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BTOD as an Approach to Urban Sustainability:
Effects on Residential Values in Seattle Metropolitan Area

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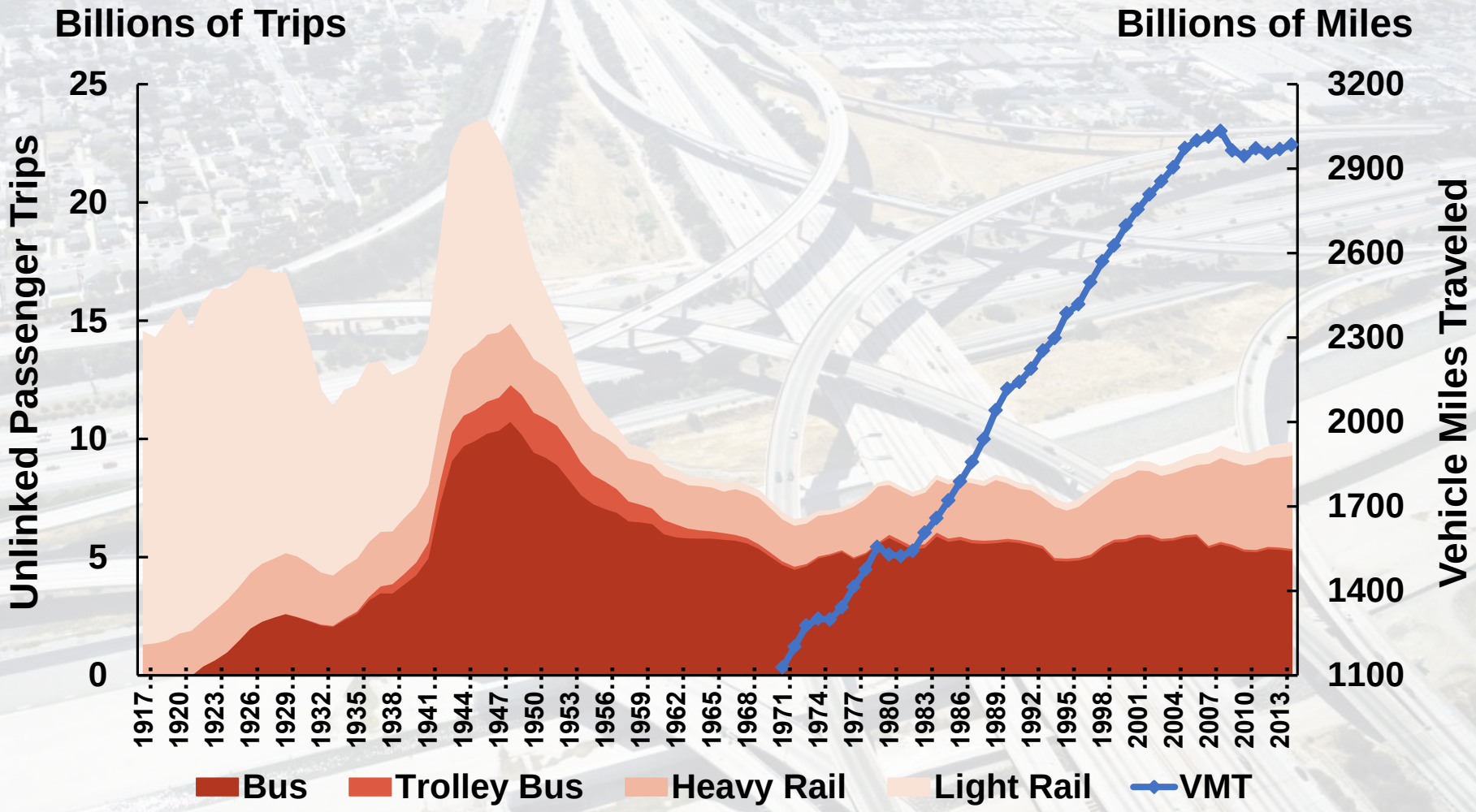
Presentation Outline

- **Introduction**
- Transit Ridership and Car VMT Trends in the U.S.
- TOD Defining Characteristics
- Bus Transit Oriented Development (BTOD)
- TOD/BTOD Land Value Creation and Capture

- **Seattle BTOD Case Studies**
- Research Questions
- Study Areas
- Methodology and Data
- Results
- Conclusions

1 Introduction
Transit Ridership and Car VMT Trends in the US



Unlinked Passenger Trips by Transit Mode & Car VMT

(Data Source: American Public Transportation Association & Federal Highway Administration)

TOD Defining Characteristics

TOD:

Proximity to Transit

Dense, Mixed Land Use

Pedestrian-Oriented Design

Atlanta: Metropolitan Atlanta Rapid Transit Authority

Broad Concept that includes any development that benefits from its **proximity to a transit facility** and that generates significant transit ridership.

Baltimore: Maryland Transit Administration

A relative **high-density** place with a **mixture of residential, employment, shopping, and civic uses** located within an **easy walk of a bus or rail transit center**.

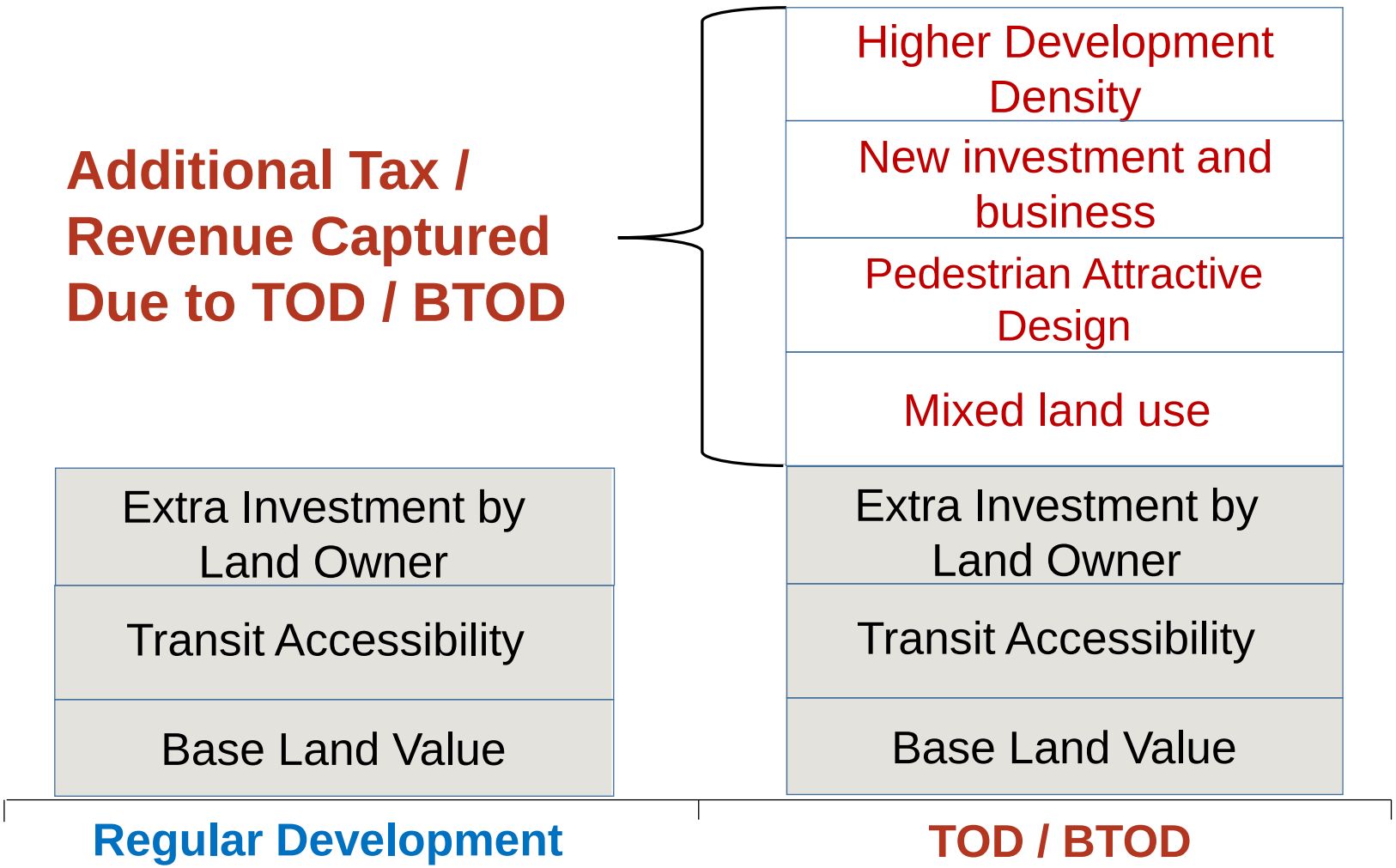
San Francisco: Bay Area Rapid Transit Authority

Moderate- to higher-density development, located within an **easy walk of a major transit stop**, generally within **a mix of residential, employment, and shopping** opportunities **designed for pedestrians** without excluding the automobile.

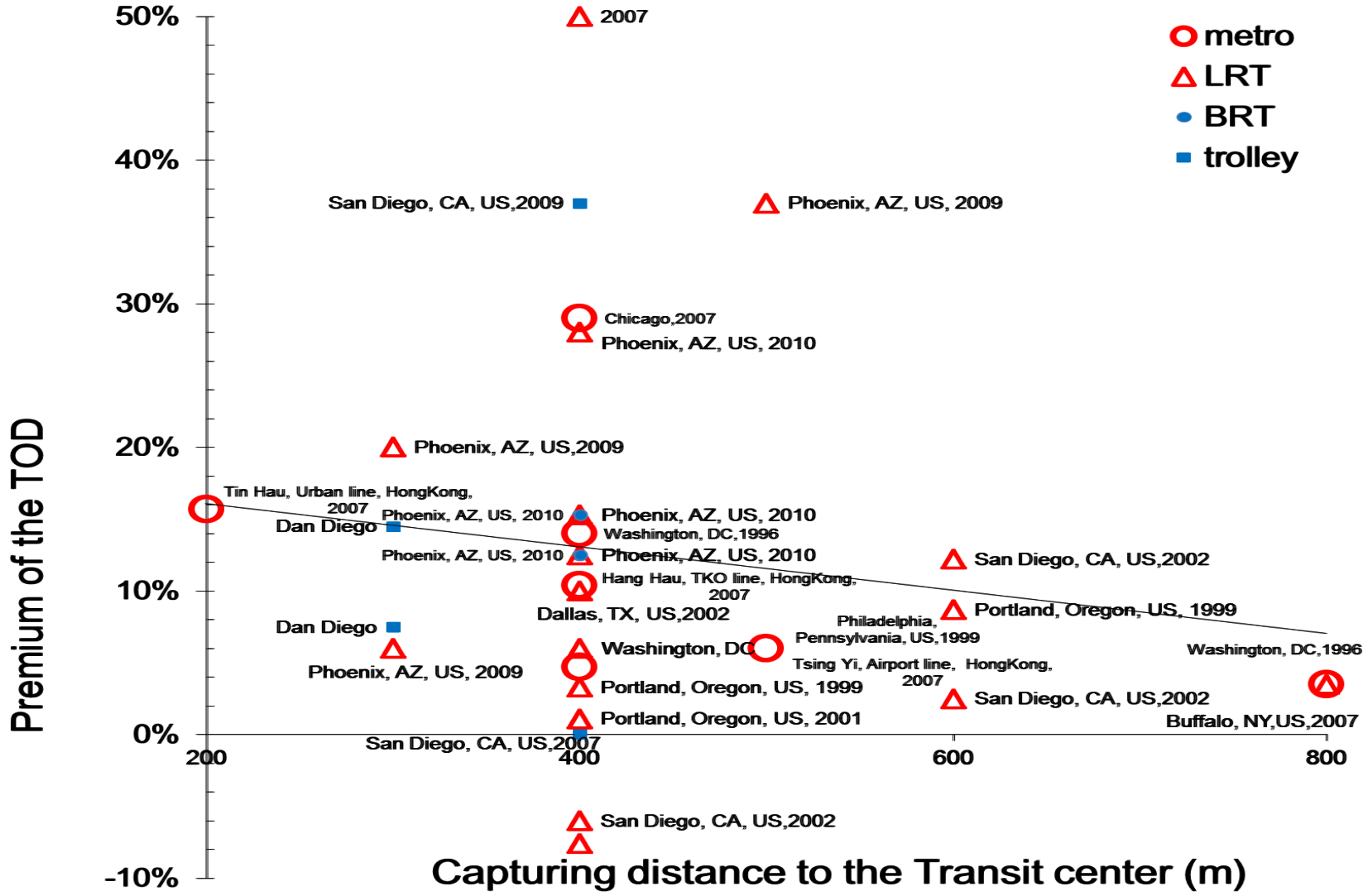
Bus Transit Oriented Development (BTOD)

- **BTOD is a type of TOD**, based on **bus transit**, typically located near a major bus node or terminal
- BTOD is particularly important for cities that cannot efficiently operate an extensive rail transit system
- BTOD has so far received relatively little attention from researchers

TOD / BTOD Land Value Creation and Capture



TOD Land / Housing Value Premiums by Different Transit Types



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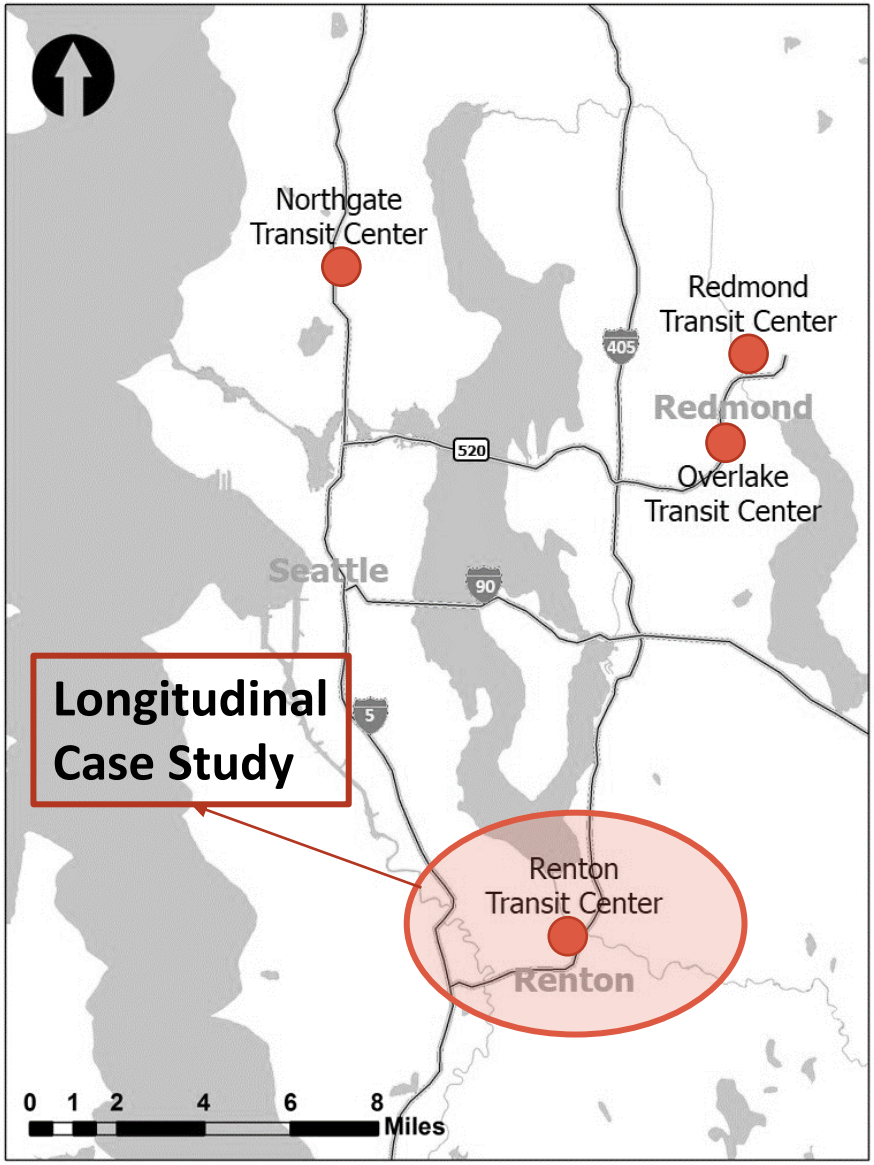
Data and graph by Li Zheng for Energy Foundation (Zheng, 2015)

2 Seattle BTOD Case Studies
Research Questions

- What are the effects of **BTODs** on the market values of **single-family residential properties** located **nearby**?
- What are the effects of **BTODs** on the market values of residential properties located **within the development sites**?

2 Seattle BTOD Case Studies
Study Areas



Four Completed BTODs in King County

BTODs	Year	TOD Features
Overlake Transit Center	2001	536 park-and-ride, 308 affordable housing units, public and private joint development
Renton Transit Center	1996	Several multi-family buildings, open spaces, street-level commercial, 250 park-and-ride spaces, public and private joint development
Redmond Transit Center	2008	Streetscape design, pedestrian-friendly design, park-and-ride lots
Northgate Transit Center	1992	278 apartments, 109 condos, 142 retirement living units, future light-rail station

Seattle BTOD Cases

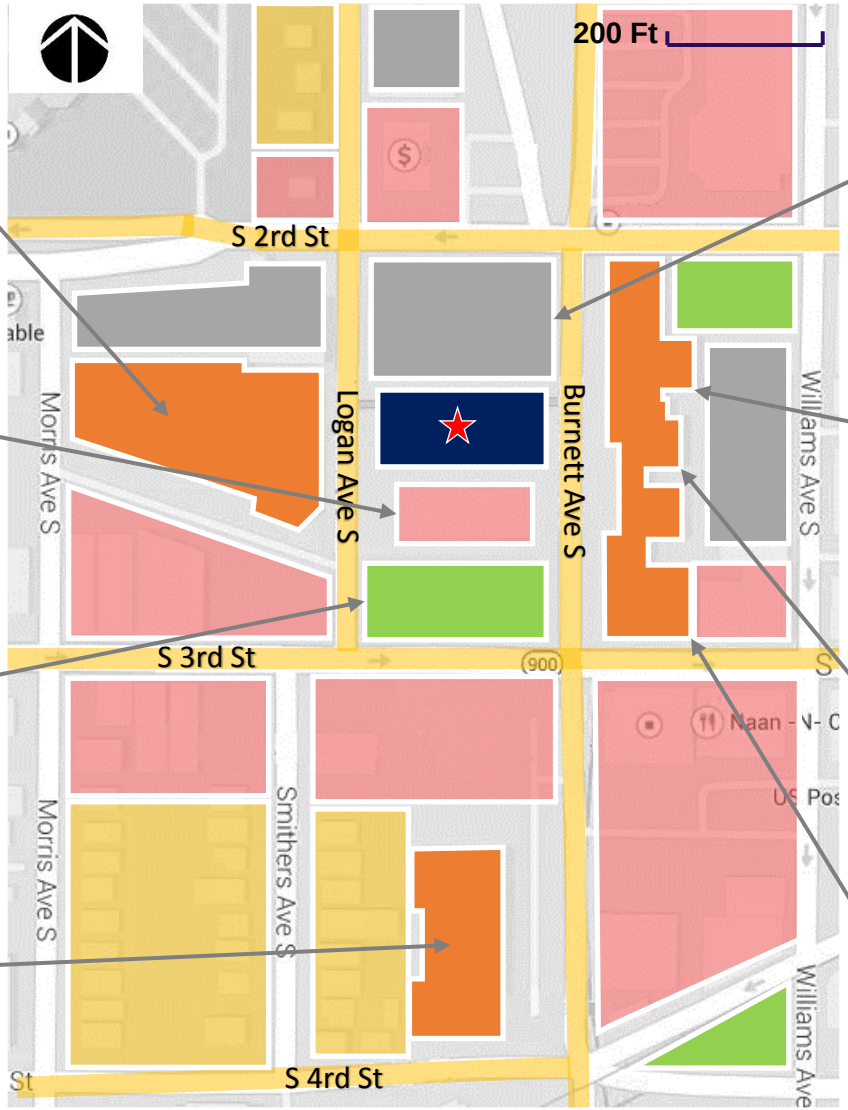
2 Seattle BTOD Case Studies
Study Areas

2. Multifamily Renaissance Place (completed in **1999**)

3. Renton Pavilion Center (completed in **2000**)

4. Renton Plaza (completed in **2000**)

6. Multifamily Burnett Station (completed in **2001**)



8. City parking garage with 250 park-and-ride (built in **2004**)

5. 150 park-and-ride stalls (opened in **2001**)

7. Multifamily Metropolitan Space (opened in **2002**)

8. Street-level retail opened

Renton Transit Center

Methodology and Data

- **Cross-Sectional Pooled Analysis (Models 1 & 2)**

Applied to **single-family properties** sold **after Transit Center opened** and **located within 1.5 miles** from any of the four BTODs.

$$P = c_0 + \sum \alpha_i A_i + \sum \beta_i B_i + \sum \mu_i U_i + \sum \nu_i V_i + \varepsilon$$

Distance to Transit Center is measured in two ways:

- **Continuous distance** to the corresponding transit center
- **Dummy distance** variables indicating three ranges of distance:

  < 0.5 mile 0.5 - 1 mile 1 - 1.5 miles

Methodology and Data

- **Longitudinal Analysis of the Renton BTOD (Models 3-7)**

Applied to **single-family properties** sold **before and after Transit Center opened** and **located within 1.5 mile** from the BTOD:

$$P = c_0 + \sum \alpha_i A_i + \sum \beta_i B_i + \sum \mu_i U_i + \sum v_i V_i + \sum t_i T_i + \varepsilon$$

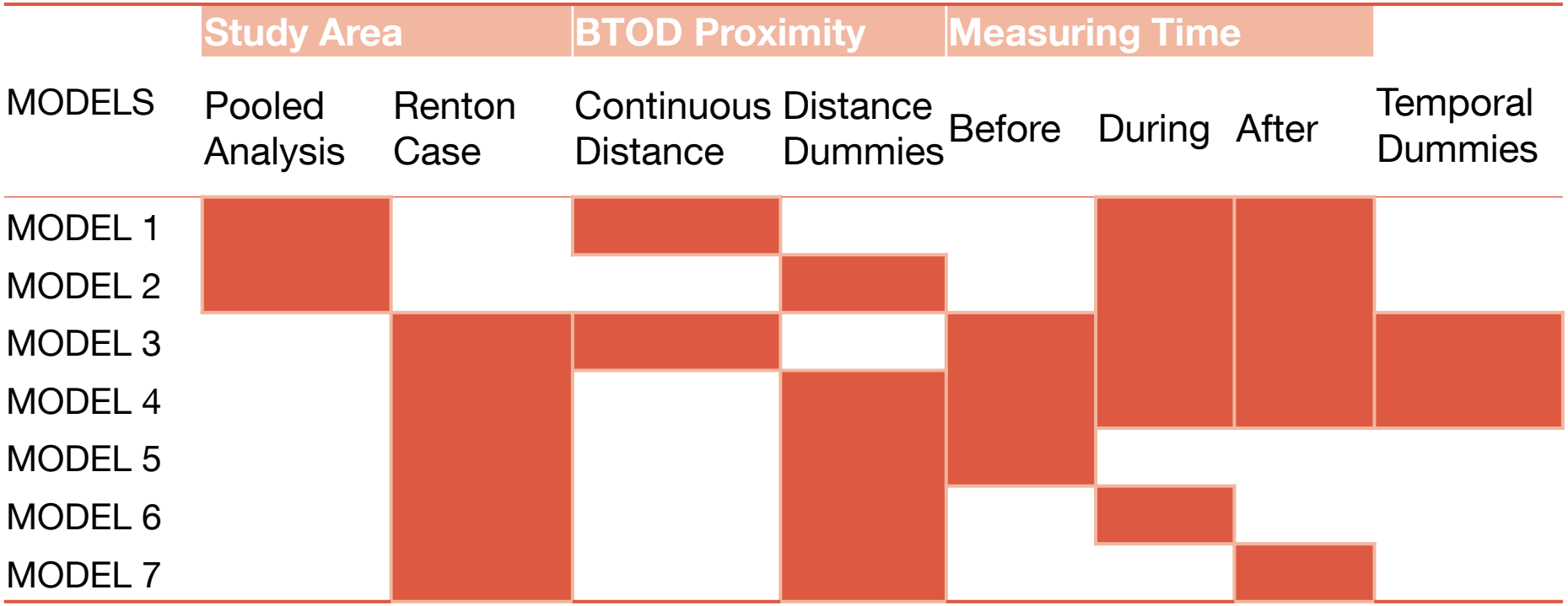
T_i - **Temporal Dummy Variables** (each variable represents two consecutive years)

Temporal Distribution of Sampled Transactions for Renton

Before-TOD		During-TOD		After-TOD	
Year	Sample size	Year	Sample size	Year	Sample size
1990-1991	36	1996-1997	75	2006-2007	116
1992-1993	77	1998-1999	113	2008-2009	66
1994-1995	83	2000-2001	98	2010-2011	68
		2002-2003	148	2012-2013	86
		2004-2005*	**226**	2014-2015	46

Methodology and Data

Model Specifications



Methodology and Data

- **Data**

Dependent Variable - Housing transaction price adjusted to current dollars

Independent Variables:

TOD CHARACTERISTICS	OTHER LOCATION VARIABLES
Continuous distance to BTOD; Distance_dummy1 (0.5 mi); Distance_dummy2 (0.5-1 mi); Land use mix; Commercial distance; Block size	Distances to CBD, highway, lake, park, river; View (1 for yes, or 0); Traffic noise (1 for yes, or 0)
PHYSICAL CHARACTERISTICS	**NEIGHBORHOOD CHARATERISTICS**
Lot size; Total finished area; Total basement area; Bedrooms; Bathrooms; House condition; Age	Percent white residents; Median household income

Outcomes of Model 1 & Model 2

	Model 1 - Distance to TOD		Model 2 - Distance Dummies	
Variables	**Coefficients**	**t-Statistics**	**Coefficients**	**t-Statistics**
Housing Structure Variables				
Lot Size (Sqft)	5.773***	20.274	5.789***	20.349
Total Finished (Sqft)	165.569***	45.286	165.377***	45.280
Total Basement (Sqft)	58.918***	17.836	58.395***	17.687
Bedrooms	-7607.575***	-3.704	-7514.899***	-3.664
Condition	8421.019***	3.456	8543.174***	3.511
Bath	23163.693***	6.721	22903.551***	6.652
Age	-869.535***	-10.039	-898.565***	-10.342
TOD-related Variables				
TOD Distance (Feet)	-2.646***	-2.654	-	-
Dummy_Distance1	-	-	38336.814***	4.782
Dummy_Distance2	-	-	5903.412*	1.798
Landuse Mix	18759.084**	2.318	11443.727	1.384
Commercial Distance (Feet)	1.465	0.651	1.477	0.658
Block Size (Acre)	417.101***	6.069	422.312***	6.149

Note: Estimates are marked with level of significance (*<0.1, **<0.05, ***<0.01)

Results

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	Model 1 - Distance to TOD		Model 2 - Distance Dummies	
Variables	**Coefficients**	**t-Statistics**	**Coefficients**	**t-Statistics**
Locational-related Variables				
CBD Distance (Feet)	-4.637***	-19.551	-4.686***	-19.767
Highway Distance (Feet)	6.060***	12.716	6.185***	13.077
River Distance (Feet)	3.866***	4.086	4.418***	4.649
Park Distance (Feet)	-17.515***	-8.175	-18.933***	-8.737
Lake Distance (Feet)	0.573	1.028	0.491	0.881
View	41222.043***	3.906	39371.551***	3.730
Traffic Noise	-15217.537***	-4.014	-15422.753***	-4.074
Social-Economic Variables				
White Percentage	86351.432***	7.531	85625.095***	7.479
Median Income	0.990***	13.969	1.003***	14.155
(Constant)	147151.854***	7.649	135170.765***	7.516
ANOVA F	534.477***		510.956***	
Adjusted R^2		0.608		0.609
Durbin-Watson		1.633		1.635
N		6877		6877

Note: Estimates are marked with level of significance (*<0.1, **<0.05, ***<0.01)

Results

Outcomes of Model 1

- Proximity to BTOD is associated with higher sales price, at $2,646 per 1,000 feet reduction in distance.
- Land use mixture is also positively related to higher sales price.
- Distance to commercial land is not significant
- Block size is positively associated with sales price

Outcomes of Model 2

- Location within 0.5 mile from BTOD is associated with higher sales price, $38,337 on average; location between 0.5 and 1 mile from BTOD, $5,903.
- Land use mixture is not significant.

Results

Outcomes of Model 3 & Model 4

	Model 3 - Distance to TOD		Model 4 - Distance Dummies	
Variables	**Coefficients**	**t-Statistics**	**Coefficients**	**t-Statistics**
TOD-related Variables				
TOD Distance (Feet)	-10.158***	-4.109	-	-
Dummy_Distance1	-	-	34812.101***	2.564
Dummy_Distance2	-	-	49646.277***	6.595
Landuse Mix	5376.726	0.341	-519.085	-0.033
Commercial Distance (Feet)	27.449***	4.732	26.907***	4.784
Block Size (Acre)	142.367	1.581	92.795	1.045
Time-series Variables				
1990_1991	2446.266	0.144	4461.911	0.265
1992_1993	-19661.106	-1.555	-22397.424*	-1.782
1994_1995	-19708.340	-1.604	-20783.171*	-1.709
1996_1997	-33273.349***	-2.615	-33718.578***	-2.679
1998_1999	-1350.754	-0.123	1853.882	0.171
2000_2001	-14194.050	-1.251	-14654.639	-1.304
2002_2003	10883.636	1.088	13591.551	1.374
2006_2007	-6725.878	-0.626	-9419.619	-0.885
2008_2009	-11478.745	-0.879	-11692.846	-0.905
2010_2011	-25306.094**	-1.942	-28818.112**	-2.231
2012_2013	-42584.574***	-3.575	-45241.369***	-3.834
2014_2015	-52740.519***	-3.472	-54509.282***	-3.617

Note: Estimates are marked with level of significance (*<0.1, **<0.05, ***<0.01)

Results

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	Model 3 - Distance to TOD		Model 4 - Distance Dummies	
Variables	**Coefficients**	**t-Statistics**	**Coefficients**	**t-Statistics**
Housing Structure Variables				
Lot Size (Sqft)	1.154*	1.759	0.959	1.479
Total Finished (Sqft)	85.581***	13.302	82.179***	12.850
Total Basement (Sqft)	44.052***	7.390	41.742***	7.074
Bedrooms	-822.751	-0.205	-719.159	-0.181
Condition	11489.439**	2.112	9292.700*	1.739
Bath	4702.074	0.679	6717.538	0.979
Age	-721.082***	-4.592	-618.351***	-3.928
Locational-related Variables				
Highway Distance (Feet)	-0.554	-0.285	-0.657	-0.343
River Distance (Feet)	-0.612	-0.291	-1.000	-0.507
Park Distance (Feet)	-9.293**	-2.135	-10.442**	-2.429
Lake Distance (Feet)	-0.446	-0.368	0.041	0.034
View	16449.228	1.612	22531.900**	2.213
Traffic Noise	-14220.712	-1.639	-12600.386	-1.472
Social-Economic Variables				
White Percentage	-18692.477	-1.114	-24083.068	-1.448
Median Income	0.516***	3.600	0.531***	3.741
(Constant)	180685.083***	5.642	117997.528***	3.714
ANOVA F	38.204***		38.667***	
Adjusted R^2		0.482		0.494
Durbin-Watson		1.559		1.593
N		1238		1238

Results

Outcomes of Model 3

- Less than half of the temporal dummy variables are significant.
- Proximity to Renton BTOD is associated with higher sales price, at $10,158 per 1,000 feet reduction in distance.
- Land use mixture is not significant.
- Distance to commercial land is *positively* related to sales price
- Block size is not significant

Outcomes of Model 4

- Half of the temporal dummy variables are significant
- Location within 0.5 mile from Renton BTOD is associated with higher sales price, $34,812 on average; location between 0.5 and 1 mile from BTOD, $49,646 (seems too high).

Results

Outcomes of Model 5, 6 & 7

	Model 5 - Before TOD		Model 6 - During TOD		Model 7 - During TOD	
Variables	Coefficients	t	Coefficients	t	Coefficients	t
Housing Structure Variables						
Lot Size (Sqft)	3.498*	1.858	-0.348	-0.401	2.478**	2.119
Total Finished (Sqft)	83.063***	3.680	82.337***	9.395	76.488***	7.478
Total Basement (Sqft)	57.179***	3.978	36.957***	4.233	33.092***	3.345
Bedrooms	-7827.452	-0.708	-3833.728	-0.676	12870.615**	1.991
Condition	5846.007	0.414	6337.521	0.737	17310.969**	2.270
Bath	-4160.866	-0.213	28177.88**	2.600	-13311.152	-1.336
Age	-1249.999***	-2.643	-292.051	-1.201	-814.506***	-3.479
TOD-related Variables						
Dummy_Distance1	-6203.330	-0.172	48114.826**	2.478	41598.497*	1.868
Dummy_Distance2	-37338.193*	-1.862	69228.432***	6.164	53623.766***	4.651
Landuse Mix	-18137.742	-0.397	-18313.379	-0.817	15326.813	0.605
Commercial Distance (Feet)	7.524	0.474	35.414***	4.303	24.725***	2.792
Block Size (Acre)	930.788**	2.347	8.502	0.075	74.722	0.486

Note: Estimates are marked with level of significance (*<0.1, **<0.05, ***<0.01)

Results

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	Model 5 - Before TOD		Model 6 - During TOD		Model 7 - During TOD	
Variables	Coefficients	t	Coefficients	t	Coefficients	t
Locational-related Variables						
Highway Distance (Feet)	-4.396	-0.844	0.874	0.311	-3.576	-1.158
River Distance (Feet)	-13.419**	-2.161	-0.351	-0.131	1.365	0.403
Park Distance (Feet)	5.395	0.479	-18.782***	-2.988	0.466	0.067
Lake Distance (Feet)	-0.053	-0.017	0.147	0.085	-0.130	-0.065
View	-7656.195	-0.307	14819.854	0.964	50037.98***	3.047
Traffic Noise	-24435.074	-1.119	-5973.092	-0.452	-16516.709	-1.312
Social-Economic Variables						
White Percentage	-20614.376	-0.452	-25306.944	-1.071	-49834.082*	-1.818
Median Income	0.286	0.679	0.485**	2.430	0.642***	2.813
(Constant)	269906.999***	3.048	87965.999*	1.847	57003.556	1.174
ANOVA F	7.299***		33.485***		21.574***	
Adjusted R^2		0.392		0.496		0.519
Durbin-Watson		1.971		1.330		1.960
N		196		660		382

Note: Estimates are marked with level of significance (*<0.1, **<0.05, ***<0.01)

Results

Outcomes of Model 5, Model 6, and Model 7

- Results show more inconsistencies, possibly due to smaller samples and changes over time
- Distances to Renton BTOD are not significant for sales during the first time period when BTOD did not exist
- For time periods during and after BTOD, location within 0.5 mile from BTOD is associated with higher sales prices, over $41,000 on average; location between 0.5 and 1 mile from BTOD, over $53,000 (seems too high).
- Land use mixture is not significant.
- Distance to commercial land is *positively* related to sales price
- Block size is not significant for during and after BTOD

Conclusions

Findings and Implications

- BTOD creates substantial price premiums (3%-8% for all cases; over 10% for Renton) for single-family properties located nearby.
  - ✓ For cities relying on an extensive bus system for public transportation provision, BTOD can be a viable approach to generating additional local tax / revenues while advancing sustainability.
- However, the effects of some BTOD features, such as land use mixture, distance to commercial land, and street block size, on the market value of single-family housing remain unclear.
  - ✓ More research is required.

Limitations

- Using one time, current data on land use and neighborhood characteristics for regression modeling.
- Longitudinal analysis relies on a single case of BTOD.

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Thank you