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Moving Toward Equitable Transit-Oriented Developments by Integrating Transit and Housing

Hongwei Dong
California State University, Fresno

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Hongwei Dong, Ph.D.

Department of Geography and City & Regional Planning

California State University, Fresno

hdong@csufresno.edu

This study is preliminary and has not been peer-reviewed. Please do NOT cite.

About Myself

- Associate Professor

  - Department of Geography and Planning at California State University Fresno (2011-present)

  - Research interests: housing and real estate, transportation and land use, & healthy cities

- Ph.D. in Urban Studies from the Toulan School at PSU (2005-10)

  - Selected my research area after attending a Friday Transportation Seminar talk by Brian Gregor (ODOT research staff) in 2008

  - Dissertation: developed a housing supply model to test Portland's smart growth policies (Part of a larger Integrated Transportation and Land Use Forecast Model)

About Myself

❑ Maintained my interest in Portland's urban growth and housing market while working in California

- Dong, Hongwei. (forthcoming). Higher-density development for lower-cost housing? Understanding the multifamily housing market and the role of density in multifamily home prices. *Journal of Planning Education and Research*.

- Dong, Hongwei, and J. Andrew Hansz. 2019. Zoning, density, and rising housing prices: A case study in Portland, Oregon. *Urban Studies*, 56(16): 3486-3503

- Dong, Hongwei. 2017. Transit induced neighborhood change and the affordability paradox of TOD. *Journal of Transport Geography*, 63, 1-10.

- Dong, Hongwei. 2016. If you build rail transit in suburbs, will development come? *Journal of the American Planning Association*, 82(4): 316-326.

My research on Portland's TOD and Gentrification

❑ Dong, Hongwei. 2017. Transit induced neighborhood change and the affordability paradox of TOD. *Journal of Transport Geography*, 63, 1-10.

➢ A longitudinal quasi-experimental design to examine five rail transit lines in suburban Portland and gentrification .

Table 1
Number of suburban neighborhoods served by rail transit in Portland.

Rail transit lines open before 2010	Open	# of suburban neighborhoods served (in Census years)			
		1990	2000	2005–2009	2010–2014
Eastside	1986	58			
Westside	1998	0	39		
Airport	2001	0		30	
Interstate	2004				
I-205	2009	0			35
WES	2009				

Note: Streetcar and the transit mall opened in 2000 are not considered because they mainly serves downtown Portland.

Fig. 1. Longitudinal quasi-experimental design.
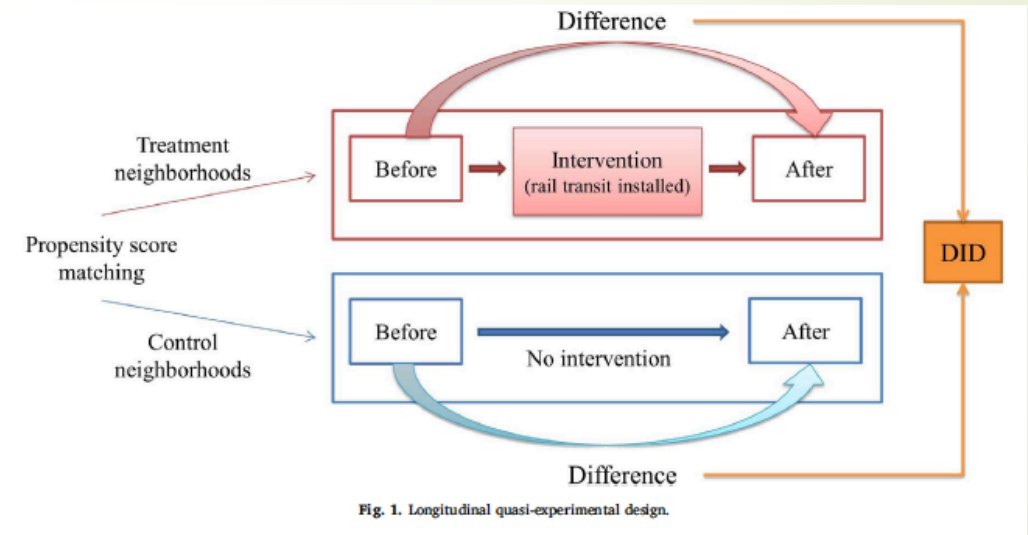
My research on Portland's TOD and Gentrification

❑ Major findings from this study

➢ No consistent evidence for rail-transit-induced gentrification in suburban Portland.

➢ No evidence that rail transit reduced home affordability

➢ More changes in the neighborhoods served by the Eastside line (the oldest)

▪ Attracted older and less-educated population

▪ Experienced densification and faster increases of the share of rental units

➢ Rail transit was more likely to be installed along low-income suburban neighborhoods

Outline

Background: TOD

❑ Transit-oriented development (TOD)

➢ Centered on transit (mainly rail transit)

➢ Walkable and compact neighborhoods

- Higher density

- Mixed land use

- Walkability
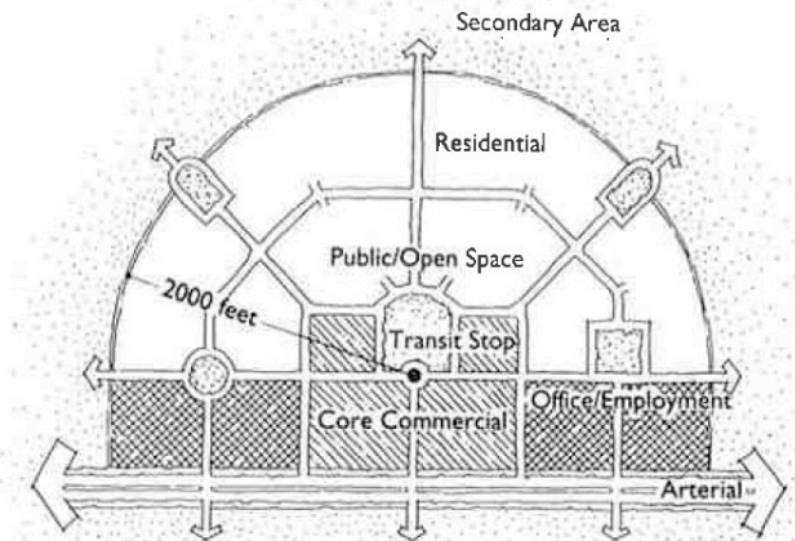
Transit-oriented development (TOD)
Source: The Next American Metropolis: Ecology, Community, and the American Dream by Peter Calthorpe (1993)

Background: Connecting Transit with Housing

❑ Alleviate California's housing affordability crisis via TOD?

❑ Proposed SB50: upzoning near transit and jobs

➢ Cities required to allow apartment buildings:

- within a 1/2-mile of a rail transit station;

- within a 1/4-mile of a high-frequency bus stop; or

- within a "job-rich" neighborhood.

➢ Upzone to allow buildings to be 45/55 feet tall

➢ Reduce parking requirement significantly

Senator Wiener Introduces Zoning Reform Bill to Allow More Housing Near Public Transportation and Job Centers

Scott Wiener Follow
Dec 4, 2018 · 8 min read

Senate Bill 50 — modeled on SB 827 of the last legislative session — legalizes more housing near job centers and public transportation by overriding hyper-restrictive low-density zoning, while protecting against displacement of renters and vulnerable communities

Source: https://medium.com/@Scott_Wiener/senator-wiener-introduces-zoning-reform-bill-to-allows-more-housing-near-public-transportation-and-3fb77b794004

Background: Connecting Transit with Housing

❑ SB50 has been very controversial

➤ Wealthy home owners: NIYMBY

➤ Low-income tenants: gentrification

The Last Days of SB50, California's Doomed Upzoning Bill

LAURA BLISS   JANUARY 30, 2020

Senate Bill 50, the transit-housing legislation championed as a market-based response to the affordability crisis, will not become law.

[f] SHARE   [tw] TWEET   ...

A controversial bill promoting higher-density housing near transit stops was defeated in a vote by California's state senate on Thursday. State Bill 50—whose multi-year journey through the state's lawmaking machinery has been closely watched by housing and transit advocates nationwide—fell three votes short of heading to the desk of Governor Gavin Newsom.

Source: https://www.citylab.com/equity/2020/01/california-sb50-vote-affordable-housing-zoning-law-transit/605767/

Efforts to build housing around transit threaten to price out those most dependent on bus and rail

BREAKING ›

Inside two hours, six people overdosed in four San Diego incidents. Three died

Fentanyl played a role in at least three of Tuesday's incidents

April 3, 2020

Woman, 62, dies after her SUV rolls over her in San Diego

Police said the driver apparently failed to shift her Toyota Highlander all the way into park Friday morning along Carmel Valley Road

April 3, 2020

A San Diego Metropolitan Transit System trolley stops at the corner of Park Boulevard and Market Street in the East Village, where expensive apartment buildings and condominiums stand in stark contrast to the neighborhood's economically challenged residents. (Howard Lipin / San Diego Union-Tribune)

Source: https://www.sandiegouniontribune.com/news/environment/sd-me-transit-gentrification-20180517-story.html

Literature: Connecting Transit with Housing

❑ Property-value effects of rail transit

➢ A well studied topic: housing transaction data are readily available

➢ Majority of studies found significant and positive impacts

▪ Benefit property owners

▪ Justify the high cost of rail transit

• Greater property tax base

• More tax revenues for local governments

Literature: Connecting Transit with Housing

❑ How about renters? Do they benefit from TOD?

➢ A understudied topic: rent data are harder to obtain

➢ Equity implications:

▪ TOD premium is a burden instead of a benefit

▪ Renters have lower income and more housing-burdened

▪ Gentrification and displacement

Research Question

❑ Today's presentation focuses on the impacts of TOD on rents

❑ **Question 1:** How much more do Californian renters have to pay to live in TODs?

❑ **Question 2**: Does TOD rent premium vary:

➢ Renters in different metro areas in California

➢ Different dwelling sizes (studio, 1 bedroom, 2 bedroom, 3+ bedroom)

➢ Different TOD types (urban TOD, suburban TOD, & TAD)

Study Area

- ❑ Rail transit stations in eight Californian metropolitan areas
  - ➢ 708 rail transit stations
    - ▪ Removed two funicular stations and 12 airport rail link stations
  - ➢ Use 694 rail transit stations for this analysis
    - ▪ San Francisco: 281
    - ▪ Los Angles: 148
    - ▪ San Diego: 83
    - ▪ San Jose: 84
    - ▪ Sacramento: 54
    - ▪ Riverside (Inland Empire): 33
    - ▪ Santa Rosa (Sonoma County): 6
    - ▪ Oxnard (Ventura County): 5

Data & Measurement

❑ Data sources

➢ Rent: Craigslist.com

➢ Rail transit: Transit Explorer 2 (thetransportpolitic.com)

➢ Neighborhood social & built environments:

▪ American Community Survey (ACS) 2014-18

▪ Longitudinal Employer-Household Dynamics (LEHD 2017)

➢ Boundary and road: Census TIGER

Data & Measurement

❑ Craigslist rent data:

➢ Scraped 12/27/2019 – 01/31/2020

➢ Non-traditional data: may not be representative

▪ Over-represent whiter, wealthier, and better-educated communities/groups

➢ Advantages of Craigslist data

▪ Crowd-sourced: comprehensive, large & free

▪ More current than traditional data set (ACS & AHS)

▪ Available at fine spatial scale (point level)

▪ Richer information about the spot market

Boeing, G., & Waddell, P. (2017). New insights into rental housing markets across the United States: Web scraping and analyzing Craigslist rental listings. *Journal of Planning Education and Research,* 37(4): 457-476.
Boeing, G. (2019). Online rental housing market representation and the digital reproduction of urban inequality. *EPA: Economy and Space*, advanced online publication.
Boeing, G, Wegmann, G., & Jiao J. (2020) Rental housing spot markets: how online information exchanges can supplement transacted-rents data. *Journal of Planning Education and Research*, advanced online publication.

Data & Measurement

❑ Craigslist rent data are messy

➢ Many duplicates

▪ Landlords re-post/update their listings every few days to maintain visibility

➢ Inaccurate/incomplete addresses information

❑ Data cleaning is very time-consuming and tedious

➢ 80% time on data cleaning & 20% time on data analysis

❑ This analysis

➢ 370,013 listings scraped

➢ 73,775 used for analysis

Data & Measurement

❑ Median rent: Craigslist over-represents higher-end rental units

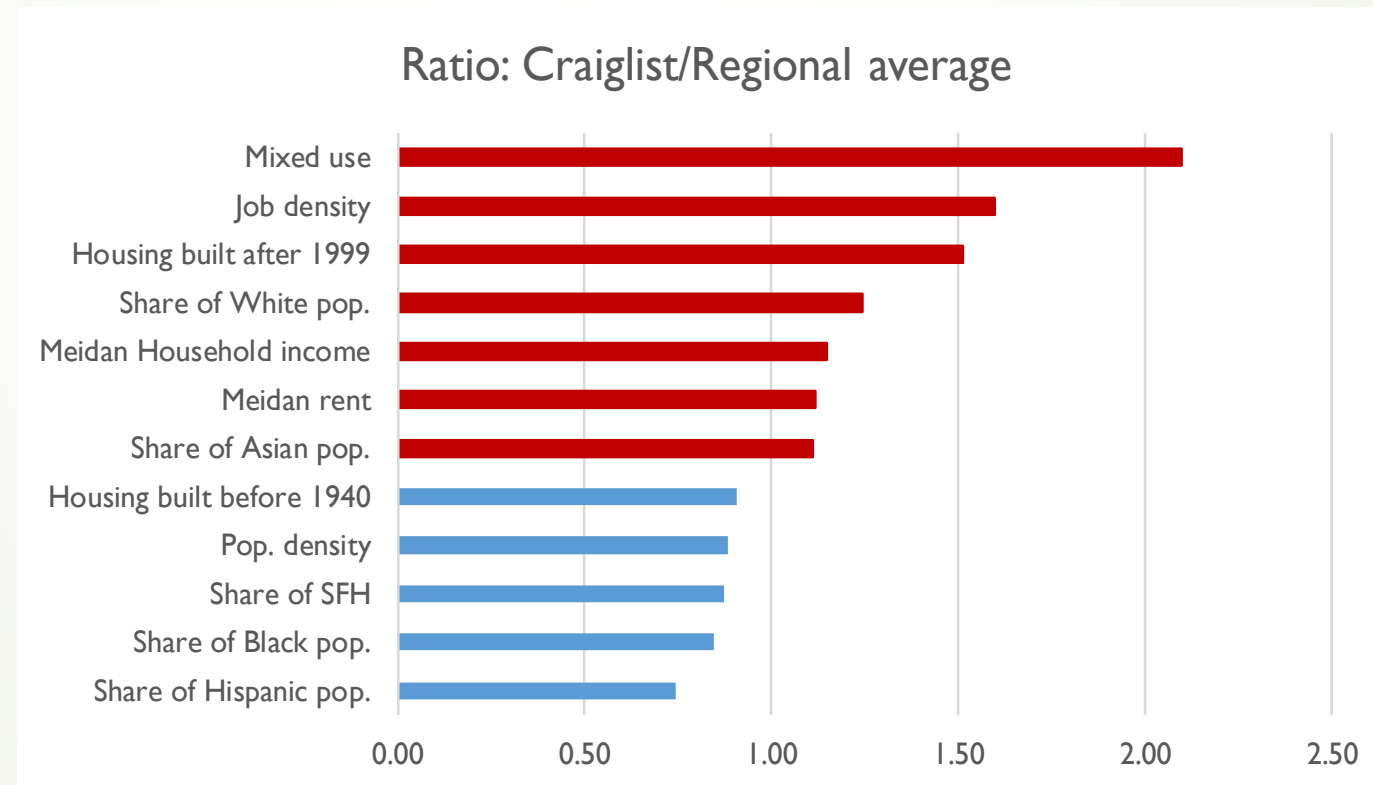| Metro	Craigslist Jan. 2020	ACS 2014-18	AHS 2017
San Francisco	$2,850	$1,687	$1,900
Los Angeles	$2,160	$1,363	$1,400
San Diego	$2,020	$1,465	n.a.
San Jose	$2,850	$1,996	$2,200
Sacramento	$1,599	$1,084	n.a.
Riverside	$1,652	$1,119	$1,100
Oxnard	$2,150	$1,595	n.a.
Santa Rosa	$2,227	$1,412	n.a.

Data & Measurement

❑ Dwelling size: Craigslist over-represents units with one-bedroom but under-represents units with 3+ bedrooms

Metro	Size	Craigslist (%)	ACS 2014-18 (%)	AHS 2017 (%)
San Francisco	studio	10.0	11.7	7.2
	1 bedroom	39.1	30.7	34.8
	2 bedrooms	35.3	34.7	35.6
	3+ bedrooms	15.6	22.9	22.4
Los Angeles	studio	10.6	10.2	5.5
	1 bedroom	39.4	31.1	35.8
	2 bedrooms	37.8	38.3	39.2
	3+ bedrooms	12.2	20.5	19.5
San Jose	studio	6.0	7.8	3.0
	1 bedroom	37.8	27.7	31.0
	2 bedrooms	39.6	37.5	37.5
	3+ bedrooms	16.6	27.1	28.5
Sacramento	studio	3.4	4.2	1.1
	1 bedroom	29.0	22.8	16.9
	2 bedrooms	40.8	38.0	40.9
	3+ bedrooms	26.8	35.0	41.1
San Diego	studio	6.3	6.1	N/A
	1 bedroom	32.5	25.1	
	2 bedrooms	43.4	42.0	
	3+ bedrooms	17.8	26.8	

Data & Measurement

❑ Neighborhood: Craigslist listings tend to be in neighborhoods with more jobs, newer homes, Whites & Asians, and higher income.

Ratio: Craiglist/Regional average

	Ratio
Mixed use	2.10
Job density	1.60
Housing built after 1999	1.50
Share of White pop.	1.25
Meidan Household income	1.15
Meidan rent	1.10
Share of Asian pop.	1.10
Housing built before 1940	0.90
Pop. density	0.88
Share of SFH	0.88
Share of Black pop.	0.85
Share of Hispanic pop.	0.72

Data & Measurement

❑ Measuring TOD: within 0.5-mile *street network distance*

➢ TOD (treated) units: rental units within 0-0.5 mile (yellow area)

➢ Non-TOD (control) units: rental units > 1.0 mile (outside of blue area)


Legend:
- ⊛ Rail transit station
- —— Half-mile street network
- —— Local streets within one-mile circle
- ⬚ Half-mile circle
- ☐ One-mile circle
- 🟨 Half-mile network buffer
- 🟦 One-mile network buffer
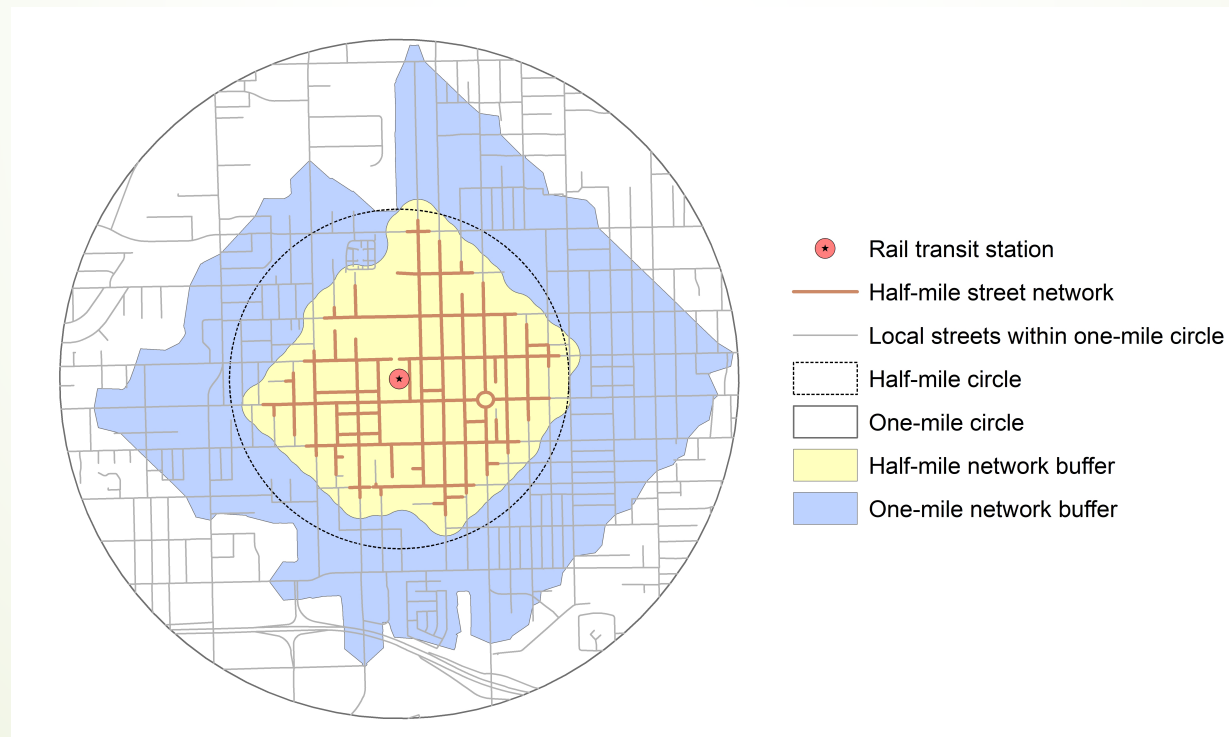
Method: Why Use PSM?

❑ Three potential approaches to tease out the effect of TOD on rents

  ➢ OLS hedonic model does not address two critical issues

    ▪ Spatial autocorrelation

    ▪ Self-selection

  ➢ Spatial regression model (spatial lag, spatial error, & Durbin/mixed)

    ▪ Assumes the spatial relationship is known

    ▪ Does not address the self-selection problem

  ➢ Propensity score matching (PSM)

Method: Why Use PSM?

❑ I adopt the propensity score matching (PSM) method
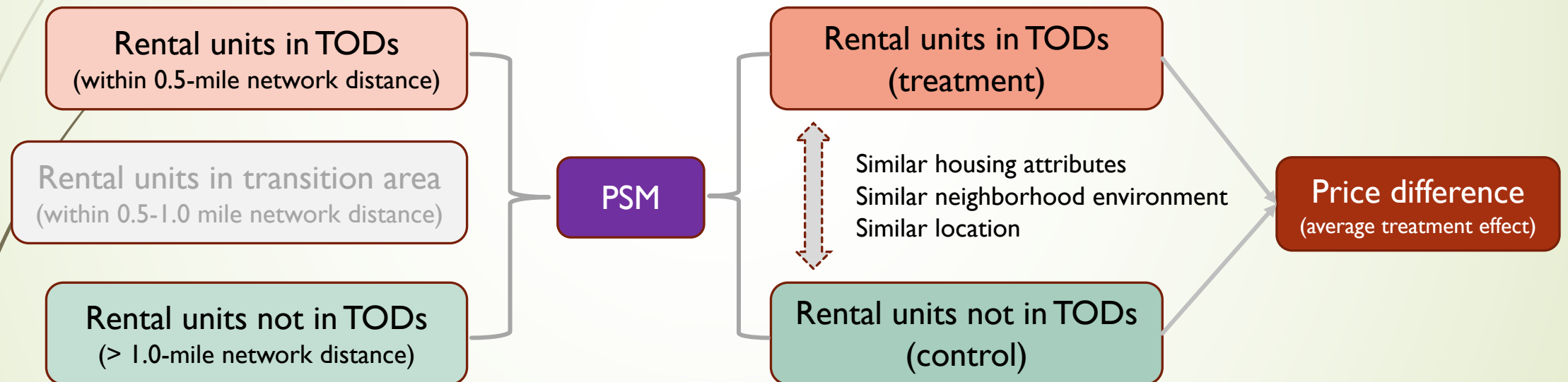
Method: Why Use PSM?

❑ Why use propensity score matching (PSM)?

  ➢ Address the self-selection bias by identifying a control group

  ➢ Spatial autocorrelation is not a concern

  ➢ Study design is determined before analysis, like randomized controlled trial

Method: PSM

❑ PSM: allow replacement or not?

➢ Without replacement:

- One untreated case can be used only *once* as a control case

- Higher-quality matching but some treated cases may not be matched

➢ With replacement:

- One untreated case can be used as a control for *multiple* treated cases

- Lower-quality matching but almost all treated cases can be matched

Analysis: Identify Control Cases

❑ In the following, I will report the results from PSM *without* replacement because of their higher quality of matching

❑ Not every TOD rental unit can be matched with a control unit when replacement is not allowed

	Matched without replacement		Matched with replacement	
	Treated	Control	Treated	Control
All	**12,863**	28,134	**12,863**	28,134
Matched	**7,446**	7,446	**12,863**	**6,097**
Unmatched	**5,417**	30,688	0	32,037
Treated = TOD rental units; control = non-TOD rental units				

Method: PSM

❑ Control variables (covariates in PSM)

➢ Housing attributes (bedroom, bathroom, building structure)

➢ Neighborhood environment

  ▪ Land use: activity density (pop. & job) & mixed land-use

  ▪ Housing stock: shares of rental units, share of single-family homes, & age (new homes built since 2000, & old homes built before 1940)

  ▪ Social environment: median household income & shares of Black and Hispanic pop.

➢ Location: distance to CBD & specific metropolitan area

Method: PSM

❑ Balance diagnostics: how similar are treatment and control groups?

➢ **Paired t-tests**: compare their mean values

- Widely used in literature

- Problem: sensitive to sample size (larger sample size becomes a "disadvantage"?)

➢ **Standardized difference** (Austin 2011)

- Not sensitive to sample size

- Standardized difference <0.1 indicates negligible difference

➢ **Variance ratio**: compare distribution (Austin 2011)

Austin, P.C. (2011). An introduction to propensity score methods for reducing the effects of confounding in observational studies. Multivariate Behavioral Research, 46: 399-424.

Analysis: Identify Control Cases

❑ The covariates of the treatment and control groups (7,446 pairs) are well balanced

	Mean value: TOD units	Mean value: non-TOD units	Mean difference	Standardized mean difference
Bedroom	1.50	1.51	-0.01	-0.011
Bathroom	1.36	1.36	-0.01	-0.019
Neighborhood environment:				
Activity density (pops & jobs per acre)	41.22	38.50	2.72	0.002
Mixed land use	0.33	0.32	0.01	0.022
Median household income ($1000)	77.50	77.86	-0.36	0.000
Share of Black pop. (%)	6.46	6.32	0.15	0.002
Share of Hispanic pop. (%)	27.64	27.41	0.23	0.000
Neighborhood housing stock:				
Share of SFHs (%)	26.52	28.31	-1.79	-0.003
Share of rental housing (%)	74.55	72.97	1.58	0.004
Share of housing built since 2000 (%)	20.86	22.06	-1.20	-0.002
Share of housing built before 1940 (%)	16.59	14.84	1.75	0.004
Location:				
distance to CBD	10.96	11.71	-0.74	-0.008
In Los Angeles (yes=1)	0.33	0.34	0.00	-0.009
In San Francisco (yes=1)	0.25	0.23	0.02	0.048
In San Jose (yes=1)	0.11	0.10	0.01	0.042
In San Diego (yes=1)	0.17	0.20	-0.02	-0.061
In Sacramento (yes=1)	0.08	0.07	0.01	0.022

Analysis: Identify Control Cases

❑ What types of TOD units were not matched when replacement is not allowed?

➢ In neighborhoods with higher levels of density and mixed use

➢ In neighborhoods with newer and older housing
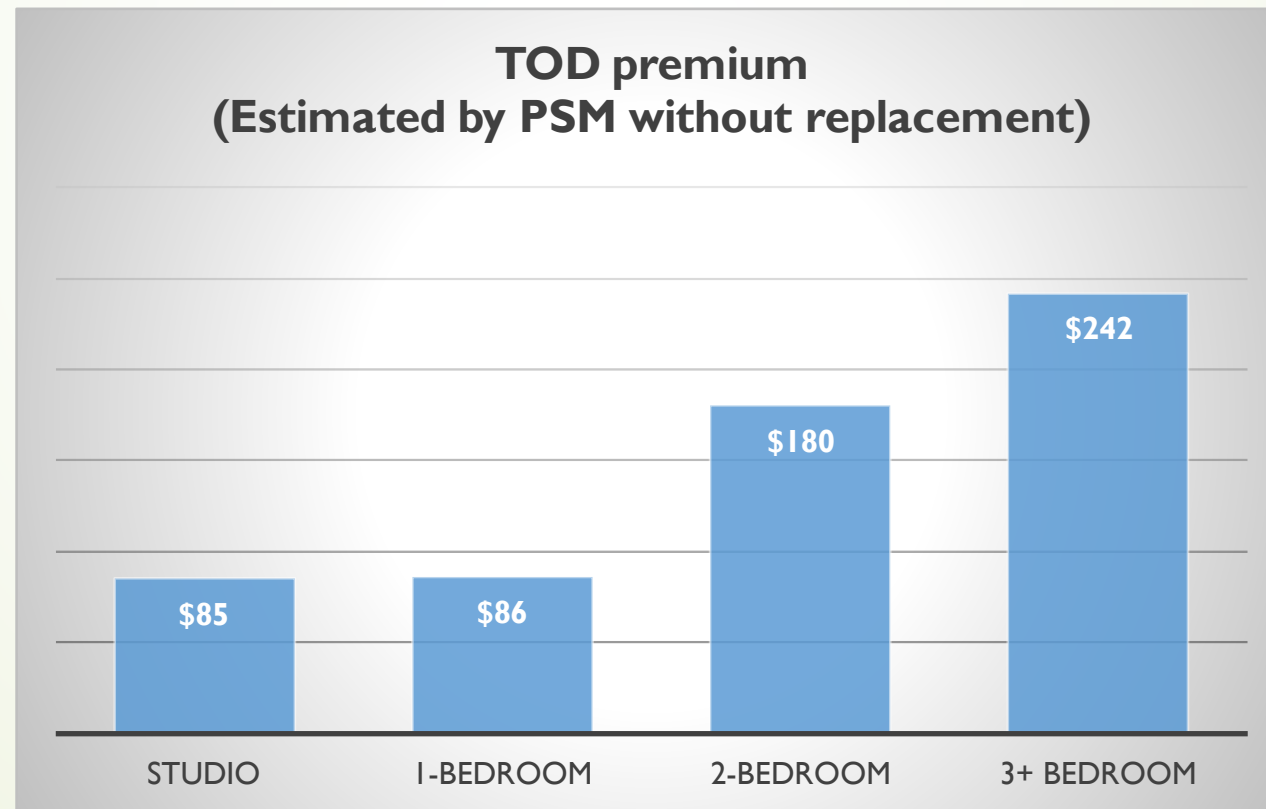
➢ Closer to CBD

➢ In San Francisco
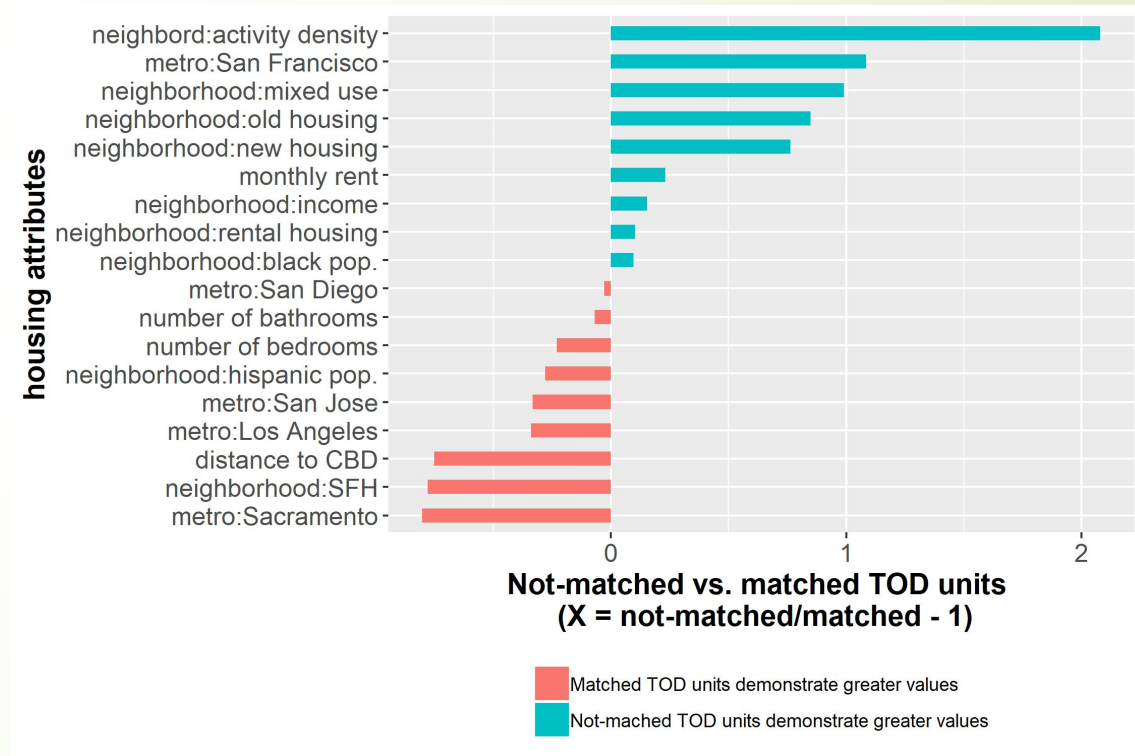
Finding: TOD Rent Premium in CA

❑ TOD premium in California: $127

	Matched without replacement	
	TOD units (treated)	Non-TOD units (control)
N	7,446	7,446
Mean monthly rent	$2,545	$2,418
TOD premium	**$127** (5.3%)	
**statistically significant at the 1% level		

Finding: TOD Rent Premium by Dwelling Size

❑ TOD premiums are higher for rental units of larger sizes

➢ Studio 4.6%; 1-bedroom: 4.0%; 2-bedroom: 6.8%; 3-bedroom: 7.6%

TOD premium
(Estimated by PSM without replacement)

$85	$86	$180	$242
STUDIO	1-BEDROOM	2-BEDROOM	3+ BEDROOM

Finding: TOD Rent Premium by TOD Types

❑ Group **694** rail transit stations into **3** clusters (via cluster analysis)

  ➢ Urban TOD,

  ➢ Suburban TOD, &

  ➢ TAD (transit-adjacent development)

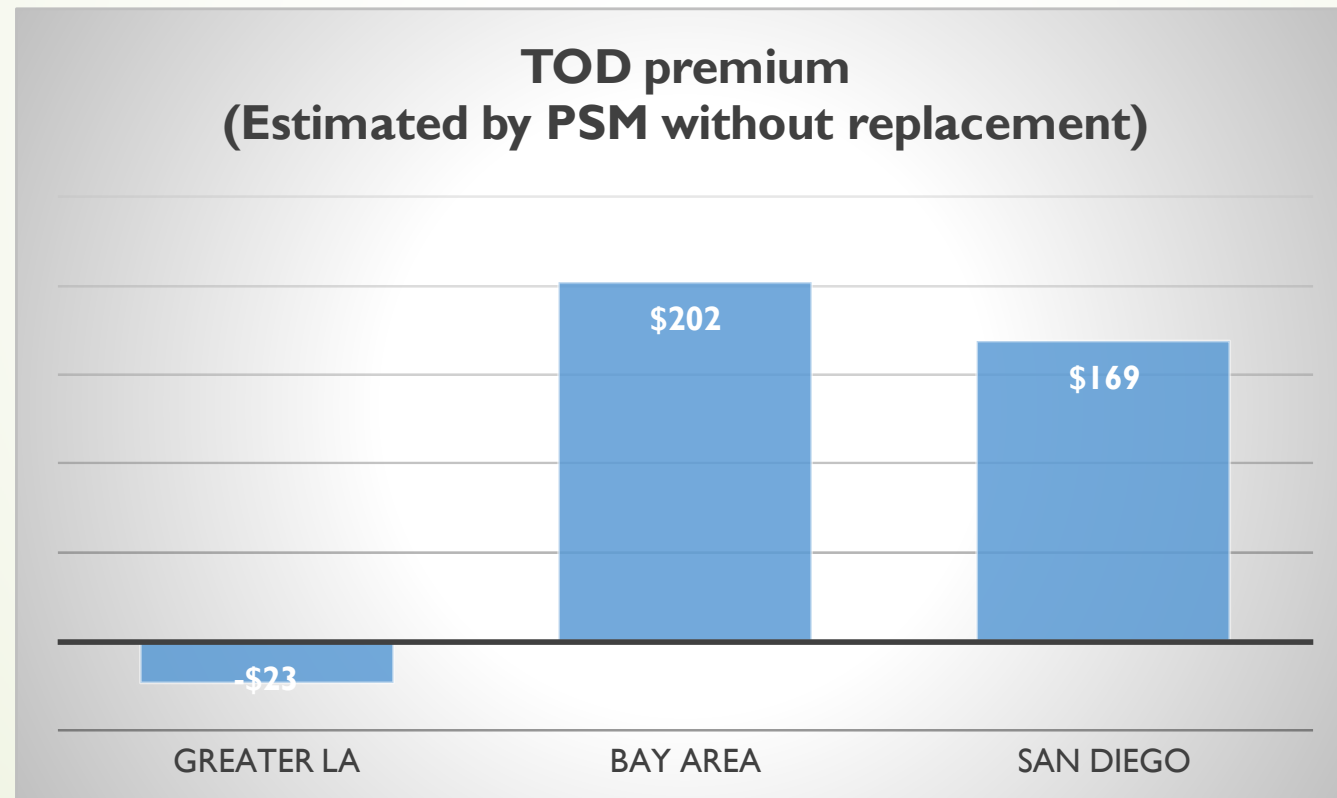|	Urban TOD (N=134)	Suburban TOD (N=339)	TAD (N=221)
Distance to CBD (mile)	1.5	6.4	16.1
Population density (persons/acre)	54.9	19.8	7.1
Job density (jobs/acre)	120.5	15.7	8.7
Street density (mile/acre)	0.038	0.029	0.019
Service area (acre)	432.5	370.3	228.7
Metro areas:			
Bay Area	79.9%	58.1%	30.3%
Los Angeles	7.5%	29.2%	34.8%
Sacramento	9.7%	4.1%	12.2%
San Diego	3.0%	8.6%	22.6%
Total	100.0%	100.0%	100.0%

Finding: TOD Rent Premium by TOD Types

❑ TOD premiums for three types of TODs

➢ Suburban TOD > Urban TOD

➢ Even TAD generates some premium

TOD premium
(Estimated by PSM without replacement)

$128	$153	$76
URBAN TOD	SUBURBAN TOD	TAD
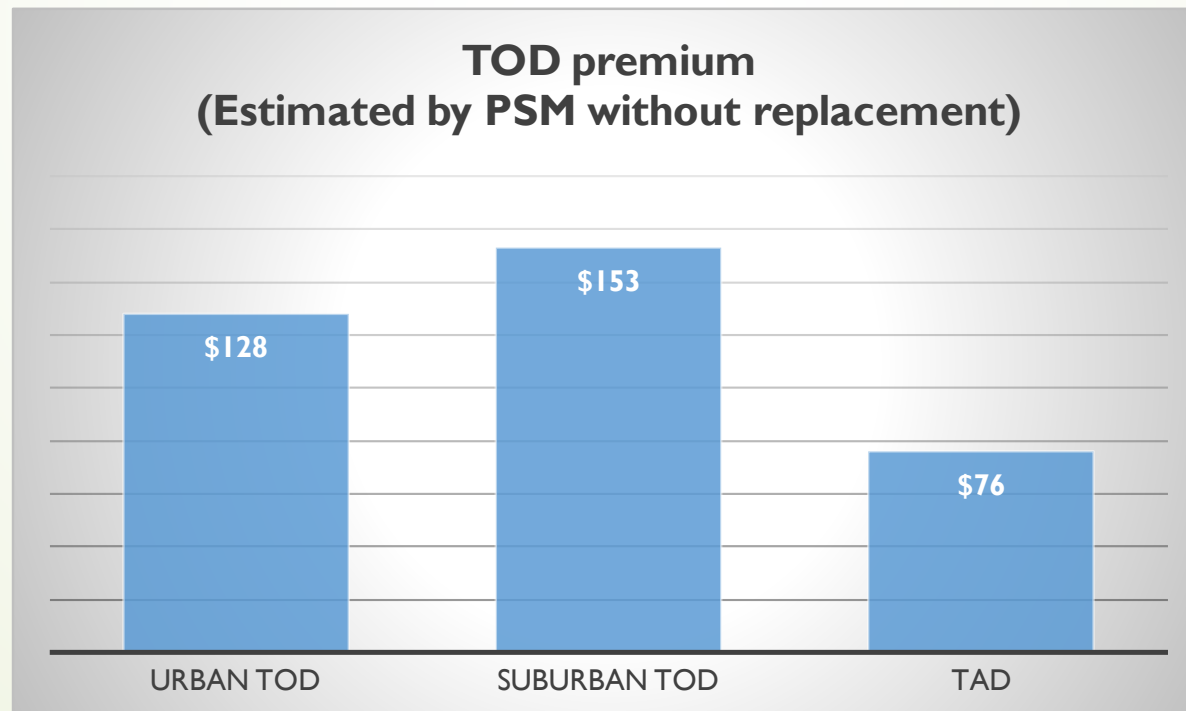
Finding: TOD Rent Premium in Metro Areas

❑ TOD rent premium in three major regions

➢ LA: none; Bay area: 7.0%; & San Diego: 8.2%.

**TOD premium
(Estimated by PSM without replacement)**

GREATER LA	BAY AREA	SAN DIEGO
-$23	$202	$169

*TOD premium in the greater LA region is not statistically different from zero

Caveat

❑ Cross-sectional data

❑ Craigslist data over-represent higher-end rental units in well-off neighborhoods

❑ Hard to find matches/control cases for TOD rental units that are:

➤ Small-sized (studios & 1-bedroom)

➤ Located in central-city neighborhoods, particularly those in San Francisco

❑ TOD premium is less certain for central-urban rental units

➤ This is a hidden (but important) issue when running a hedonic regression

Conclusion

❑ Craigslist data are very useful

➢ Until local governments systematically collect rent data and make them public (like what they do with housing transaction data)

➢ Portland to require landlords to register rental properties to the city by 2020

❑ PSM shows advantages over and more transparency than the hedonic regression method

Conclusion

❑ The average TOD rent premium is $127

  ➢ About 5.3% of average rent in TODs

❑ TOD rent premium is greater for larger rental untis in absolute value and in percentage

❑ TOD rent premium varies in different metro areas

  ➢ None in LA and around 7.0% in the Bay area, and 8.2% in San Diego

❑ Suburban TOD rent premium is greater than urban TOD rent premium

Conclusion

❑ TOD & gentrification

➤ The threat of gentrification is real, at least in the Bay area and San Diego

➤ TOD rent premium could worsen the housing affordability crisis

➤ However, the overall effect depends on how much renters could save on transportation expenditures

❑ Equity implications

➤ Renters vs. homeowners

▪ Renters are in a more disadvantaged position, compared to homeowners

➤ A windfall for landlords/housing investors

▪ They may have to pay higher property taxes. Is this enough?

▪ We may need better value-capture mechanisms

Conclusion

❑ Next step:

➢ Estimate the transportation cost saving effects of TOD

➢ Compare TOD rent premium with transportation cost savings
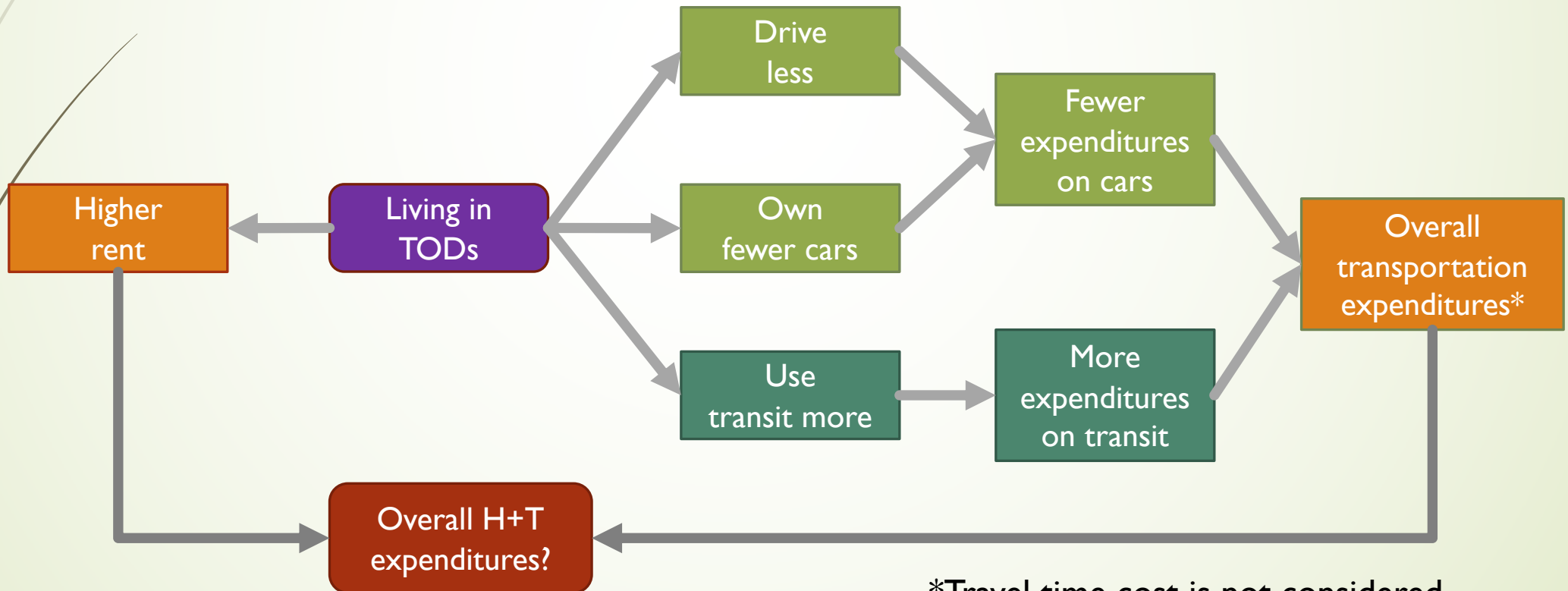
*Travel time cost is not considered.