SOCIO ECONOMIC ANALYSIS

Housing Needs and Conditions

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Are Condominium Units With Three or More Bedrooms Scarce?

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"This analysis seeks to identify if the prices for units with three bedroom units significantly increase because of their bedroom count, when accounting for property characteristics of the unit. Results of this analysis suggest that units with more than two bedrooms in Vancouver are undersupplied."

Introduction

As the urban form of Toronto and Vancouver change and become denser and single-detached homes increase in price, more families with children may opt to live in apartment-style rental units or condominiums. Builders have responded by altering construction patterns. In Metro Vancouver, for example, apartment units represent a growing share of all construction activity in the last five years. In 2011, 51% of all units supplied were apartments; in 2016, the proportion of apartments increased to 61% of all new units. A similar pattern can be observed in Toronto, where the ratio of apartment units completed to all units completed plateaued in 2011 at around 55%, after a decade of growth.

The vast majority of condominium units built are either one-bedroom or two-bedroom. However, one-bedroom units are not well suited for families because they lack play space and are insufficient for growing families. Families of four require at least a two-bedroom unit and a larger footprint to accommodate the needs of teenagers. A standard economic assumption would suggest larger units would sell at a premium if demand is strong but supply is scarce.

Thus, this analysis seeks to identify if the prices of units with three bedrooms significantly increase because of their bedroom count, when accounting for the property characteristics of the unit. A large price difference would indicate three-bedroom units are scarce. The results of this analysis show a premium exists in Vancouver but not Toronto, suggesting that units with more than two bedrooms in Vancouver are undersupplied.

Data

The analysis focuses on the condominium market in Vancouver and Toronto during 2016. We retrieved sales of apartment-style units from CMHC's Property Sales and Assessment Database (PSAD). PSAD aggregates data from British Columbia Assessments, and LANDCOR for British Columbia, and Terranet for Ontario. These data include the unit selling and a set of property characteristics, such as price, size, age, number of bedrooms, number of bathrooms and geographic location. The distance from the nearest transit station[1] was also calculated.

[1] Public transit includes all SkyTrain stations; West Coast Express stations in the Vancouver CMA; all Toronto Transit Commission Subway Stations, excluding stations exclusive to future lines 5 and 6; all TTC streetcar terminus loops and Queen's Quay streetcar station; and all GO Train stations in the Toronto CMA.

To build a useable data set, we removed observations without a sale price, units with more than ten bedrooms or bathrooms, larger than 10,000 square metres, or duplicate entries. Then, we trimmed the data set to remove further outliers by excluding the top and bottom 1% priced entries. Summary statistics for each city are available in table 1. Table 1 shows the average price of a condominium in Vancouver is $467,679, while the average price of a condominium in Toronto is $397,421 even though condominiums in Toronto include more bedrooms and more living space on average.

Among the resulting sample, two-bedroom apartments are generally the most common units. Over half of the condominium units sold were two-bedroom units in Vancouver. Meanwhile, less than 5% of units sold were three-bedroom units. Units larger than three bedrooms are rare in Vancouver, less than 1% of the sample.

The distribution of units sold in Toronto shows more diversity across bedroom types than in the sample for Vancouver. Around 40% of the units sold in Toronto in 2016 were two-bedroom units. Three-bedroom units were also more common, with about 30% of units sold being three-bedroom units. If the assumption made in the introduction holds, we would expect a premium for three-bedroom units to be smaller in Toronto than in Vancouver, as there is a larger share of three-bedroom units.

Methodology

The hedonic regression model is a standard approach to calculate how buyers value the particular attributes of a housing unit (Rosen 1974). This model allows us to measure the values homeowners place on particular attributes of their homes. Our focus is on how additional bedrooms affect the prices of units. The analysis seeks to evaluate if there is a premium on apartments with more bedrooms. A more complete discussion of the methodology is available in the technical appendix.

Results

Neither city had a significant premium for two-bedroom units. This suggests buyers do not place a large value of moving from a one-bedroom condominium to a two-bedroom condominium. Given the large values taken by the coefficients on unit size and the lack of a significant two-bedroom premium, the value of a two-bedroom unit is better explained by the size of the unit and not the fact it has two bedrooms.

The premium between a one- and three-bedroom unit was more than twice the premium for a two-bedroom unit in Vancouver and was statistically significant. Adding a bedroom in Vancouver increases the price that buyers are willing to pay by around 12%. This suggests that a premium for units with three bedrooms exists, and is more than a premium for more space. In Vancouver, three-bedroom units are rare. It is likely that households looking for extra bedrooms in a condominium are having a hard time finding it, and are willing to pay substantially more for the extra bedrooms. The premium for units with more than three bedrooms is also large.

This was not the case in Toronto. The premium for three-bedroom units was not significantly different from zero. This means that three-bedroom condominium units in the GTA were not scarce. Given that just under a third of the units sold in Toronto were three-bedroom units, it is unlikely that households looking for a three-bedroom condominium had difficulty finding one. Units in sufficient supply do not attract a higher than usual price, thus, the absence of a premium for three-bedroom units in Toronto. Absence of a premium in Toronto and existence of a premium in Vancouver could suggest that the bedroom premium is due to the scarcity of units.

Are bedroom effects the same in low-priced and high-priced condominium units?

One concern with our method is that comparing averages may overlook differences in the lower and upper end of the sales distribution. It is possible buyers of expensive condominium units value some characteristics more than buyers of affordable units do. Such characteristics include amenity spaces and year of construction for instance as opposed to the raw number of bedrooms. To measure such differences, we apply a quantile regression.

It would be reasonable to think that buyers in the higher end of the market have different concerns than that of the lower end of the market. Families that are trying to buy a unit with a specific number of bedrooms may find the equivalent single-detached home too expensive for their budget and purchase the lower end condominium equivalent instead. These buyers are different from those who purchase expensive condominiums. Since the buyers of expensive condominiums could likely afford the equivalent single-detached home, they may value the specific amenities that condominium living offers or have purchased the condominium as a rental property.

We present the results in figure 3. The red lines are the value of the coefficients for the unit having two bedrooms and the unit having three bedrooms from the initial regression and two standard error band around the estimates. The blue line and blue dotted lines are the coefficients for the quantile regression, starting at the first decile and going to the ninth decile. There is a general downward trend in the value of the bedroom coefficients. As the price of the condominium unit gets more expensive, the buyer puts less value on an additional bedroom. The three-bedroom coefficient exhibits this effect stronger than the two-bedroom effect. In fact, for buyers in the upper range of the condominium distribution, the effect on the condominium price of either extra bedroom is indistinguishable from zero. It appears that people buying higher-priced condominiums are not willing to pay extra for more bedrooms. The increased willingness to pay for additional bedrooms is mostly among homebuyers purchasing in the lower deciles of the condominium market.

Potential conclusions

Unmet demand for larger units may push up prices for larger units in the condominium resale market and may contribute to pushing up the price of substitute low-rise housing types as well. Continued unmet demand could suggest that the premium is not high enough for developers to consider altering their unit mix. Through 2017, the average new unit in Vancouver has been stable and remained close to 100 square metres since 2011.

In efficient markets, price premium should eventually close, as builders would make above-average profits if they build more three-bedroom units. In this work, we do not identify why these premiums last and persist, but they warrant further analysis. It takes years to plan and build an apartment building that is compliant with all regulations and earns sufficient return; however, builders may not be acting in an inefficient manner by allowing a premium for three-bedroom units to exist unclaimed as it can represent a higher profit margin.

References

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Fik, T. J., D.C Ling, and G.F. Mulligan. 2003. "Modeling Spatial Variation in Housing Prices: A Variable Interaction Approach." *Real Estate Economics* 623-646.

Rosen, Sherwin. 1974. "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition." *Journal of Political Economy* 34-55.

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Appendix: Charts and tables

Table 1: Summary statistics

Summary Statistics, Vancouver CMA, 2016

	Sale Price	Bedrooms	Bathrooms	Age	Bed/Bath Ratio	House Size
Unit	$CAD	Rooms	Rooms	Years	Ratio	m^2
Mean	$467,679	1.7	1.6	1998.2	1.1	83.1
Std. dev	$290,001	0.6	0.6	12.8	0.4	28.9
Min	$135,200	1.0	1.0	1904	0.2	34.0
Q1	$277,000	1.0	1.0	1991	1.0	65.0
Median	$398,000	2.0	2.0	1999	1.0	80.0
Q3	$560,000	2.0	2.0	2009	1.0	95.0
Max	$2,366,000	6.0	12.0	2016	4.0	963.0
MAD	$200,151	0.0	1.5	13.3	0.0	22.2
CV	0.62	0.34	0.36	0.01	0.34	0.35
Skewness	2.34	0.25	0.79	-1.10	2.03	8.20
SE. skewness	0.02	0.02	0.02	0.02	0.02	0.02
Kurtosis	8	0	7	3	5	183
Observations	15,696	15,696	15,696	15,696	15,696	15,696

Summary Statistics, Toronto CMA, 2016

	Sale Price	Bedrooms	Bathrooms	Age	Bed/Bath Ratio	House Size
Unit	$CAD	Rooms	Rooms	Years	Ratio	m^2
Mean	$397,421	2.1	1.7	1992.5	1.2	100.6
Std. dev	$154,715	0.8	0.6	14.2	0.5	39.9
Min	$104,000	1.0	1.0	1870	0.3	1.0
Q1	$292,500	1.0	1.0	1979	1.0	74.0
Median	$375,000	2.0	2.0	1996	1.0	97.0
Q3	$475,000	3.0	2.0	2005	1.5	120.0
Max	$1,148,000	5.0	4.0	2010	5.0	1,000.0
MAD	$131,951	1.5	0.0	14.8	0.0	34.1
CV	0.39	0.4	0.4	0.0	0.4	0.4
Skewness	1.16	0.2	0.4	-1.0	1.9	5.9
SE. skewness	0.02	0.0	0.0	0.0	0.0	0.0
Kurtosis	2.35	-0.8	-0.3	2.9	4.7	97.0
Observations	9,716	9,716	9,716	9,716	9,716	9,716

Table 2: Regression results

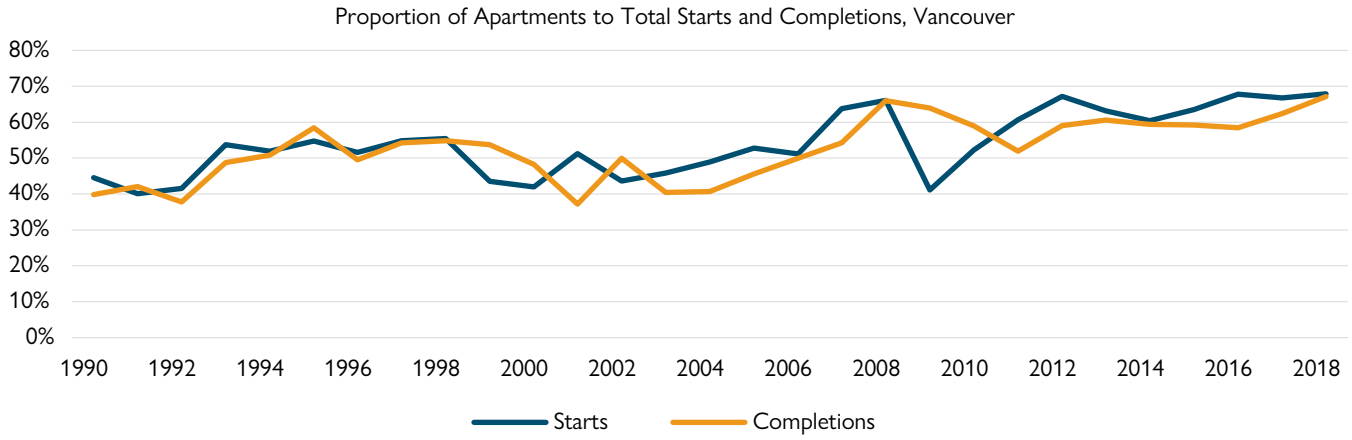
Percent Increase on Condominium Sale Price of Going from One Bedroom to x Bedrooms, Vancouver, 2016

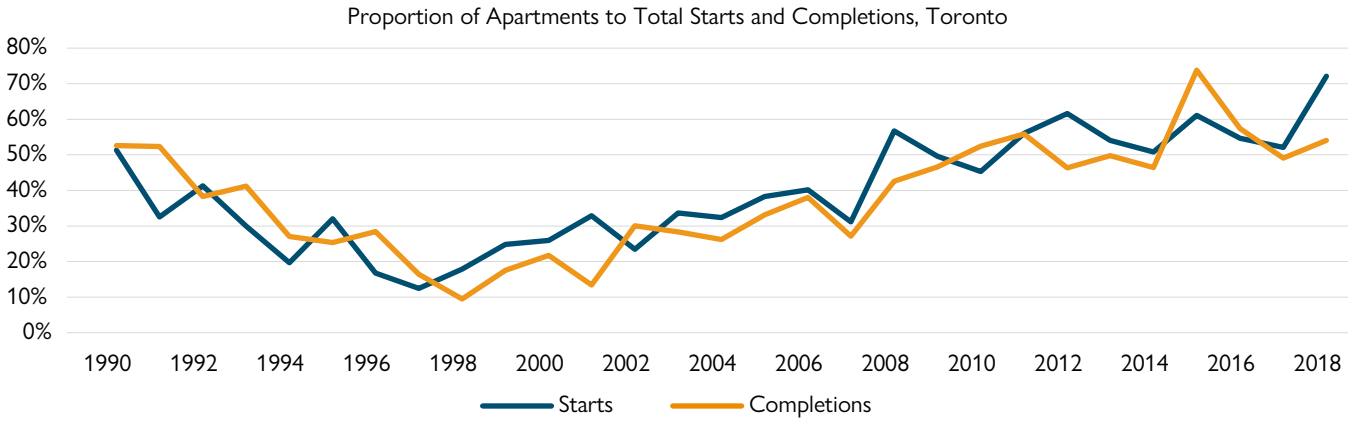
	Two-Bedroom	Three-Bedroom	Four or More	ln (square metres)
Coefficient	0.025	0.120	0.200	0.806
standard error	0.019	0.032	0.072	0.012
R Squared		0.837		
Observations		15,347		

Percent Increase on Condominium Sale Price of Going from One Bedroom to x Bedrooms, Toronto, 2016

	Two-Bedroom	Three-Bedroom	Four or More	ln (square metres)
Coefficient	0.032	-0.090	-0.060	0.524
standard error	0.029	0.041	0.094	0.028
R Squared		0.488		
Observations		9,716		

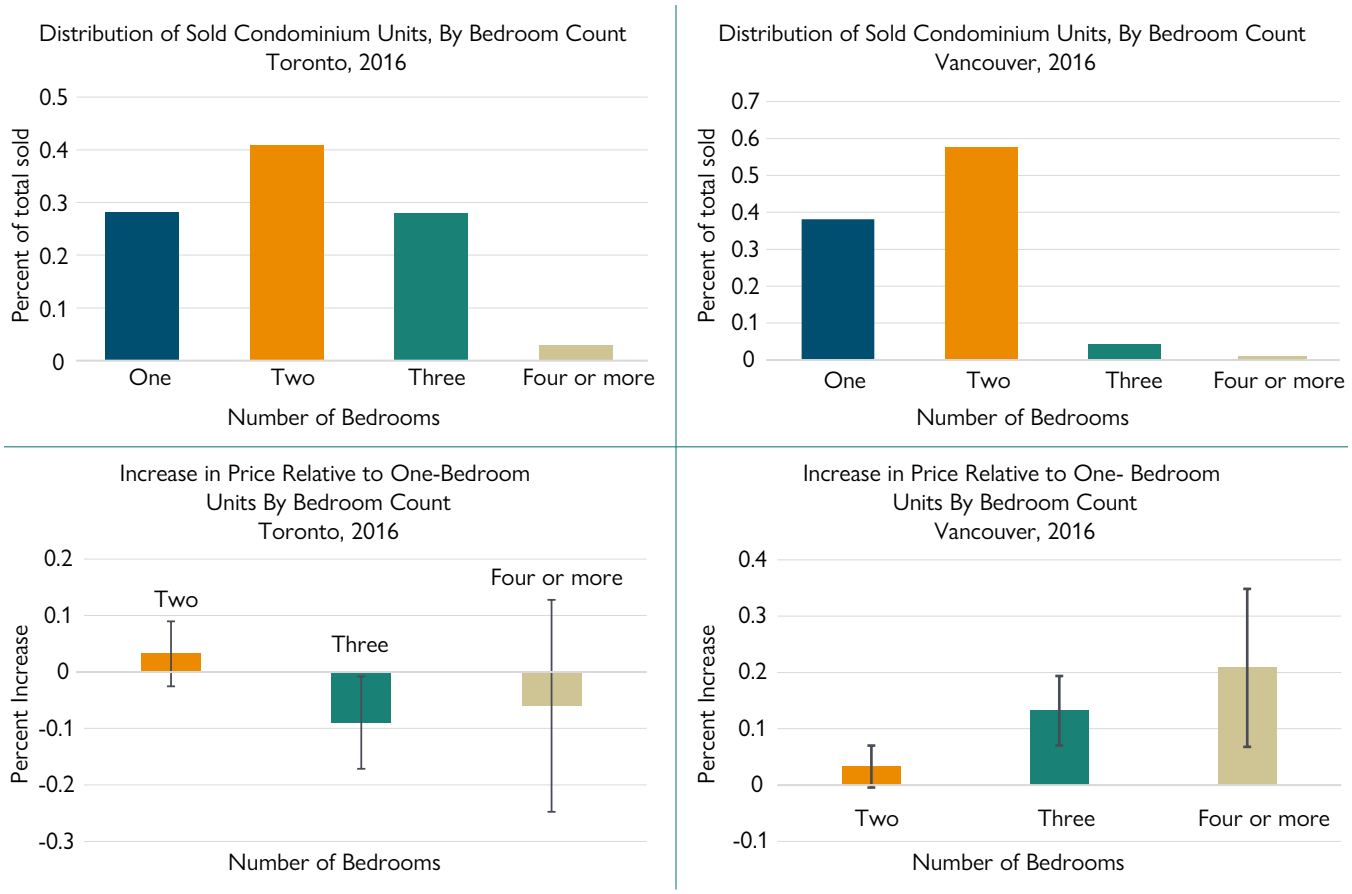
Figure 1: Ratio of apartment completions to total completions





Sources: CMHC-SCHL Starts and Completions Survey. CMHC-SCHL calculations

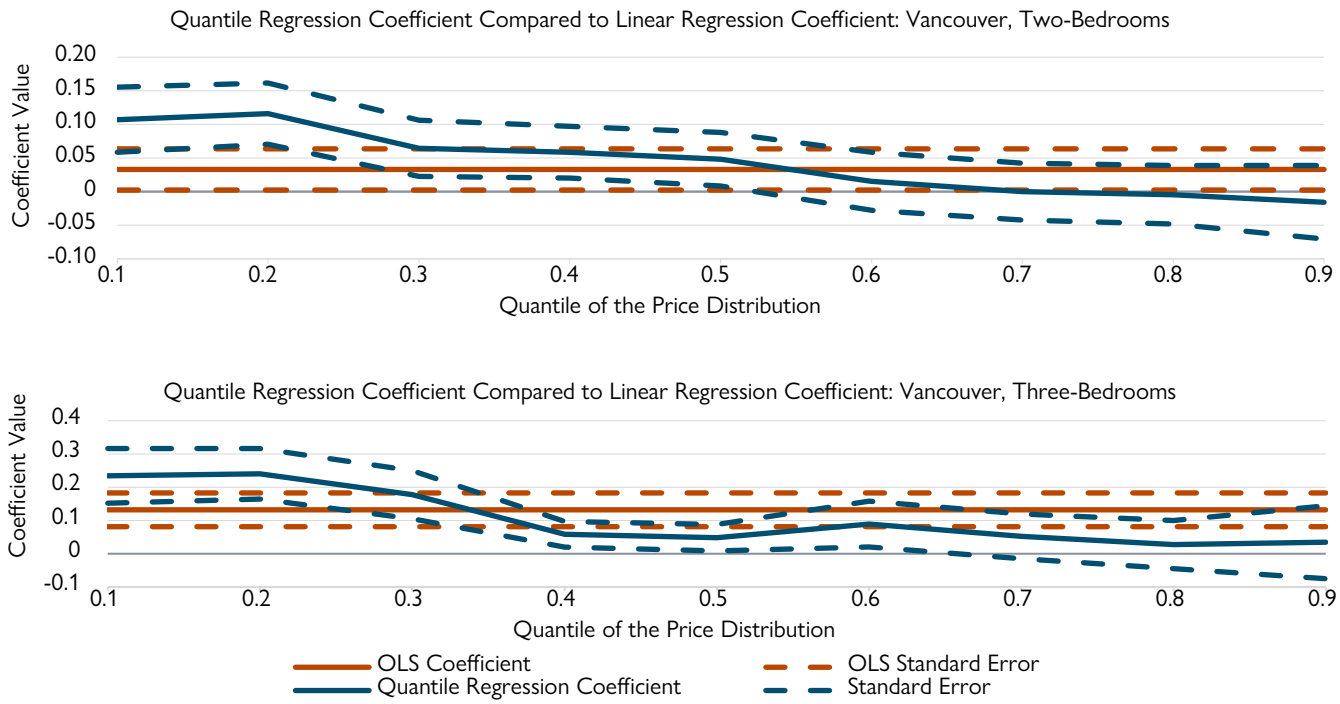
Figure 2: Distribution of sold condominium units and regression results, Vancouver and Toronto, 2016



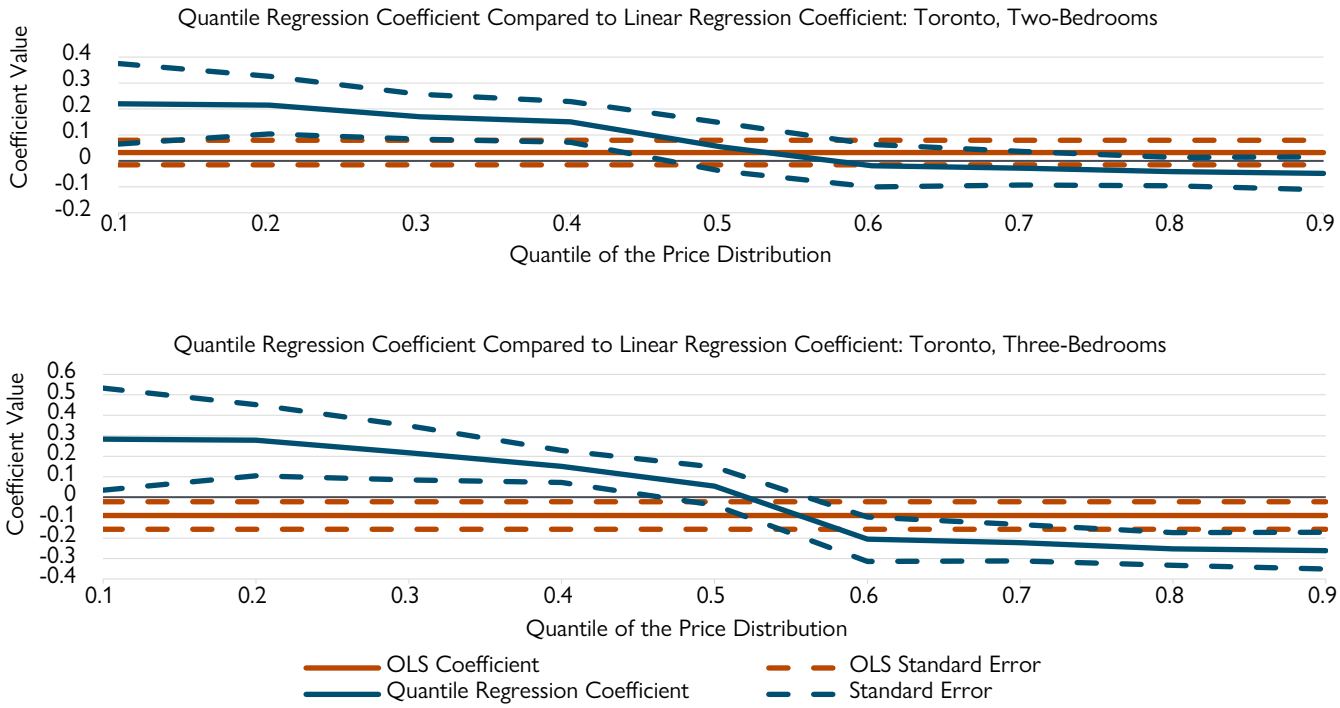
Sources: BC Assessments, LANDCOR, and Terranet, CMHC-SCHL calculations

Figure 3: Quantile regression results for the bedroom coefficients at each decile

A: Vancouver



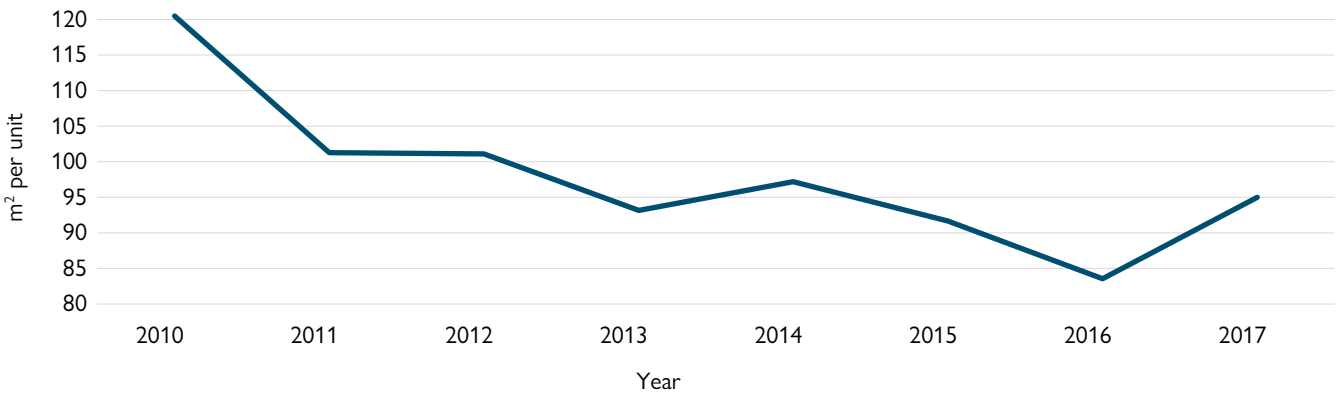
B: Toronto



Sources: BC Assessments, LANDCOR, and Terranet. CMHC-SCHL calculations

Top panel: Quantile regression results on the two-bedroom dummy variable coefficient.
Bottom panel: Quantile regression results for the three-bedroom dummy variable coefficient.

Figure 4: Average space per completed units, Vancouver



Sources: CMHC-SCHL Starts and Completions Survey. CMHC-SCHL calculations

Technical appendix

The hedonic regression model is a standard approach to calculate how buyers value the particular attributes of a housing unit (Rosen 1974). This model allows us to measure the values homeowners place on particular attributes of their homes. Our focus is on how additional bedrooms affect the prices of units. The analysis seeks to evaluate if there is a premium on apartments with more bedrooms. The regression equation assigns a dummy variable to two-bedroom units and three-bedroom units.

That results in the estimation of the following equation:

$$\ln(Price_i) = \beta_{2br} TwoBedInd_i + \beta_{3br} ThreeBedInd_i + \beta_{4br} FourPlusBedInd_i + \beta_{sqft} \ln(UnitSquareFootage_i) + \Gamma X_i + \epsilon_i$$

A logarithmic form on both dependent and continuous independent variable entails the coefficients measure the elasticities, such as the relationship between price and square footage of the unit. In the current equation, we interpret a change in a specific variable on the right-hand side as percent change of the variable on the left. If the two-bedroom dummy variable is equal to one, indicating that the unit has two bedrooms, the price of the unit will increase by β_{2br} percent.

To ensure the effect of additional bedrooms is isolated, reasonable controls are included. The matrix of variables X includes property characteristics such as the number of bathrooms, building age, distance from the nearest metro station, and the geographic coordinates of the city derived from the latitude and longitude of each unit relative to the southwest corner of each city (Fik, Ling and Mulligan 2003). The coordinates measure the value of location and amenities found in a particular neighbourhood. This allows us to account for hard to measure features that are location-specific such as shopping areas, services, parks and other neighbourhood characteristics. We interact the other independent variables with the location measure, as we expect location will have some influence on the value of individual unit features and distort the value of those features. Table 2 reports the coefficients of interest, the betas, along with their standard errors.

Note on quantile regression

Quantile regression is similar to the linear regression above, but it estimates the value of the parameter at specific quantiles instead of just a mean. Quantile regression allows us to assess if specific characteristics are valued differently throughout the house price distribution (Zietz, Zietz and Sirmans 2008). Essentially, we run the regression to see how it holds at the first decile of the condominium price distribution, the 9th decile, and the deciles in between.

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Alternative text and data for figures

Figure 1: Ratio of apartment completions to total completions,Vancouver and Toronto

Proportion of Apartments to Total Starts and Completions, Vancouver

Year	Starts	Completions
1990	45%	40%
1992	42%	38%
1994	52%	51%
1996	52%	50%
1998	55%	55%
2000	42%	48%
2002	44%	50%
2004	49%	41%
2006	51%	50%
2008	66%	66%
2010	52%	59%
2012	67%	59%
2014	60%	59%
2016	68%	58%
2018	68%	67%

Proportion of Apartments to Total Starts and Completions, Toronto

Year	Starts	Completions
1990	51%	53%
1992	41%	38%
1994	20%	27%
1996	17%	28%
1998	18%	9%
2000	26%	22%
2002	23%	30%
2004	32%	26%
2006	40%	38%
2008	57%	43%
2010	45%	52%
2012	62%	46%
2014	51%	46%
2016	55%	57%
2018	72%	54%

Sources: CMHC-SCHL Starts and Completions Survey. CMHC-SCHL calculations

Figure 2: Distribution of sold condominium units and regression results, Vancouver and Toronto, 2016

Distribution of Sold Condominium Units, By Bedroom Count, Toronto 2016

Number of Bedrooms	Percent of total sold
One	0.282
Two	0.408
Three	0.280
Four or more	0.030

Distribution of Sold Condominium Units, By Bedroom Count, Vancouver 2016

Number of Bedrooms	Percent of total sold
One	0.381
Two	0.576
Three	0.041
Four or more	0.002

Increase in Price Relative to One-Bedroom Units By Bedroom Count, Toronto 2016

Number of Bedrooms	Percent Increase
Two	0.032
Three	-0.090
Four or more	-0.060

Increase in Price Relative to One-Bedroom Units By Bedroom Count, Vancouver 2016

Number of Bedrooms	Percent Increase
Two	0.033
Three	0.132
Four or more	0.208

Sources: BC Assessments, LANDCOR, and Terranet, CMHC-SCHL calculations

Figure 3: Quantile regression results for the bedroom coefficients at each decile

A: Vancouver

Quantile of the Price Distribution	OLS Coefficient (red line)	OLS Standard Error (dotted red line)	Quantile Regression Coefficient (blue line)	Standard Error (dotted blue line)
Quantile Regression Coefficient Compared to Linear Regression Coefficient: Vancouver, Two-Bedrooms				
0.1	0.033	0.002	0.107	0.155
0.2	0.033	0.002	0.116	0.161
0.3	0.033	0.002	0.064	0.106
0.4	0.033	0.002	0.059	0.097
0.5	0.033	0.002	0.048	0.088
0.6	0.033	0.002	0.015	0.058
0.7	0.033	0.002	0.000	0.042
0.8	0.033	0.002	-0.005	0.039
0.9	0.033	0.002	-0.016	0.039
Quantile Regression Coefficient Compared to Linear Regression Coefficient: Vancouver, Three-Bedrooms				
0.1	0.132	0.081	0.234	0.316
0.2	0.132	0.081	0.240	0.316
0.3	0.132	0.081	0.178	0.250
0.4	0.132	0.081	0.059	0.097
0.5	0.132	0.081	0.048	0.088
0.6	0.132	0.081	0.089	0.158
0.7	0.132	0.081	0.052	0.120
0.8	0.132	0.081	0.027	0.100
0.9	0.132	0.081	0.035	0.144

Sources: BC Assessments, LANDCOR, and Terranet. CMHC-SCHL calculations

B: Toronto

Quantile of the Price Distribution	OLS Coefficient (red line)	OLS Standard Error (dotted red line)	Quantile Regression Coefficient (blue line)	Standard Error (dotted blue line)
Quantile Regression Coefficient Compared to Linear Regression Coefficient: Toronto, Two-Bedrooms				
0.1	0.032	-0.015	0.220	0.375
0.2	0.032	-0.015	0.215	0.326
0.3	0.032	-0.015	0.170	0.257
0.4	0.032	-0.015	0.150	0.229
0.5	0.032	-0.015	0.054	0.147
0.6	0.032	-0.015	-0.019	0.063
0.7	0.032	-0.015	-0.028	0.036
0.8	0.032	-0.015	-0.041	0.013
0.9	0.032	-0.015	-0.048	0.015
Quantile Regression Coefficient Compared to Linear Regression Coefficient: Toronto, Three-Bedrooms				
0.1	-0.090	-0.157	0.284	0.533
0.2	-0.090	-0.157	0.278	0.452
0.3	-0.090	-0.157	0.217	0.349
0.4	-0.090	-0.157	0.150	0.229
0.5	-0.090	-0.157	0.054	0.147
0.6	-0.090	-0.157	-0.206	-0.097
0.7	-0.090	-0.157	-0.223	-0.133
0.8	-0.090	-0.157	-0.253	-0.173
0.9	-0.090	-0.157	-0.261	-0.172

Sources: BC Assessments, LANDCOR, and Terranet. CMHC-SCHL calculations

Figure 4: Average space per completed units, Vancouver

Year	m^2 per unit
2010	120.489
2011	101.267
2012	101.123
2013	93.170
2014	97.208
2015	91.664
2016	83.558
2017	94.985

Sources: CMHC-SCHL Starts and Completions Survey. CMHC-SCHL calculations