A Study on the Impact of Chicago L Train(Elevated Train) accessibility on Housing Prices

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Density

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LITERATURE REVIEW

Literature Review

Findings	City, Authors
Analysis of the impact of highway and light rail accessibility on housing prices using a **hedonic model**. Both variables had a **positive effect** on housing prices, but highway accessibility had a greater effect than light rail.	Phonix(Arizona) Seo et al, 2014
Using a **hedonic model**, and the results showed that the presence of the station had a **positive effect** overall, but this was limited to areas classified as high-income areas. It shows a negative effect in areas classified as low-income areas.	Buffalo(New York) Hess & Almeida, 2007
Using **geographically weighted regression (GWR)** , and the results shows that the presence of a station has a **positive effect** on housing prices, but only for properties located in lower-middle areas, and for properties located in high-income areas, light rail The impact appears not to be very large.	Kuala Lumpur(Malaysia) Dziauddin, 2019
Using **hedonic model** and **GWR**. all analysis methods revealed that the physical characteristics of the house (total floor area, age, etc.) were the factors that had the greatest impact on the house price. Additionally, the conclusion was drawn that **GWR is the most appropriate analysis**.	Cracow(Poland) Tomal, 2020
Using **hedonic model**. The opening of a station has a **positive effect** on housing prices, and the closer the station opens, the greater the effect.	Chicago(Illinois) McMillen &McDonald, 2004

Literature Review

—Research question

Will the presence of a train in Chicago have a positive effect on housing prices?

Will GWR provide better analysis results than the hedonic model?

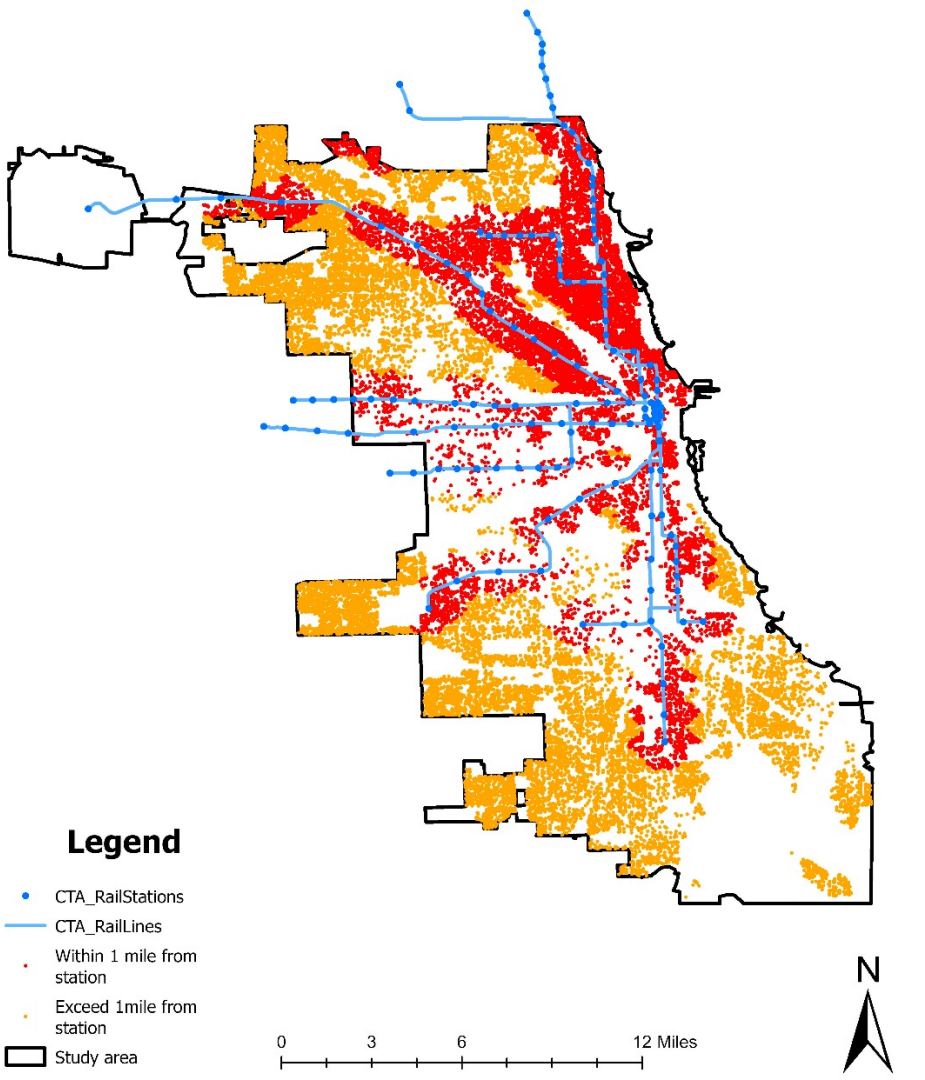
03 METHOD DISCRIPTION

Study Area

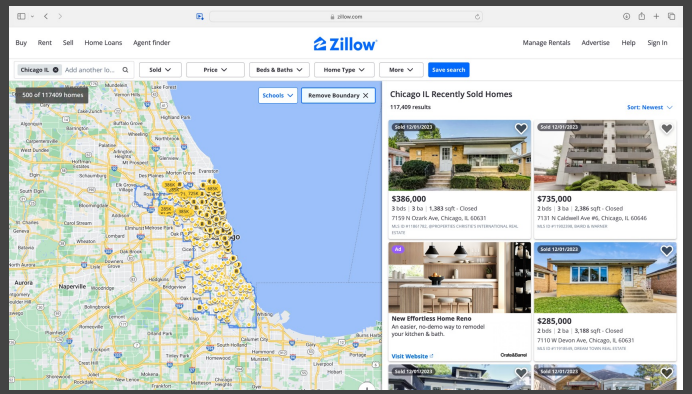
Total Housings in Chicago(47,914)

Located within 1 mile of the Chicago L train(27,887 cases)

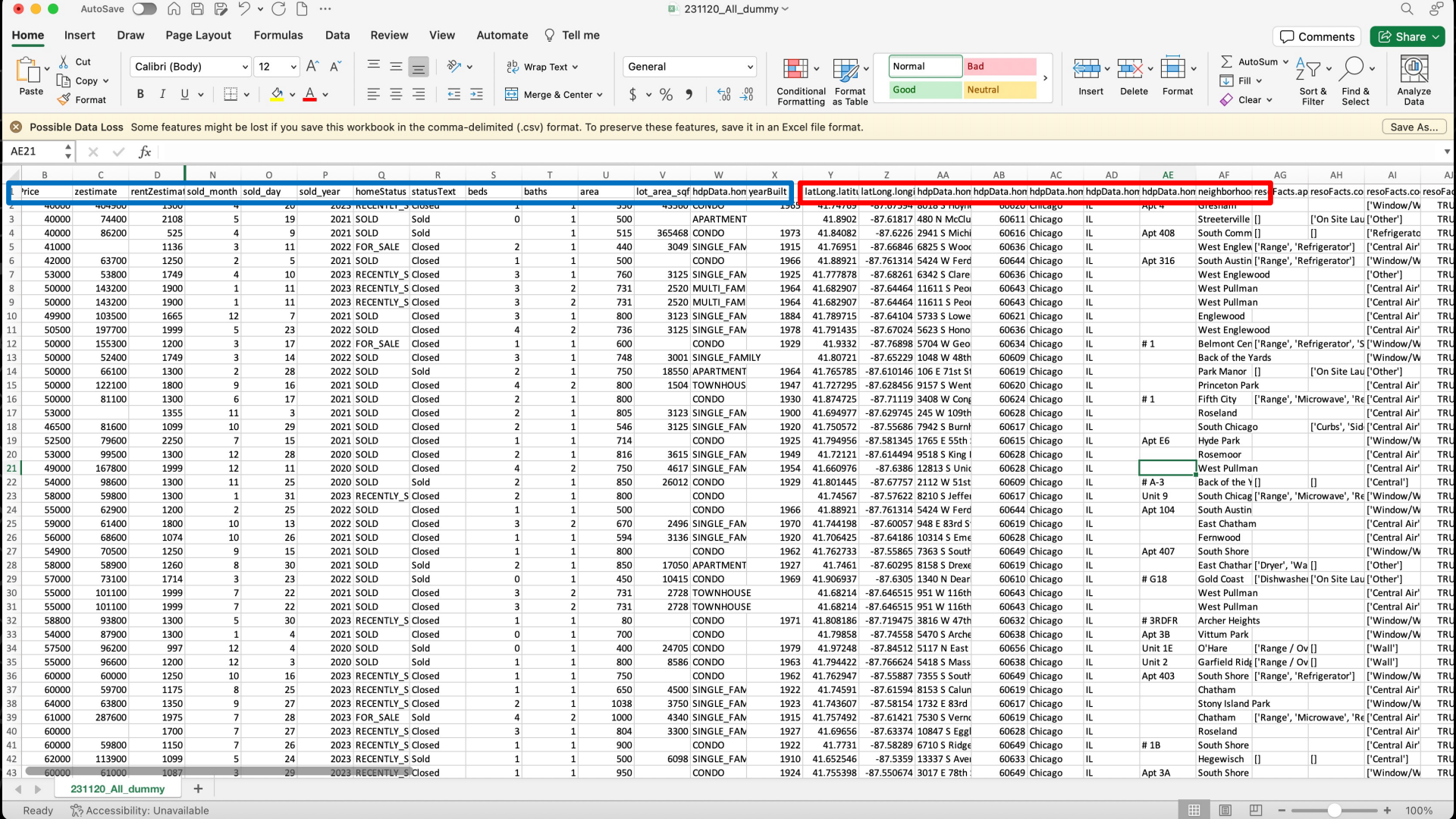
Located outside the 1-mile radius (20,027 cases)



DATA COLLECTION METHOD



Data from 47,914 houses traded in Chicago
over the past three years (Nov.10.2021-Nov.09.2023) were collected via Zillow.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Possible Data Loss Some features might be lost if you save this workbook in the comma-delimited (.csv) format. To preserve these features, save it in an Excel file format.
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Composition of Variables

Variable category	Variable name		Definition	Value type
Dependent variable	Transaction price (per square feet)		Actual transaction price divided by exclusive use area	$ (Dollar)
Independent variable	Distance to station		Distance to the nearest Elevated Train station (mile)	Ratio scale
	Housing characteristics	Area for exclusive use	Area for exclusive use of the target housing (sqft)	Ratio scale
		Number of beds	Number of beds	Ratio scale
		Number of baths	Number of baths	Ratio scale
		Built year	Year the house was built	Ratio scale
		Parking availability	Divided into no parking (0) and parking available (1) (ref.no parking)	(0, 1)
	Surrounding environment characteristics	Primary school rating	Based on research conducted by GreatSchools.org, an independent non-profit organization, It is based on four levels of the School Assessment Scale: Student Progress Rating or Academic Progress Rating, College Readiness Rating, Equity Rating, and Test Score Rating.	Ratio scale
		High school rating		Ratio scale
		Distance to park	Distance to the nearest park (mile)	Ratio scale
		Distance to general hospital	Distance to the nearest general hospital (mile)	Ratio scale
	Crime frequency		Indicates the number of crimes (only violent or more serious crimes) from 2001 to 2023 for the zip code belonging to the property.	Ratio scale
	Population		Average 2020 population of the zip code in which the property belongs	Ratio scale
	Region		Within1 (0) & exceed1 (1) mile of station dummy (ref.within1 mile)	(0, 1)

Analysis Method

Multiple Regression analysis(Hedonic Model)

Considers the impact of multiple independent variables on the dependent variable. However, it fails to take spatial correlation into account.

$$Y = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \cdots + \beta_n X_n + \epsilon$$

$X_1 - X_n$: *Distance to station variable, Housing characteristic variable, Surrounding environment characteristics varaiable, Crime frequency variabl, Population varaible, Region variable*

Geographically Weighted Regression (GWR)

Generates regionally different regression models by taking into account the spatial characteristics of the data

$$y_i = \beta_0(u_i, v_i) + \sum_k^p \beta_k (u_i, v_i) x_{ik} + \varepsilon_i$$

(u_i, v_i) are the geographical coordinates.

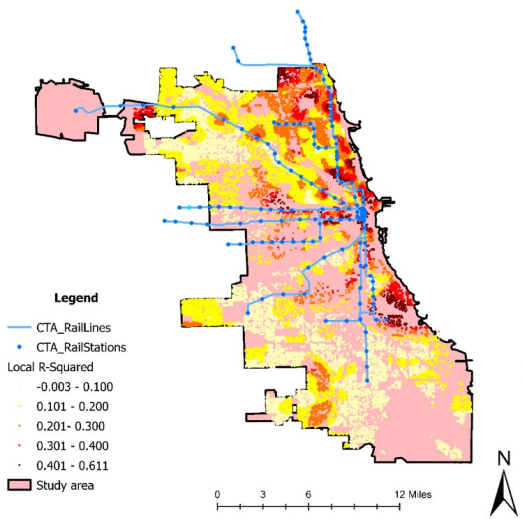
04
ANALYSIS RESULT

Analysis Result

		All areas of Chicago						Area within 1 mile of L train						Area 1 mile outside of L train					
		Multiple Regression Analysis			GWR Coefficient(β)			Multiple Regression Analysis			GWR Coefficient(β)			Multiple Regression Analysis			GWR Coefficient(β)		
		R	β	VIF	Min	Max	Mean	R	β	VIF	Min	Max	Mean	R	β	VIF	Min	Max	Mean
Distance to station(sqft)		-11.373***	-0.138	2.870	-838.2	737.5	6.1	-24.014***	0.052	1.157	-905.2	608.2	5.5	-10.141**	-0.18	1.2	-205.600	162.40	3.800
Housing characteristics	Area for exclusive use	-0.023***	-0.208	3.601										-0.054***	-0.52	1.9			
	Number of beds	-0.152	-0.002	2.922	-32.4	33	2.7	-5.147***	-0.06	3.313	-34.5	32.6	5.1	5.754***	0.089	1.71	-19.900	24.600	-0.455
	Number of baths	29.524***	0.285	3.750	-44.6	79	3.4	21.024***	0.224	3.062	-47.5	79.4	6.7	26.178***	0.298	1.99	-22.700	35.100	-1.220
	Built year	0.38***	0.137	1.219	-1.24	7	0.137	0.404***	0.159	1.167	-0.85	6.7	0.276	0.250***	0.101	1.2	-1.750	1.740	-0.039
	Parking availability (ref.no parking)	20.173***	0.065	1.133	-103.1	67.5	9.6	18.031***	0.062	1.164	-82.9	64.2	9.1	22.588***	0.092	1.06	-103.100	67.400	9.600
Surrounding environment characteristics	Primary school rating	6.108***	0.132	1.442										6.167***	0.167	1.550			
	High school rating	3.000***	0.060	1.327				2.065***	0.047	1.37				-0.325	-0.01	1.09			
	Distance to park	-19.019***	-0.036	1.248	-666.5	1284.5	-1.46	-7.421	-0.011	1.056				-21.42***	-0.07	1.08	-208.000	149.100	2.000
	Distance to general hospital	-7.535***	-0.086	1.416	-864	476.2	-3.7	-9.338***	-0.059	1.277	-710.2	519.6	-5.3	-2.295***	-0.050	1.3	-186.700	189.000	-0.390
Crime frequency		-0.007***	-0.271	1.684				-0.012***	-0.325	1.893				-0.005***	-0.36	1.68			
Population		0.0001***	-0.018	1.487				0.0001***	-0.025	1.76				0.001***	0.146	1.35			
Witin 1 & exceed 1 dummy (ref.=witihn 1 mile)		-35.016***	-0.156	3.069															
Constant		-477.902***			-13834.2	2627.4	-44.6	-492.285			-13185.4	2232	-283	-288.847***			-3253.000	3655.600	255.400
N		47,914			44,109			27,887			25,398			20,027			18,712		
AICc		434299			492361.949			280,510			286,855.24			148,026			205,081		
R2		0.410			0.646			0.304			0.615			0.358			0.426		
Adjusted R2		0.409			0.629			0.304			0.596			0.358			0.399		

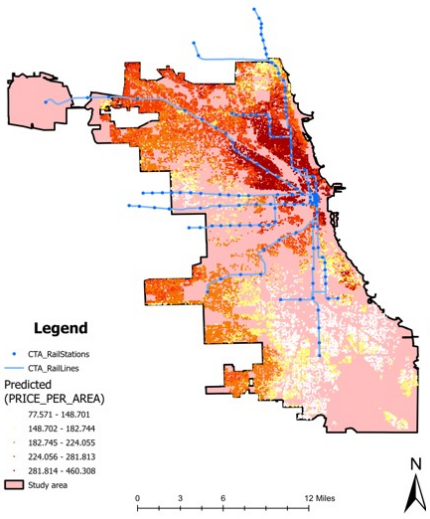
Analysis Result : All Areas of Chicago

R-square



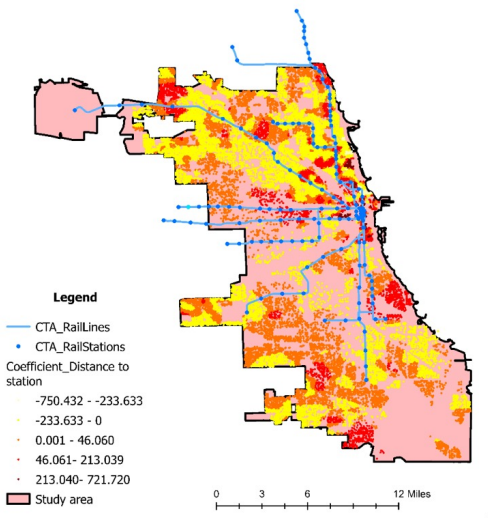
Explanatory power of the model. The higher it is, the higher the explanatory power.

Prediction

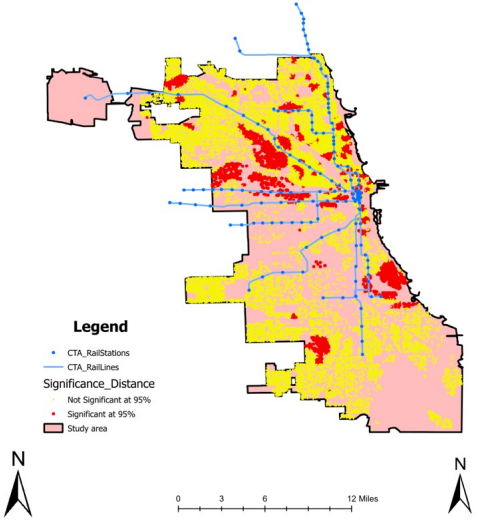


Prediction of price.
The higher it is,
the higher the housing price.

Coefficient for distance to station



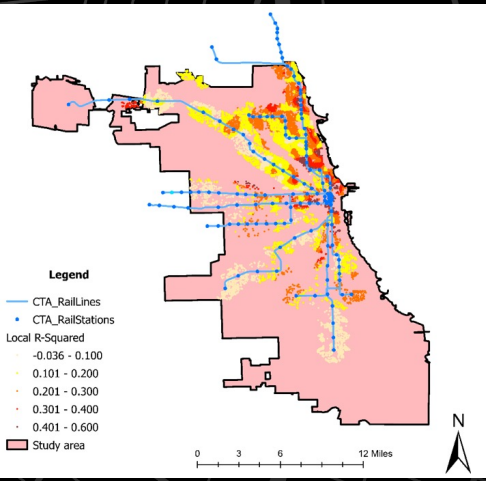
Significance for distance to station



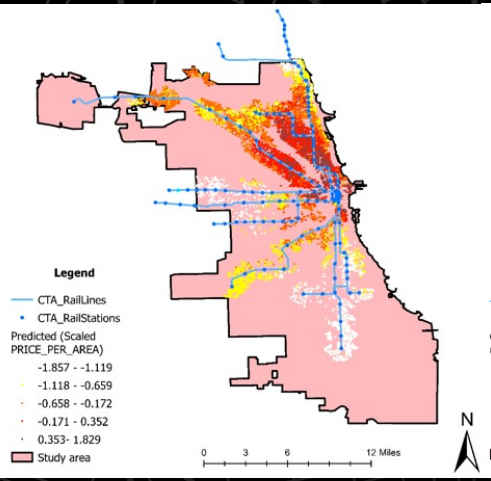
The relationship between housing prices and distance to the station. A low coefficient means that the closer the distance to the station, the higher the housing price, and a high coefficient means that the farther the distance from the station, the higher the housing price.

Analysis Result : Within 1 Mile of Chicago L Train Station

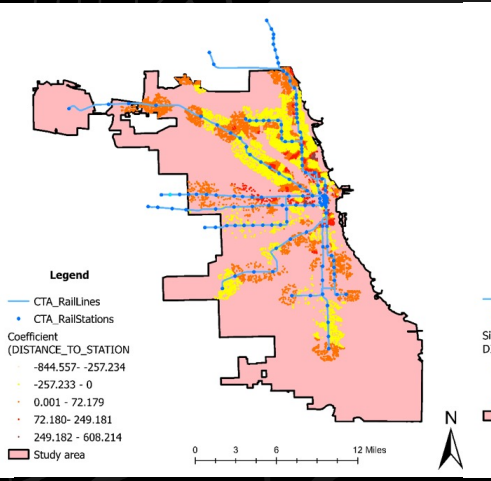
R-square



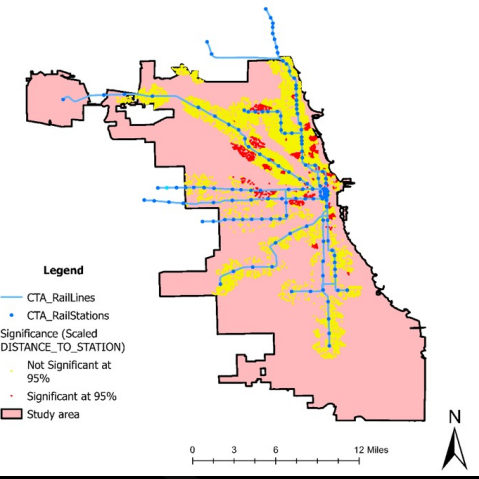
Prediction



Coefficient for distance to station

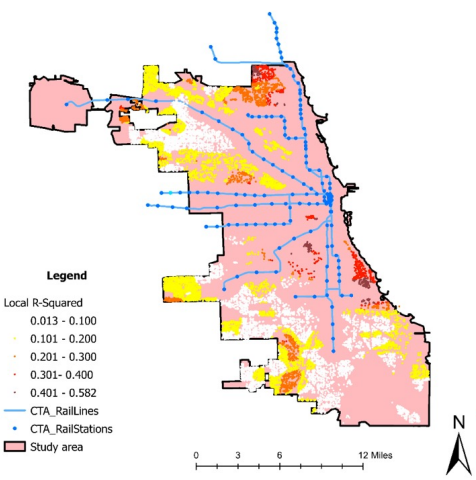


Significance for distance to station

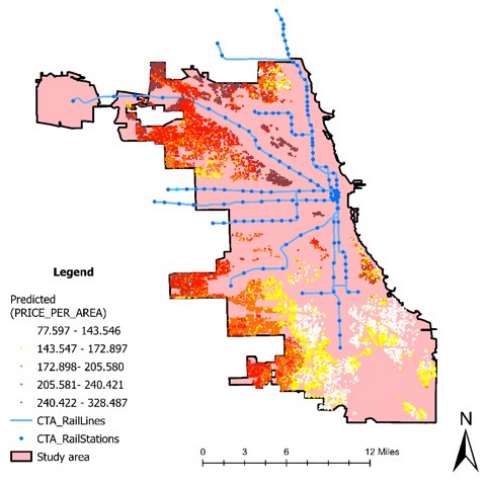


Analysis Result : 1 Mile Outside Chicago L Train

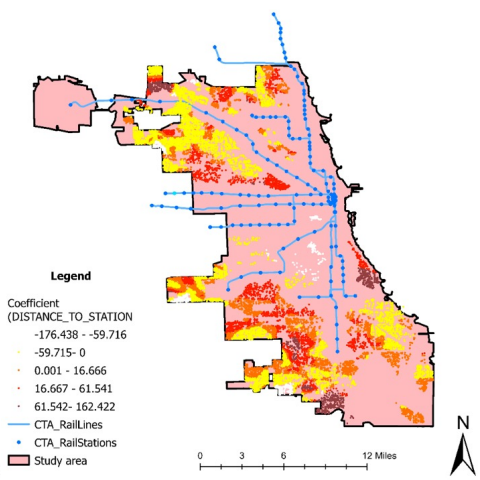
R-square



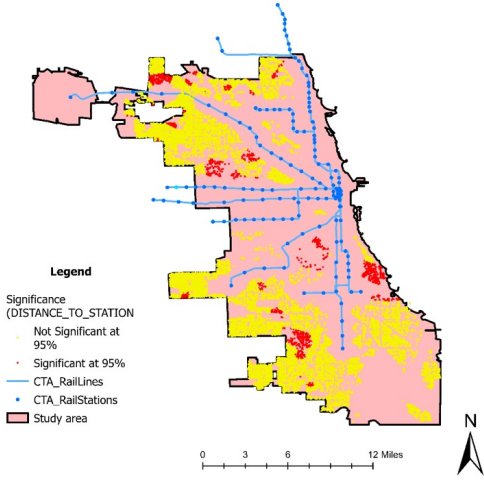
Prediction



Coefficient for distance to station



Significance for distance to station

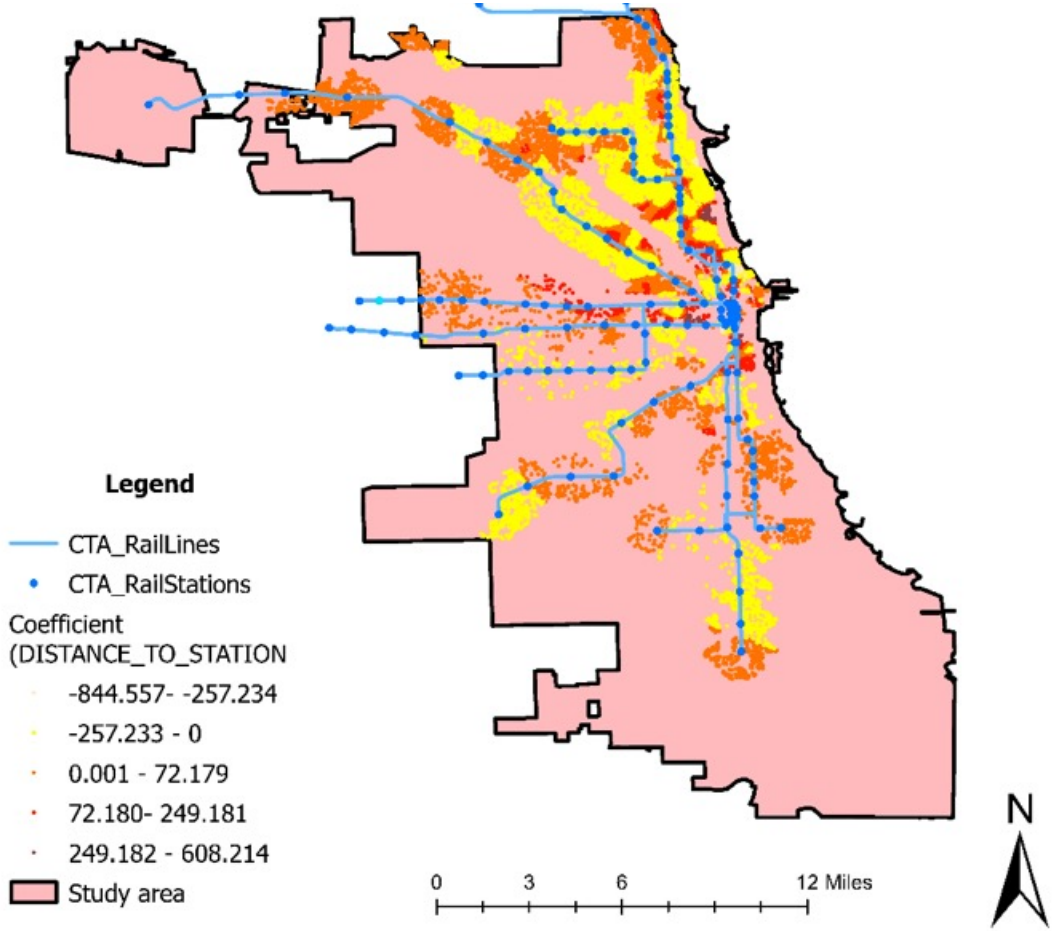


05
Conclusion

1. The impact of Chicago's L Train is greater in the north than in the south.

Public transportation tends to be more effective in high-income areas (Seo et al., 2014 ; Hess & Almeida., 2017)

Local coefficient estimates for “distance to station” within 1 mile of the Chicago L Train

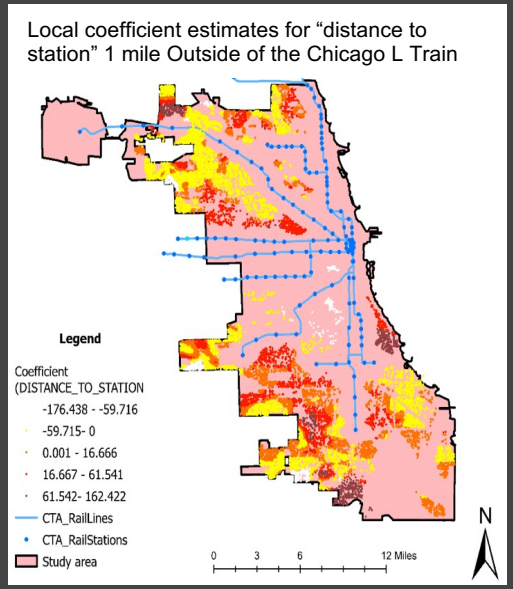


Failing to provide detailed regional explanations

1. The impact of Chicago's L Train is greater in the north than in the south.

Public transportation tends to be more effective in high-income areas (Seo et al., 2014 ; Hess & Almeida., 2017)

		All areas of Chicago					
		Multiple Regression Analysis			GWR Coefficient(β)		
		P	β	VIF	Min	Max	Mean
Distance to station(sqft)		-11.373***	-0.138	2.870	-838.2	737.5	6.1
Housing characteristics	Area for exclusive use	-0.023***	-0.208	3.601			
	Number of beds	-0.152	-0.002	2.922	-32.4	33	2.7
	Number of baths	29.524***	0.285	3.750	-44.6	79	3.4
	Built year	0.38***	0.137	1.219	-1.24	7	0.137
	Parking availability (ref.no parking)	20.173***	0.065	1.133	-103.1	67.5	9.6
Surrounding environment characteristics	Primary school rating	6.108***	0.132	1.442			
	High school rating	3.000***	0.060	1.327			
	Distance to park	-19.019***	-0.036	1.248	-666.5	1284.5	-1.46
	Distance to general hospital	-7.535***	-0.086	1.416	-864	476.2	-3.7
Crime frequency		-0.007***	-0.271	1.684			
Population		0.0001***	-0.018	1.487			
Witin 1 & exceed 1 dummy (ref.=witihn 1 mile)		-35.016***	-0.156	3.069			
Constant		-477.902***			-13834.2	2627.4	-44.6
N		47,914			44,109		
AICc		434299			492361.949		
R2		0.410			0.646		
Adjusted R2		0.409			0.629		



2. GWR delivers results that are easy to understand and highly persuasive.
However, this may not apply in all regions.

		Area 1 mile outside of L train					
		Multiple Regression Analysis			GWR Coefficient(β)		
		B	β	VIF	Min	Max	Mean
Distance to station(sqft)		-10.141***	-0.18	1.2	-205.600	162.400	3.800
Housing characteristics	Area for exclusive use	-0.054***	-0.52	1.9			
	Number of beds	5.754***	0.089	1.71	-19.900	24.600	-0.455
	Number of baths	26.178***	0.298	1.99	-22.700	35.100	-1.220
	Built year	0.250***	0.101	1.2	-1.750	1.740	-0.039
	Parking availability (ref.no parking)	22.588***	0.092	1.06	-103.100	67.400	9.600
Surrounding environment characteristics	Primary school rating	6.167***	0.167	1.550			
	High school rating	-0.325	-0.01	1.09			
	Distance to park	-21.42***	-0.07	1.08	-208.000	149.100	2.000
	Distance to general hospital	-2.295***	-0.050	1.3	-186.700	189.000	-0.390
Crime frequency		-0.005***	-0.36	1.68			
Population		0.001***	0.146	1.35			
Witin 1 & exceed 1 dummy (ref.=witihn 1 mile)							
Constant		-288.847***			-3253.000	3655.600	255.400
N		20,027			18,712		
AICc		148,026			205,081		
R2		0.358			0.426		
Adjusted R2		0.358			0.399		

LIMITATION

Data collection Scope

3 year is too short

Not Using Rental Price

It is appropriate to use the rental price, but the transaction price was used.

THANKS

Do you have any questions?

References

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