0.002)	(0.009)	(0.001)
Log Firms Non-Local	0.624	0.657	0.639	0.020	0.637	0.021
	(0.204)***	(0.015)	(0.013)	(0.002)	(0.013)	(0.002)
Share Income-elastic	0.115	0.027	0.021	-0.005	0.028	0.006
	(0.038)***	(0.002)	(0.001)	(0.000)	(0.002)	(0.001)

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Spillovers of EZ Program in Model

	(1)	(2)	(3)	(4)	(5)
Treatment	EZ	less 1km from EZ	1-2.5km from EZ	2.5-5km from EZ	Log Distance from EZ
Log Skill Share	0.248	0.096	0.037	0.014	-0.019
	(0.005)	(0.004)	(0.002)	(0.001)	(0.001)
Log HH Income HS	0.013	0.003	0.002	0.001	-0.001
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Log HH Income LS	0.026	0.005	0.003	0.002	-0.001
	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Log Price Index HS	0.020	-0.002	0.000	0.001	0.000
	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Log Price Index LS	0.030	-0.002	0.001	0.001	0.000
	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Log Firms	0.565	-0.005	-0.007	-0.005	0.002
	(0.010)	(0.001)	(0.000)	(0.000)	(0.000)
Log Firms Local	0.482	-0.049	-0.021	-0.008	0.010
	(0.009)	(0.003)	(0.001)	(0.000)	(0.000)
Log Firms Non-Local	0.657	0.052	0.011	-0.003	-0.008
	(0.015)	(0.004)	(0.001)	(0.001)	(0.001)
Share Income-elastic	0.027	0.017	0.005	0.001	-0.003
	(0.002)	(0.001)	(0.000)	(0.000)	(0.000)

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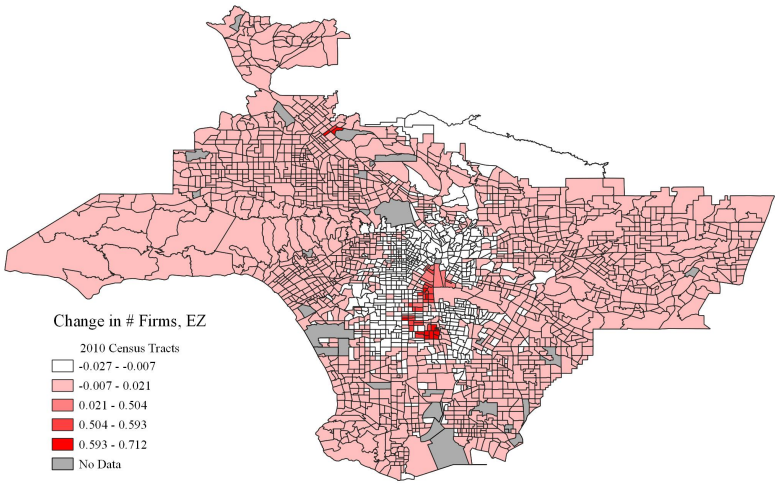
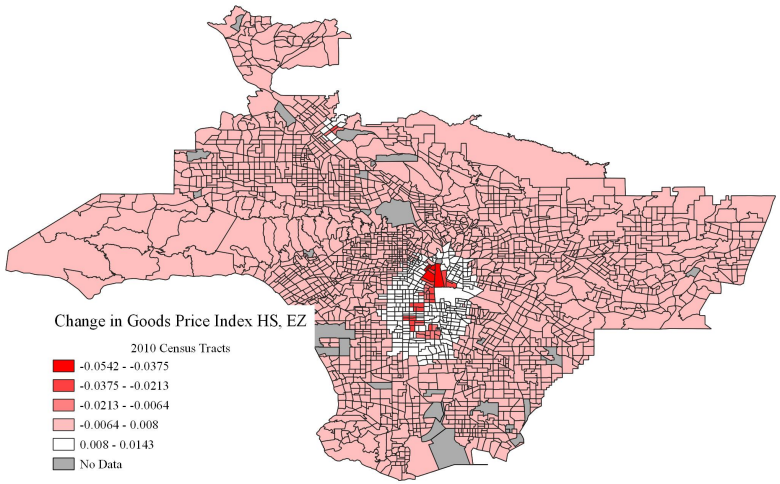
Spillovers of EZ Program in Model





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