Investigating the influence of cycleway infrastructure on residential property prices

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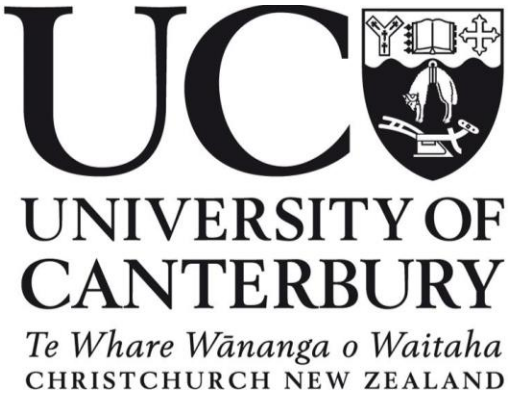

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Executive summary

Introduction

Homeowners have opposed the building of cycleways on their street as they claimed the loss of on-street parking will negatively impact property prices. This project explored the relationship between cycleways and residential property prices to evaluate the validity of this claim.

Method

A Hedonic model was used to analyse the city-wide effects of cycleways. The hedonic model estimates the relative influence of multiple variables, including cycleway density, on market value. The street level impact of cycleways was found using a street level model. This used properties on and close to a cycleway sold before and after the cycleway was built. Interviews with property developers and real estate agents were undertaken to understand stakeholder perception of cycleways.

Results

The hedonic model found a statistically significant positive correlation between cycleway density and market value at a rate of $\$55.06/m/km^2$. Cycleway density attributed a 0.2% ($997 NZD) increase in property prices. $1.52M of the 2024/25 rates collected by the Christchurch City Council can be attributed to cycleways. The street-level analysis found no statistically significant relationship. Stakeholder interviews found cycleways were not considered in the decision-making process as other factors, on-street parking, took priority.

Limitations

The applicability of these results to other New Zealand cities is unknown. The hedonic model did not consider spatial autocorrelation, and its predictive power was limited for higher market values. The street-level analysis had a small sample size (~200 sales). Selection bias and limited participants may have skewed the stakeholder interview findings.

Conclusion

Cycleway density has a positive effect on house prices city-wide. This opposes the view of local homeowners who oppose cycleway infrastructure development. However, the same effect is not perceived at the street level. These results can inform local decision makers and key stakeholders.

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Introduction

As people become increasingly interested in environmentally friendly actions, many city planners and officials are required to address problems such as traffic congestion, housing availability, and urban sprawl with more sustainable solutions (FAO, 2020). A proposed solution for reducing traffic congestion is increased bicycle infrastructure. Increased commuter access to alternative transport methods to driving are intended to improve community liveability and green score, while reducing carbon emissions (Gotschi, 2011). Developing greener cities have a positive effect on biodiversity, climate, community wellness, and air quality (Williams, 2010). These are large infrastructure investments and understanding the economic impact of these investments is vital for city planners when evaluating the economic viability of these projects.

An important concern for council officials and property owners alike is the impact infrastructure projects have on property values. The building of on-street bicycle infrastructure (cycleways) has received complaints from residents on the streets that cycleways are being built on due to the perceived negative influence of cycleways on property value (Field, 2018). Most available literature on the relationship between residential property prices and bicycle infrastructure are focused on American cities (Conrow et al., 2020; Welch et al., 2016). Christchurch, New Zealand was chosen to apply research methods of existing studies to evaluate how property prices are influenced by bicycle infrastructure in New Zealand. Christchurch is a suitable choice to understand this relationship in New Zealand due to the cities' well-developed bicycle network.

The Christchurch city bicycle infrastructure network is broken down into cycleways, cycle lanes, and shared paths. Each can be expected to have a different effect on property prices. Cycleways are a designated lane on the road for cyclist physically separated from the road via a buffer. Cycle lanes are a cyclist only lane on the road separated from traffic via a painted line on the road. Shared paths are available for both pedestrians, cyclists, and the public, typically separated from the road on a footpath (NZTA, 2024).

Figure 1-3: A cycleway, cycle lane, and shared path respectively (NZTA, 2024).

This research project evaluates the relationship between bicycle infrastructure and residential property prices in Christchurch, New Zealand. This research contributes to the existing literature and applies research methods to a New Zealand city. The results of this research can be used by local New Zealand councils to help develop research-informed decision making about future infrastructure projects and how they can influence property values.

Literature Review

In New Zealand, housing is often the largest expense in an individual's life (StatsNZ, 2023). This makes the market value of a property highly important. Market value (the price a house can be expected to sell for) is influenced by household characteristics (property size, number of bathrooms, age of house etc.), perceived value of amenities available in the area (parks, bicycle infrastructure etc.), and neighbourhood characteristics (school zones, crime rate, median income etc.) (Conrow et al., 2020). Favourable circumstances of these three factors will increase the market value, and thus increase an individual's return on their property investment. Local councils also have interest in increasing market value, as capital value (which yearly rates are based on) is calculated from property market value at a specific date in time. Yearly rates account for around 1/2 of income for Christchurch City Council (CCC, 2023). Thus, higher rates increase council income and allow further projects to be undertaken in the community.

Previous studies have used a hedonic pricing model to find that proximity to bicycle infrastructure had a statistically significant small positive impact of residential property prices when accounting for additional impacts on property prices (number of rooms, crime rate, school zones etc.) (Conrow, 2020; Liu & Shi, 2017). The extensiveness (density) of bicycle infrastructure indicates the completeness of bicycle infrastructure surrounding a property and can indicate ease of transport via cycling in an area. Previous studies have shown extensiveness of bicycle infrastructure has a negligible or positive and statistically significant effect on property prices in hedonic pricing models. (Choi et al., 2021; Conrow, 2020; Liu & Shi, 2017; Vega et al., 2024; Welch et al., 2016). Research into variables influencing property prices found that School zones, crime rates, the overall housing market, surrounding amenities and the satisfaction of the neighbourhood were control variables that impacted property prices (Bonakdar and Roos, 2022; 2022; Margaretic and Sosa, 2023; Rehm & Filippova, 2020).

Cycleways have been shown to have several positive effects (Gotschi, 2011). Benefits from more people cycling and less CO_2 emissions were found when cycle networks were constructed and less people chose to drive, it is estimated that Portland Oregon can avoid between 540 and 830 million metric tons of CO_2 (Gotschi, 2011; Mueller, 2018; Schepers, 2015). Mental health improvements were also found due to stress levels being reduced and people feeling healthier (Crane, 2016; Teixeira, 2020). Economic benefits were identified, Gotschi (2011) calculated investing 138 - 605 million USD by 2040 in Portland, Oregon would save between $7 – 12 billion USD in Statistical lives, a measurement to quantify the economic benefit of avoiding a fatality. McCoy et al. (2019) showed cycle infrastructure can also have benefits for commercial properties by increasing sales. Mueller (2018) found a cost-benefit saving ratio of 3.8 to 1.2 to 1 in European cities that invest in cycle infrastructure.
Past research that looked to calculate the effect transit corridors such as Mass Rapid Transit and cycleways had on property values were analysed (Mead, 2014). These papers could be split into two groups, cross-sectional studies that utilise a traditional hedonic model that take into account housing characteristics, locational amenities, and neighbourhood characteristics, and before-after studies that utilise a repeat-sales model that creates dummy variables for year and either a control group or a price gradient describing proximity to a transit network.

Method

Cycle infrastructure on housing prices were broken into two key areas. The first was the wider-scale cycle network effect. This was analysed using a hedonic model. The second was the effect of having a separated cycleway built directly adjacent to a property, removing on-street parking. This is a smaller scale effect and is typically what individual property owners are more concerned about as the loss of on-street parking has the potential to decrease property values. To analyse whether this is the case, we used a repeat-sales model to split properties into cycleway adjacent and non-cycleway adjacent groups. Lastly, stakeholder interviews were conducted with property developers and real estate agents to gain key knowledge on whether cycleways are considered in the property development and sales process.

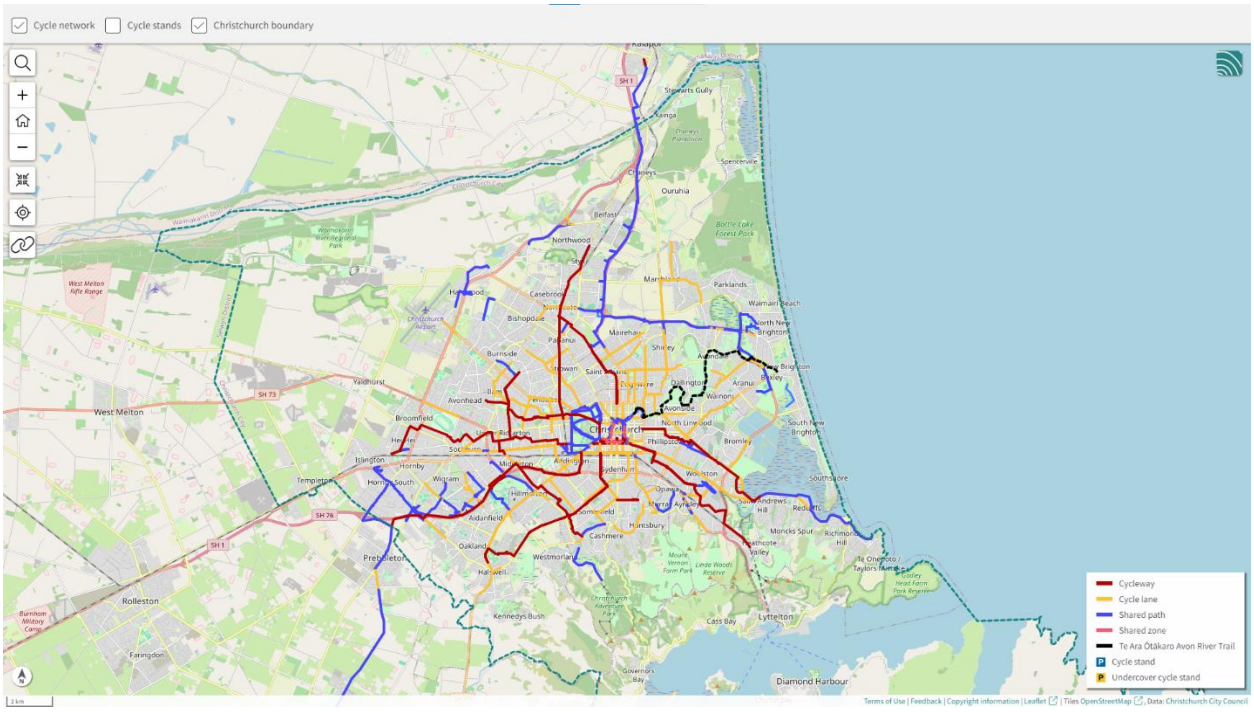

Figure 4: The Christchurch bike map as of 17/10/2024 (CCC, 2024).

Hedonic Model (Network effects)

A hedonic OLS pricing model was used to find the fractional impact of multiple variables on a single dependent variable. A hedonic model is commonly used in economics to evaluate the different influences on house prices. The defining equation of the hedonic model is:

$$P_i = \beta_o + \sum \beta_x V_{xi} + \varepsilon_i$$

Where P_i is the price of house i, β_x is the coefficient of variable x found by the hedonic model, V_{ij} is the value of variable x for house sale i and ε_i is model residual for house i. The independent variables considered in this model (fig. 8) were gathered from multiple sources. The household

characteristics and market value were derived from house sale data between 2012-2024 provided from the Christchurch City Council (CCC). Household variables were land area, floor area, age, and year of sale. The decade of construction was provided, the middle of the decade was used as the year of construction. This dataset was filtered to keep market sales of single-family houses in Christchurch city. The CCC data included section sales. These sales can be identified by having a large capital value relative to market value. This corresponded to a house built on a section between the capital value re-evaluations. Figure 5 motivated removing sales with a capital to market value ratio greater than 1.5. This removed ~2,000 section sales and kept ~60,000 property sales.

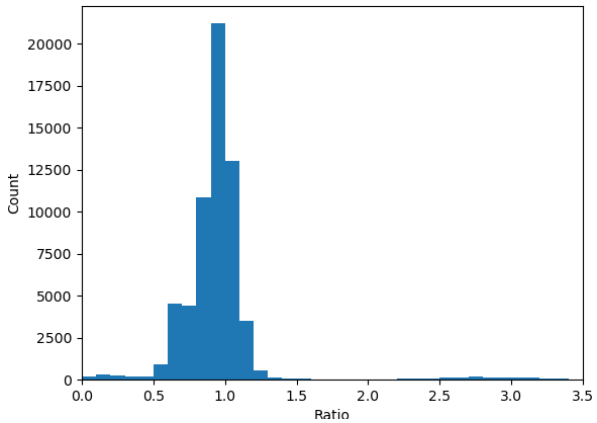

Figure 5: Histogram of capital to market value ratio. Ratio greater than 1.5 represents section sales.

The cycle characteristics was derived from cycleway data from the CCC. On-street cycle infrastructure is a combined category of cycle lanes and shared paths. Each property was matched to the nearest cycleway (fig. 6) and on-street cycle infrastructure, which represents access to cycle infrastructure. The density of cycle infrastructure is a measure of completeness of cycle infrastructure. A buffer of 1km was used to be in line with existing literature (Vega et al., 2024). The total length of cycleways and on-street cycle infrastructure within the 1km buffer around a house sale was found and normalized by area to find the density.

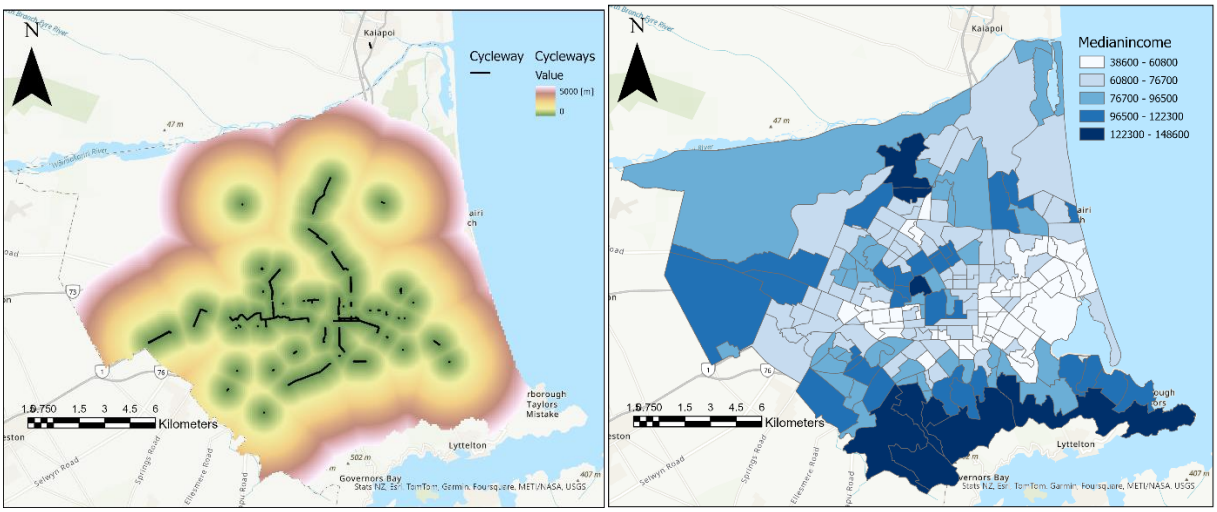

Figure 6-7: Distance to cycleways across Christchurch (left), distance is capped at 5km. Median household income by SA2 areal unit around Christchurch (right).

The neighbourhood characteristics accounted for socio-economic factors influencing property prices around the house sale. Distance to nearest bus stop was used as a measure of access to public transport, and distance to greenspace and waterways were included as a measure of an individual's access to nature. These datasets were provided by the CCC. The suburb level median household income (fig. 7) in 2018 was provided by StatsNZ. Quality of education was measured by decile of the primary (0-6), intermediate (7-8), and high school (9-13) zone the household was within. Zoning data was provided by Canterburymaps and decile data from the Ministiry of Education. For schools that cross multiple education levels (e.g. Middleton Grange School was Year 0-13), the school was included in each relevant education level. The assumption was that a child's eligibility to attend a school was the key factor parents considered when evaluating school zones during the property-buying process. The final neighbourhood variables considered were from the New Zealand Index of Multiple Deprivations (IMD). A weighted average of seven key domains of deprivation used to quantify deprivation in each data zone, a region of ~750 people, in New Zealand. The seven domains (employment, income, crime, housing, health, education, and access) have a normalized ranking for each data zones. This project used the crime and access domains due to their applicability to property prices.

Variable	Median	Mean	Standard Deviation
Dependent Variable			
Sold 2014 (3,018)	432,000	479,896	209,648
Sold 2015 (5,688)	430278	477350	189,879
Sold 2016 (5,226)	449,000	495,667	208,743
Sold 2017 (5,339)	446,660	502,586	217,932
Sold 2018 (6,213)	451,500	501,226	210,831
Sold 2019 (6,246)	462,500	511,150	213,970
Sold 2020 (7,756)	499,000	558,021	238,472
Sold 2021 (7,976)	607,125	648,039	243,555
Sold 2022 (4,797)	659,000	704,136	241,771
Sold 2023 (5,060)	652,000	699,623	231,267
Sold 2024 (1,990)	650,000	700,142	225,736
All Years (59,601)	512,000	565,161	238,647
Independent Variables			
Land Area	615.0	702.7	2148.0
Total Floor Area	120.0	137.1	59.4
Age	45	47	30
Cycleway Density	73.5	264.4	347.8
On-street Density	3866.2	2977.6	1614.6
Distance to Cycleways	735.5	920.4	780.4
Distance to On-street	145.5	188.1	227.9
Distance to Greenspace	133.0	154.9	113.8
Distance to Waterways	192.4	254.1	250.7
Distance to Bus Stops	188.0	233.3	201.1
Distance to CDB	3,111.0	3,456.9	2,444.7
Median Household Income	70,789	73,089	14,525
Primary School Decile	6.0	5.75	2.95
High School Decile	6.0	6.10	2.59
Access to Amenities Rank	2,885	2,904	1,629
Crime Rate Rank	2,698	2,770	1,681

Figure 8: Stats of variables considered in Hedonic model

The correlation of each independent variables with market value was considered. Non-correlated variables were removed, and market value outliers (±3σ) were removed.

Repeat-Sales Model (Effects of removing on-street parking)

Our second model focused on analysing any direct effects of protected cycleways on property values. To do this we used a longitudinal model to compare property values before and after the existing Christchurch MCR (Major Cycle Routes) were constructed. The model used was a repeat-sales model, adapted to fit the spatio-temporal difference-in-differences model format. The repeat sales model is a method used primarily in real estate and housing economics to estimate price changes over time by analysing properties that have sold multiple times. It is based on tracking the price of the same property across time, which controls for variations in neighbourhood characteristics, since the property itself remains the same. Therefore, characteristics such as school zones and deprivation can be ignored, as opposed to a hedonic model. However, household characteristics must still be considered in the model. Our study adapted the repeat-sales model to the spatio-temporal difference-in-differences (STDiD) format, wherein the dataset of properties is split into treatment and control groups. In this case, the control group is properties within 250m of a cycleway of focus, and the treatment group is properties directly adjacent to a cycleway of focus. The two groups can then be compared to see whether they have tracked prices at different rates or not. This is a model type has been used successfully in several other mobility route studies (Mead, 2014; Huang et. al., 2024).

To provide an effective before-after comparison, years with cycleway construction were removed to ignore the effects of cycleway construction on property value. Most of the major cycle routes (MCR) in Christchurch were constructed between 2017 to 2021. In this period, the South Express Cycleway (to Middlepark Rd), Quarryman's Trail Cycleway, Strickland St Cycleway, Heathcote Expressway (to Ensors Rd), and the Papanui Parallel Cycleway were all constructed. Therefore, the period of January 2017 to December 2021 was selected as the construction period, and cycleways constructed in this period selected as the cycleways of focus. Of these cycleways, those which have removed on-street parking (dedicated on-street cycleways) that are currently in service and with a length of more than 50 metres were selected for the analysis (fig. 9).

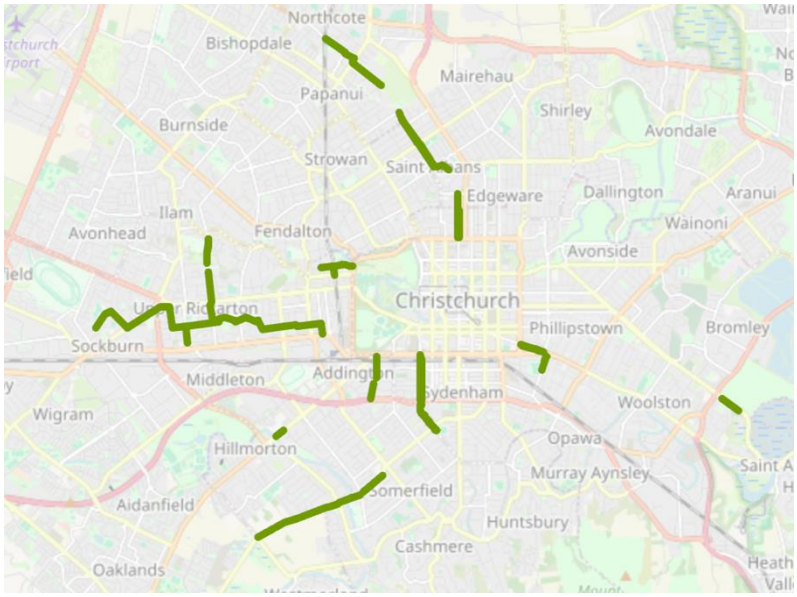

Figure 9: Location of cycleways of interest (on-street dedicated cycleways that have removed on-street parking)

Property sales were filtered to single-unit properties with a capital value less than $10m, within 250 meters of a cycleway of focus, a land area of less than 0.1km² and with index market sales. Addresses could then be filtered to those which had at least one sale between July 2012 and January 2017 and at least one subsequent sale between December 2021 and August 2024 (fig. 10).

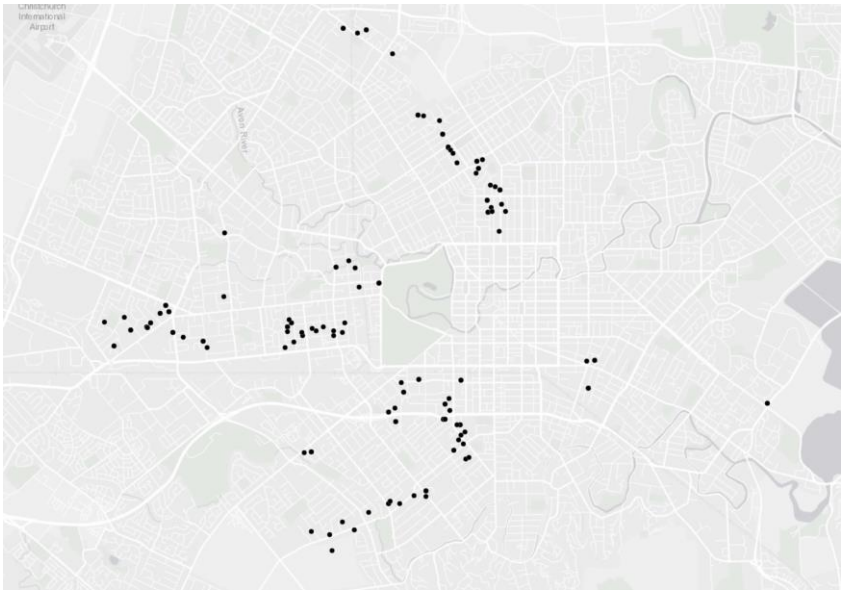

Figure 10: Location of addresses of interest

The resulting sales were joined with LINZ address data, which was then spatially joined with LINZ NZ property title data, so that the extent of the property could be known. If the property was adjacent to a street with a protected cycleway, it was placed in the treatment group.

Otherwise, it was placed in the control group (fig. 11). The definition of “adjacent” was if any area of property title was within 30m of the cycleway (30m spatial buffer).

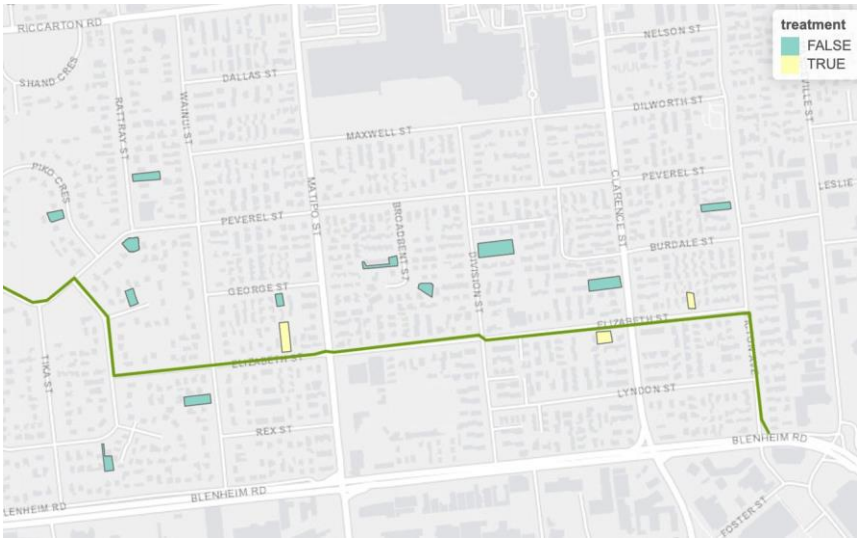

Figure 11: CCC Street Hierarchy data

Street hierarchy data was also gathered from the Christchurch City Council, as it is an important non-neighbourhood characteristic and covariate that is also likely to affect property value. Street hierarchy included collector, local, private, major arterial and minor arterial street types (fig. 12). Street type was assigned to properties in the same way the treatment/control group was.

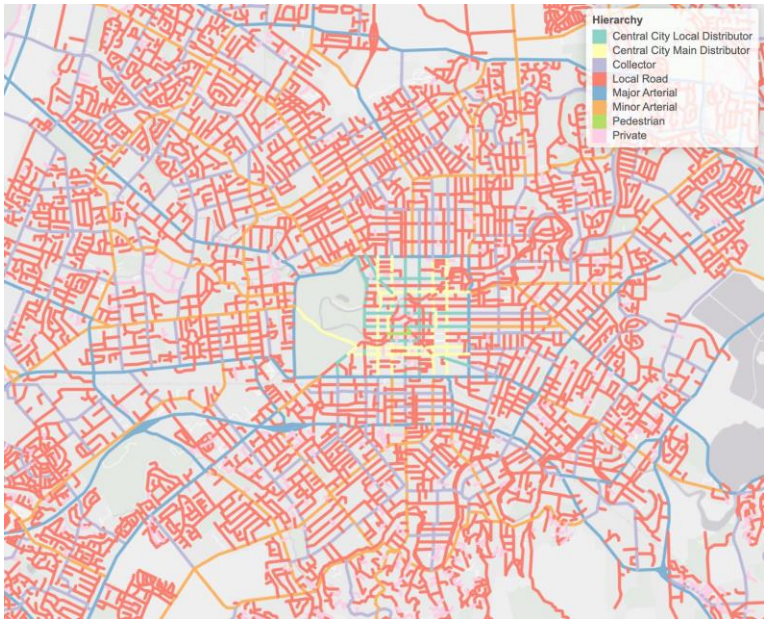

Figure 12: CCC Street Hierarchy data

Lastly, for all properties of interest, the sale price and valuation delta between the before and after sales were calculated. This is the dependent variable for the regression, which can be

used to find out whether property values have increased more for the control group than for the treatment group.

The regression was implemented as a linear regression with treatment group status as the focal independent variable. Non-housing characteristics were included as covariates. The sales data included the covariates year property was built, total floor area and land area, while street type was provided from the hierarchy data.

Stakeholder Interviews

Interviews to garner qualitative data on stakeholders' views on cycleways and the loss of parking took place. Five individuals were interviewed, four real estate agents and one property developer, all based in Christchurch and working within the residential sector. All questions were open ended to avoid leading questions. Each interview was recorded to create a transcript. Prior to interviews and recordings/transcripts taking place, the required ethics and permissions were followed adhering to the University of Canterbury requirements (Rapley, 2001).

The results of the key stakeholder interviews were compared to how property listings were advertised. The keyword “Cycleway” was searched in the property section. Properties in Christchurch that advertised cycleways as a positive feature for the property were put into an ArcGIS layer. A map of 20 properties was then produced showing the location of cycleways and property listings that advertised cycleways in Christchurch.

Results

Hedonic Model (Network effects)

Single variable regression on independent variables showed, distance to bus stops, greenways, waterways, cycleways, and on-street infrastructure, intermediate and primary school decile had no correlation with market value. Unlike similar studies, land area was found to have no correlation with market value. Likely this result was due to an error in the housing data. Hedonic model results showed a statistically significant positive correlation between cycleway density and market value. Re-examination of the locations of high cycleway density showed they were close to the central business district (CBD). Thus, distance to the CBD may be the causal variable. Distance to the CBD was introduced as a neighbourhood characteristic. This slightly improved the model fit (0.627 vs 0.631). The coefficient for cycleway density decreased implying the distance to CBD influenced the first cycleway density coefficient.

Variable	OLS 1	OLS 2	OLS 3	OLS 3 B_{xy}
Land Area	N/A	N/A	10.07***	0.0897
Total Floor Area	2,284.7***	2,295.2***	2,168.5***	0.5405
Age	-249.4***	-318.5***	-416.5***	-0.0554
Sold 2014	13,689	11,713	14,410	0.0123
Sold 2015	14,963*	12,897	16,216	0.0194
Sold 2016	33,779***	32,405***	37,791***	0.0442
Sold 2017	35,370***	33,533***	39,445***	0.0473
Sold 2018	39,573***	38,456***	39,624***	0.0504
Sold 2019	46,818***	45,066***	50,426***	0.0636
Sold 2020	95,799***	93,728***	96,393***	0.1355
Sold 2021	203,097***	200,322***	219,046***	0.3073
Sold 2022	252,448***	251,072***	274,006***	0.3115
Sold 2023	248,920***	247,465***	272,258***	0.3205
Sold 2024	N/A	262,675***	287,260***	0.2155
Cycle Characteristics				
Cycleway Density	46.91***	36.5***	55.06***	0.0710
On-street Density	15.47***	8.07***	9.44***	0.0593
Neighbourhood Characteristics				
Distance to Greenspace	159.3***	132.1***	143.0***	0.0683
Distance to CDB	N/A	-8.89***	-12.53***	-0.1248
Median Household Income	2.29***	2.24***	2.29***	0.1426
High School Decile	6,796***	6,664***	9,295***	0.0973
Access to Amenities Rank	23.56***	24.03***	11.13***	0.0766
Crime Rate Rank	-38.18***	-39.54***	-27.94***	-0.1974
Intercept	-98,148***	-27,978***	-12,722	N/A
Observations	59,601	59,601	41,437	N/A
R^2	0.627	0.631	0.677	N/A
Adjusted R^2	0.627	0.631	0.677	N/A
AIC	1.586e+6	1.586e+6	1.098e+6	N/A

Figure 13: Value of coefficient associated with each hedonic model. Final column is the regression coefficient of x on y of the third OLS model. *=p<10%, **=p<5%, ***=p<1%

Year of sale was a dummy variable used to capture market inflation. Comparision of the coefficient of each year in the hedonic model (fig.13) with the median house sale price (fig. 8) showed the model captured market inflation. Figures 14-15 show a scatter plot of observed and model market value. Figure 14 shows the model predicts market value better at lower prices with higher prices being underpredicted. This may be due to the outlier decreasing model fit. Outlier analysis showed the outliers were caused by floor area.

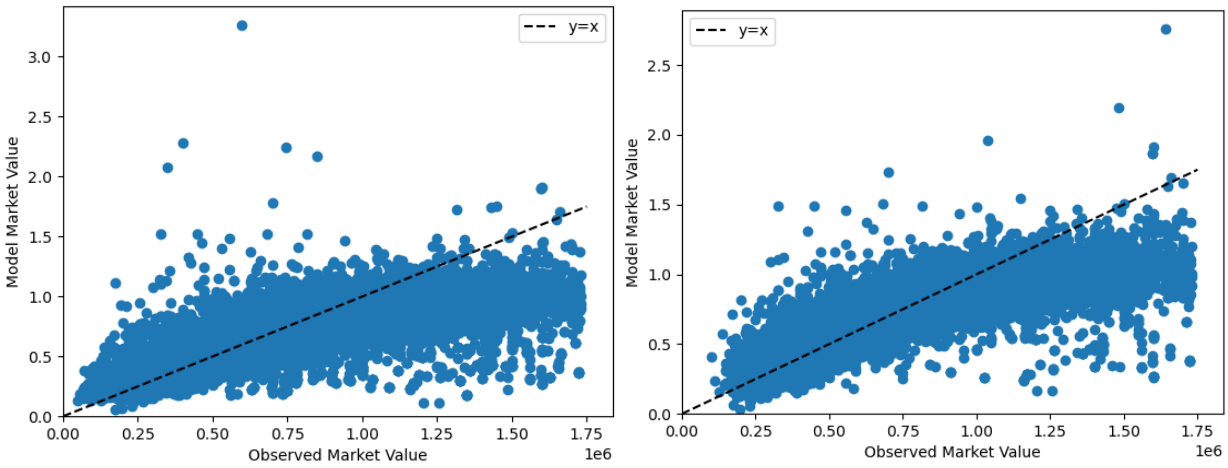

Figure 14-15: Scatter plot of hedonic model 2 (left) and scatter plot of hedonic model 3 (right). Models underpredict large market value. Model 3 has better fit due to less extreme outliers.

A histogram of the ratio between floor area and land area showed few properties with a ratio of above 1.5 (fig. 16). Removing sales with ratio above 1.5 removed ~20k sales. The filtered sales were used in a new hedonic model with land area included. This improved the model fit to 0.677. A scatter plot of this model (fig. 15) showed an improved fit. However, the model continued to under-predict at higher market values.

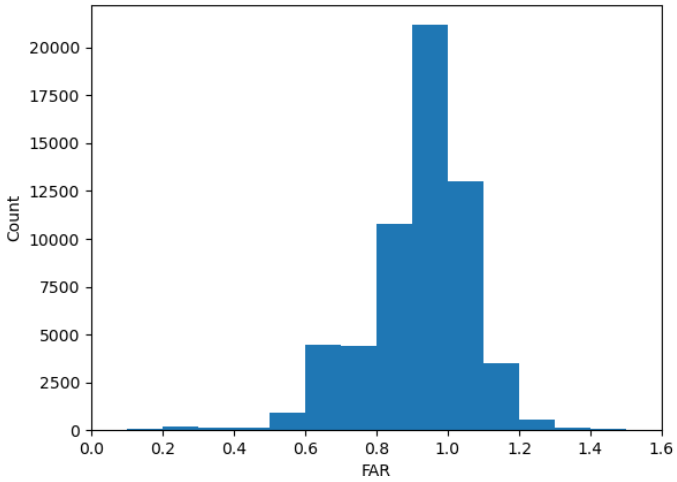

Figure 16: Ratio between total floor area and land area.

The coefficients of each independent variable were in different units. Finding the relative influence of each variable required normalisation of the coefficients using the regression coefficient of x on y: $B_{xy} = \beta_x \frac{\sigma_x}{\sigma_y}$

Where β_x is the coefficient of variable x, σ_x is the standard deviation of variable x, and σ_y is the standard deviation of market value. Finding the regression coefficients of x on y showed floor area was the dominant variable on house price and explained the outliers in fig 14. Crime rank, year of sale, and median household income were the other dominant variables.

Repeat-Sales Model (Effects of removing on-street parking)

```
Residuals:
    Min      1Q  Median      3Q     Max
-343153  -67980  -18794   50657  478285

Coefficients:
                                Estimate Std. Error t value Pr(>|t|)
(Intercept)                    4.224e+05  9.614e+05   0.439  0.66095
treatmentTRUE                 -3.195e+04  2.939e+04  -1.087  0.27862
DatePriceAgreed_before        -1.058e-04  3.990e-04  -0.265  0.79129
DatePriceAgreed_after         -8.085e-05  5.058e-04  -0.160  0.87320
LandArea                       2.797e+06  5.979e+05   4.678 6.04e-06 ***
TotalFloorArea                 1.288e+03  2.676e+02   4.812 3.36e-06 ***
YearsBuiltDescription1900-1909 -2.392e+04  9.450e+04  -0.253  0.80045
YearsBuiltDescription1910-1919 -1.746e+04  9.386e+04  -0.186  0.85262
YearsBuiltDescription1920-1929 -1.256e+05  9.905e+04  -1.268  0.20669
YearsBuiltDescription1930-1939 -1.011e+05  1.004e+05  -1.006  0.31579
YearsBuiltDescription1940-1949 -8.715e+04  1.087e+05  -0.802  0.42377
YearsBuiltDescription1950-1959 -1.713e+05  8.986e+04  -1.906  0.05836 .
YearsBuiltDescription1960-1969 -1.466e+05  9.197e+04  -1.594  0.11288
YearsBuiltDescription1970-1979 -2.010e+05  1.057e+05  -1.902  0.05890 .
YearsBuiltDescription1980-1989 -1.320e+05  9.095e+04  -1.452  0.14848
YearsBuiltDescription1990-1999 -3.282e+04  9.315e+04  -0.352  0.72502
YearsBuiltDescription2000-2009 -6.306e+04  8.899e+04  -0.709  0.47958
YearsBuiltDescription2010-2019  4.272e+04  9.507e+04   0.449  0.65374
HierarchyLocal Road            -1.032e+05  3.491e+04  -2.957  0.00357 **
HierarchyMajor Arterial        -1.323e+05  5.166e+04  -2.562  0.01132 *
HierarchyMinor Arterial        -3.812e+04  4.752e+04  -0.802  0.42358
HierarchyPrivate               -1.519e+05  5.640e+04  -2.693  0.00781 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 138200 on 164 degrees of freedom
  (9 observations deleted due to missingness)
Multiple R-squared:  0.4686,    Adjusted R-squared:  0.4005
F-statistic: 6.886 on 21 and 164 DF,  p-value: 6.288e-14
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Figure 17: Results of the street level regression model.

Single variable regression on independent variables showed that the most significant predictors of a higher resell value in the period of December 2021 – August 2024 compared to July 2012 – January 2017 were land area and floor area (fig. 17) (p=0.00). Road hierarchy was another significant factor. Properties on local, minor arterial, and private roads were more likely to gain less value than properties on collector roads (p=0.00, p=0.11, p=0.00, respectively). However, our model showed that a property being directly adjacent to a protected cycle lane which removed on-street parking (treatment=TRUE) had no statistically significant effect on the change in property value (p=0.28).

Repeat purchase rate, calculated by dividing repeat sales by all sales in the area of study, was 3.3% for the periods used for this study. Due to this low rate, combined with the small study area due to the small population of on-street dedicated cycleways within the Christchurch area, overall observations were low (treatment(n)=41, control(n)=154).

Stakeholder Interviews

The interviews produced varying answers. One realtor said no clients had mentioned the need or consideration to be in proximity or adjacent to a cycleway. Discussions with another realtor showed an increase in the number of people cycling to open homes and auctions with the understanding that some clients are more likely to cycle, such as those who work in the CBD. A main theme of the interviews was that realtors used access to amenities (school zones, parks, shops, on street parking etc.) to create competition and increase prices. These amenities are a priority to buyers and have more influence on price and strength of competition when valuing a property. These amenities are prioritised over cycleways as they influence a greater percentage of property buyers' lives.

A realtor mentioned that cycleways are commonly built on busy streets. These streets are usually less desirable than adjacent streets due to increased traffic volume. Figure 18 shows the location of property listing mentioning cycleways as a positive against the locations of cycleways. This showed that real estate agents are using cycleways as a marketing tactic. This opposes what was mentioned in interviews as realtors are using cycleways as a marketing tactic, even if it is not seen as an important.

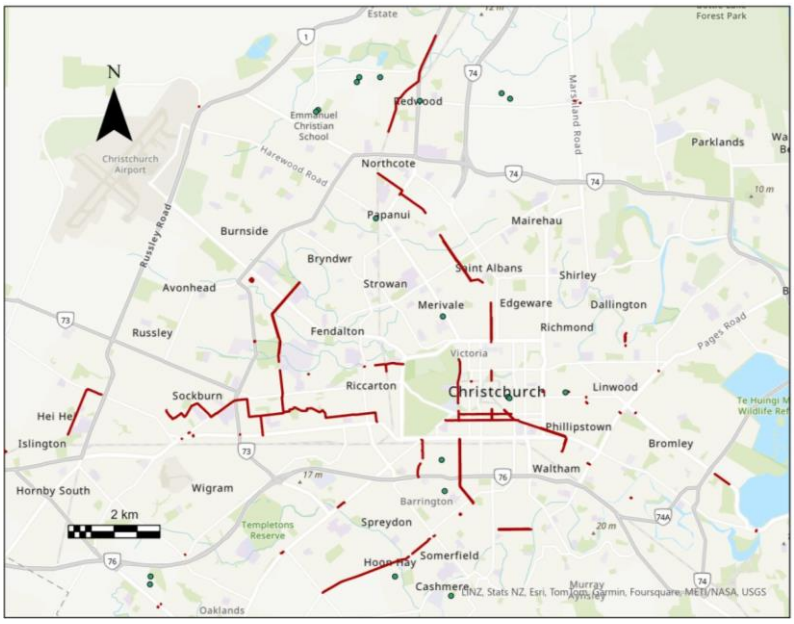

Figure 18: Cycleways and properties for sale that advertise proximity to cycleways.

Discussion

Our hedonic model showed that there is a positive impact on property prices from a better developed cycleway network. Additionally, our repeat-sales model showed that being located on a cycleway that removes on-street parking had no statically significant effect (p=0.28). While the hedonic model showed that property prices in Christchurch city benefited from a better developed cycle network, we cannot conclude whether on-street cycleways have any negative effect on property value for properties directly adjacent. The stakeholder interviews found

cycleways were generally not considered by realtors as other amenities are prioritised by home buyers. However, figure 18 showed that cycleways are used as a marketing tactic in property listings, which goes against the results of our stakeholder interviews.

The best hedonic model had a cycleway density coefficient of $55.6/m/km^2 and a median household increase due to cycleways of $997 or 0.19%. The city council set rates collected to $760.8 million NZD in 2024/25 (CCC, 2024). $1.52million of the rates collected can be attributed to cycleways. The $1.52million is solely considering rates and ignores the other positive benefits cycleways can provide. Benefits include health benefits resulting from reduced healthcare costs, economic benefits through a reduction in congestion as well as environmental benefits through a reduction in vehicle emissions. Calculating the exact economic benefit of cycleways due to these factors is outside the scope of this study. Previous literature has shown the economic impact of these benefits outweighs the cost of building cycle infrastructure (Mueller, 2018). A study by Gotschi (2011) calculated investing 138-605 million USD in cycle infrastructure by 2040 in Portland, Oregon would save between $7-12 billion USD and reduce CO_2 emissions by 540-830 million metric tons.

During our research several limitations became apparent. One such limitation is that there is no guarantee the research can apply to other New Zealand cities, as Christchurch is in a unique position, having flat geography and the most extensive cycleway network out of the NZ cities. A major limitation of the hedonic model is that spatial effects were not considered. If spatial effects were accounted for our results may change. A limitation of our repeat-sales model is that due to the design of the model, observations were limited to ~n=200, creating a small dataset. With a larger dataset, trends could be observed with greater confidence, improving the statistical significance of the results. The model could potentially be expanded to other cities within New Zealand to increase the amount of data and improve the reliability of the model.

Other limitation to consider is that that although the hedonic model results showed cycleway density and property values were correlated, the causality of the results in unknown, as the correlation may be due to a hidden variable not considered in our model. Finally, the interviews conducted could have a level of bias due to the method used to source participants. Systematic bias in interviews can sway answers from the participant (Colombotos, 1969). Finding participants who do not have a personal connection could limit systematic bias.

Conclusion

Cycleways were found to have a statistically significant positive effect city-wide on residential property prices in Christchurch. However, there is no statistically significant negative effect of cycleways removing on-street parking on property values. Stakeholder interviews found cycle infrastructure is not often considered and their perceived effect of cycleways contradict the city-wide results. Cycleways were shown to be used as a marketing tactic on property listings. Limitations of both models decreased the viability of the results. Further research can develop these models to investigate if our results accurately represent the real world.

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