Price Appreciation Patterns around Transit Stations

Real Estate Economics

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ABSTRACT

The main purpose of this study is to measure the effects of a rapid transit station on housing appreciation in the surrounding area after different project milestones of a rapid transit line. We have measured the effects on housing appreciation before the line's announcement, confirmation of the project, during construction, and after completion of the Canada Line to find when, if ever, price appreciation becomes apparent for homes near transit.

The Canada Line is one of many rapid transit lines in Metro Vancouver. It was announced shortly after Vancouver's successful bid for the 2010 Winter Olympic Games to connect Richmond City Centre and Vancouver International Airport to Downtown Vancouver. However, the controversial project was not given approval until December 2004. Construction began mid-2005 and opened in mid-2009 to better than expected ridership levels.

In order to explore these questions we used a multiple sales analysis with three distance rings to separate houses that are near and not near to the transit stations. We chose to focus on five Canada Line stations located along the Cambie Corridor: Broadway/City Hall, King Edward, Oakridge/41st Ave, Langara/49th Ave, and Marine Drive station. We used three rings with 0.5KM, 1KM and 2KM radiuses to measure whether there is an effect of being near to the station at the 0.5KM and 1KM distance, with the 1 to 2KM ring considered not near.

Transit premiums were somewhat observed for homes within the 0.5KM ring compared to homes in the 1KM ring; however, the value was small at around 2.6% overall. When considering 1KM and closer as "near" and 1KM to 2KM as "not near" no distance premiums were observed. This may be due to the areas of study that have high vehicle dependency and are relatively wealthy, and therefore, are not target users of rapid transit, as well as the limitations of the multiple sales method.

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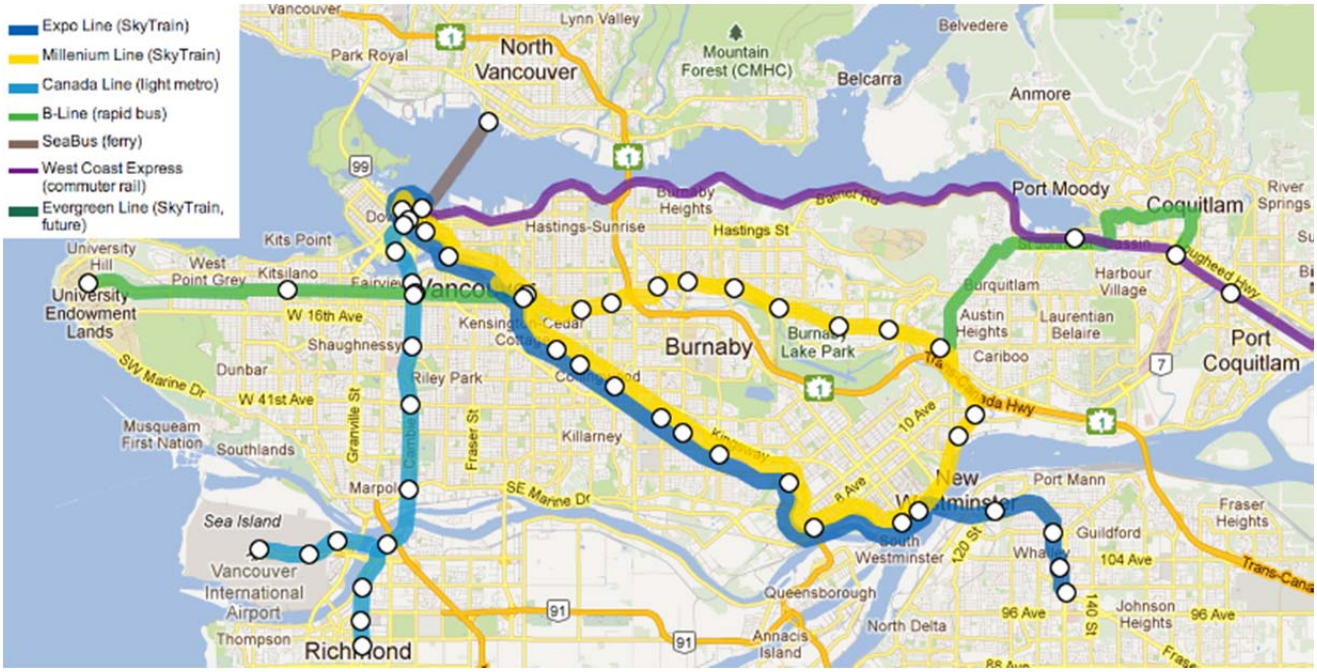
INTRODUCTION

Our paper addresses two questions: 1) whether there is an appreciation of housing prices after the confirmation of a rapid transit station in the immediate area and 2) if there is an appreciation, at what point it takes effect. We examined whether there is an increase in housing values with the expectation of rapid transit completion and at what points these increases occurred over the years a rapid transit line was built, as well as after completion. Our research focused on Vancouver's Canada Line: we examined housing prices in the areas surrounding five Canada Line stops located along the Cambie Corridor within Vancouver. By analyzing house sales within a 0.5KM, 1KM and 2KM radius of each stop during different time periods of the building of the Canada Line, we are able to see whether the anticipation of a rapid transit stop within a highly walkable distance demands an increase in housing values. We also analyzed 0-1KM and 1-2KM radiuses to understand how far the effect of transit may be felt. Using a repeat sales analysis allowed us to control for the attributes of each house and isolate the possible effect of the transit stop announcement. The findings in this analysis can be applied towards upcoming proposed transit lines in the Greater Vancouver area, such as the proposed UBC extension, proposed additional Canada Line transit stops and the Evergreen Line to Coquitlam and Port Moody.

Additional questions we attempt to answer with our analysis price appreciation trends based on station characteristics and if housing type has a significant effect on rates. Our analysis has allowed us to estimate the impact of future proposed transit nodes on current housing prices in areas targeted for Transit-Oriented Development (TOD). We are able to apply these forecasts to future Metro Vancouver transit infrastructure projects and extrapolate the impact of transit additions and expansions. The constant improvements to urban infrastructure affect how people and companies locate, which changes how land is valued. Our study benefits professionals in determining the timing and choice of land acquisition and housing product development, as well as individuals in making more informed buying or investment decisions.

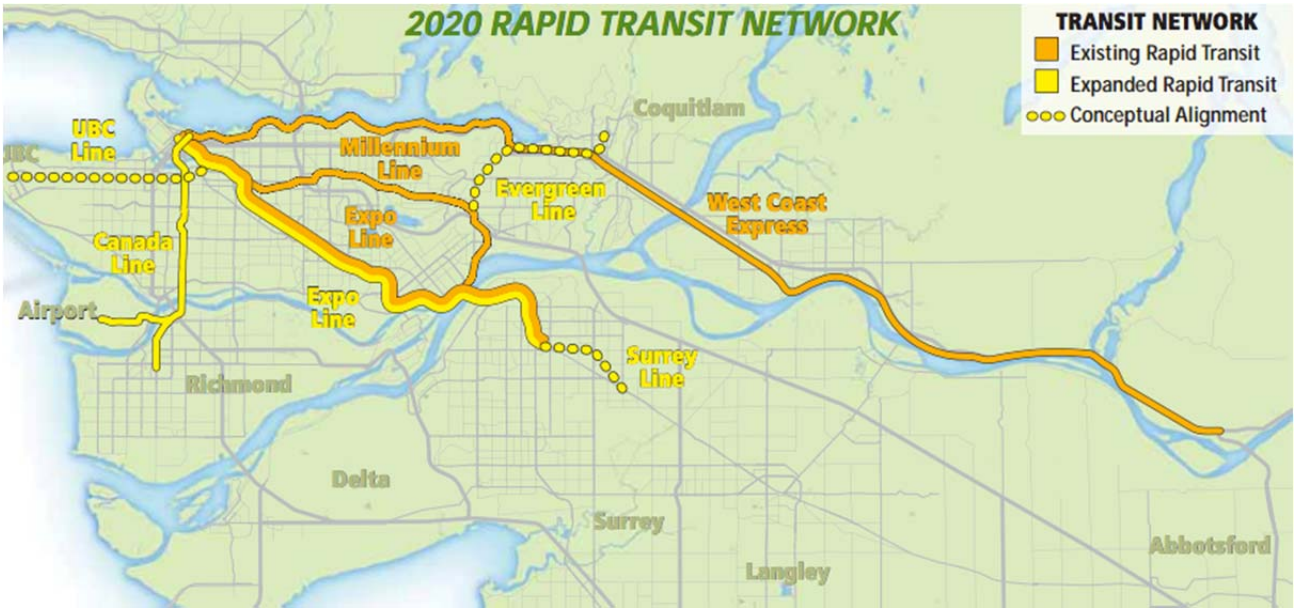
RAPID TRANSIT IN VANCOUVER

Metro Vancouver has three rapid transit lines referred to as the Skytrain: the Expo Line, Millennium Line, and Canada Line, as seen below. In addition, Metro Vancouver offers commuters rapid bus services, ferry services, and a commuter train, the Westcoast Express. The Expo Line was the first rapid transit line constructed in the Metro Vancouver serving the World's Fair, Expo 86'. The Expo line has been expanded multiple times, extending services to the City of Surrey.



The Millennium Line, Vancouver's second rapid transit line, opened in 2002 serving North Burnaby and East Vancouver. The Millennium Line was originally to have a second phase connecting to Coquitlam City Centre. This phase, known as the Evergreen Line, was postponed due to a change in the provincial government but is now scheduled to open by mid-2016. This expansion will cost an estimated $1.4 billion (Ministry of Transportation and Infrastructure, 2011). The Canada Line, which opened in August of 2009, is Vancouver's newest rapid transit line, connecting Richmond and the Vancouver International Airport (YVR) to Downtown Vancouver. Another expansion, the UBC Line/Broadway Corridor extension, is in its planning stages to connect the Expo Line with the University of British Columbia. This expansion is still being considered and would replace Translink's busiest bus routes along Broadway where over 100,000

trips are made daily. This proposed line is estimated to cost $2.8 billion and to open by 2020 (Ministry of Transportation, 2008).



Canada Line

In this research paper, our hypothesis will be focusing on the effects of the Canada Line on surround house values. The Canada Line was originally referred to as the Richmond-Airport-Vancouver Line or RAV Line as it connects these three major points of transit. The line was originally proposed in 2003, shortly after Vancouver's successful bid to host the 2010 Winter Olympics. However, the 19.2 KM line remained in jeopardy as proponents argued against its proposed cost, $1.7 billion, and its public-private partnership plan (Mickelburgh, 2003). In June 2004 the provincial government agreed to take responsibility for the project and assume financial risks, putting the project back on track (Armstrong, 2004). In December 2004, regional politicians voted 8-4 for the project to proceed, setting the controversial project in motion (Mickleburgh, 2004).

The Canada Line officially opened on August 17th, 2009, on budget and three and a half months ahead of schedule. Since then, ridership has continuously exceeded projected targets. Translink originally projected the break-even ridership to occur by 2014 at 100,000 passengers per day. However, by late 2010 the line had reached this projected ridership, three years early (Stuek, 2011). In addition to greater

than expected ridership, the Canada Line has driven increased densification along the Cambie Corridor, where the majority of the stops are placed. In May 2011, the Vancouver City Council approved density changes that add as many as 14,000 people, between King Edward Avenue to Marine Drive, in the next 30 years and its effects are already being felt (Lee, 2011).

AREA CHARACTERISTICS

The area surrounding the Cambie Corridor is composed of mostly single-family homes with high average housing values relative to the rest of Vancouver (see Appendix A). The areas surrounding our four chosen stops: Broadway/City Hall, King Edward, Oakridge/41st. Langara/49th, and Marine Drive, also have relatively high average housing values, with the exception of the Broadway/City Hall stop that has lower values but is of much higher density.

Each area surrounding a Canada Line station carries unique characteristics offering diverse features to service the public. Developments surrounding Broadway/City Hall are primarily newer and older mid- to high-rise mixed-use developments. Street-level commercial and higher-level offices file along main arterial roads and of the stations studied it holds the highest concentration of urban use and density; the area collect strong traffic flows due to the proximity of highly frequented locations such as City Hall and Vancouver General Hospital. As the Canada Line travels south, the area has an active pedestrian flow with low-rise commercial and small strip malls running along Cambie Street and with low density detached residential and single family homes in the proximate area. Oakridge/41st station's highlighting factor is Oakridge mall, which provides city wide and local serving shops and services. The area mainly houses single family homes and numerous schools and parks, while the arterial roads are busy commuter routes. Only nine blocks south is the Langara/49th station, primarily servicing the stream of college students attending nearby Langara College. The area has a popular golf course nearby, housing consists of low density residential units, mainly detached housing with some low-rise attached dwellings. The Marine Drive area is currently undergoing high density development; however the area is still predominately

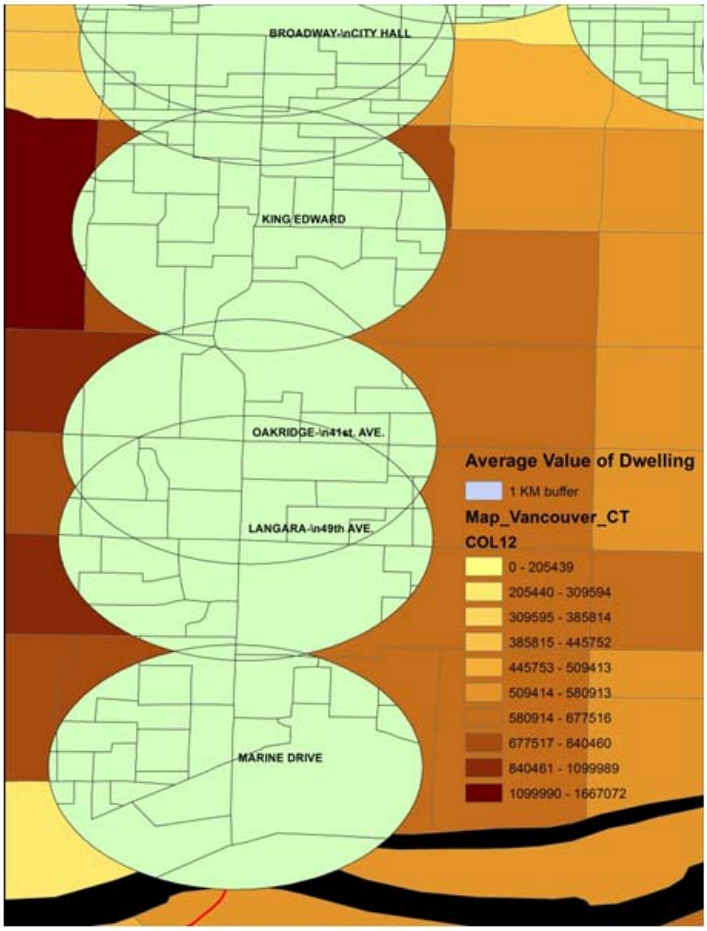
industrial and big box commercial retailers, while to the north of Marine Drive there is some low-density housing.

The number and average value of households, and the average income per capita of those located within a 1 KM buffer zone of each transit stations, is shown below.

Transit Stations	Average Housing Values	Number of Private Households	Average Income per Capita
Broadway/City Hall	$426,567	462	$40,327
King Edward	$680,365	197	$35,516
Oakridge/41st Ave	$757,608	220	$32,558
Langara/49th Ave	$700,455	241	$36,474
Marine Drive	$577,789	194	$28,829

* Based on 2005 data

Figure 1 | Average Area Values with 1 KM Buffer



Literature Review: Theories and Findings

Given the assumptions that rapid transit improves accessibility, and reduces travel time and travel costs for the neighbourhoods near the transit stations, we expect higher house price appreciation for properties that are located close to transit lines. Furthermore, improved accessibility and pedestrian flow would make rail transit stations more attractive for commercial uses, amenities, and higher density, transit-oriented developments. This in turn would create more vibrant neighbourhoods, which may also contribute to increased house price appreciation. We have formulated our hypothesis based on past literature that we will summarize below, as well as the aforementioned reasons.

There have been several studies that have examined the effect of rapid transit on residential housing values. Although none of these case studies have focused specifically on the Canada Line, they are nonetheless relevant and have assisted us in forming our hypothesis. The results from these studies have varied depending on several influences that each study has controlled for. For instance, many have compared price appreciation to the median incomes of the immediate areas surrounding the stations and have found this to be an important factor in determining which stations will observe higher price appreciation. Additionally, some have considered "net benefit" effects, accounting for factors that may increase as well as decrease property values.

However, some studies have observed lower values for residential properties located near transit stations. An example of this is a study conducted by Cervero and Duncan where they examined the land value impacts of rail transit in Los Angeles County (Cervero & Duncan, 2002). The authors mentioned that one explanation for this may have been that many major transit stops in the County lie within redevelopment districts. This shows that every study is unique and that there may be numerous factors in addition to transit station proximity that may affect house prices.

A negative impact on house prices, however, has been less common. A report published in 2010 by the Real Estate Investment Network in Calgary examined the impact of transportation improvements on

housing values in Calgary, and in addition created a synopsis of published works that have studied the topic (see Appendix B). This table further solidifies our expectation that price appreciation will be higher for homes that are located closer to Canada Line stations. Although the results have been mixed, the majority of past studies have found that there is a positive effect on house values, though this varies in terms of magnitude.

As Bowes and Ihlanfeldt have discussed in their study, the mixed results may have been due to "simultaneous and competing effects of rail stations on nearby properties" (Bowes & Ihlanfeldt, 2001). To account for this, they went beyond the simple effect of proximity and looked at four factors simultaneously and separately, two of which have positive effects and two that have negative effects. Positive factors include the access advantage due to shorter, less stressful commutes, and the indirect externality of increased commercial services that locate near transit stations. Negative factors include the direct effect of the increase in noise, pollution and general unsightliness of the stations, in addition to the indirect effect of heightened crime due to improved access to the area. The authors found that all four of these factors played significant roles in the connection between property values and rail stations. However, their significance varied depending on the distance of the neighbourhood from the CBD, and the median income of the neighbourhood. Our study did not take a "net benefit" approach. Rather, our paper differs from several past studies in that, in addition to looking at the effect of proximity to transit stations, we also look into the difference in price appreciation at different time intervals, and also compare the results of different stations.

McMillen and McDonald took an approach similar to ours, in that they studied the effect of a new transit line in Chicago on single-family house prices before and after the opening of the line, using data over a 17 year time period to see how prices varied over time (McMillen & McDonald, 2004). Their results showed that although the line was not completed until 1993, house prices were being affected as early as 1987, when the plans became known. Generally, the authors found that appreciation rates were approximately 6.89% higher between 1986 and 1999 than comparable homes farther from the nearest

transit station. Although this approach is similar due to the fact that it looks for price appreciation caused by the anticipation of the transit line, we have decomposed the data further to before, during, and after construction, in addition to by transit station to see which area and/or time interval was most impacted by the Canada Line.

Perhaps the closest case study comparison is one that was conducted by Ferguson in 1984, where he studied the impact of Vancouver's first Advanced Light Rail Transit, the Expo Line, on single-family property values before the transit system was in operation (Ferguson, 1984). Ferguson discovered that the market in Vancouver was reacting to the transit system approximately two and a half years prior to the completion of the transit line, showing evidence of speculation in the market's expectation of future gains.

In terms of methodology, several studies used hedonic regression models to look at the general house price appreciation controlled for those near and not near transit stations. However, since our study examines the effect of specific events, we have used the repeat sales analysis to look at price changes for the same house before and after certain events, thus controlling for the physical characteristics that may affect housing price differences. We will expand on our methodology in the following section of this paper.

METHODOLOGY

Our study used repeat sales analysis and ln-specification regression to determine the level of price appreciation in homes near Canada Line rapid transit stations before and after certain events. A repeat sales method was appropriate for our study because it required much less data regarding the characteristics of each transaction and allowed us to control for other factors that may affect housing prices. By looking at the transaction of the same property over a certain period of time, we no longer required the specific characteristics of the house, assuming that these characteristics remained stable. The data we used was extracted from the Real Estate Board of Greater Vancouver's MLS database, called

MLS Link. We were able to find data for houses sold between 2000 and 2012. This time period was sufficient for our study because it covered the time before the Canada Line announcement, confirmation of the project, during construction, ad post-construction.

We chose Broadway/City Hall, King Edward, Oakridge/41st Ave, Langara/49th and Marine Drive for their Vancouver location. We excluded Downtown and Richmond due to their different natures and dynamics, as well as to focus our scope of analysis. The Olympic Village was excluded due to the lack of repeat sales data, as the area is transitioning from industrial lands with a focus on pre-sale products and any repeats were already part of the Broadway/City Hall area.

Research conducted by the Planning Committee of Fairfax Country, Virginia regarding walking distances for Transit Oriented Developments determined that distances within 500 metres are considered highly walk-able, while 500 to 800 metres is considered to be an acceptable walking distance (Fairfax County, 2006). Their research showed that up to 0.25 miles (402 metres) is generally defined as within walking distance, but highlighted that for rail transit stations and residential uses, people are willing to walk up to 0.5 miles (805 metres). Comparing 1KM, as was defined by our data set, to a larger ring of 2KM allowed us encompass all the walkability around a station up to 10 minutes. However, as a 0.5 KM radius is considered most walk-able, we were curious to find out if there was a significant difference between the 0.5 KM rings and the 1 KM rings. Consequently, we organized our data to look at two sets of comparisons:

1| **Small Set:** Comparison of homes where **Near = a 0.5KM ring** around a station and **Not Near = a 0.5KM-1KM ring** around a station. This allowed us to complete a smaller-scale analysis to determine premiums associated with highly-walkable distances.

2| **Large Set:** Comparison of homes where **Near = a 1KM ring** around a station and **Not Near = a 1KM-2KM** ring around a station.

Each observation (a unique address) was assigned a "1" to whichever categories they fell into: station, proximity, and attachedness, where detached is a single family home and attached includes all multi-family home varieties. This allowed us to execute per-station analyses to control for and understand

the impact that transit stations have on areas with differing levels and types of real estate development, based on our understanding of each station's area characteristics and the regression results.

We used Microsoft Excel to categorize each observation according to the station it was closest to and how close. If an observation appeared in more than one station area, the observation was 'given' to the smallest proximity as the home likely enjoys the closer proximity - for example, an observation that showed up in the 1 KM ring of one station and the 0.5 KM ring of another was given to the 0.5 category. Homes within the same proximity ring were merged and assigned a value of 1 for both stations. We also identified whether the observation was an attached home or not to control for the possible difference in price appreciation patterns for the two product types.

The next step involved using data within our specified rings and sorting them into six time periods based on the following key dates:

1| **Confirmation:** January 1, 2005. Actual confirmation was in December 2004, but for simplicity in sorting the data, we looked at before and after January 1, 2005.

2| **Construction:** January 1, 2006. Actual construction began in September 2005. However, construction may not have been disruptive at this point, and the colder season may have reduced open-air, disruptive construction. To control for negative effects of construction and to make sorting the data simpler, we set this date to January 1, 2006.

3| **Post Construction/Operation:** January 1, 2009. Substantial completion occurred in early 2009. At this point, heavy, nuisance-causing construction was completed.

The dates noted above created the following dummy variable time periods:

Time Period	Description	Date Range
BeforeConf(Near/Far)	Both sales occurred before confirmation of the Canada Line	Before January 1, 2005
StraddleConf(Near/Far)	First sale occurred before confirmation of the Canada Line. Subsequent sale occurred after confirmation, including during construction, but before completion.	From 2000-2004, and from 2005-2008, inclusive
Constr(Near/Far)	Both sales occurred during construction.	2006-2008, inclusive
BefAfConstr(Near/Far)	First sale occurred any time before construction began; subsequent sale	Before 2005, and in 2009 or later

	occurred after completion.	
StraddleOp(Far/Near)	First sale occurred during construction, subsequent sale after the Canada Line went into operation	In 2006-2008, and in 2009 or later
AfterOp(Near/Far)	Both sales occurred after the Canada line went into operation	2009 or later

By creating these time periods, we were able to track what happened to house prices in different scenarios throughout the development of the Canada line. "Before Confirmation" can be viewed as a control to show the general rate of price appreciation before rapid transit became a certainty. Assigning a dummy variable for each time period and whether the home was near or far provided us with absolute certainty that the TimePeriods*Near/Far categories, a series of quasi-interaction variable, were fully utilized. This format also allowed us to present time trend data more easily. After sorting, we noted that the number of observations for near and not-near sales pairs was fairly evenly distributed throughout.

Regressions

Regressions were performed in Stata 10 and included an "Overall" regression which comprised all observations within a set, as well as "Per-Station" regressions to observe how particular stations were affected differently by the events of the Canada Line development. Our final regression took the form of:

$$ln(P_{i,b} - P_{i,a}) = \beta_0 + \beta_{1\text{-}6}(timeperiod\_near) + \beta_{7\text{-}12}(timeperiod\_far) + \beta_{13}(attached) + \beta_{18}(attachedxnear) + \varepsilon$$

where P is the prices of property *i* when sold in period *a* and period *b*. β_0 is an ambiguous constant that is detached, but has no specific nearness, time period or station area (as in the "Overall" regression). $\beta_{1\text{-}6}(timeperiod\_near)$ denotes the six near time period dummy variables and $\beta_{7\text{-}12}(timeperiod\_far)$ does the same for observations not near a transit station. $\beta_{13}(attached)$ and $\beta_{18}(attachedxnear)$ are dummy variables for attachedness and attached homes near the station respectively. Additional dummy variables for stations were used in the "Overall" regression.

Interpretation of these regressions included reading the rate of price appreciation for each time period and then testing whether the means between near and far were significantly different. We used the

test x1=x2 command (Wald test) and determined that if *Prob >F* was less than 0.05, then the means were significantly different at the 95% level. We took *e* to the power of the difference between the near and far means as an estimate of the difference in price appreciation rates of near and far homes.

Initially, we had planned to include dummy variables for each year from 2000-2012, which seemed ideal to control for unusual years of appreciation. However, we realized this had limited modeling power for us, as each price difference value is assigned to a single sales pair and to track year-by-year averages from across all sales pairs was beyond our scope and tools at the time. Instead, we focused on the significance of nearness during particular time periods.

RESULTS & INTERPRETATION

We found evidence of transit premiums for near homes more often in the Small Set, where homes within 500 meters of Canada Line transit stations in Vancouver were considered near. However, not all stations experienced positive or significant transit effects. The Large Set presented seemingly conflicting, significantly negative transit reductions in comparison. Attached homes significantly reduced appreciation rates in both the Small and Large sets. In contrast, some homes which were attached and near (*AttachedxNear*) in existing high-density, transit-oriented areas showed significant positive appreciation in Large Set results, while in the Small Set, all small positive effects were insignificant. We believe this is highly correlated to area characteristics and the supply of attached homes. For the former, areas already highly developed relative to the other stations seemed to show little or negative price appreciation compared to their non-near counterparts. Station areas believed to have high development potential, such as King Edward and Marine Drive Station, posted particularly high premiums. This effect may be explained by the expected benefit of connecting these otherwise highly vehicle-reliant, residential areas to rapid transit, as they present an opportunity for higher-density, mixed-use development and general improvement to create pedestrian-friendly, transit-oriented neighbourhoods. As such, both owner-occupiers and developers may be willing to buy homes and land at a premium for the future

opportunity of an improved neighbourhood or for development, respectively. For the latter, a possible explanation is that attached homes are increasing in supply, while detached homes are decreasing, resulting in lower price appreciation for attached homes. Nevertheless, existing stocks of attached homes near stations are valued more highly than non-near attached homes, which is a result we expected.

The Large and Small Sets' conflicting results may be explained by a few factors:

1| The Small Set's non-near homes are still affected by transit proximity, such that the overall difference between near and non-near is insignificant; conversely, the Large set's 1-kilometre ring captures all positive effects of transit proximity compared to non-near counterparts.

2| The Large Set's 2-kilometre rings reach into multiple Vancouver neighbourhoods, many of which currently comprise, for the most part, detached single family homes (higher appreciation rates) or are serviced by other major feeder routes which have their own transit or accessibility premiums.

3| In some predominantly residential areas, attached homes are low-density types such as townhomes, duplexes, and low-density apartment complexes. Consequently, there may be little difference in near homes that are attached than not attached, or attached and not near, compared to the significant differences seen around stations such as Broadway and Oakridge. Low-density attached homes are more likely to be targeted for higher-density redevelopment near stations, such that transit premiums may become more apparent only after an area completes the bulk of its changes.

As it has only been a couple of years since the completion of the Canada Line, Vancouver requires more transition time before it consistently shows a pattern of transit premiums, if any, in repeat sales data.

Our results also show that Vancouver experienced clear price appreciation trends specific to each time period during the development of the Canada Line, with higher appreciation rates at the time of confirmation and at completion of the Canada Line. We can attribute the overall increases to the positive expectation of a new rapid transit line to Vancouver and the benefits it will provide throughout the city, rather than just areas near the stations. Regression outputs can be found in Appendix E.

All Stations – "Overall" Regression

Based on testing the significance of the difference of means for each time period pair, we found time periods with significant price appreciation rates for homes near a station in each set, as follows:

Time Period	**Observation**
	Estimated premium/discount for near homes, based on ***e****^(the mean difference of coefficients).*
Small Set	
Before and After Construction	7.23% transit premium
During and After Construction	4.85% transit premium
Large Set	
Before Confirmation	-3.78% reduction
During Construction	-5.35% reduction
Before and After Construction	-9.48% reduction
During and After Construction	-4.11% reduction

Stations were generally not significant at the 95% level in determining price appreciation differences, which we expected, but tested for on the off-chance that a few would be. Small Set's 41st Avenue Station and Large Set's Marine Drive Station were significant, reducing price appreciation by -3.0% and -4.2% respectively.

Next page: Overall Results

Regression Output for Transit Premium Patterns around Stations

$$\ln(P_{i,b} - P_{i,a}) = \beta_0 + \beta_{1\text{-}6}(\text{timeperiod\_near}) + \beta_{7\text{-}12}(\text{timeperiod\_far}) + \beta_{13\text{-}17}(\text{station}) + \beta_{18}(\text{attached}) + \beta_{19}(\text{attachedxnear}) + \varepsilon$$

Set 1: 0.5 v 1km

Overall

Source	SS	df	MS		
				# of Obs	5180
				F(19, 5160)	476.01
Model	273.2548	19	14.3818	Prob >F =	0
Residual	155.9015	5160	0.03021	R-squared =	0.6367
				Adj R-squared =	0.6354
Total	429.1564	4555	0.07989	Root MSE	0.17382

lndiff	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]	Exp(near-far)	Sign. Diff of Mean
beforconf_near	0.230873	0.0142	16.26	0	0.2030389	0.2587078	-2.32%	
beforconf_far	0.254322	0.01207	21.07	0	0.2306606	0.2779841		
straddleconf_near	0.444011	0.00994	44.67	0	0.4245236	0.4634987	-1.91%	
straddleconf_far	0.463337	0.00805	57.54	0	0.4475521	0.4791228		
constr_near	0.168932	0.02536	6.66	0	0.1192206	0.2186428	-2.02%	
constr_far	0.189342	0.01893	10	0	0.1522336	0.2264506		
befafconstr_near	0.654918	0.01242	52.72	0	0.6305628	0.6792736	7.23%	Yes
befafconstr_far	0.585103	0.00971	60.26	0	0.566068	0.6041373		
straddleop_near	0.21682	0.01398	15.51	0	0.1894177	0.2442215	4.85%	Yes
straddleop_far	0.169505	0.01079	15.71	0	0.1483522	0.1906583		
afterop_near	0.224792	0.02138	10.52	0	0.1828844	0.2666987	3.43%	
afterop_far	0.191051	0.01826	10.46	0	0.1552481	0.2268541		
Broadway	0.005082	0.01156	0.44	0.66	-0.0175891	0.0277931		
King Edward	-0.0076	0.00963	-0.79	0.43	-0.0264812	0.0112834		
41st	-0.03008	0.01151	-2.61	0.009	-0.0526472	-0.007505	-2.96%	
49th	0.001107	0.01117	0.1	0.921	-0.0207855	0.0229992		
Marine Drive	-0.02442	0.01379	-1.77	0.077	-0.051452	0.0026117		
Attached	-0.082	0.00828	-9.9	0	-0.09823	-0.065767	-7.87%	
Attached x Near	0.001282	0.0081	0.16	0.874	-0.0145945	0.0171581	0.13%	
_cons	0.066618	0.01122	5.94	0	0.0446161	0.0886208		

Set 2: 0-1km vs 1-2km

Overall

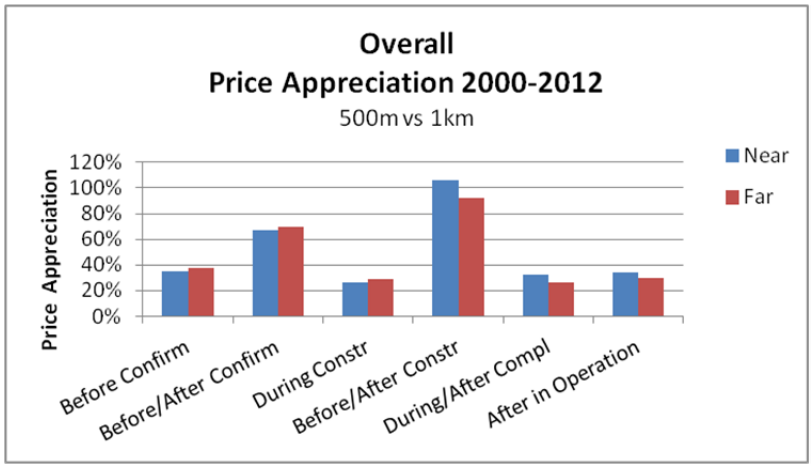
Source	SS	df	MS		
				# of Obs	8070
				F(19,8050)	729.04
Model	459.8391	19	24.20206	Prob >F =	0
Residual	267.2363	8050	0.033197	R-squared =	0.6325
				Adj R-squared =	0.6316
Total	727.0754	8069	0.090107	Root MSE	0.1822

lndiff	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]	Exp(near-far)	Sign. Diff of Mean
beforconf_near	0.247165	0.00965	25.6	0	0.228239	0.2660905	-3.78%	Yes
beforconf_far	0.28569	0.01345	21.23	0	0.259315	0.312065		
straddleconf_near	0.458062	0.00657	69.72	0	0.445183	0.4709415	-1.71%	
straddleconf_far	0.47534	0.00879	54.06	0	0.458104	0.4925756		
constr_near	0.186007	0.0159	11.7	0	0.154834	0.2171808	-5.35%	Yes
constr_far	0.240968	0.01764	13.66	0	0.206383	0.2755536		
befafconstr_near	0.613739	0.00803	76.42	0	0.597997	0.6294818	-9.48%	Yes
befafconstr_far	0.71333	0.01077	66.26	0	0.692226	0.734433		
straddleop_near	0.189778	0.00895	21.19	0	0.172225	0.2073313	-4.11%	Yes
straddleop_far	0.231695	0.0116	19.97	0	0.208957	0.2544323		
afterop_near	0.207677	0.01457	14.25	0	0.179116	0.2362382	-3.80%	
afterop_far	0.246454	0.01679	14.68	0	0.213547	0.2793606		
Broadway	0.005719	0.00867	0.66	0.51	-0.01128	0.0227201		
King Edward	-0.00246	0.00676	-0.36	0.715	-0.01571	0.0107793		
41st	-0.01498	0.009	-1.66	0.096	-0.03262	0.0026606		
49th	-0.00366	0.00886	-0.41	0.68	-0.02102	0.0137043		
Marine Drive	-0.04255	0.00971	-4.38	0	-0.06158	-0.023526	-4.17%	
Attached	-0.10257	0.00757	-13.55	0	-0.11741	-0.087736	-9.75%	
Attached x Near	0.020166	0.00732	2.76	0.006	0.005825	0.0345072	2.04%	
_cons	0.063722	0.00903	7.06	0	0.046023	0.0814213		

Throughout our analysis, we found that attached homes experienced significantly lower price appreciation at all times, ranging from -7.9% to -3.1% in the Small Set and -14.2% to -4.2% in the Large Set. Within individual station areas, attached homes in the Large Set reduced overall price appreciation more than those in the Small Set (i.e. attached homes closer to stations appreciated more, but still reduced the overall appreciation rate), with some stations in the Small Set showing almost half the decreasing effect of attached homes than their Large Set counterparts. A possible explanation is that the Large Set's not-near rings encompass more areas with single family homes, which appreciate higher as attached homes increase in supply over time.

Overall Time Period Trends

Our time period regressions show an overall price appreciation pattern for homes bought and sold at specific points along the Canada Line development timeline. Results indicate great increases in prices upon the confirmation of the Canada Line, as expected of positive news. The jump in appreciation rates is regardless of nearness to a station, which shows the expectation of the positive benefits the Canada Line will provide the city overall. This is in contrast to the notably lower appreciation rates for homes near a planned station during the construction period, which can be attributed to the nuisance of construction happening close by.



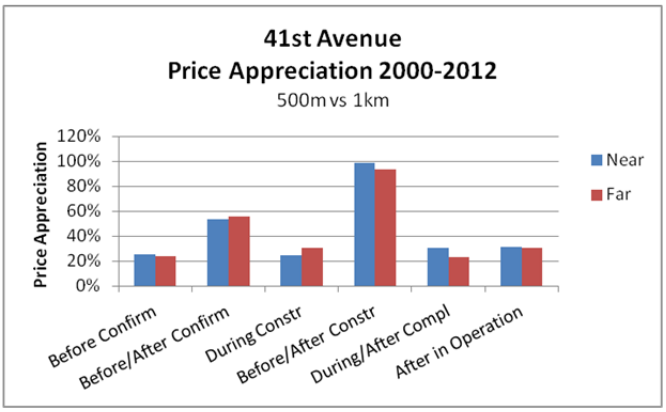
Before/After Construction shows the highest appreciation rates. This is likely due to both the passage of time -- as this time period comprises the most number of years -- and selling again only when the Canada Line is complete. Time periods after the confirmation of the Canada Line generally fell back in line with the appreciation rates of past periods, but with some evidence of an upward, downward or steady trend unique to the station.

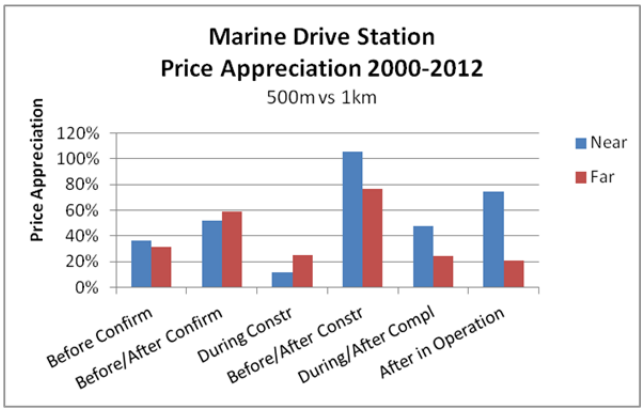
Individual Stations

Based on the characteristics of each station's immediate area, it seems that homes near stations with relatively higher levels of pre-existing non-residential development and major transit connections at the time the Canada Line was confirmed met with the least amount of significant rapid-transit-based price appreciation. For example, Broadway City Hall experienced limited or reduced price appreciation in both the Small Set and Large Set ring comparisons. In contrast, stations with primarily single-family homes, low-density zoning or limited commercial amenities, but with the opportunity for development and revitalization, resulted in the highest levels of transit premiums: in particular, King Edward's estimated transit premium when the station completed was 49.56% for homes within 0.5 KM of the station, while homes within 0.5 KM of Marine Drive Station saw a 45.09% transit premium. Attached homes continued to post lower appreciation rates across all stations and set sizes. However, only the stations with a history of higher-density development showed significant price appreciation for attached homes near a station (Large Set): Broadway with 2.39% and Oakridge at 8.20%.

The rate of price appreciation followed the general trend as described above: a sudden increase upon confirmation, a sharp decrease during construction that is often below pre-confirmation rates and much lower for those near than far, and an increase when construction completes. Whether the post-completion price appreciation rate exceeded the pre-confirmation rate or maintained a premium over non-near counterparts was unique to the station and remained ambiguous overall.

The following selected graphs show the relative price appreciation rate co-efficients by time period for two contrasting stations: 41st Avenue, where there is no significant evidence of a transit premium, and Marine Drive Station.





The variance between each station's price appreciation patterns seems to contribute to the ambiguity of whether or not a transit premium exists overall.

The following is a summary of each station's highlights, along with possible contributing factors based on area characteristics for certain price appreciation observations. Observations are for homes near stations and are calculated by raising *e* by the difference between the near and non-near coefficients.

Broadway/City Hall

Broadway/City Hall	**Observation**
Small Set	
Before and After Construction	4.18% transit premium
Large Set	
Before and After Confirmation	-3.34% reduction
Before and After Construction	-10.96% reduction
During and After Construction	-3.82% reduction
Highlights	- The Large Set's AttachedxNear is significant and positive at 2.39%. - Posted largest price appreciation rate drop of all stations for During Construction from the previous time period (Before/After Confirmation). - During/After and After Completion time periods show uniformly less price appreciation than Before Confirmation.
Possible Factor(s)	- Broadway has always been highly connected by major bus routes. - High levels of existing commercial and government buildings and a mix of new and old residential developments. - Discount/reduction may be due to the existing prominence and gradual increase of attached homes (including converted single family) in the immediate area.

King Edward Avenue Station

King Edward Avenue	Observation of price appreciation
Small Set	
Before and After Construction	49.56 % transit premium
During and After Construction	23.14% transit premium
Large Set	
Before and After Construction:	-22.19% reduction
Pattern Highlights	- Small set: While not all the near variables are significant at the 95% level, the area shows a distinct transit proximity trend throughout.
Possible Factor(s)	- Premiums due to land use change opportunities: existing area is primarily low-rise/low-density residential, previously with limited connections and few non-residential features/amenities. - Large Set reduction: Since there is a large transit premium for homes within 500m of a station, there is less impact when the 0.5 KM ring is merged with the 1KM ring for the Large Set.

Oakridge Mall/41st Avenue Station

Oakridge Mall/41st Avenue	Observation
Large Set	
Before and After Confirmation	-11.92% reduction
Before and After Construction:	-18.78% reduction
During and After Construction	-24.77% reduction
Highlights	- Near is completely insignificant for the Small Set: smallest levels of estimated near/far differences of all stations for each time period pair. - Posted highest reduction numbers for Attached in both the Small and Large Set of all stations: -7.29% and 14.24% respectively. - AttachedxNear is significant in the Large Set, showing an 8.20% premium.
Possible Factor(s)	- Oakridge/41st has large stock of existing commercial (mall, undergoing upgrades), a relatively even gradient of attached homes and smaller single families across the 1KM ring, and connections to a variety of arterial roads and bus routes.

Langara/49th Avenue Station

Langara/49th Avenue	Observation of price appreciation
Small Set	
Before and After Construction	-25.16% reduction
After Completion	-16.19% reduction
Large Set	
Before and After Confirmation	12.87% transit premium
Highlights	- Is the only station whose nearness at 500m consistently and/or significantly reduces appreciation rates across all time periods. - Considerably higher post-completion appreciation rates than Before Confirmation rate.
Possible Factor(s)	- Area has Langara college, golf course, low-density residences; otherwise limited pedestrian and other destination activities. Opportunity for revitalization. - Near reduction: Possibly related to perceptions of area demographics and therefore what house type and features "ought to be" there and who is interested in the area. e.g. student/faculty-based. The 1KM ring likely resolves the downside of being too close to the station, whatever it proves to be.

Marine Drive Station

Marine Drive (SW)	Observation
Small Set	
Before and After Construction	16.17% transit premium
During and After Construction	18.58% transit premium
After Completion	45.09% transit premium
Large Set	
Before and After Construction	-8.14% reduction
Highlights	- Small set shows potential for sustained high growth for the near future: the estimated premiums increased over time
Possible Factor(s)	- Marine Drive was primarily industrial with some low-density housing forms to the north and limited pedestrian-related commercial activity despite the South Bus Loop. - Large Set: 2KM ring reaches into established single-family neighbourhoods, and the high-premium 500m ring loses its proximity effect when merged with the 1KM ring. - Marine Drive has been a focal point in the Cambie Corridor Plan with many plans for high-density development land use changes and revitalization in place.

LIMITATIONS

There are several uncontrollable factors binding our study, which may have affected data, analysis, and our outcome. Three primary limitations are detailed below:

Proximity to East-West Feeder Transit Routes

The Canada Line runs north-to-south along Cambie Street in Vancouver. In our study, a number of our analyzed transit nodes intersect with major bus routes connecting Vancouver from east to west. These feeder transit routes may be influencing housing price appreciation. For example, the 99 B-line runs along Broadway Avenue and is North America's busiest bus route carrying 50,000 passengers per day (Dobrovolny, 2010). Additional express bus routes include the 84, traveling along West 4th Avenue and the 43, which operates during morning and evening peak rush hour commuting times on 41st Avenue.

Cambie Corridor Plan Densification

On May 9, 2011, Vancouver's City Council adopted the Cambie Corridor Plan. This study designates future land use along Cambie Street from 16th Avenue south to the Fraser River (Vancouver Corridor Plan, 2011). The study shows the City's plan to increase density within 800m (10 minute walk) around existing Canada Line Transit Stations and proposed stations at 33rd and 57th in Vancouver (see Appendix D). Although it appears the approval of the Cambie Corridor Plan would only affect 2011 data analysis, speculation leading up to the Plan's approval may have skewed sales prices and number of sales. However, this potential appreciation due to densification can be attributed to the Canada Line, and therefore should be included in our analysis on the effect of the Canada Line. As per the research in the 'Impacts of Rail Transit on Property Values', rail transit may increase property values in close proximity to stations for potential development. Existing low density use can be converted to higher density; however, such changes are highly dependent on local jurisdictions perspectives on development growth (Diaz, 1999).

Repeat Sales Analysis

The repeat sales method obviates information associated with the heterogeneous nature of housing; it simply measures the price change of the same housing unit over time (Guntermann & Taylor, 2009). While a hedonic regression analysis includes a value for each housing attribute such as size, location, and number of bedrooms, a repeat sales analysis assumes the house maintains the same attributes over time. Therefore, if a house has been renovated between the repeated sales, this would not be reflected in the repeat sales method. In addition, any improvement to the neighbourhood, such as increased amenities, that occurred between the repeat sales dates could appreciate the housing values in the area. Using the repeat-sales method, this appreciation would not be attributed to increased amenities as the method assumes all the housing attributes remain the same, including location factors. Therefore, this could artificially attribute an increase in housing prices due to the Canada Line.

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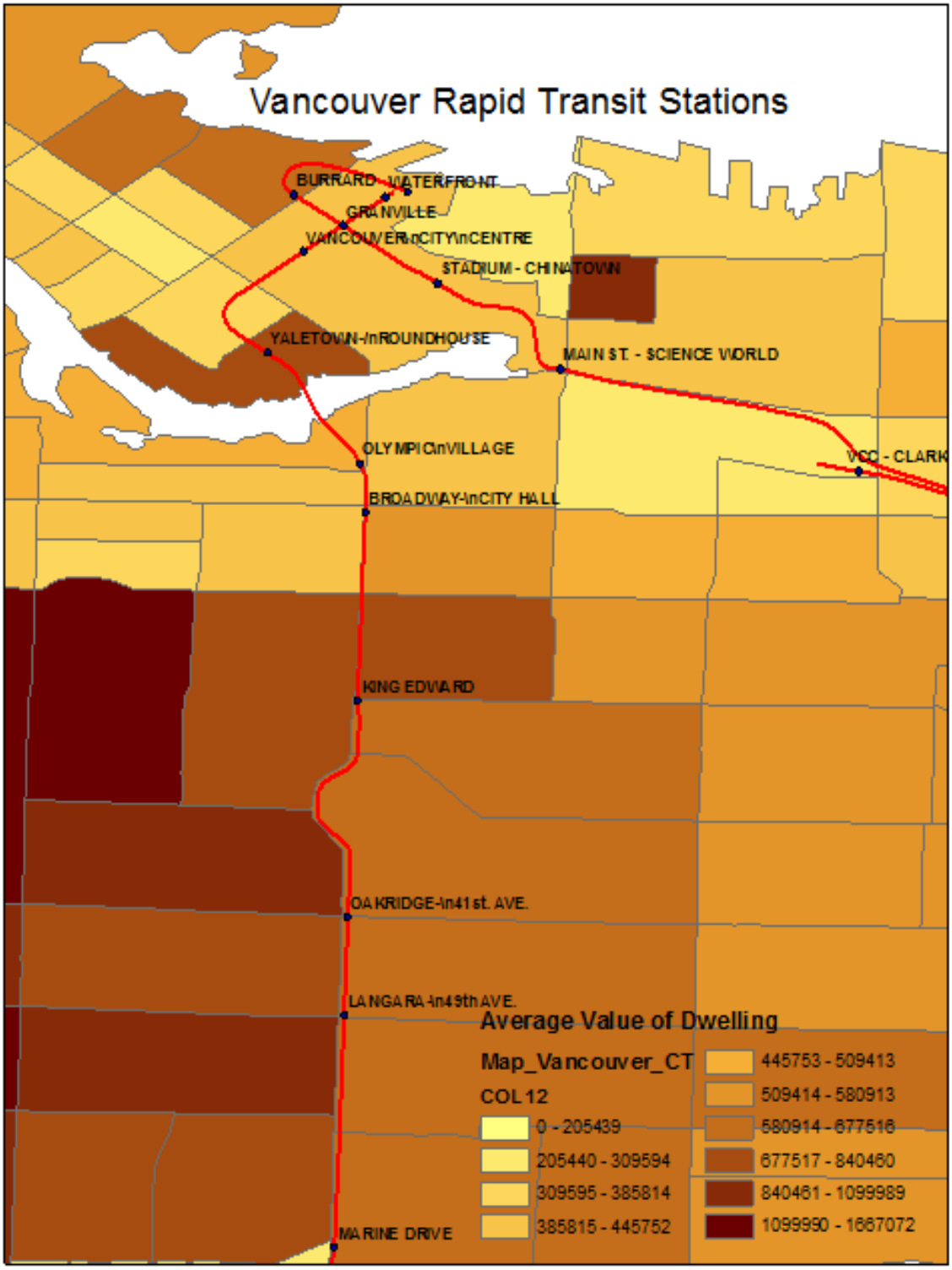
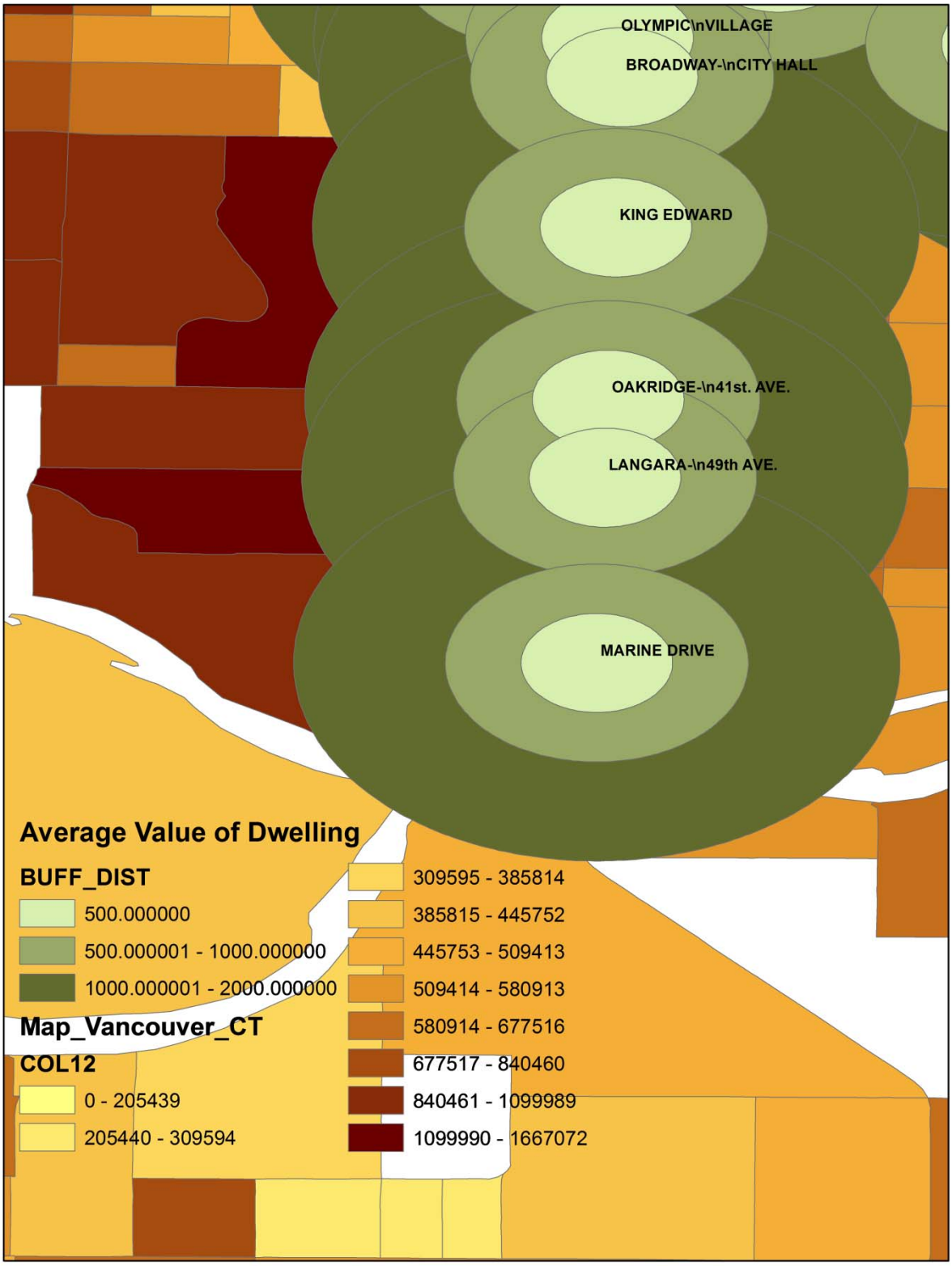
Appendix A


Vancouver Rapid Transit Stations
BURRARD
WATERFRONT
GRANVILLE
VANCOUVER\nCITY\nCENTRE
STADIUM - CHINATOWN
YALETOWN-\nROUNDHOUSE
MAIN ST. - SCIENCE WORLD
OLYMPIC\nVILLAGE
VCC - CLARK
BROADWAY-\nCITY HALL
KING EDWARD
OAKRIDGE-\n41st. AVE.
LANGARA-\n49th AVE.
MARINE DRIVE
Average Value of Dwelling
Map_Vancouver_CT
COL12
0 - 205439
205440 - 309594
309595 - 385814
385815 - 445752
445753 - 509413
509414 - 580913
580914 - 677516
677517 - 840460
840461 - 1099989
1099990 - 1667072

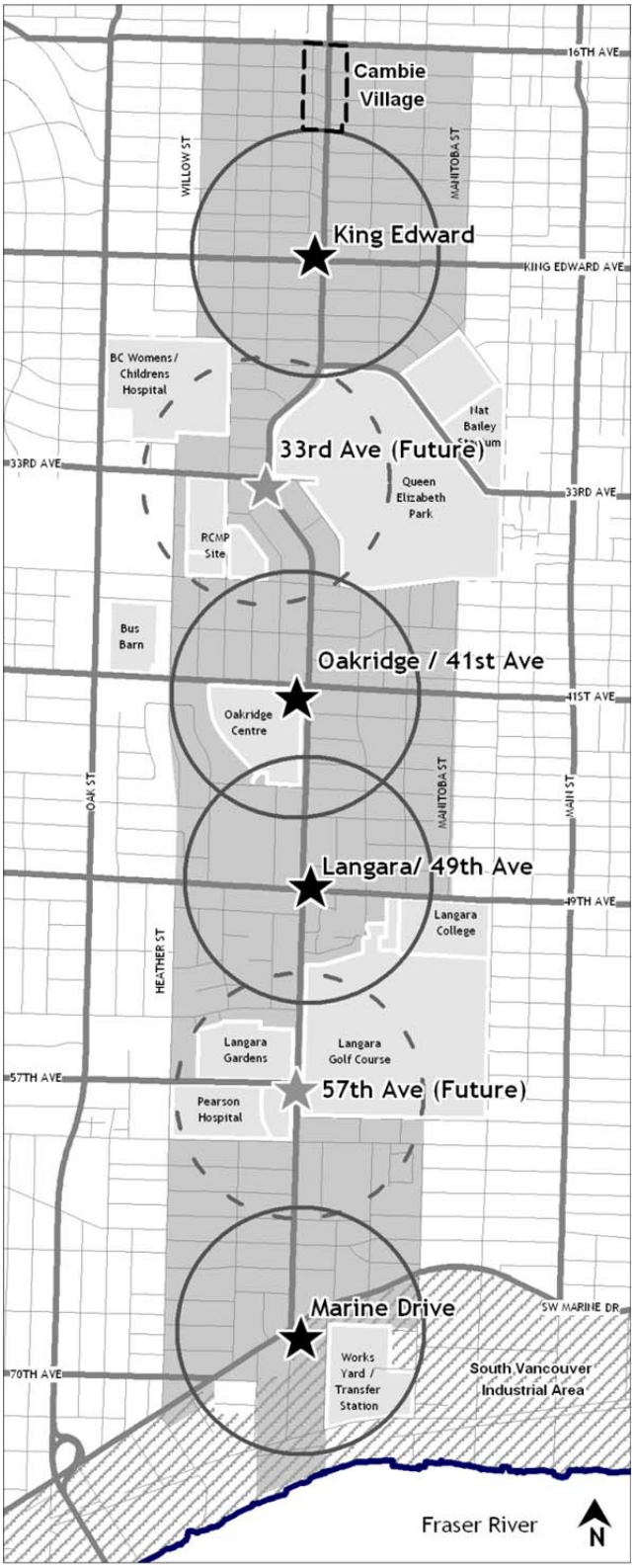
Appendix B

Table 1 - Effects of Light Rail Systems on Commercial Property Values	
Light Rail System	Effect on Property Values
Dallas	
2003 Lyons & Hernandez	Value of properties rose 39% more than the control group not served by rail.
2002 Weinstein & Clower	Proximity to DART resulted in a 24.7% increase vs. 11.5% for non-DART properties for office buildings
2002 Weinstein & Clower	Median values of residential properties increased 32.1% near DART compared to 19.5% in the control group areas.
1999 Weinstein & Clower	There was a 5% penalty over time for units nearer stations, less than 1/4 mile.
1999 Weinstein & Clower	The value of offices less than 1.4 miles from a station increased by 10% & retail property increased by 30%
San Diego	
2002 Cevero & Duncan	A 72% premium resulted for parcels near stations in the Mission Valley
2002 Cevero & Duncan	17% and 10% premiums resulted respectfully for multi family homes near East Line and South Line stations.
2001 Cevero & Duncan	The value of condos and apartments from 1/4-1/2 mile from a station increased 2-18%; the value of single family homes decreased 0-4%.
1997 Ryan	No significant premium in 3 market areas; a penalty in 2; and a small premium for industrial areas.
1995 Landis & Huang	There were no significant premiums for property 1/4-1/2 mile from stations.
1995 Landis et al.	The typical home sold for $272 more for every 330 ft. closer it was to a light rail station.
1994 Landis et al.	For every 1, 000 ft. closer to a station, prices increased $337 or 1%, but decreased 4% for units closer than 900 ft. to a station.
Santa Clara/San Jose	
2000/01 Cevero & Duncan	Properties less than 1/4 mile from a station experienced a 23% premium
2001/2000 Weinberger	Rent for units within a 3/4 mile of a station increased 4-12%
Los Angeles	
2002 Cevero & Duncan	Values rose 103.5% for apartments and homes 1/4-1/2 mile from a station, but decreased 6% for condos.
Portland (Eastside)	
1999 Dueker & Bianco	Median house values rose at increasing rates the closer to the station. The largest change, $2, 300, was for homes up to 200 ft. from a station.
1998 Al-Mosaind et al.	A 10.6% premium for homes 500 meters from a station was observed.
1997 Lewis-Workman et al	Property values increased by $75 for every 100 ft. closer to the station (within 2,500 - 5,280 ft. radius).
1996 Knapp et al.	The value of parcels located 1/2 mile of the alignment rose the farther they were from the line; values rose the closer parcels are to stations.
1993 Al-Musaind et al.	The value of homes within 500 metres increased by 10.6% or $4, 324.
Sacramento	
1994/95 Landis et al.	There was no discernable positive or negative impact to property values (not statistically significant). Single family homes rose 0.4% for every 1, 000 ft. closer to a station, and 6.2% if very near a station.
Santa Clara/San Jose	
1994 Landis	The price of single family homes increased by 0.1% for every 1, 000 ft. closer to a station, but decreased 10.8% if closer than 900 ft.
Toronto	
1983 Bajic	There was a $2,237 premium for the average home.
Vancouver	
1998 Ferguson	A $4.90 premium per foot associate with proximity to station was found.
London	
2007 Savills	A one-minute reduction to commuter rail journey increaser the average home value by £1,000.
Source: Huang, H. (1996). "Land Use Impacts of Urban Rail Transit Systems" in Journal of Planning Literature, vol. 11, iss. 17.	

Appendix C


OLYMPIC\nVILLAGE
BROADWAY-\nCITY HALL
KING EDWARD
OAKRIDGE-\n41st. AVE.
LANGARA-\n49th AVE.
MARINE DRIVE
Average Value of Dwelling
BUFF_DIST
500.000000
500.000001 - 1000.000000
1000.000001 - 2000.000000
Map_Vancouver_CT
COL12
0 - 205439
205440 - 309594
309595 - 385814
385815 - 445752
445753 - 509413
509414 - 580913
580914 - 677516
677517 - 840460
840461 - 1099989
1099990 - 1667072

Appendix D


Cambie Village
16TH AVE
WILLOW ST
MANITOBA ST
King Edward
KING EDWARD AVE
BC Womens / Childrens Hospital
Hat Bailey Stadium
33rd Ave (Future)
33RD AVE
Queen Elizabeth Park
RCMP Site
Bus Barn
Oakridge / 41st Ave
41ST AVE
Oakridge Centre
OAK ST
MAIN ST
Langara/ 49th Ave
49TH AVE
Langara College
HEATHER ST
Langara Gardens
Langara Golf Course
57TH AVE
57th Ave (Future)
Pearson Hospital
Marine Drive
SW MARINE DR
70TH AVE
Works Yard / Transfer Station
South Vancouver Industrial Area
Fraser River
N

Appendix E

Regression Output for Transit Premium Patterns around Stations

Set 1: 0.5 v 1km

$$\ln(P_{i,b} - P_{i,a}) = \beta_0 + \beta_{1-6}(\text{timeperiod\_near}) + \beta_{7-12}(\text{timeperiod\_far}) + \beta_{13-17}(\text{station}) + \beta_{18}(\text{attached}) + \beta_{19}(\text{attachedxnear}) + \varepsilon$$

Overall

Source	SS	df	MS		
Model	273.2548	19	14.3818		
Residual	155.9015	5160	0.03021		
Total	429.1564	4555	0.07989		

# of Obs	5180
F(19, 5160)	476.01
Prob >F =	0
R-squared =	0.6367
Adj R-squared =	0.6354
Root MSE	0.17382

lndiff	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]	Exp(near-far)	Sign. Diff of Mean
beforconf_near	0.230873	0.0142	16.26	0	0.2030389	0.2587078	-2.32%	
beforconf_far	0.254322	0.01207	21.07	0	0.2306606	0.2779841		
straddleconf_near	0.444011	0.00994	44.67	0	0.4245236	0.4634987	-1.91%	
straddleconf_far	0.463337	0.00805	57.54	0	0.4475521	0.4791228		
constr_near	0.168932	0.02536	6.66	0	0.1192206	0.2186428	-2.02%	
constr_far	0.189342	0.01893	10	0	0.1522336	0.2264506		
befafconstr_near	0.654918	0.01242	52.72	0	0.6305628	0.6792736	7.23%	Yes
befafconstr_far	0.585103	0.00971	60.26	0	0.566068	0.6041373		
straddleop_near	0.21682	0.01398	15.51	0	0.1894177	0.2442215	4.85%	Yes
straddleop_far	0.169505	0.01079	15.71	0	0.1483522	0.1906583		
afterop_near	0.224792	0.02138	10.52	0	0.1828844	0.2666987	3.43%	
afterop_far	0.191051	0.01826	10.46	0	0.1552481	0.2268541		
Broadway	0.005082	0.01156	0.44	0.66	-0.0175891	0.0277531		
King Edward	-0.0076	0.00963	-0.79	0.43	-0.0264812	0.0112634		
41st	-0.03008	0.01151	-2.61	0.009	-0.0526472	-0.007505	-2.96%	
49th	0.001107	0.01117	0.1	0.921	-0.0207855	0.0229992		
Marine Drive	-0.02442	0.01379	-1.77	0.077	-0.051452	0.0026117		
Attached	-0.082	0.00828	-9.9	0	-0.09823	-0.065767	-7.87%	
Attached x Near	0.001282	0.0081	0.16	0.874	-0.0145945	0.0171581	0.13%	
_cons	0.066618	0.01122	5.94	0	0.0446161	0.0886208		

$$\ln(P_{i,b} - P_{i,a}) = \beta_0 + \beta_{1-6}(\text{timeperiod\_near}) + \beta_{7-12}(\text{timeperiod\_far}) + \beta_{13}(\text{attached}) + \beta_{18}(\text{attachedxnear}) + \varepsilon$$

Broadway/City Hall

Source	SS	df	MS		
Model	163.2945	14	11.6639		
Residual	73.72599	3211	0.02296		
Total	237.0204	3225	0.07349		

# of Obs	3226
F(14, 3211)	508
Prob >F =	0
R-squared =	0.6889
Adj R-squared =	0.6876
Root MSE	0.15153

lndiff	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]	Exp(near-far)	Sign. Diff of Mean
beforconf_near	0.238034	0.01814	13.12	0	0.2024657	0.2736029	-3.48%	
beforconf_far	0.27348	0.01276	21.43	0	0.2484552	0.2985047		
straddleconf_near	0.473161	0.01234	38.35	0	0.4489702	0.4973525	0.05%	
straddleconf_far	0.472693	0.00864	54.74	0	0.4557605	0.4896256		
constr_near	0.157958	0.03112	5.08	0	0.0969401	0.2189754	-0.83%	
constr_far	0.166315	0.02015	8.25	0	0.1268005	0.2058297		
befafconstr_near	0.59632	0.01545	38.59	0	0.5660242	0.6266148	4.18%	Yes
befafconstr_far	0.555408	0.01026	54.15	0	0.5352967	0.5755184		
straddleop_near	0.133236	0.01689	7.89	0	0.1001289	0.166343	-0.84%	
straddleop_far	0.141635	0.01109	12.77	0	0.1198953	0.1633741		
afterop_near	0.139193	0.02809	4.96	0	0.0841228	0.1942639	-1.31%	
afterop_far	0.152353	0.01927	7.91	0	0.1145666	0.1901384		
Attached	-0.0742	0.0132	-5.62	0	-0.1000847	-0.048318	-7.15%	
Attached x Near	0.008113	0.0088	0.92	0.357	-0.0091372	0.0253636	0.81%	
_cons	0.068429	0.01313	5.21	0	0.0426925	0.0941645		

Set 2: 0-1km vs 1-2km

Overall

Source	SS	df	MS		
Model	459.8391	19	24.20206		
Residual	267.2363	8050	0.033197		
Total	727.0754	8069	0.090107		

# of Obs	8070
F(19, 8050)	729.04
Prob >F =	0
R-squared =	0.6325
Adj R-squared =	0.6316
Root MSE	0.1822

lndiff	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]	Exp(near-far)	Sign. Diff of Mean
beforconf_near	0.247165	0.00965	25.6	0	0.228239	0.2660905	-3.78%	Yes
beforconf_far	0.28569	0.01345	21.23	0	0.259315	0.312065		
straddleconf_near	0.458062	0.00657	69.72	0	0.445183	0.4709415	-1.71%	
straddleconf_far	0.47534	0.00879	54.06	0	0.458104	0.4925756		
constr_near	0.186007	0.0159	11.7	0	0.154834	0.2171808	-5.35%	Yes
constr_far	0.240968	0.01764	13.66	0	0.206383	0.2755536		
befafconstr_near	0.613739	0.00803	76.42	0	0.597997	0.6294818	-9.48%	Yes
befafconstr_far	0.71333	0.01077	66.26	0	0.692226	0.734433		
straddleop_near	0.189778	0.00895	21.19	0	0.172225	0.2073313	-4.11%	Yes
straddleop_far	0.231695	0.0116	19.97	0	0.208957	0.2544323		
afterop_near	0.207677	0.01457	14.25	0	0.179116	0.2362382	-3.80%	
afterop_far	0.246454	0.01679	14.68	0	0.213547	0.2793606		
Broadway	0.005719	0.00867	0.66	0.51	-0.01128	0.0227201		
King Edward	-0.00246	0.00676	-0.36	0.715	-0.01571	0.0107793		
41st	-0.01498	0.009	-1.66	0.096	-0.03262	0.0026606		
49th	-0.00366	0.00886	-0.41	0.68	-0.02102	0.0137043		
Marine Drive	-0.04255	0.00971	-4.38	0	-0.06158	-0.023526	-4.17%	
Attached	-0.10257	0.00757	-13.55	0	-0.11741	-0.087736	-9.75%	
Attached x Near	0.020166	0.00732	2.76	0.006	0.005825	0.0345072	2.04%	
_cons	0.063722	0.00903	7.06	0	0.046023	0.0814213		

Broadway/City Hall

Source	SS	df	MS		
Model	246.8508	14	17.6322		
Residual	117.0582	4541	0.025778		
Total	363.909	4555	0.079892		

# of Obs	4556
F(14, 4541)	684
Prob >F =	0
R-squared =	0.6783
Adj R-squared =	0.6773
Root MSE	0.16056

lndiff	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]	Exp(near-far)	Sign. Diff of Mean
beforconf_near	0.261567	0.01104	23.7	0	0.23993	0.2832037	-2.20%	
beforconf_far	0.283762	0.0176	16.12	0	0.249258	0.3182668		
straddleconf_near	0.472806	0.00746	63.39	0	0.458183	0.4874278	-3.34%	Yes
straddleconf_far	0.506806	0.01196	42.37	0	0.483357	0.5302555		
constr_near	0.163439	0.01789	9.13	0	0.128359	0.1985197	-4.71%	
constr_far	0.211709	0.02244	9.43	0	0.167709	0.2557089		
befafconstr_near	0.567573	0.00901	63	0	0.549911	0.5852342	-10.96%	Yes
befafconstr_far	0.683663	0.01426	47.94	0	0.655705	0.7116212		
straddleop_near	0.138754	0.00978	14.18	0	0.119573	0.1579355	-3.82%	Yes
straddleop_far	0.177754	0.01466	12.12	0	0.149005	0.2065037		
afterop_near	0.147871	0.01681	8.8	0	0.114922	0.1808194	-3.61%	
afterop_far	0.184644	0.0223	8.28	0	0.140934	0.228353		
Attached	-0.09725	0.0092	-10.58	0	-0.11528	-0.079225	-9.27%	
Attached x Near	0.02363	0.00822	2.88	0.004	0.007518	0.0397419	2.39%	
_cons	0.0706	0.00815	8.66	0	0.054622	0.0865779		

Regression Output for Transit Premium Patterns around Stations

$$\ln(P_{i,b} - P_{i,a}) = \beta_0 + \beta_{1\text{-}6}(\text{timeperiod\_near}) + \beta_{7\text{-}12}(\text{timeperiod\_far}) + \beta_{13}(\text{attached}) + \beta_{18}(\text{attachedxnear}) + \varepsilon$$

Set 1: 0.5 v 1km

King Edward Avenue

Source	SS	df	MS		
Model	46.82849	14	3.34489	# of Obs	772
				F(14, 757)	78.36
Residual	32.31456	757	0.04269	Prob >F =	0
				R-squared =	0.5917
				Adj R-squared =	0.5841
Total	79.14305	771	0.10265	Root MSE	0.20661

lndiff	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]	Exp(near-far)	Sign. Diff of Mean
beforconf_near	0.276586	0.04656	5.94	0	0.1851832	0.3679892	6.19%	
beforconf_far	0.216527	0.03903	5.55	0	0.1399098	0.2931442		
straddleconf_near	0.436739	0.03342	13.07	0	0.3711291	0.5023494	-1.40%	
straddleconf_far	0.450884	0.023	19.61	0	0.4057383	0.4960296		
constr_near	0.242767	0.1207	2.01	0.045	0.0058112	0.4797234	9.50%	
constr_far	0.152009	0.08546	1.78	0.076	-0.0157626	0.3197811		
befafconstr_near	0.916156	0.0436	21.01	0	0.8305622	1.00175	49.56%	Yes
befafconstr_far	0.513661	0.0273	18.81	0	0.4600669	0.567255		
straddleop_near	0.366579	0.04662	7.86	0	0.2750522	0.4581049	23.14%	Yes
straddleop_far	0.158463	0.03332	4.76	0	0.0930608	0.2238645		
afterop_near	0.29176	0.06789	4.3	0	0.1584829	0.4250379	15.88%	
afterop_far	0.144351	0.07409	1.95	0.052	-0.0010986	0.2898012		
Attached	-0.03887	0.02232	-1.74	0.082	-0.0826937	0.0049517	-3.81%	
Attached x Near	-0.03678	0.03565	-1.03	0.303	-0.1067747	0.0332093	-3.61%	
_cons	0.029331	0.01845	1.59	0.112	-0.006891	0.0655529		

Oakridge/41st Avenue

Source	SS	df	MS		
Model	27.71449	14	1.97961	# of Obs	596
				F(14, 581)	84.56
Residual	13.60087	581	0.02341	Prob >F =	0
				R-squared =	0.6708
				Adj R-squared =	0.6629
Total	41.31536	595	0.06944	Root MSE	0.153

lndiff	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]	Exp(near-far)	Sign. Diff of Mean
beforconf_near	0.171618	0.02815	6.1	0	0.1163326	0.2269039	1.14%	
beforconf_far	0.160282	0.04036	3.97	0	0.081005	0.2395593		
straddleconf_near	0.376702	0.02057	18.32	0	0.3363097	0.417095	-1.09%	
straddleconf_far	0.38765	0.02511	15.44	0	0.3383289	0.4369717		
constr_near	0.167001	0.06935	2.41	0.016	0.0307953	0.3032075	-4.61%	
constr_far	0.214171	0.05004	4.28	0	0.1158887	0.3124525		
befafconstr_near	0.632996	0.02769	22.86	0	0.5786179	0.687374	2.74%	
befafconstr_far	0.605938	0.02937	20.63	0	0.5482449	0.663632		
straddleop_near	0.211126	0.03152	6.7	0	0.1492211	0.2730311	6.01%	
straddleop_far	0.15278	0.04327	3.53	0	0.0677966	0.2377637		
afterop_near	0.218319	0.04244	5.14	0	0.134955	0.3016824	0.65%	
afterop_far	0.211867	0.04852	4.37	0	0.1165736	0.3071594		
Attached	-0.07573	0.01905	-3.97	0	-0.1131454	-0.038308	-7.29%	
Attached x Near	0.004467	0.01976	0.23	0.821	-0.0343471	0.0432813	0.45%	
_cons	0.053055	0.01422	3.73	0	0.0251281	0.0809822		

Set 2: 0-1km vs 1-2km

King Edward Avenue

Source	SS	df	MS		
Model	97.45278	14	6.960913	# of Obs	1327
				F(14, 1312)	147.4
Residual	61.95766	1312	0.047224	Prob >F =	0
				R-squared =	0.6113
				Adj R-squared =	0.6072
Total	159.4104	1326	0.120219	Root MSE	0.21731

lndiff	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]	Exp(near-far)	Sign. Diff of Mean
beforconf_near	0.253933	0.03088	8.22	0	0.193347	0.3145195	-4.89%	
beforconf_far	0.304092	0.04046	7.52	0	0.224722	0.3834622		
straddleconf_near	0.462592	0.0194	23.84	0	0.424532	0.5006519	-3.45%	
straddleconf_far	0.497673	0.02584	19.26	0	0.446984	0.548363		
constr_near	0.197843	0.0731	2.71	0.007	0.054439	0.3412468	-7.13%	
constr_far	0.271823	0.04767	5.7	0	0.178302	0.3653431		
befafconstr_near	0.63805	0.02379	26.81	0	0.59137	0.6847293	-22.19%	Yes
befafconstr_far	0.888982	0.02826	31.46	0	0.83355	0.9444132		
straddleop_near	0.243085	0.02797	8.69	0	0.188213	0.2979566	-7.50%	
straddleop_far	0.32109	0.03071	10.46	0	0.26085	0.3813301		
afterop_near	0.227724	0.05203	4.38	0	0.125645	0.3298034	0.49%	
afterop_far	0.222848	0.0373	5.97	0	0.149679	0.2960172		
Attached	-0.11642	0.02105	-5.53	0	-0.15771	-0.07512	-10.99%	
Attached x Near	0.026779	0.02369	1.13	0.259	-0.0197	0.0732634	2.71%	
_cons	0.047595	0.01102	4.32	0	0.025977	0.0692124		

Oakridge/41st Avenue

Source	SS	df	MS		
Model	55.17114	14	3.940796	# of Obs	895
				F(14, 880)	117.07
Residual	29.62265	880	0.033662	Prob >F =	0
				R-squared =	0.6507
				Adj R-squared =	0.6451
Total	84.7938	894	0.094848	Root MSE	0.18347

lndiff	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]	Exp(near-far)	Sign. Diff of Mean
beforconf_near	0.16878	0.0275	6.14	0	0.114811	0.2227493	-0.55%	
beforconf_far	0.174345	0.04203	4.15	0	0.091854	0.2568356		
straddleconf_near	0.381164	0.01896	20.11	0	0.343956	0.4183724	-11.58%	Yes
straddleconf_far	0.504184	0.02588	19.48	0	0.453381	0.5549856		
constr_near	0.197643	0.04845	4.08	0	0.10256	0.2927254	-13.98%	
constr_far	0.348273	0.06604	5.27	0	0.218665	0.4778799		
befafconstr_near	0.620206	0.02415	25.68	0	0.572805	0.6676072	-16.72%	Yes
befafconstr_far	0.80315	0.03229	24.88	0	0.739781	0.8665188		
straddleop_near	0.191191	0.03033	6.3	0	0.131672	0.2507097	-20.46%	Yes
straddleop_far	0.420126	0.03665	11.46	0	0.348188	0.4920638		
afterop_near	0.215321	0.03817	5.64	0	0.140413	0.2902286	3.29%	
afterop_far	0.182997	0.05446	3.36	0.001	0.076105	0.2898884		
Attached	-0.15352	0.02115	-7.26	0	-0.19503	-0.112016	-14.23%	
Attached x Near	0.078825	0.02334	3.38	0.001	0.033019	0.1246302	8.20%	
_cons	0.053999	0.0123	4.39	0	0.029854	0.0781439		

Regression Output for Transit Premium Patterns around Stations

$$\ln(P_{i,b} - P_{i,a}) = \beta_0 + \beta_{1\text{-}6}(\text{timeperiod\_near}) + \beta_{7\text{-}12}(\text{timeperiod\_far}) + \beta_{13}(\text{attached}) + \beta_{18}(\text{attachedxnear}) + \varepsilon$$

Set 1: 0.5 v 1km

Langara/49th Avenue

Source	SS	df	MS
Model	45.90319	13	3.53101
Residual	23.33647	633	0.03687
Total	69.23966	646	0.10718

# of Obs	647
F(13, 633)	95.78
Prob >F =	0
R-squared =	0.663
Adj R-squared =	0.656
Root MSE	0.19201

lndiff	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]	Exp(near-far)	Sign. Diff of Mean
beforconf_near	0.179798	0.03349	5.37	0	0.1140421	0.2455529	-2.14%	
beforconf_far	0.201431	0.04149	4.86	0	0.1199584	0.2829026		
straddleconf_near	0.408207	0.02585	15.79	0	0.357444	0.4589695	-6.17%	
straddleconf_far	0.471926	0.03013	15.66	0	0.412751	0.5311018		
constr_near	0.239843	0.05921	4.05	0	0.1235666	0.3561201	-5.09%	
constr_far	0.29205	0.06543	4.46	0	0.1635574	0.4205416		
befafconstr_near	0.637096	0.03077	20.7	0	0.5766674	0.6975243	-25.16%	Yes
befafconstr_far	0.926925	0.03609	25.68	0	0.8560573	0.9977923		
straddleop_near	0.313305	0.03698	8.47	0	0.2406894	0.3859204	-6.91%	
straddleop_far	0.384927	0.03938	9.78	0	0.3075995	0.4622545		
afterop_near	0.237549	0.04822	4.93	0	0.1428609	0.3322363	-16.19%	Yes
afterop_far	0.414216	0.06222	6.66	0	0.292025 3	0.536407		
Attached	-0.05243	0.01823	-2.88	0.004	-0.0882216	-0.016639	-5.11%	
Attached x Near	(dropped)							
_cons	0.020475	0.01361	1.5	0.133	-0.0062498	0.0471992		

Marine Drive

Source	SS	df	MS
Model	21.42614	13	1.64816
Residual	10.32597	387	0.02668
Total	31.75211	400	0.07938

# of Obs	401
F(13, 387)	61.77
Prob >F =	0
R-squared =	0.6748
Adj R-squared =	0.6639
Root MSE	0.16335

lndiff	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]	Exp(near-far)	Sign. Diff of Mean
beforconf_near	0.29777	0.04762	6.25	0	0.2041344	0.3914062	3.95%	
beforconf_far	0.25904	0.04083	6.34	0	0.1787701	0.3393106		
straddleconf_near	0.405126	0.03127	12.95	0	0.3436399	0.4666127	-4.37%	
straddleconf_far	0.449769	0.02811	16	0	0.3945038	0.5050339		
constr_near	0.098519	0.05959	1.65	0.099	-0.0186414	0.2156784	-10.48%	
constr_far	0.209177	0.05939	3.52	0	0.0924184	0.325936		
befafconstr_near	0.707325	0.03937	17.97	0	0.6299249	0.784725	16.17%	Yes
befafconstr_far	0.557444	0.0343	16.25	0	0.490005	0.6248819		
straddleop_near	0.376426	0.04762	7.9	0	0.2827902	0.4700619	18.58%	Yes
straddleop_far	0.206024	0.03647	5.65	0	0.1343246	0.2777223		
afterop_near	0.545654	0.07451	7.32	0	0.3991544	0.6921535	45.09%	Yes
afterop_far	0.173479	0.0632	2.74	0.006	0.0492192	0.2977397		
Attached	-0.03182	0.01971	-1.61	0.107	-0.0705622	0.0069305	-3.13%	
Attached x Near	(dropped)							
_cons	0.013257	0.01469	0.9	0.367	-0.0156164	0.0421296		

Set 2: 0-1km vs 1-2km

Langara/49th Avenue

Source	SS	df	MS
Model	52.97839	14	3.78417
Residual	30.41239	796	0.038207
Total	83.39078	810	0.102952

# of Obs	811
F(14, 796)	99.05
Prob >F =	0
R-squared =	0.6353
Adj R-squared =	0.6289
Root MSE	0.19546

lndiff	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]	Exp(near-far)	Sign. Diff of Mean
beforconf_near	0.186862	0.02705	6.91	0	0.133766	0.2399584	1.25%	
beforconf_far	0.174405	0.05301	3.29	0.001	0.070342	0.2784684		
straddleconf_near	0.432057	0.02068	20.89	0	0.391466	0.4726466	0.91%	
straddleconf_far	0.422956	0.03586	11.8	0	0.352571	0.4933415		
constr_near	0.256843	0.04508	5.7	0	0.168355	0.345331	8.13%	
constr_far	0.178692	0.09959	1.79	0.073	-0.01679	0.3741798		
befafconstr_near	0.752567	0.0245	30.72	0	0.704477	0.8006571	12.87%	Yes
befafconstr_far	0.631517	0.0461	13.7	0	0.541034	0.721999		
straddleop_near	0.336553	0.02817	11.95	0	0.281257	0.3918486	8.02%	
straddleop_far	0.25941	0.06572	3.95	0	0.130397	0.3884227		
afterop_near	0.299255	0.03922	7.63	0	0.222275	0.3762337	13.98%	
afterop_far	0.168443	0.07692	2.19	0.029	0.01746	0.3194251		
Attached	-0.09681	0.02574	-3.76	0	-0.14733	-0.046288	-9.23%	
Attached x Near	-0.00381	0.02809	-0.14	0.892	-0.05896	0.0513303	-0.38%	
_cons	0.043836	0.01224	3.58	0	0.01981	0.0678613		

Marine Drive

Source	SS	df	MS
Model	93.39653	14	6.671181
Residual	54.01352	1571	0.034382
Total	147.4101	1585	0.093003

# of Obs	1586
F(14, 1571)	194.03
Prob >F =	0
R-squared =	0.6331
Adj R-squared =	0.63
Root MSE	0.1855

lndiff	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]	Exp(near-far)	Sign. Diff of Mean
beforconf_near	0.284624	0.03446	8.26	0	0.217025	0.3522229	-3.12%	
beforconf_far	0.316277	0.02107	15.01	0	0.27495	0.3576044		
straddleconf_near	0.437943	0.02258	19.4	0	0.393655	0.482231	0.30%	
straddleconf_far	0.434966	0.01392	31.25	0	0.407663	0.4622684		
constr_near	0.162355	0.04712	3.45	0.001	0.069932	0.2547785	-8.75%	
constr_far	0.253879	0.0283	8.97	0	0.198376	0.3093815		
befafconstr_near	0.630753	0.02848	22.15	0	0.574893	0.6866136	-8.14%	Yes
befafconstr_far	0.71571	0.01735	41.25	0	0.681678	0.7497421		
straddleop_near	0.276849	0.03214	8.61	0	0.2138	0.3398979	1.11%	
straddleop_far	0.265796	0.01929	13.78	0	0.227956	0.3036356		
afterop_near	0.337844	0.05425	6.23	0	0.231429	0.4442578	-1.11%	
afterop_far	0.349035	0.02748	12.7	0	0.295141	0.4029303		
Attached	-0.08696	0.01799	-4.83	0	-0.12224	-0.051669	-8.33%	
Attached x Near	0.036326	0.02412	1.51	0.132	-0.01099	0.0836458	3.70%	
_cons	0.011804	0.00743	1.59	0.112	-0.00276	0.026372		