Land value gradients and the level and growth of housing prices

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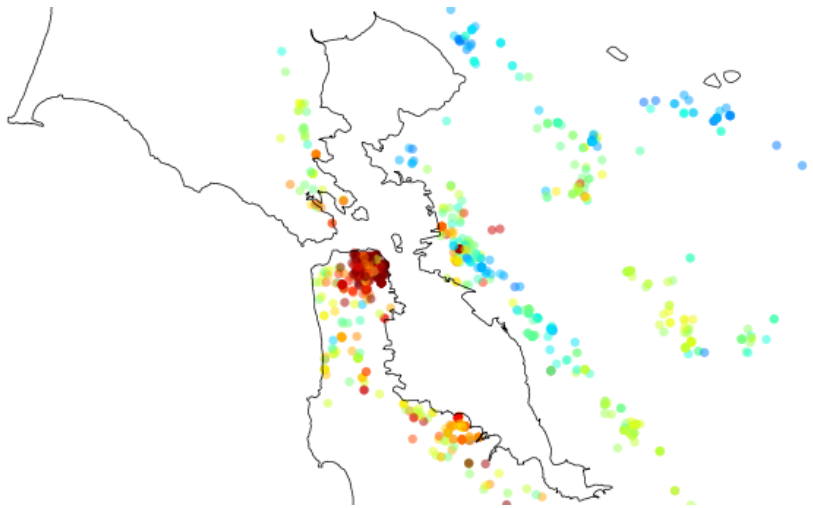


Introduction

- Coastal cities do better than others — why is this?
- Introduce a new measure: gradient of rents
- Important, but does not explain away coastal advantage

Why do coastal cities do well?

Quantile	Price		Rent	
	Non-Coastal	Coastal	Non-coastal	Coastal
Min	-2.1	0.1	0.1	0.9
25th	-0.9	0.8	0.8	1.4
50th	-0.6	1.2	1.0	1.4
75th	-0.1	1.6	1.3	1.5
Max	2.1	2.5	1.8	1.7

Growth since 1980: coastal California and Acela corridor win by far

Constrained vs unconstrained?

(a) San Francisco: highly constrained, steady price increase

(b) Atlanta: less constrained, less price growth

Previous literature

- **Limits on supply due to regulations, geography**
  Malpezzi (1996), Green, Malpezzi, and Mayo (2005), Saiz (2010), Glaeser, Gyourko, and Saks (2005)
  - Wharton Residential Land Use Regulatory Index
  - Share of unbuildable land

- **Higher productivity growth**
  Moretti (2013), Diamond (2013)
  - Bartik shock

- Explanations likely correlated due to amenities, migration, other spillovers (Davidoff (2015))

What does this really measure?

- Trying to compare very different cities
  - Supply constraints and productivity
  - Amenities and governance
  - Demographics and politics
- Attempts to explain differences: reverse-engineering?
- Ideally want factors that are not just predictive but explain away coastal vs non-coastal difference

New gradient-based measure

Intuition: cities with steeper rent gradient less substitutable

$$\vec{\nabla} f(x, y) = \left(\frac{\partial f}{\partial x}, \frac{\partial f}{\partial y} \right)$$

- Gradient picks out rate of change of rent along direction of steepest ascent — we calculate a representative value for whole city
- High gradient: strong locational premium, more price response to demand
- Endogenous to prices, includes both supply and demand components (like other measures in literature)

Agenda for this paper

1. Define kernel-based estimator for gradient

2. Calculate gradient measures using one-bedroom apartment rent, spatial density of Starbucks outlets

3. Regress price growth, rent, price-rent ratio on gradient measures, canonical measures from literature

Preview of results: strong effect, but not enough to explain coastal outperformance

Gradient measure

- At location (x, y), underlying rent $g(x, y)$ (gradient $\vec{\nabla} g(x, y)$)

- Define $\bar{g}$ as root mean square gradient over entire city:

$$\bar{g} = \sqrt{\frac{1}{|\mathcal{A}|} \iint_{\mathcal{A}} \left(\vec{\nabla} g(x, y) \right)^2 \, \mathrm{d}y \, \mathrm{d}x}$$

Calculating the gradient

- Observe collection of values (x_i, y_i, r_i) for each city
- Get gradient from kernel estimator based on Fukunaga and Hostetler (1975)
- Three-step process:
  1. Get gradient at observation points
  2. Interpolate to intermediate values
  3. Average over metro area
- Sensitive to bandwidth — follow Horová, Koláček and Vopatová (2012)

Alternative: monocentric measure

- Gradient measure average over entire city, not just downtown — nice for polycentric cities, but is this what matters?
- Also try alternate measure: **hazard of Starbucks locations** as function of distance from city centre
- If results driven by monocentric decay, this would capture it

Data sources

Gradients: rent and Starbucks

- One-bedroom apartment rents from Craigslist
- Starbucks locations from company website

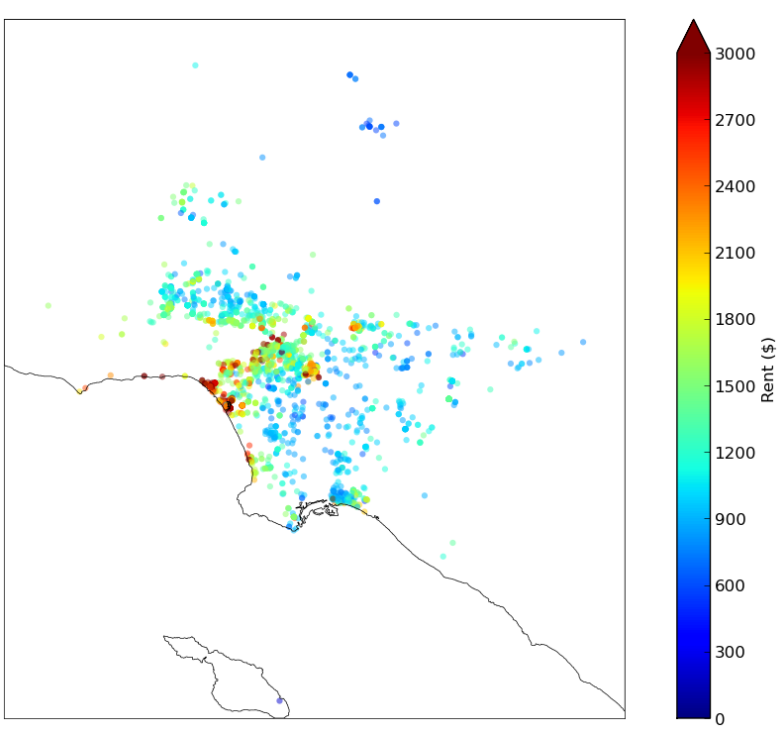
Other variables: price, rent, covariates

- Current, long-run prices from Zillow, FHFA
- WRLURI, unusable share from Gyourko et al. (2008), Saiz (2010)
- Bartik shock 2000–2010 from American Community Survey

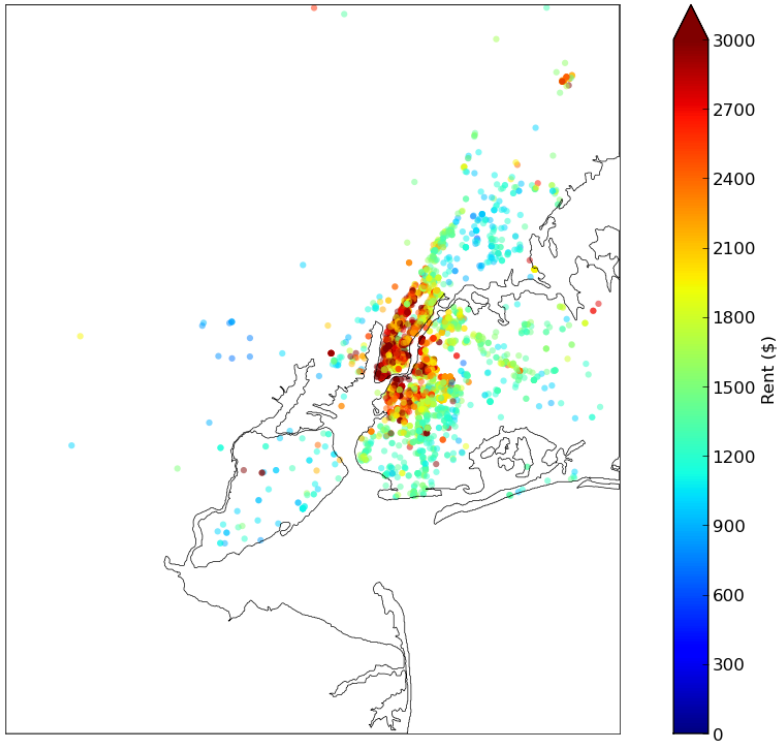
Why Starbucks locations?

- Using Starbucks as proxy for **high-rent commercial locations**
- Very high revenue per square foot, non-franchised — can therefore outbid
- Qualitatively appears to be highly correlated with dense commercial districts, downtown centres
- Many locations in all large cities, all locations known

Craigslist data

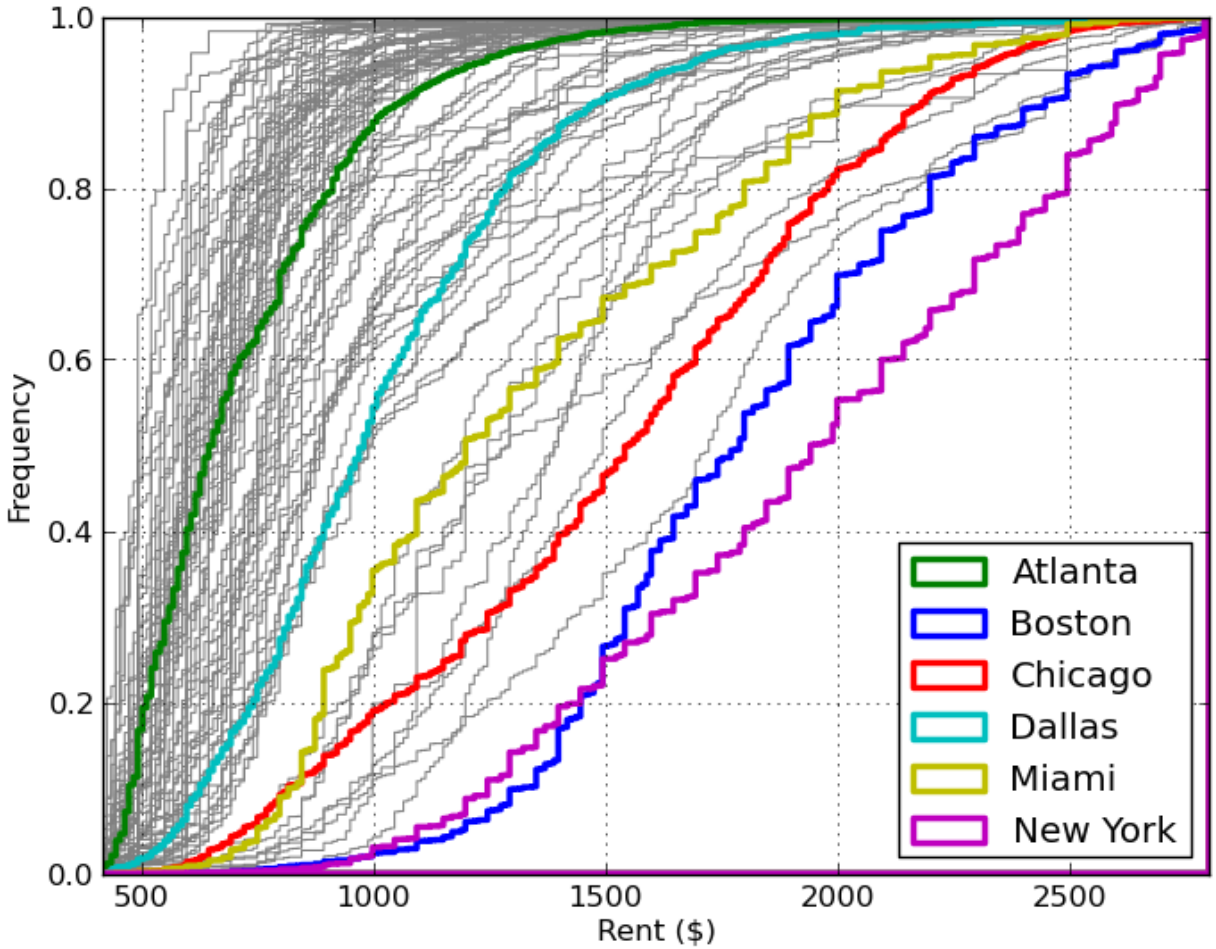


(a) Los Angeles

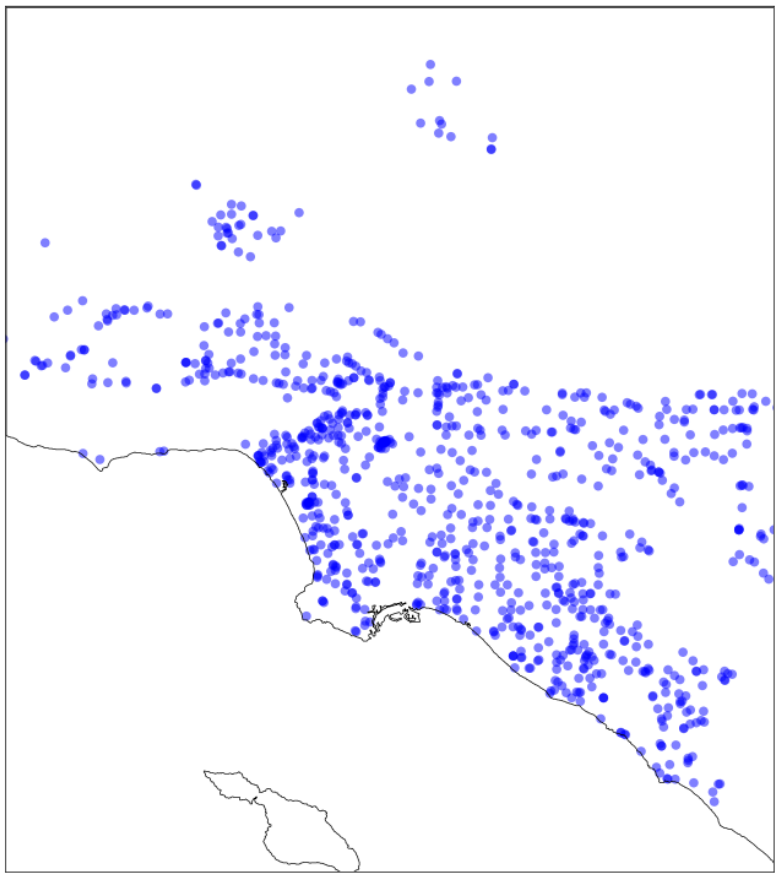


(b) New York

One-bedroom rent distribution



Starbucks data



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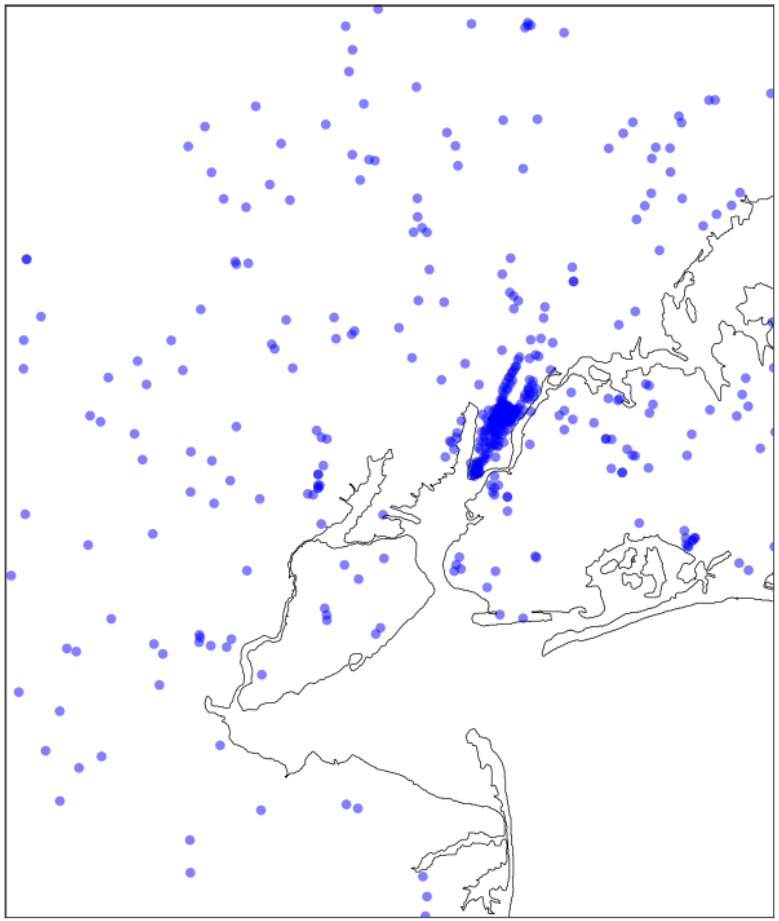
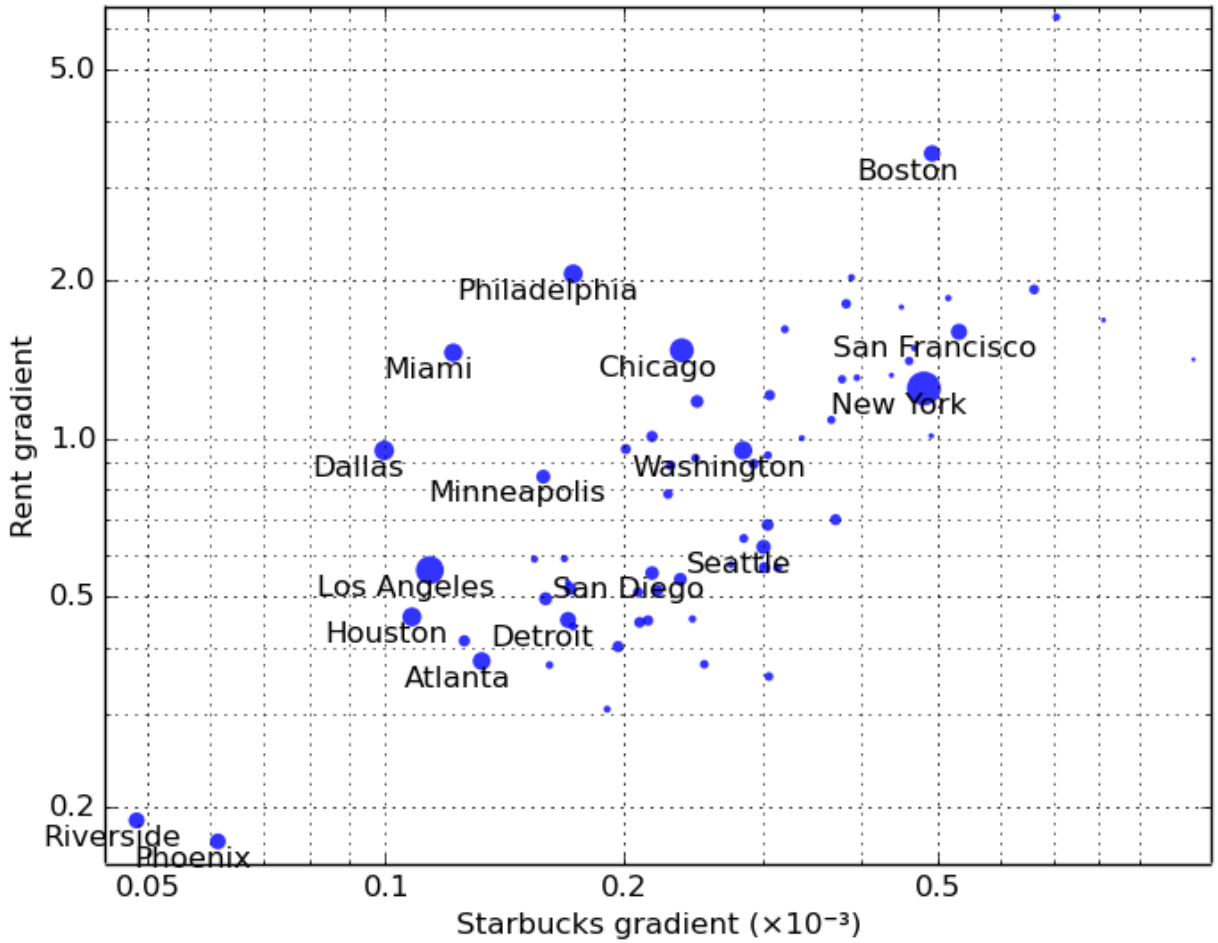


(b) New York

Gradient values



Highly correlated measures

	Rent grad	Unusable land	WRLURI	Coastal	Dem lean	Grad degrees
Starbucks grad	0.71	0.20	0.20	0.17	0.48	0.42
Rent grad		0.32	0.35	0.27	0.47	0.40
Unusable land			0.37	0.38	0.38	0.42
WRLURI				0.43	0.48	0.56
Coastal					0.47	0.49
Dem lean						0.71

All highly correlated with each other (and coastal indicator)

Regression plan

- Regression long-term price growth, current rent, price-rent ratio on factors impacting price growth:
  - Rent and Starbucks gradients
  - WRLURI and unusable land
  - Employment Bartik shock
- Unit of observation: MSA-bedroom pair, clustered at MSA
- Other heterogeneity: scale, property taxes, bedroom$\times$square footage

Current housing rent

Intercept	−4.842	−2.726	−2.379	−1.387
	(4.835)	(5.373)	(3.428)	(3.294)
Bartik shock	0.149	0.558***	0.240**	0.141
	(0.158)	(0.153)	(0.107)	(0.136)
WRLURI	0.190***			0.121*
	(0.059)			(0.067)
Unusable land	0.072*			0.043
	(0.037)			(0.037)
Starbucks gradient		0.291***		0.047
		(0.038)		(0.038)
Rent gradient			0.322***	0.221***
			(0.041)	(0.053)
Num. obs.	243	277	264	240
Adj. R^2	0.555	0.592	0.656	0.66

Price-rent ratio

Intercept	−0.001	7.687***	7.862	6.237
	(4.548)	(2.549)	(4.873)	(4.132)
Bartik shock	−0.058	0.220*	−0.031	−0.012
	(0.138)	(0.120)	(0.097)	(0.140)
WRLURI	0.050			0.043
	(0.040)			(0.044)
Unusable land	0.031			0.022
	(0.030)			(0.034)
Starbucks gradient		0.129***		0.112**
		(0.022)		(0.048)
Rent gradient			0.120***	0.017
			(0.038)	(0.051)
Num. obs.	218	251	242	218
Adj. R^2	0.347	0.44	0.412	0.449

Housing prices since 1980

Intercept	-0.6988	0.6436	0.6778	0.5278
	(0.5219)	(0.7533)	(0.7775)	(0.6381)
Bartik shock	0.0506	0.4868	0.4573	0.0214
	(0.3454)	(0.3647)	(0.3948)	(0.324)
January temp.	-0.0002	0.0029	0.0031	0.0005
	(0.0025)	(0.0026)	(0.0027)	(0.0024)
WRLURI	0.1736**			0.1435**
	(0.0368)			(0.036)
Unusable land	0.4897**			0.3748**
	(0.1372)			(0.1342)
Starbucks gradient		0.2773**	0.2758**	0.1644**
		(0.059)	(0.06)	(0.0549)
Starbucks decay			-0.2008	
			(0.9769)	
Num. obs.	58	59	58	57
Adj. R^2	0.52	0.41	0.40	0.58

Role of gradients

- Gradient measures matter to cross-city price differences
- Cities with steeper gradients have higher prices, faster growth, bigger response — more constrained
- Add indicator for coastal cities: have we explained away difference?

Current housing rent

Intercept	−2.573	−6.151*	−8.851**
	(2.712)	(3.682)	(3.949)
Bartik shock	0.307**	0.186	0.211
	(0.131)	(0.143)	(0.153)
WRLURI		0.113*	0.087
		(0.058)	(0.082)
Unusable land		0.034	0.060
		(0.035)	(0.039)
Starbucks gradient			0.103***
			(0.035)
Coastal	0.533***	0.425***	0.265***
	(0.066)	(0.078)	(0.072)
Num. obs.	277	243	243
Adj. R^2	0.58	0.609	0.643

Price-rent ratio

Intercept	7.024^{***}	-1.487	0.226
	(1.690)	(3.609)	(3.283)
Bartik shock	0.024	-0.032	-0.010
	(0.097)	(0.110)	(0.115)
WRLURI		-0.019	-0.054
		(0.033)	(0.046)
Unusable land		0.001	0.032
		(0.027)	(0.027)
Starbucks gradient			-0.018
			(0.041)
Coastal	0.308^{***}	0.363^{***}	0.368^{***}
	(0.059)	(0.063)	(0.056)
Num. obs.	251	218	218
Adj. R^2	0.501	0.497	0.468

Housing prices since 1980

Intercept	-0.8595*	0.0535
	(0.4621)	(0.552)
Bartik shock	0.3987	0.0442
	(0.2986)	(0.2757)
January temp.	0.001	0.000
	(0.0021)	(0.002)
WRLURI		0.1035**
		(0.0317)
Unusable land		0.2511*
		(0.1171)
Starbucks gradient		0.0701
		(0.0507)
Coastal	0.4928**	0.3259**
	(0.0628)	(0.0684)
Num. obs.	59	56
Adj. R^2	0.61	0.70

Discussion and interpretation

- Land rent gradients do matter, even conditional on coastal status
- Highly correlated with other measures, but dominates in regressions
- New measure can be widely generalized (given spatially fine data)
- Still cannot explain away coastal status gap

Further research

- Technical aspects: density-weighted gradient, bandwidth selection
- Data on commercial rents, density, other very local measures of underlying land value
- Longer-term: how to explain gradients?