Valuing Bicycle Infrastructure in Portland, Oregon

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Research Questions

- What is the **value of different types of bicycle facilities** to households, as represented by property value impacts?
- How much does **ease of access**, measured by **network distance**, impact these values?
- How much does **extensiveness of the bike network**, considering **multiple buffer zone radii**, impact these value?

Literature Review

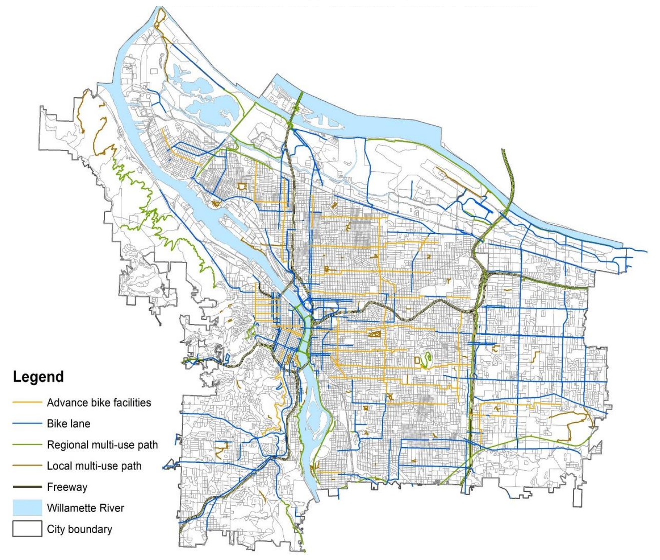
- Proximity to off-street recreational trails and other park-based greenways trails generate positive to neutral property value impacts.
- Emerging but limited studies examine property value impacts of **on-street** bicycle facilities.
- Krizek (2006) and Welch et al. (2016) exemplify the few examples of research that differentiate the property impacts of various types of bicycle and other transportation facilities. Krizek (2006) found some negative effects of proximity to on-street bicycle facilities and off-street bike trails for suburban neighborhood in Minneapolis; while Welch et al. (2016) found that proximity to off-street trails generally increase property value while on-street bike lanes display opposite effects in Portland, Oregon.
- Researchers (Hood et al. 2011, Broach et al. 2012) have shown that cyclists have different preferences for different levels of on-street bicycle facilities within the context of transportation route choice study.

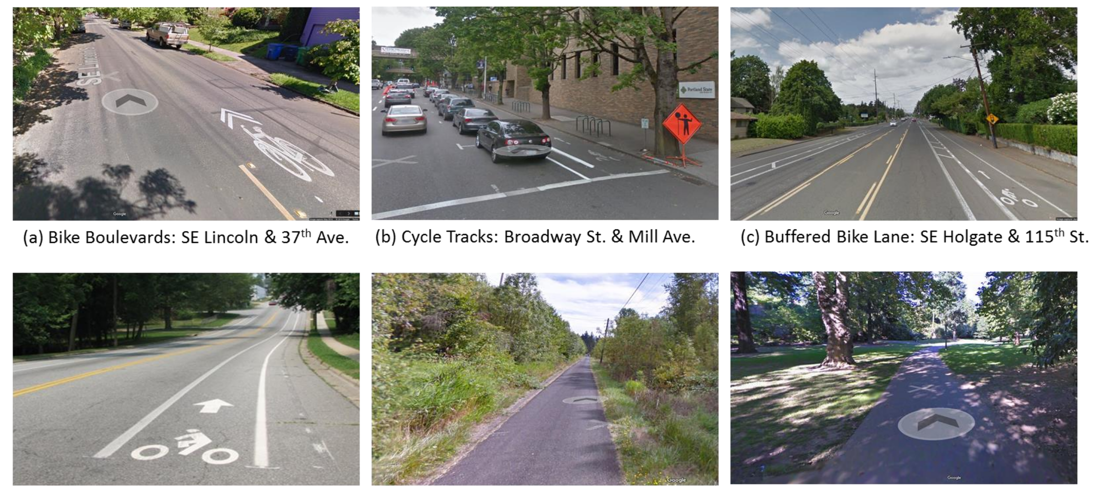
Types of Bike Facilities in Portland

In the context of Portland, Oregon, 11 types of bike facilities are defined. This study focuses on four broader types that encompass the majority of the facilities in the city:

- Advanced Bike Facilities
- On-Street Bike Lanes
- Regional Multi-Use Paths
- Local Multi-Use Paths

Distribution of Four Types of Bicycle Facilities in Portland





(a) Bike Boulevards: SE Lincoln & 37th Ave. (b) Cycle Tracks: Broadway St. & Mill Ave. (c) Buffered Bike Lane: SE Holgate & 115th St.
(d) Bike Lanes: Multnomah Boulevard (e) Regional Multi-use Paths: Springwater Trail (f) Local Multi-use Paths: Laurelhurst Park Trail

Methodology

Hedonic Price Model

The general ordinary least squares (OLS) specification is as follows:

$$P_i = \beta_0 + \beta_1 T_i + \beta_2 H_i + \beta_3 R_i + \beta_4 B_i + \varepsilon_i$$

- P_i – Property sale price;
- T_i – Transaction characteristics, such as year and season of the sale;
- H_i – Internal property characteristics , such as age, size and property tax liability;
- R_i – External neighborhood characteristics, such as school quality, crime rate, and walk score;
- B_i – Bike facility characteristics, such as distance to nearest advanced bicycle facility, and advanced bike facility density within a half-mile radius

Spatial Autoregressive Model

- Home values are often heavily influenced and determined by nearby properties. Ignoring this spatial autocorrelation may lead to inefficient coefficient estimates in OLS specification.
- Two commonly used spatial autoregressive (SAR) models are spatial lag and spatial error models:

Spatial lag model:

$$Y = \rho WY + X\beta + \varepsilon$$

- Interpret spatial dependency as omitted variable bias;
- ρWY: spatially lagged dependent variable that represents the omitted variable in the regression model;
- ρ: spatial lag parameter;
- W: spatial autocorrelation matrix.

Spatial error model:

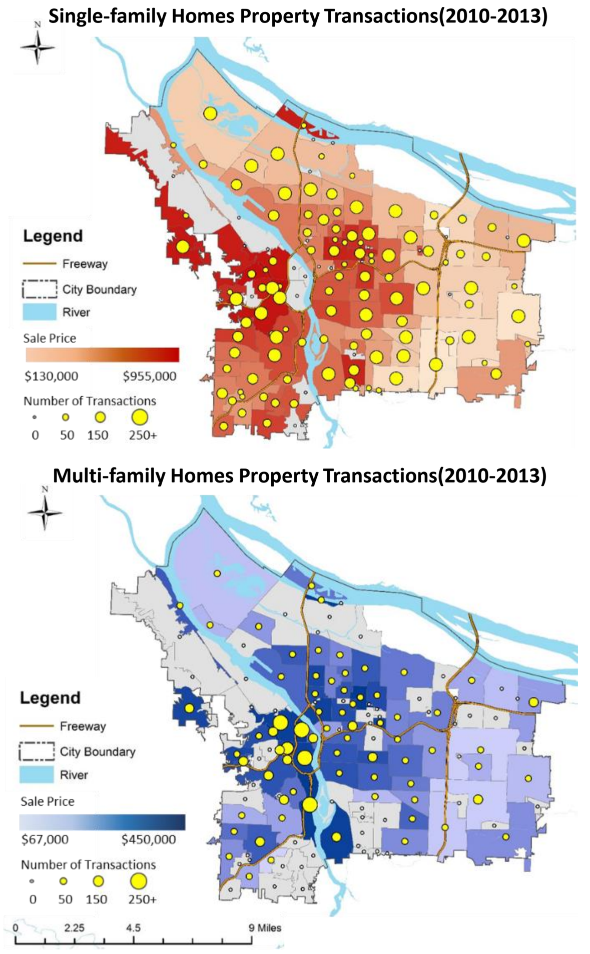
$$Y = X\beta + \lambda W\epsilon + v$$

- Interpret spatial dependency as model misspecification;
- $\lambda W\epsilon + v$: autoregressive error term;
- λ: spatial error parameter;
- $W\epsilon$: spatial error, interpreted as the mean error from neighboring locations.

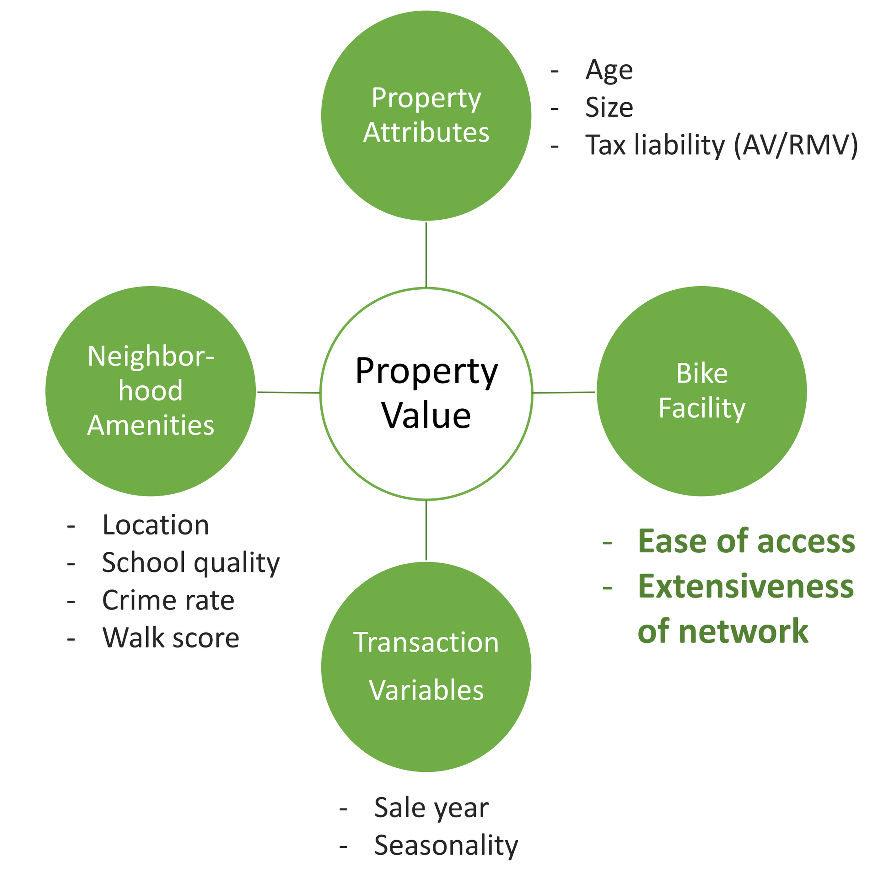
Data

Dependent Variable

Multnomah County residential property sales **2010-2013**, including both single-family homes (SFH) and multi-family homes (MFH)



Independent Variables



Conclusion & Policy Implications

Conclusion

- The property value impacts from both **ease of access** (distance) and **extensiveness of bike network** (density) are **distinct across all types of bicycle facilities**:
  - Both single-family homes and multi-family homes prefer to be located close to advanced bike facilities, and enjoy a denser advanced bike facility network;
  - Bike lanes tend to contribute negatively to property values in most cases, although multi-family properties are positively affected by extensiveness of bike lane network;
  - Off-street trails have unclear impact on property values, although consumers do show some preference for proximity to regional multi-use paths.
- The impact of extensiveness of bicycle facilities generally diminish as the buffer zone radius is increased.
- The estimated impacts can be seen as a **strong and persistent preference for high quality on-street bike facilities** by households.
- Enhancing the model specifications with **spatial autocorrelation effects** prevents overestimation of coefficient estimates, and yields slightly tempered impacts of both proximity and density of bike facilities on residential property values.

Policy Implications

- Bicycle facilities do not all provide the same benefits for all households. Consumers tend to prefer higher quality bicycle facilities that afford them safer and more comfortable riding.
- It is important to consider both ease of access and extensive of network when making bicycle infrastructure investment decisions about where, what and why to build or upgrade bicycle facilities.
- We caution against inferring causal relationships from these findings, but rather establish positive consumer preferences for certain types of facilities of amenities.

Findings & Results

- **Separate SFH and MFH hedonic price models** are estimated, due to existence of structure change between the determinants of SFH and MFH property values.
- The four bicycle facility types have **distinct impacts** on residential property values:
  - Proximity and extensiveness of advanced bike facilities positively affect residential property value;
  - Bike lanes negativity affect value of single family homes;
  - No clear pattern is found about the impact of off-street trails on property value;
- The impact of extensiveness of bike network generally diminishes as the buffer zone radii becomes larger for all four types of bike facilities.
- As expected, residential property values are positively impacted by its size, , lower property tax liabilities, proximity to CBD and better school districts, neighborhood safety, and overall economic status.
- **Spatial autocorrelation models** are estimated to avoid the bias of inefficient coefficient estimates in the OLS model. The estimated coefficients of the spatial autoregressive models generally have the **same signs** although with **smaller magnitudes**.

Single Family Homes

	1/4 mile buffer	1/2 mile buffer		3/4 mile buffer	1 mile buffer	
	OLS.I	OLS.II	SAR.II	OLS.III	OLS.IV	SAR.IV
Advanced Bike Facilities	↑ $453 ⇧ $321	↑ $144 ⇧ $2,106	↑ $102 ⇧ $1,032	↑ $72 ⇧ $1,494	↑ $8 ⇧ $1,321	↑ $49 ⇧ $601
On-Street Bike Lanes	↓ $992 ⇩ $2,262	↓ $839 ⇩ $1,341	↓ $300 ⇩ $495	↓ $882 ⇩ $681	↓ $1,013 ⇩ $244	↓ $361 ⇩ $148
Regional Multi-Use Paths	↑ $75 ⇩ $3,516	↑ $75 ⇩ $854	↑ $186 ⇩ $277	↑ $325 ⇩ $1,232	↑ $729 ⇩ $1,679	↑ $560 ⇩ $828
Local Multi-Use Paths	↑ $16 ⇧ $1,622	↑ $936 ⇧ $993	↑ $318 ⇩ $1,939	↑ $173 ⇩ $747	↑ $217 ⇩ $2,226	↑ $255 ⇩ $1,216

Multi-Family Homes

	1/4 mile buffer	1/2 mile buffer		3/4 mile buffer	1 mile buffer	
	OLS.I	OLS.II	SAR.II	OLS.III	OLS.IV	SAR.IV
Advanced Bike Facilities	↑ $42 ⇧ $11,423	↑ $725 ⇧ $3,558	↑ $489 ⇧ $3,450	↑ $426 ⇧ $3,712	↑ $636 ⇧ $2,295	↑ $435 ⇧ $2,345
On-Street Bike Lanes	↑ $47 ⇧ $834	↑ $77 ⇧ $715	↑ $215 ⇧ $646	↓ $52 ⇧ $442	↓ $66 ⇧ $292	↑ $107 ⇧ $137
Regional Multi-Use Paths	↑ $1,408 ⇩ $17,985	↓ $219 ⇧ $4,500	↑ $39 ⇧ $4,920	↓ $283 ⇧ $3,052	↓ $377 ⇧ $2,455	↓ $117 ⇧ $2,624
Local Multi-Use Paths	↑ $936 ⇩ $14,150	↑ $726 ⇩ $5,553	↑ $143 ⇩ $2,579	↑ $621 ⇩ $4,037	↑ $593 ⇩ $4,664	↑ $284 ⇩ $4,408

↑ ↓ **Proximity**: Each 10% closer to nearest bike facilities will cause increase or decrease in property value

⇧ ⇩ **Extensiveness**: Each 1/4 mile increase in bike facilities in specified buffer radius will cause increase or decrease in property value

Darker color arrows represent statistically significant impacts; light color arrows represent insignificant impacts

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