Seattle Housing Values Report - 2015
City of Seattle
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FINAL REPORT

In the 1930s, the federal Home Owners' Loan Corporation (HOLC) created residential security maps that classified several Seattle neighbourhoods as "hazardous," a designation now known as redlining. These grades systematically restricted access to mortgage credit and discouraged investment in predominantly minority communities for decades (Mapping Inequality Project, 2016). Although these practices were outlawed under the Fair Housing Act of 1968, recent research suggests that their economic effects may persist, influencing present-day housing markets.

This report was prepared for the City of Seattle to evaluate whether properties located in historically redlined areas exhibited lower 2014 sale prices, after accounting for relevant housing characteristics. Understanding this relationship is essential for policymakers evaluating potential reparative measures and identifying communities that continue to bear the economic costs of past discriminatory policies.

This analysis uses administrative data from the King County Department of Assessments, including information on all residential properties sold in Seattle in 2014. The dataset provides sales prices, structural and property characteristics. These records were matched to historical HOLC map boundaries to identify if a home was in a neighbourhood historically graded "D."

The original dataset represents 10,508 residential transactions. To ensure accuracy and consistency across observations, variables required for the regression models, such as building area, home age, renovation status, and housing-type indicators, were retained only when reported. Variables with substantial missingness, like lot size, bedroom and bathroom count, were excluded to avoid selection bias.

The exclusion of the condominium indicator from the model was to avoid perfect multicollinearity among housing-type categories, serving as the reference group. Also excluded are properties that sold for at least 6.2 million, losing 10 entries. Upon manual observation, we noticed these were atypical transactions, likely multi-unit structures or misreported entries. After applying these criteria, the final analytical sample includes 10,497 homes, preserving a large and representative cross-section of the Seattle housing market. Because the selected variables had very low missingness, nearly all observations remained. These sales entries exerted disproportionate leverage on the estimated relationship between redlining and sale price, so we excluded them to obtain more representative estimates.

Descriptive Statistical Table for Seattle Housing Characteristics:

Dependent Variable (Y): Sales Price - price of the house in USD
Population and time = All homes sold in Seattle in 2014

Variable	Definition	Units	Mean	SD
Sale Price	Transaction price for each home sold in 2014.	USD	519135.4	388140.2
Redlined Area	1 = property located in a historically HOLC "D" (redlined) neighbourhood. 0 = not located in a redlined area.	1/0	0.139	0.346
Home Age	Calculated as (2014 minus year built).	Years	51.565	35.881
Building Area	The total interior living space of the home.	Sq. Ft	1557.353	840.142
Renovated	1 = home has been renovated, else = 0.	1/0	0.295	0.456
Single Family Home	1 = Dummy variable for single-family homes, else =0.	1/0	0.623	0.485
Townhome	1 = Dummy variable for townhomes sold, else = 0.	1/0	0.1387	0.346

The descriptive statistics reveal the average sale price for residential properties sold in 2014 was approximately $519,000, with a large standard deviation that highlights substantial variation across neighbourhoods and property types. About 14% of homes are located in historically redlined areas, providing a meaningful sample for assessing legacy effects.

Homes are typically 52 years old and average around 1,560 square feet, indicating considerable variation in age and size - two factors known to influence housing values and therefore essential controls in our models. Roughly 29% of properties have been renovated, and the distribution of housing types reflects Seattle's diverse housing stock.

Overall, the dataset captures broad heterogeneity in price, structure, and neighbourhood characteristics, offering a strong foundation for examining whether historical redlining continues to shape contemporary housing values.

Models:

This report estimates two regression models: one with sale price in dollars and one with the natural log of sale price. The level model is useful for understanding dollar differences in value, while the log model expresses effects in percentage terms and reduces the influence of extremely high-priced homes. Comparing the two helps city officials see both absolute and proportional gaps in housing values.

Economic theory predicts that neighbourhood quality, structural characteristics, and housing amenities influence property values. Larger homes provide more living space and therefore higher utility, so their prices should be higher. Older homes may carry architectural or historical value that buyers are willing to pay for. Renovations improve the quality of the structure and are expected to raise value. For housing type, condominiums

serve as the reference category; therefore, coefficients on single-family homes and townhomes reflect the expected price differences relative to condominiums. Redlined neighbourhoods are included as an indicator of neighbourhood quality. If such areas differ systematically from others in amenities or perceived desirability, theory suggests this may be reflected in prices.

Appropriated Coefficients for Dummy Variables from the log linear model.

Based on Model 4: Log Trimmed

Variable	**Coefficient (β)**	**Percentage Change**
Redlined	-0.1573	-14.6%
Renovated	0.00442	+0.44%
Single-family home	0.06070	+6.26%
Townhome	0.1966	+21.7%

Results

Effects of Housing Characteristics on Home Sale Price (Seattle, 2014)

We eliminated the outliers in trimmed models 3 and 4 to eliminate inaccuracies or unusual transactions, which affect the multiple regression model's estimation and assumption. Eliminating these outliers stabilizes the models, reflecting a more precise relationship between independent variables and house sales price.

	Model 1: Level Full	**Model 2: Log Full**	**Model 3: Level Trimmed**	**Model 4: Log Trimmed**
Intercept	37961.804*	12.192***	52828.500***	12.073***
	(15881.376)	(0.026)	(7825.845)	(0.020)
Homes located in redlined neighbourhoods	-78789.728***	-0.178***	-71660.038***	-0.157***
	(6766.145)	(0.014)	(3977.474)	(0.012)
Age of home (years)	1159.318***	0.001***	948.336***	0.002***
	(146.013)	(0.000)	(72.031)	(0.000)
Building area (sq ft)	336.174***	0.000***	276.192***	0.000***
	(10.655)	(0.000)	(3.833)	(0.000)

Home recently renovated	-6115.994	-0.012	8838.863	0.004
	(14399.881)	(0.023)	(7045.268)	(0.015)
Single-family home	-130215.888***	0.083*	-46879.989***	0.061**
	(23063.240)	(0.033)	(9538.315)	(0.022)
Townhome	-59822.334***	0.165***	9211.612	0.197***
	(16636.857)	(0.027)	(7997.825)	(0.020)
Num.Obs.	10497	10497	10049	10049
R2	0.479	0.382	0.554	0.413
R2 Adj.	0.478	0.382	0.554	0.413
RMSE	280213.16	0.50	170101.95	0.44

Note: Standard errors are heteroskedasticity-robust (HC1).
*p < 0.05; **p < 0.01; ***p < 0.001

We eliminated the outliers in trimmed models 3 and 4 (Technical Appendix) omitting inaccuracies or unusual transactions, which affect the multiple regression model's estimation and assumptions. Eliminating these outliers stabilises the models, reflecting a more linear relationship between independent variables and house sales price.
After estimating the full model, we removed additional price outliers using diagnostic plots, reducing the analytic sample to 10,049 observations.

Across all models, homes located in historically redlined neighborhoods sell for substantially less than comparable homes elsewhere in Seattle. In the trimmed linear model, homes in redlined areas sell for about $71,660 less, on average, after controlling for size, age, renovation, and housing type. The trimmed log model shows a similar pattern, estimating redlined homes sell for 14.6% less than otherwise similar homes. These findings are statistically significant at the 0.1% level, unlikely due to chance.

Other housing characteristics also show consistent patterns. Larger homes sell for more: each additional square foot adds approximately $276 in the trimmed linear model and increases price by about 0.05% in the log model. Older homes tend to sell for more, with every increasing year, by $948, on average. This may reflect the value of older architecture or desirable locations where older homes are concentrated.

Controlling for all other characteristics, constant, single-family homes sell for 6.3% more, and townhomes sell for 21.7% more, according to the trimmed log model, showing a strong

preference for them relative to condominiums. Renovation has no statistically significant effect in any model.

Together, these results provide clear evidence that historical redlining continues to affect home prices today, even after controlling for key features of each property. (Glaeser & Gyourko, 2014).

Implications

The analysis reveals a substantial and statistically significant price penalty for homes in historically redlined areas. After controlling for structural characteristics and removing influential outliers, homes in these neighborhoods sold for approximately 14.6% less than comparable homes in non-redlined areas in 2014. This corresponds to a price discount of roughly $71,660 in the trimmed linear model.

These findings suggest that the economic legacy of redlining persists nearly eight decades after the discriminatory practice began. The persistent price gap likely reflects multiple factors: decades of systematic disinvestment in infrastructure, reduced access to mortgage credit, lower-quality public services in these neighbourhoods, and possibly continued social stigma or reduced neighbourhood desirability.

The results are consistent across multiple model specifications, strengthening the evidence that historical redlining continues to influence housing markets in Seattle. While this analysis establishes correlation rather than causation, the magnitude and statistical significance of the effect warrant attention from policymakers considering measures to address historical inequities

Limitations

A notable limitation is that our analysis does not account for environmental hazard exposure, which varies sharply across Seattle neighbourhoods and strongly influences property values. For example, South Park and Georgetown, both historically redlined, lie along the industrialised stretch of the Duwamish River and are repeatedly identified in city flood hazard maps as high-risk areas. Homes in these neighbourhoods face a combination of flooding, poor air quality, and proximity to active industrial sites.

Other redlined or formerly redlined areas also overlap with steep slopes or landslide-prone zones that fall under the city's Environmentally Critical Areas classification, which reduces land desirability and property values. Because our dataset contains no information on floodplain status, industrial pollution exposure, or landslide risk, part of the price difference we attribute to historical redlining may instead reflect these unmeasured geographic hazards that independently depress housing prices.

Sources

Nelson, R. K., Winling, L, et al. (2023). Mapping Inequality: Redlining in New Deal America. Digital Scholarship Lab.

References

Gujarati, D. N., & Porter, D. C. (2014). *Basic Econometrics* (5th ed.). McGraw-Hill.

Geltner, D., Miller, N., Clayton, J., & Eichholtz, P. (2014). *Commercial Real Estate Analysis and Investments* (3rd ed.). Cengage Learning.
Glaeser, E., & Gyourko, J. (2014). The impact of building restrictions on housing affordability. *Journal of Urban Economics*, 75, 20–38.
Rothstein, R. (2014). *The Color of Law: A Forgotten History of How Our Government Segregated America*. Liveright Publishing.
Sirmans, G. S., Macpherson, D. A., & Zietz, E. N. (2014). The composition of hedonic pricing models. *Journal of Real Estate Literature*, 22(1), 3–44.
City of Seattle. (2023). Seattle climate vulnerability assessment. Seattle, WA: City of Seattle.

AI Declaration

We acknowledge the use of ChatGPT (OpenAI) to assist with editing language and checking R code formatting. All statistical analysis, model selection, and substantive interpretations were conducted by the authors.

Technical Appendix

BP Test (Breusch–Pagan Tests)

The Breusch–Pagan test was used to evaluate whether each model satisfies the assumption of homoskedasticity. All four models strongly reject the null hypothesis of constant variance.

Model	BP Statistic	p value	Conclusion
Model 1 (Level Full)	406.21	< 0.001	Heteroskedasticity detected
Model 2 (Log Full)	62.84	< 0.001	Heteroskedasticity detected
Model 3 (Level Trimmed)	866.17	< 0.001	Heteroskedasticity detected
Model 4 (Log Trimmed)	50.86	< 0.001	Heteroskedasticity detected

Since homoskedasticity is rejected in all cases, all statistical inference relies on heteroskedasticity-robust (HC1) standard errors.

Robust Standard Error Matrix (HC1)

Covariate	Model 1 SE	Model 2 SE	Model 3 SE	Model 4 SE
Intercept	15881.376	0.026	7825.845	0.020
Redlined Area	6766.145	0.014	3977.474	0.012
Home Age	146.013	0.000	72.031	0.000
Building Area (sq ft)	10.655	0.000	3.833	0.000

Renovated	14399.881	0.023	7045.268	0.015
Single-family home	23063.240	0.033	9538.315	0.022
Townhome	16636.857	0.027	7997.825	0.020

Regression Models

Model 1: salespriceamount
Residuals:

Min	1Q	Median	3Q	Max
-221107	-122775	-15336	85612	5247153

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	3.796e+04	1.360e+04	2.792	0.00525
redlined	-7.879e+04	7.989e+03	-9.862	<2e-16
Home_Age	1.159e+03	1.069e+02	10.848	<2e-16
buildingareasqft	3.362e+02	3.801e+00	88.437	<2e-16
Renovated	-6.116e+03	1.227e+04	-0.498	0.61831
Single_family	-1.302e+05	1.554e+04	-8.381	<2e-16
Townhome	-5.982e+04	1.446e+04	-4.136	3.57e-05

Signif. codes: 0 ‘’ ***0.001*** ‘’ *0.01* ” 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 280300 on 10490 degrees of freedom Multiple R-squared: 0.4788, Adjusted R-squared: 0.4785 F-statistic: 1606 on 6 and 10490 DF, p-value: < 2.2e-16

Model 2: log(salespriceamount)
Residuals:

Min	1Q	Median	3Q	Max
-6.4004	-0.2003	0.0455	0.256	2.8951

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	1.219e+01	2.440e-02	499.773	<2e-16

redlined	-1.782e-01	1.433e-02	-12.430	<2e-16
Home_Age	1.109e-03	1.918e-04	5.781	7.64e-09
buildingareasqft	4.324e-04	6.820e-06	63.400	<2e-16
Renovated	-1.239e-02	2.202e-02	-0.563	0.57360
Single_family	8.339e-02	2.788e-02	2.992	0.00278
Townhome	1.649e-01	2.595e-02	6.355	2.17e-10

Signif. codes: 0 ‘***0.001**” 0.01 ” 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.5029 on 10490 degrees of freedom Multiple R-squared: 0.3819, Adjusted R-squared: 0.3816 F-statistic: 1080 on 6 and 10490 DF, p-value: < 2.2e-16

Model 3: salespriceamount Trimmed

Residuals:

Min	1Q	Median	3Q	Max
-721587	-98626	-6346	85921	925772

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	52828.500	9135.639	5.783	7.57e-09 ***
redlined	-71660.038	4953.648	-14.466	< 2e-16 ***
Home_Age	948.336	68.431	13.858	< 2e-16 ***
buildingareasqft	276.192	2.956	93.426	< 2e-16 ***
Renovated	8838.863	8226.055	1.074	0.283
Single_family	-46879.989	10352.296	-4.528	6.01e-06 ***
Townhome	9211.612	9458.170	0.974	0.330

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 170200 on 10042 degrees of freedom
Multiple R-squared: 0.5539, Adjusted R-squared: 0.5536
F-statistic: 2078 on 6 and 10042 DF, p-value: < 2.2e-16

Model 4: log(salespriceamount) Trimmed

Residuals:

Min	1Q	Median	3Q	Max

-6.4342	-0.1913	0.0460	0.2488	1.3150

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	1.207e+01	2.387e-02	505.693	< 2e-16 ***
redlined	-1.573e-01	1.295e-02	-12.151	< 2e-16 ***
Home_Age	1.615e-03	1.788e-04	9.033	< 2e-16 ***
buildingareasqft	4.920e-04	7.726e-06	63.690	< 2e-16 ***
Renovated	4.420e-03	2.150e-02	0.206	0.8371
Single_family	6.070e-02	2.705e-02	2.244	0.0249 *
Townhome	1.966e-01	2.472e-02	7.953	2.02e-15 ***

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.4447 on 10042 degrees of freedom
Multiple R-squared: 0.4132, Adjusted R-squared: 0.4128
F-statistic: 1178 on 6 and 10042 DF, p-value: < 2.2e-16