HOUSING RESEARCH REPORT

Supply Constraints Increased Prices of Apartment Condominiums in Canadian Cities

Canada

CMHC SCHL

This study was conducted for Canada Mortgage and Housing Corporation (CMHC) under Part IX of the National Housing Act. The analysis, interpretations and recommendations are those of the consultant and do not necessarily reflect the views of CMHC.

Executive Summary

Since the end of the US Financial Crisis, housing affordability concerns rose in some of Canada's major cities. Prices increased rapidly in cities like Toronto and Vancouver in the last decade. However, unaffordable housing itself is not a market failure. When the price of housing is similar to the cost of producing more of it, the market is operating properly and housing prices cannot decrease by adding more supply. If prices are above the cost to provide additional units, the market has failed. Market failure has several possible causes. Among them are supply constraints, regulatory and non-regulatory, and a lack of competition. To differentiate between these major causes, the analysis must establish whether suppliers can respond to higher prices by building more units. If they cannot, then it is apparent they are constrained in some way.

In the Toronto and Vancouver Census Metropolitan Areas (CMAs), prices per square foot of new condominium units are much higher than the cost per square foot to provide more of them. Further, the number of new units initiated has little relation to the price of new units in previous years. Supply constraints, and not market power, are constraining construction and increasing the price of apartment condominiums in Toronto and Vancouver. This is not true for the Montreal CMA.

When CMAs are broken down into their subdivisions, it becomes apparent that the constraints most bind in the central city. This is true in Montreal, where the price to cost ratio in the central city is above the threshold indicative of an unconstrained market while Laval is not. Such a result suggests that the city's height limit may push up costs in the central city and induce sprawl.

In terms of overall frictions, Canadian cities experience relatively low constraints compared to their peers. It is possible to attenuate loss of affordability due to supply constraints if the constraints can be reduced in the near-term.

Résumé

Depuis la fin de la crise financière aux États-Unis, les préoccupations relatives à l'abordabilité du logement ont pris de l'ampleur dans quelques grandes villes canadiennes. Les prix ont augmenté rapidement dans des villes comme Toronto et Vancouver au cours de la dernière décennie. Cependant, l'inabordabilité du logement en soi n'est pas un échec du marché. Lorsque le prix d'un logement est proche de son coût de production, le marché fonctionne correctement, et l'augmentation de l'offre ne fera pas diminuer le prix des logements. Si le prix d'un logement dépasse son coût de production, alors le marché a échoué. Plusieurs causes peuvent expliquer les défaillances du marché. Parmi elles figurent les contraintes liées à l'offre, qu'elles soient règlementaires ou non, et le manque de concurrence. Pour différencier ces causes majeures, notre analyse doit établir si les fournisseurs peuvent réagir aux prix plus élevés en construisant plus de logements. S'ils ne le peuvent pas, il est alors évident qu'ils sont contraints, d'une certaine manière.

Dans les régions métropolitaines de recensement (RMR) de Toronto et de Vancouver, le prix par pied carré des logements en copropriété neufs est beaucoup plus élevé que le coût de production par pied carré. En outre, la relation entre le nombre de mises en chantier et les prix observés sur le marché du neuf les années précédentes est ténue. Ce sont les contraintes liées à l'offre, et non les forces du marché, qui limitent la construction et font augmenter le prix des appartements en copropriété à Toronto et à Vancouver. Ce n'est cependant pas le cas dans la RMR de Montréal.

Lorsque les RMR sont subdivisées par quartier, il devient évident que les contraintes sont plus importantes dans la partie centrale de la ville. C'est le cas à Montréal, où le rapport prix-coût dans le centre de la ville dépasse le seuil indiquant la présence de contraintes sur le marché, alors que ce n'est pas le cas à Laval. Ce résultat semble indiquer que la limite de hauteur de la ville peut faire augmenter les coûts dans le centre de la ville et provoquer l'étalement urbain.

En ce qui concerne les frictions dans leur ensemble, les villes canadiennes subissent relativement peu de contraintes par rapport aux villes étrangères. Lorsqu'il est possible de réduire, à court terme, les contraintes liées à l'offre, il est également possible d'atténuer la détérioration que subit l'abordabilité en raison de ces contraintes.

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Supply Constraints increased prices of apartment condominiums in Canadian Cities

This Report is a simplified version of a section from a forthcoming larger project. It reports less detailed versions of the Methodology and data. When the project reaches a more complete state, a working paper will become available. Data and Methodological points will be contained in an appendix

Since the end of the US financial crisis, concerns over the affordability of housing in some of Canada's major cities have been rising. This is especially true in Vancouver and Toronto, two cities that have seen rapid price increases in the last decade (Canada Mortgage and Housing Corporation 2018). Price growth in Vancouver has been especially strong in the last five years. However, housing that is considered unaffordable to many is not a failure of the housing market per se (Glaeser and Gyourko 2003).

Economists believe that a change from an equilibrium reached in a competitive market cannot make someone better off without making someone else worse off[1]. Competitive markets are ones where companies and consumers can enter and leave at will. Further, they are markets where a few companies cannot dominate the market. A hallmark of a competitive market is prices are equal to the cost of providing more of that resource. Stated differently, prices are equal to marginal costs.

If prices are equal to marginal costs suppliers cannot reduce the price of units by supplying more units in a sustainable way, as the units would be selling for less than it costs to create them. Marginal costs increase as more units are produced; the marginal cost of buildings increase when they get taller (Canada Mortgage and Housing Corporation 2017) (See also table 1). Accommodating lots of demand will increase the marginal cost of supplying units. Thus, prices may still be unaffordable to many people in a market that is operating efficiently. Prices may be high in these cities even if prices are equal to marginal costs. If this is the case, there is room for various levels of government to build housing they deem affordable. Individual wages in Toronto and Vancouver are above average for Canada (Statistics Canada 2019) and Canadian cities consistently rank among the world's most pleasant cities to live (The Economist Intelligence Unit 2019), two things that increase housing demand in those cities.

If the prices are much greater than marginal costs, supply frictions or market power[2] exist. Supply friction or market power prevent the market from reaching the efficient outcome of a competitive

[1] This is the First Welfare Theorem of Economics. The technical definition of the First Welfare Theorem states that the equilibrium outcome of a competitive market is weakly Pareto Efficient. A weakly Pareto efficient outcome is one where a change in outcome cannot make someone better off without making someone else worse off

[2] Market power is a situation where one or a few firms are large enough to set the price in the market to some degree. A firm that is a monopoly is an example of a firm with market power.

market. Removal of the supply friction or removing the market power will allow the market to reduce prices by increasing supply of units to the market equilibrium level. The price of an apartment unit may be higher than the cost to produce the unit for many reasons. One form of frictions are supply constraints such as regulation or geographic constraints. Regulation can increase the cost of housing in a variety of ways (Gyourko and Molloy, Regulation and Housing Supply 2015) and reduce overall social welfare (Albouy and Ehrlich 2018). Height limits and zoning bylaws are two types of regulation that can constrain supply. Geographic constraints like mountains and oceans can increase prices over marginal costs as they prevent builders from building in certain areas of the city (Saiz 2010). They may even increase prices when they do not bind (Nathanson and Zwick 2018). On the other hand, prices may be elevated over cost due to an inability to meet strong demand no matter how responsive suppliers are to customer demand (Davidoff, 2013). Further, many things considered as constraints, like oceans and mountains, can be thought of as amenities themselves. Simply considering them a constraint to building and not a feature that affects demand is an incomplete or improper treatment of the feature rendering inaccurate analysis (Davidoff, 2015).

Thus, this analysis must accomplish two tasks if it wants to establish whether a supply constraint or market power in apartment construction is causing affordability issues, and differentiate between the two. First, it must show that new units sell for a price much higher than what they cost to build, establishing that an increase in supply could reduce prices in the long run. Second, we must show the builders are unable to respond easily to changes in prices to differentiate the supply constraint from the existence of an oligopoly. Oligopolists will still build more units if prices increase, while supply constraints prevent the amount supplied to increase in response to higher selling prices in the market.

Results of this analysis suggest that the marginal cost of producing new apartment units is far below the average price per square meter that they sell for in Vancouver and Toronto, whereas this is not the case for Montreal. Builders in Toronto and Vancouver do not respond to past changes in prices for new units by building more units while builders in Montréal do. Supply constraints, and not market power, are constraining construction and increasing the price of apartment condominiums in Toronto and Vancouver.

Brief Methodology

The methodology of this report follows closely the methods deployed by Glaser, Gyourko and Saks (2005). In a well-functioning market without market power, they argue, the price of a housing unit will be equivalent to its average cost of production. In the long run, the average cost of production is equal

to the marginal cost of production. A difference between price and cost will erode as new builders enter the market to provide new supply and compete on price. Competition will continue to add supply and push down prices until prices are equal to marginal costs. This report's methodology relies on the free entry of firms to compete. If a few firms can exercise market power in multifamily unit construction by doing only lucrative work and keeping other firms out then prices can remain above costs indefinitely, as these firms produce less than what a competitive market would. This allows them to capture consumer surplus and a higher profit than a competitive market would allow. That behavior is indicative of monopolies and oligopolies in a particular industry.

Average costs for multi-family apartment buildings are hard to determine. Land sales in Canada are infrequent and development fees can vary greatly from project to project within a city. Marginal costs, however, are much easier to observe. The marginal cost of producing a multifamily unit is simply the cost of building another floor of units, and estimated with available industry data.

Data for the costs of new multi-family units is typically an average cost of construction for a specific type of building at a specific height. A description of converting between average and marginal cost is in the appendix. The final number for marginal cost for the city is the cost suggested by the marginal cost of the highest floor covered by the range of floors provided, 24. This creates a measure that is less likely to suggest that supply constraints exist when they do not, as marginal costs tend to increase as a building gets taller.

Unlike Toronto and Vancouver, Montreal's new units tend not to be high rises. In fact, the majority of new apartments built in Montreal are low-rise buildings: As demonstrated in Figure 2, 89% of apartments completed in Montreal where height information exists were three stories or shorter, according to the CMHC Starts and Completions Survey. Thus, for Montreal the height level for a marginal unit will be four stories. Such an extreme cut off at a low building height suggests that Montreal's variable height limit, which bans buildings that block the view of Mount Royal, with some exceptions (Ville de Montreal n.d.), may bind.

We compare the estimated marginal costs to the sale prices[3] of units by dividing the sale price of units by the marginal cost of a unit. This creates a measure of potential supply constraints in a given city for the given year. If the value is exactly one, then prices are equal to marginal costs. A ratio below one

[3] We use two measures of price, the MLS® HPI benchmark price for an apartment and the recorded sale price of apartments that are less than five years old.

suggests that prices are below marginal cost. A ratio above one suggests that prices are above marginal costs. This is not to say that a market with a ratio above one is operating inefficiently. The price of the unit must accommodate things that the marginal cost does not cover to allow builders to break even or make a small profit, like land. However, builders in Canada typically follow a rule of thumb: the cost of land should not be more than a third of the total project[4]. Thus, markets that have a ratio below 1.3 are markets where this methodology cannot detect a friction. These guidelines roughly line up with the boundaries for a "flexibly supplied city" when Glaeser and Gyourko investigated a similar methodology for single detached homes (Glaeser and Gyourko, 2018).

See the Appendix for details on data sources and definitions.

Results

When evaluating the price to cost ratios using the HPI Apartment Benchmark Price, an immediate difference between Vancouver and the other two cities is apparent. At no point between 2005 and 2018 is the ratio for Vancouver below one. Toronto and Montreal both start the period with the benchmark price per square-foot lower than the marginal cost of construction. In Montreal, the ratio fluctuates around one for the entire sample, a value that suggests that housing prices are in line with marginal costs of construction.

In the early period of the sample prices grew in line with or slightly faster than the cost of construction. Unlike the cost of construction that continues to grow slowly over the entire period, price per square foot growth accelerates in all three cities at the end of the sample. The growth in prices overall is far more volatile than the growth in the cost of construction, suggesting a strong change in demand in this period has driven the increase in the difference between prices and costs. Since the actual cost of construction has changed slowly, the high price volatility cannot be due to changes in marginal costs.

While Toronto and Montreal continue to have prices close to the cost of production by this measure, Vancouver's ratio grows in excess of 1.3. In the last year of the sample, units in Vancouver sell for 1.77 times more than the cost of goods and labour for an additional floor of units. The ratio of price to sales had grown by 20 percentage points each year.

[4] Several members of various chapters of CHBA and BILD, the national association of homebuilders and developers in Canada, suggested that they follow such a rule of thumb, and American homebuilders follow a similar rule (Glaeser and Gyourko, 2018).

When considering only the prices of new units, the picture changes dramatically for Toronto. When the HPI is the price measure, Toronto exhibits a stable ratio of sale price to marginal cost of below one until 2015. However, when the prices of units built five years or less prior to sale is the price measure, the ratio of price to marginal cost consistently increases throughout the sample. It starts around .8 in 2005 and increases steadily to 1.66 in 2018. Using a benchmark price masks what prices builders are actually considering when making price decisions. Montreal also exhibits a higher ratio than it does with the HPI, but it remains below 1.33, the threshold suggested for a healthy market. Toronto and Vancouver, on the other hand, are above the 1.33 threshold.

Condominium apartment markets in Toronto and Vancouver are not delivering efficient outcomes. Vancouver's has been persistent, with a ratio close to or above 1.3 for the majority of the sample when new units are considered. Toronto's on the other hand is recent.

A potential issue that arises when selecting the proper price measures is the location of the units themselves. Including units at the edge of the CMA in an analysis of the main city will reduce the value of the price to marginal cost ratio. This mainly becomes an issue where a large number of units are in different municipalities than the core cities. The municipalities have different laws that affect permitting and construction, even if they may not change the way prices change relative to the distance one has to commute to the central city (Glaeser and Ward 2009). Including these units will distort the analysis if we believe the different municipalities operate as different cities with different centers and different regulations. This is an ecology fallacy. This is not a question with a clear-cut answer. If the municipalities serve as places for people to live and commute into the city center, it is reasonable to include the outlying municipalities in the sample analyzed, even if the regulations are different. Determining whether the municipalities are significantly different from each other is outside the scope of this report, we will present results from the City of Montreal and the City of Vancouver[5] and their major municipalities for 2018 and mapped in figure 6.

Within Vancouver, most of the new multifamily units sold were not within the city of Vancouver, but in other municipalities. In 2018, Burnaby and Richmond specifically. Richmond is Vancouver's immediate neighbor to the south, and not surprisingly, Richmond and the City of Vancouver have similar

[5] Results are not presented for Toronto, as the vast majority of units in the sample are in the City of Toronto and an ecology fallacy is unlikely to arise.

price to marginal costs ratios, 1.71 and 1.89. Both of which are similar to that as the CMA as a whole. Burnaby however has a lower but elevated ratio of 1.45.

When we consider just the city of Montreal, the ratio rises from just at the edge of the flexibly supplied city line to 1.49 while Laval has a ratio of 1.1. This suggests that prices are higher than marginal costs in the central city. Montreal's height limit may bind, which would cause sprawl out of the central city and into the suburbs. Sprawl results in increased price over building costs as land in prime areas can serve less people and becomes more expensive, a theoretical prediction of binding height limits (Bertaud and Brueckner 2005).

To determine if we have observed supply side frictions in Canada's major cities, we must determine if builders can react to changes in demand indicated by increasing prices.

Responsiveness

There are many ways to measure how responsive builders are to prices in general. A complete treatment that fits into this extensive literature is outside the scope of this analysis. The simple measure for responsiveness is a scatterplot comparing lagged prices by one year[6] to current starts and permits. Builders use past prices of new units to guide the amount of units they prepare to build. Quantity and price are determined at the same time, and thus changes in price will cause changes in quantities and vice versa. However, past prices are pre-determined; a change in permits or starts today cannot change prices yesterday. The assumption applied in the previous sections suggests that if a constraint impeding new construction is the reason that prices are above costs, then developers are not able respond to price changes. If this is the case, the relationship between past prices and current starts should be weak or non-existent. If it is the case that builders increase current building after seeing prices go up, the price above cost situation is either transitory, due to exceptionally strong demand, or due to market power structure like an oligopoly.

Choice of price measure for the responsiveness exercise is crucial. The choice of price measure greatly affects the slope of the line of best fit. Apartments built in the last five years was selected as the measure of choice as these prices are the prices that developers receive when they sell units, hence are what they use to plan. Other measures, like benchmark prices take into account very old buildings.

[6] This analysis were performed with lag lengths of two and three years, but did not alter the interpretation of the analysis. Those results are omitted.

Choosing the price of units built in the last five years is least likely to commit an ecology fallacy, or to compare unlike populations. Including the price and features of old buildings with the cost of constructing new ones by using the HPI in the comparison, on the other hand, very likely commits an ecology fallacy. Old buildings have features are likely not relevant to the present builders; old homes have depreciated due to use and do not have the same amenities that new buildings do. Unfortunately, the sale price data for individual municipalities was too variable in number of observations year over year to allow for a stable analysis. Thus, responsiveness can only be tested at the CMA level. For results of this analysis, see table 3 and figure 7.

In Vancouver and Toronto, the relationship between new units and past prices is almost non-existent. Vancouver's relationship is weakly negative with a very low R^2 while the relationship in Toronto is almost flat with an R^2 of zero. It is clear that response from past prices to current construction is very weak, indicative of some sort of supply restriction. Meanwhile, in Montreal a robust positive relationship exists with an R^2 of 47%. This suggests that builders in Montreal are able to respond to price changes. Combined with the previous analysis, the only market that currently has a price to cost ratio indicative of a normally functioning market, Montreal, is the only market where developers are able to respond to price signals. This suggests that supply constraints have muted supply responses in Vancouver and Toronto while existing supply constraints in Montreal, like its height limit, do not bind new construction.

Conclusion

This report compares the prices of new housing units in three of Canada's largest cities to the costs to produce an additional unit. The marginal cost of producing new apartments unit is far below the average price per square meter that they sell for in Vancouver and Toronto. This is not the case for Montreal as a whole. If a market friction preventing new supply from entering the market is causing the large difference between marginal costs and sale prices, we would expect to find a weak relationship or no relationship between past sale prices and current starts or permits. Again, this is observed in Toronto and Vancouver, while there is a strong positive relationship between past prices and starts in Montreal. Supply constraints are increasing the price of units in Toronto and Vancouver. Unfortunately, this method is unable to identify what is the cause of the friction. Identifying the source of the constraint is the subject of future research.

In terms of absolute frictions, Canadian cities experience relatively low frictions compared to their peers. Recently, researchers in Australia (Kendal and Tulip 2018) and New Zealand (Lees 2017)

conducted similar analysis and found larger frictions in the cities of Auckland and Sydney than any city in Canada. In 2016, Sydney had a price to cost ratio of 1.85 while Auckland's was 3.5. Meanwhile, no city in Canada had a price to cost ratio reach 1.85, let alone sale prices over three times the marginal cost of construction. It is possible to attenuate the loss of affordability due to supply constraints if policy makers rectify them in the near-term.

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Figures and Tables

Table 1: Construction Costs per Square Foot (Canadian Dollars) for each city, 2018

	Montreal		Toronto		Vancouver	
	Average Cost	Marginal Cost	Average Cost	Marginal Cost	Average Cost	Marginal Cost
RS Means: Apartments in each City						
1-3 Story	$ 283.35	$ 286.20	$ 297.94	$ 300.34	$ 281.37	$ 284.31
4-7 Story	$ 293.32	$ 289.52	$ 306.79	$ 315.43	$ 291.56	$ 300.61
8-24 Story	$ 357.53		$ 371.87	$ 477.23	$ 354.87	$ 450.41
Atlus : Apartments in Each City†						
	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Up to 6 Story (Hybrid)	$ 198.90	$ 251.55	$ 228.15	$ 310.05	$ 257.40	$ 339.30
Up to 12 Story	$ 216.45	$ 286.65	$ 251.55	$ 327.60	$ 292.50	$ 368.55
13-39 Story	$ 234.00	$ 327.60	$ 251.55	$ 339.30	$ 310.05	$ 380.25
40-60 Story	$ 257.40	$ 345.15	$ 274.95	$ 362.70	$ 315.90	$ 409.50
60+	n/a	n/a	$ 321.75	$ 386.10	$ 374.40	$ 432.90

Sources: RS Means Corporation and Altus Group

Marginal cost reported is the marginal cost for the top floor of the group except for Montreal's 4-7 story marginal cost, which is the marginal cost for the 4th floor.

†Altus group data adjusted to add in "soft costs" omitted in their reporting for which RS Means includes a 17% allowance.

Table 2: Distribution of Price per Square Foot, Units Built in the Last Five Years

By City, In Canadian Dollars

	Montreal					Toronto					Vancouver				
	Mean	25th Percentile	Median	75th Percentile	N (Count)	Mean	25th Percentil	Median	75th Percentil	N (Count)	Mean	25th Percentil	Median	75th Percentil	N (Count)
City	287	208	269	350	21773	466	353	454	567	95640	681	490	605	730	29633
Rest of CMA	188	151	178	215	18000	355	267	346	431	27149	444	333	423	517	49564
By Year, CMA															
2005	184	143	172	212	1818	263	233	272	319	8012	366	272	325	416	5082
2006	192	147	177	220	2215	261	235	274	318	5815	400	290	352	453	5055
2007	202	153	185	226	3139	296	259	304	357	9842	447	339	402	503	6509
2008	209	157	191	239	3339	296	259	303	370	5316	482	356	435	550	7501
2009	226	165	204	254	3176	315	278	332	397	6075	489	376	457	562	8283
2010	241	175	218	283	3205	373	315	367	448	9673	572	379	480	632	5244
2011	251	182	230	291	2923	426	348	408	490	10842	536	364	476	622	4910
2012	255	185	235	299	2775	435	366	418	499	6687	521	369	468	561	5023
2013	259	192	240	301	2459	498	393	448	520	7454	533	376	465	591	4985
2014	270	196	250	320	2372	461	389	435	509	10179	572	416	555	680	5303
2015	295	205	267	344	2353	526	449	516	581	12582	554	424	514	627	6134
2016	313	214	288	374	2384	567	476	558	651	15374	648	442	564	713	3940
2017	347	224	304	427	2551	619	484	585	718	11898	659	514	587	696	5401
2018	384	237	340	500	2094	791	656	784	938	3040	771	582	670	804	5827

Source: BC Assessments, LANDCOR, Terranet, Centris, CMHC Calculations

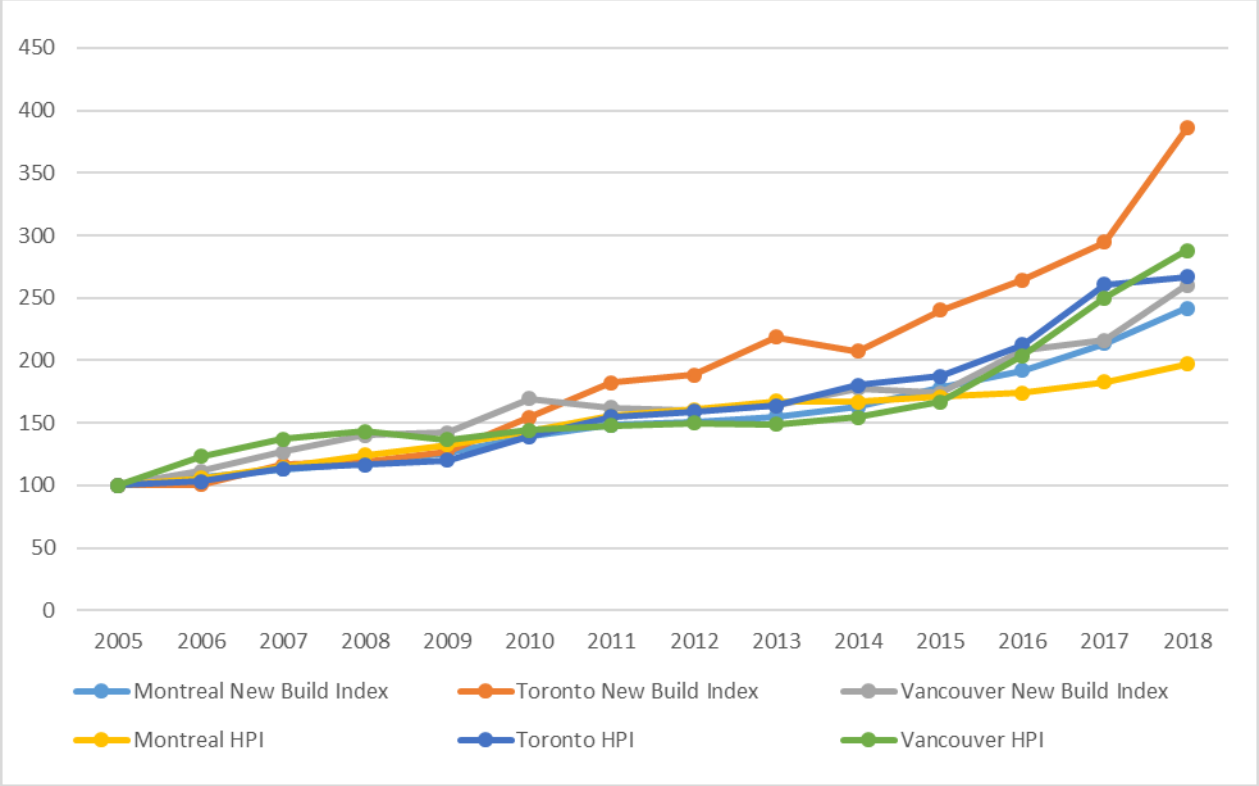
Table 3: Lagged Price Coefficient from Regression on Apartment Starts

	Montreal	Toronto	Vancouver
Coefficient	48625	-3919	-8497
t-statistic	2.95*	-0.14	-0.52
R Squared	0.46	0.01	0.03
Observations	12	12	12

*: Relationship is significant at the 5% significance level

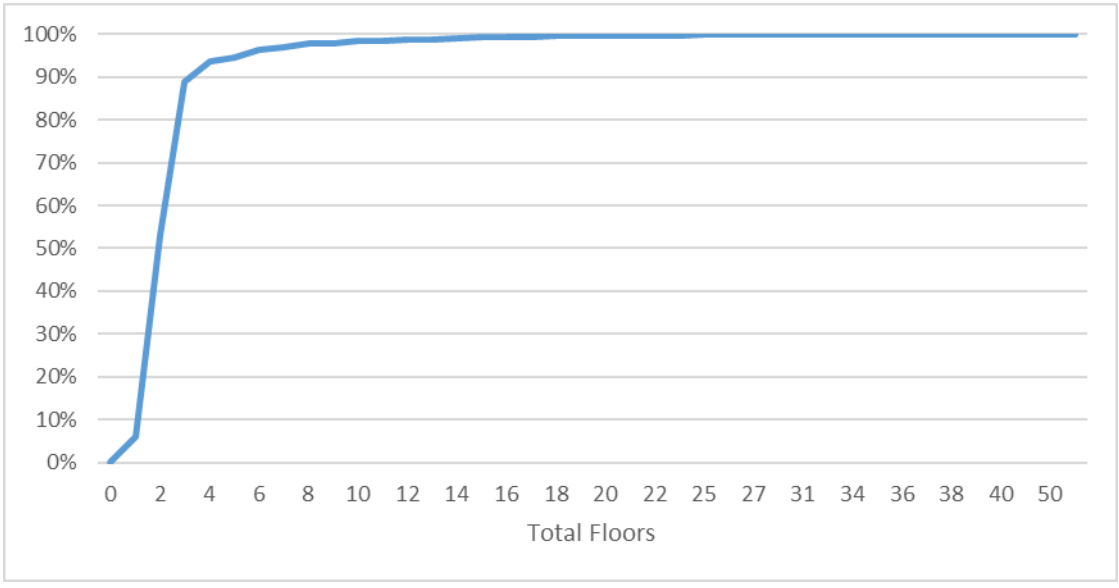
Sources: BC Assessments, LANDCOR, Terranet, Centris, CMHC Data and Calculations

Figure 1: Sale prices, HPI Benchmark Price and average price of new units. (Index: 2005 = 100)



Sources: Canadian Real Estate Association, BC Assessments, LANDCOR, Terranet, Centris

Figure 2: Cumulative Distribution of Completed Apartments in Montreal, 2006 to 2018

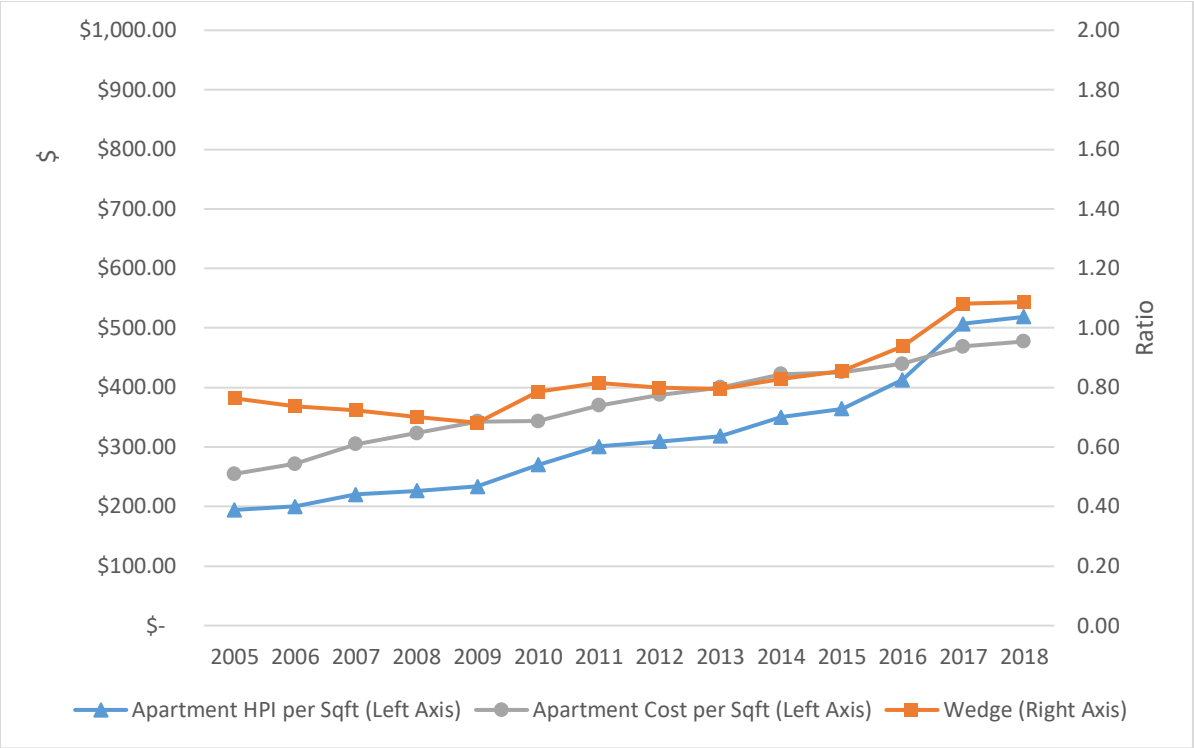


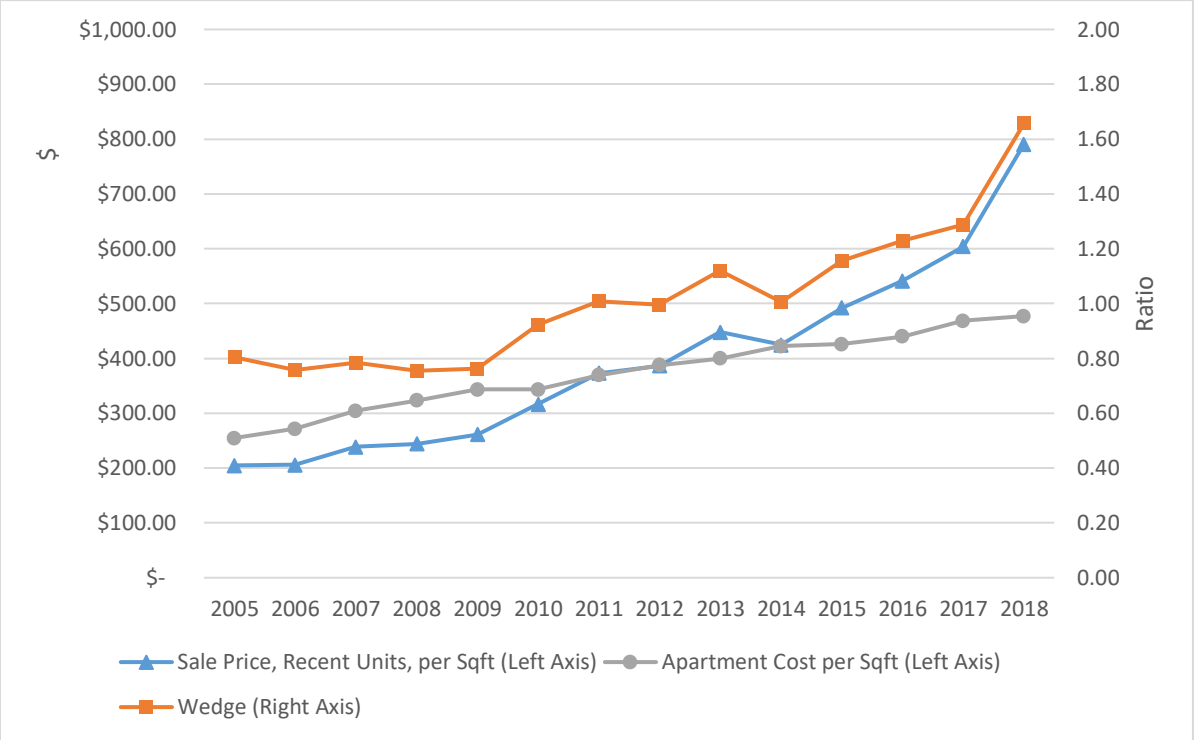
Source: CMHC Data and Calculations

Figure 3: Comparison of Sale Prices and Construction Costs: Montreal (HPI: Top, New Units: Bottom)

Sources: Centris, CMHC Data and Calculations

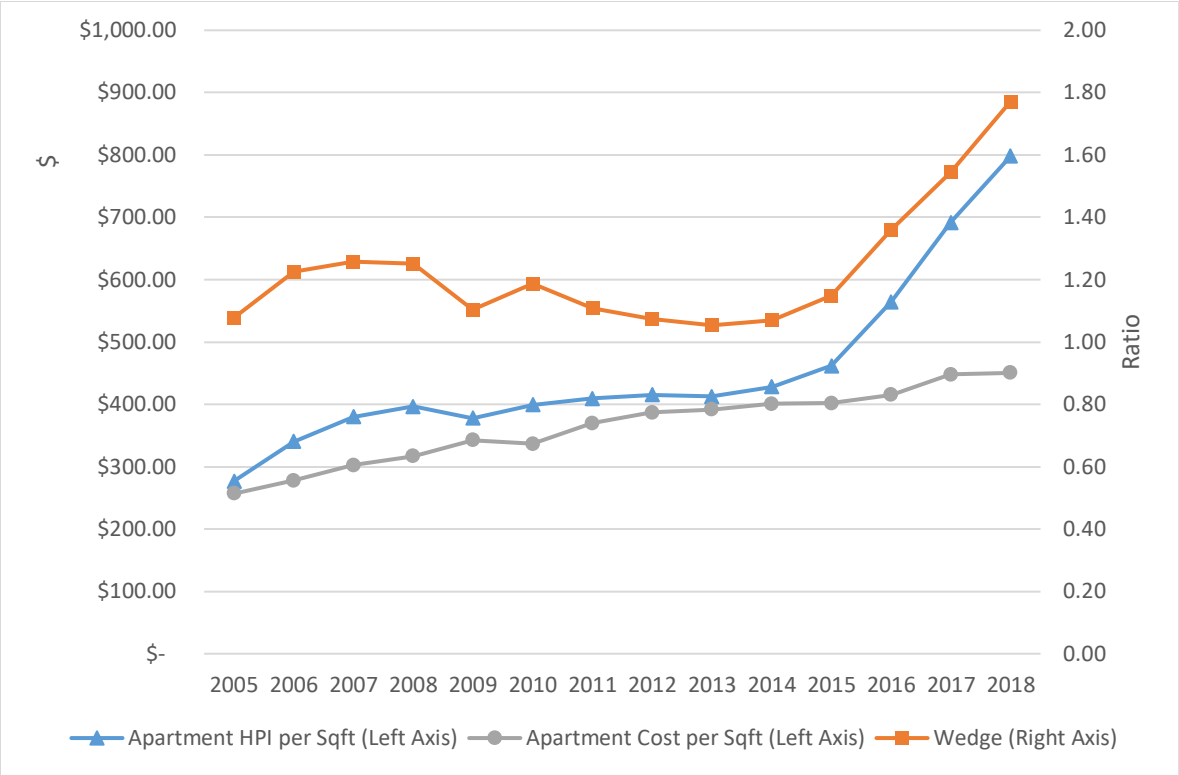
Figure 4: Comparison of Sale Prices and Construction Costs: Toronto (HPI: Top, New Units: Bottom)

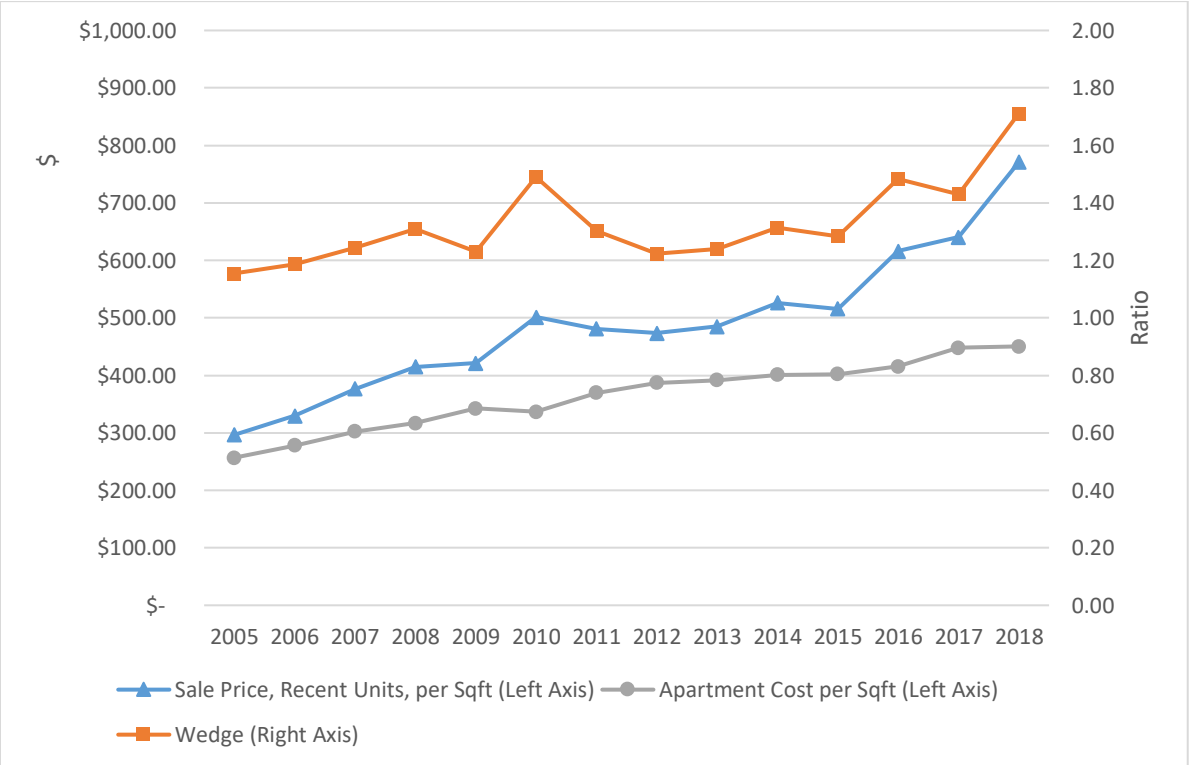




Sources: Terranet, CMHC Data and Calculations

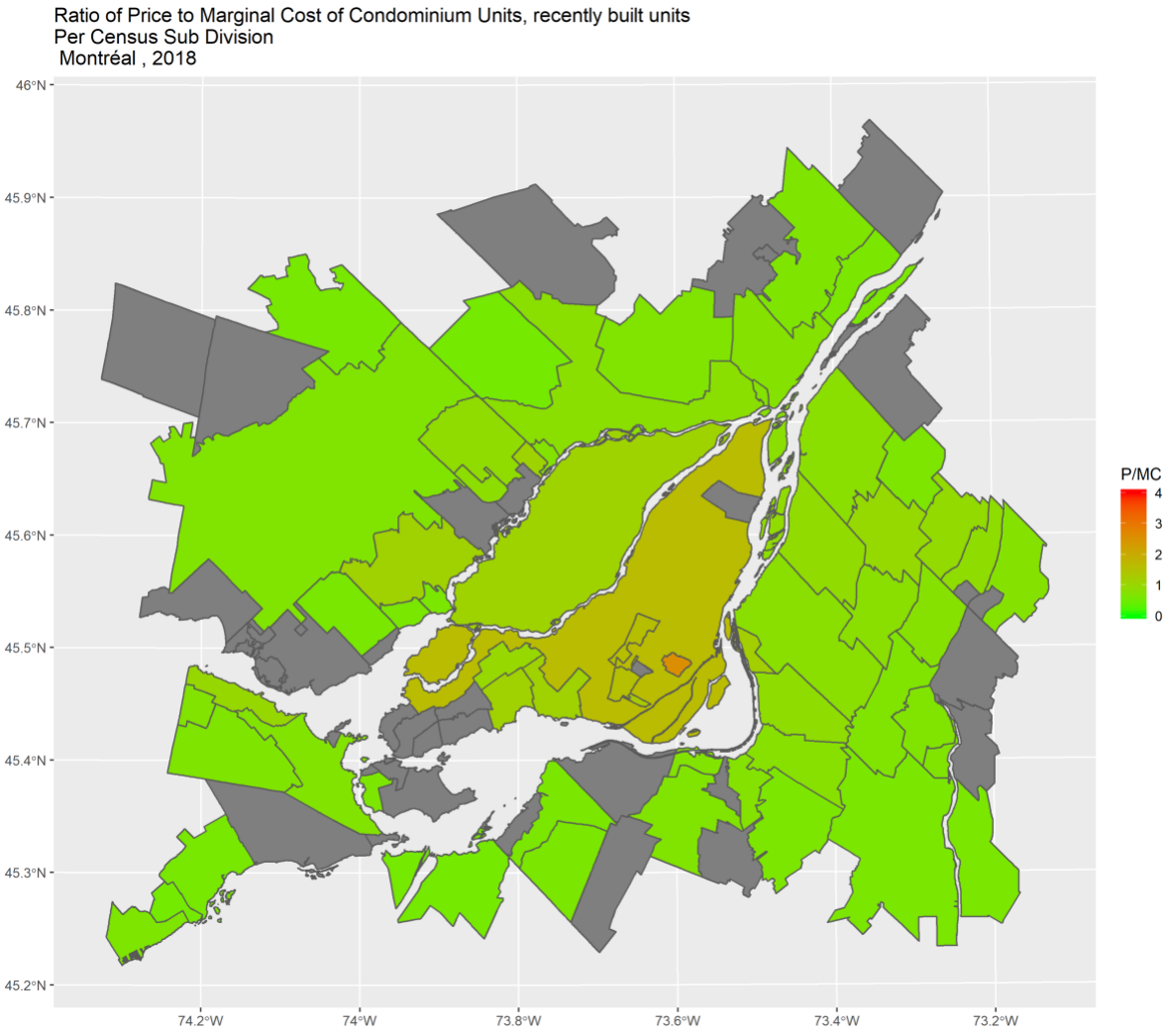
Figure 5: Comparison of Sale Prices and Construction Costs: Vancouver (HPI: Top, New Units: Bottom)

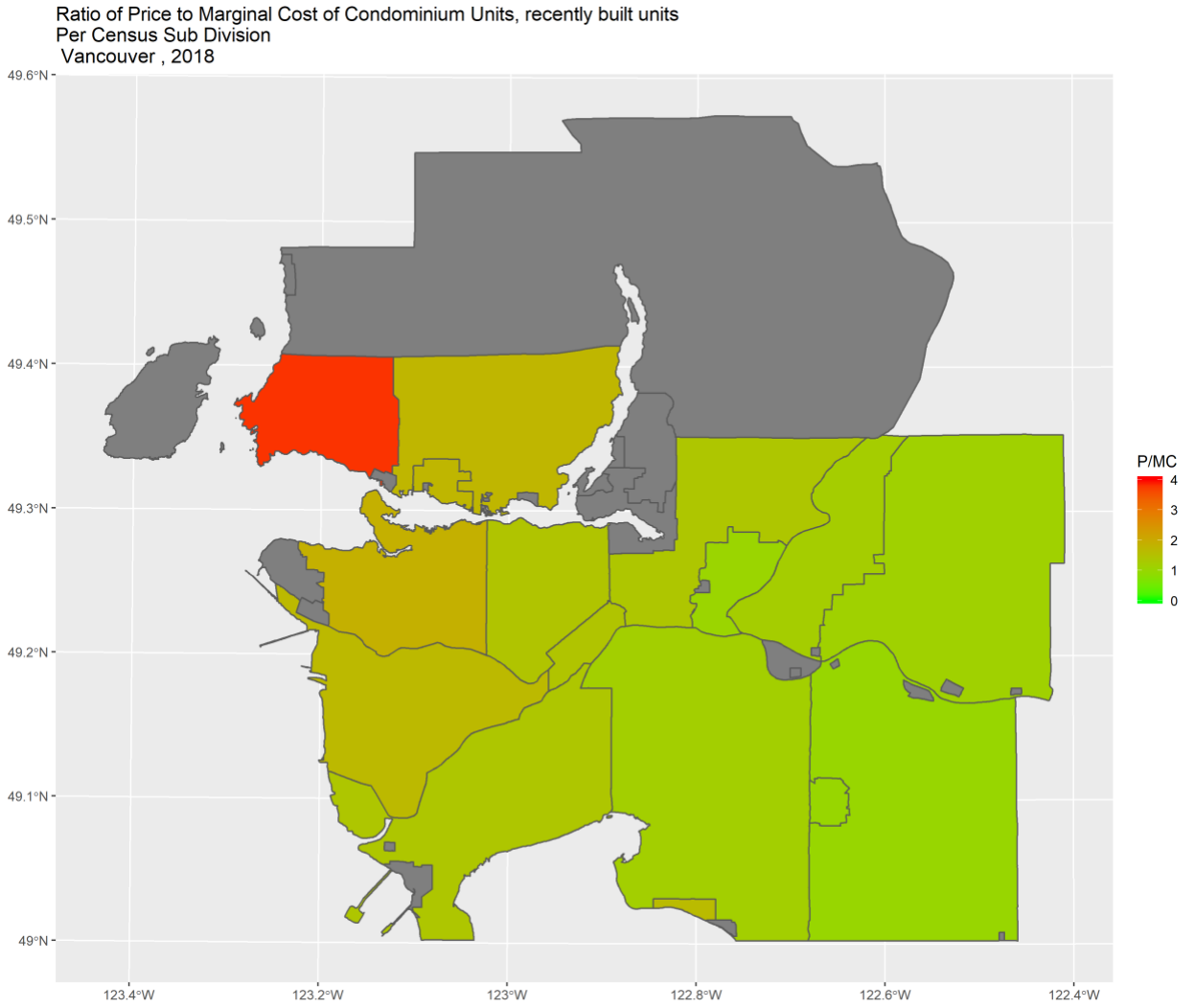




Sources: BC Assessments, LANDCOR, Statistics Canada, CMHC Calculations

Figure 6: Maps of Price to Marginal cost in municipalities within the Vancouver and Montreal CMAs. 2018.





Montreal

Municipality	Wedge Effect
Montreal	1.63
Laval	1.11
Longueuil	0.80

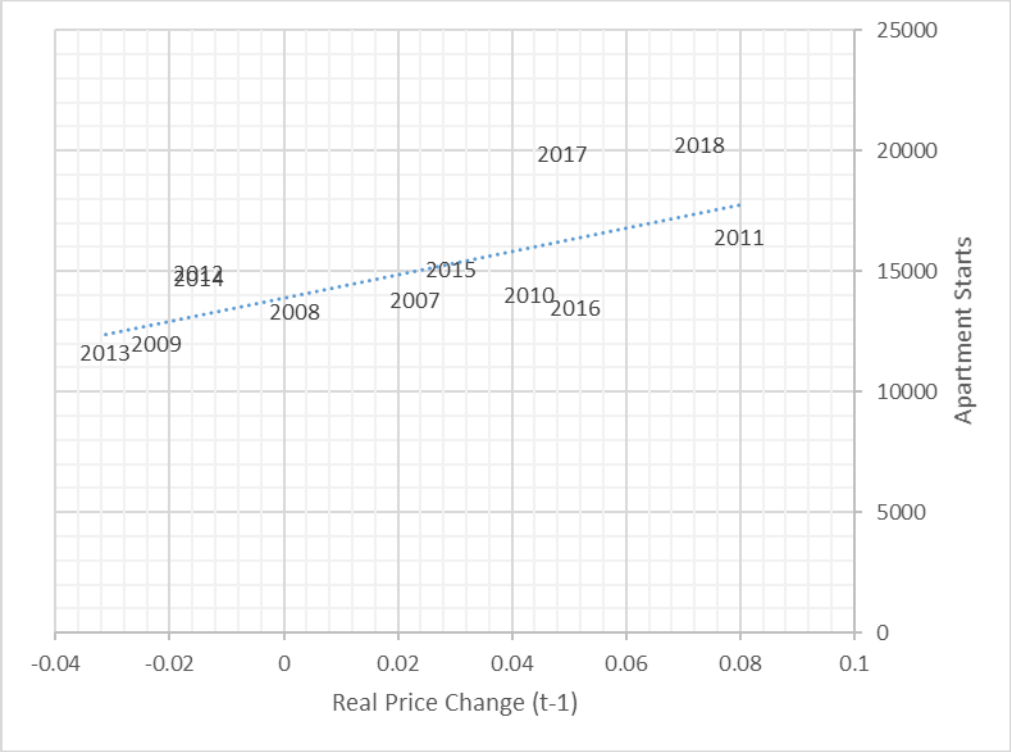
Vancouver

Municipality	Wedge Effect
Vancouver	1.89
Richmond	1.71
Burnaby	1.45
Surrey	1.20
North Vancouver	1.77

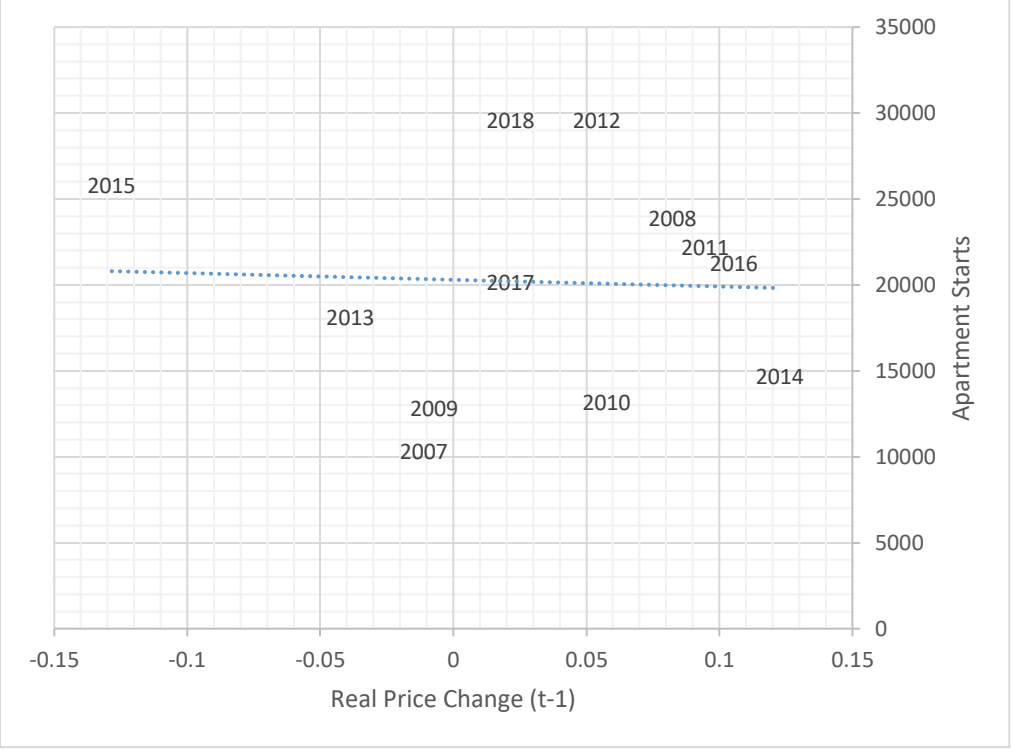
Sources: BC Assessments, LANDCOR, Statistics Canada, Centris, CMHC Calculations

Figure 7: Responsiveness of new units to prices

A: Montreal Apartment Construction Starts, Changes in Lagged New Prices, 2006 to 2018



B: Toronto Apartment Construction Starts, Changes in Lagged New Prices, 2006 to 2018



C: Vancouver Apartment Construction Starts, Changes in Lagged New Prices, 2006 to 2018

Sources: BC Assessments, LANDCOR, Terranet, Centris, CMHC Data and Calculations

Appendix 1: Data and Methodology

Methods

The methodology of this report follows closely the methods deployed by Glaser, Gyourko and Saks (2005). Instead of documenting and collecting information on regulation in each of the three cities studied, like the Wharton Residential Land Index in the US (Gyourko, Saiz and Summers, A New Measure of the Local Regulatory Environment for Housing Markets: The Wharton Residential Land Use Regulatory Index 2008), they invoke a neo-classical equilibrium argument to detect the presence of supply constraints. In a well-functioning market without market power, the price of a housing unit will be equivalent to its average cost of production. In the long run, the average cost of production is equal to the marginal cost of production. A difference between price and cost will erode with free entry to the housing market; i.e. new builders will enter the market to provide new supply and compete on price. The new competition will continue to enter and push down prices until prices are equal to marginal costs.

This report's methodology relies on the free entry of firms to compete. If there are a few firms that can exercise market power, monopolies or oligopolies, in multifamily unit construction then prices can remain above costs indefinitely as the firms will produce less than a competitive market would to earn extra normal profits.

Average costs for multi-family apartment buildings are hard to determine. Land sales in Canada are infrequent and development fees can vary greatly from project to project. Marginal costs, however, are much easier to observe. The marginal cost of producing a multifamily unit is simply the cost of building another floor of units. These costs are easily estimated with available industry data. This is because the cost of building up is a function of construction materials and labour, no additional land or fees are required.

Data for the costs of new multi-family units is typically an average cost of construction for a specific type of building at a specific height. To convert this into a marginal cost, we can fit a cost curve to these data and retrieve the estimated cost at a particular floor. We fit a quadratic function to the cost data, the simplest curve that allows marginal cost to vary with building height as applied in Glaeser, Gyourko and Saks (2005). We fit this curve by interpolating a relationship through each data point provided by RS Means[7]. Then, the final number for marginal cost for the city is the cost suggested by the marginal cost

[7] The only fact that requires verifications is the estimated cost curve is the correct shape. We have applied a framework based off the neo-classical model of the firm, and this asserts that cost curves are increasing over their

of the highest floor covered by the range of floors provided by RS Means, 24[8]. Unlike Toronto and Vancouver, Montreal's new units are not high rises. In fact, the majority of new apartments built in Montreal are low-rise buildings: As demonstrated in figure 2 89% of apartments completed in Montreal where height information exists were three stories or shorter, according to the CMHC Starts and Completions Survey. Thus, for Montreal the height level for a marginal unit will be four stories.

Costs are then compared to the sale prices of units by dividing the sale price of units by the marginal cost of a unit. This creates a unit less measure of potential supply constraints in a given city for the given year. If the value is exactly one, then prices are equal to marginal costs. A ratio below one suggests that prices are below marginal cost. A ratio above one suggests that prices are above marginal costs. This is not to say that a market with a ratio above one is operating inefficiently. The price of the unit must accommodate things that the marginal cost does not cover, like land. However, builders in Canada typically follow the following rule of thumb: the cost of land should not be more than a third of the total project. Thus, markets that have a ratio below 1.3 are markets where this methodology cannot detect a friction. These guidelines line up with the boundaries for a "flexibly supplied city" when Glaeser and Gyourko investigated a similar methodology for single detached homes (Glaeser and Gyourko, 2018).

Data

Construction Costs

In Canada, both RS Means and Atlus provide Construction cost data for residential apartment buildings. RSMeans is a construction cost database created by Gorridan. The company collects the cost for labour, materials, and services related to the construction of a building. Their data does not include land or

domain. Given that we are fitting a parabola to our data, we have to confirm that both the first and second derivative are positive from the range of [1,25]. The curve's slope is increasing and not levelling off also visually confirms the proper shape of the curve.

[8] A concern of this type of analysis is whether the estimated cost curve represents the city itself. Chief among them is that RS means only provided cost estimates for buildings that are up to and including 24 stories tall. Outside of Toronto, skyscrapers are quite rare in Canada. In fact, at the time of writing, buildings that are shorter than 30 stories are included in the list of the 50 tallest buildings in Vancouver (Wikimedia Foundation 2019) and Montreal (Wikimedia Foundation 2019) on Wikipedia. For these cities, if the extreme end of the height distribution is near where our cost curve ends the rest of the distribution is likely well covered. In the case of Toronto, our RS Means average costs fall within the cost bands provided by Atlus for taller buildings, assuaging this concern for a city that has taller buildings. Further, as figure A suggests, the mean new Canadian buildings is no more than 20 stories, within our cost curve. Montreal's low average does complicate interpretation of the supply friction, as many of the apartments are likely not high-rises unlike Toronto or Vancouver. Using a high floor's marginal cost may be making the measure too conservative and obscuring market frictions that really exist. However, due to the existence of very tall buildings in Montreal, it is not obvious that large buildings are impossible either. Choosing a low floor will make Montreal's results more likely to suggest a market is not a flexibly supplied market. Caution is of utmost importance with rejecting a null hypothesis when considering Montreal.

permitting costs, but does include a profit margin of 17% for the builders included. Industry consultation suggests that this margin is reasonable. RSMeans provides an estimate for the cost per square foot to construct a new building of six varying styles and three different height profiles. The height ranges are 1-3 stories, 4-7 stories and 8-24 stories. We take the simple average of all six styles of building at each height to generate an average cost of that height profile.

Further, the RSMeans data is per square foot of built space. To make the RSMeans data conformable with sale prices, which are set to make the project must at least breakeven, the cost per square-foot must scale by the non-livable spaces in the building. Non-livable space includes things like the fire escapes, elevators, amenity spaces, and any other communal space. RSMeans refers to this adjustment as converting gross space to net space. RSMeans suggests that the ratio of net floor space to gross floor space is .64, so we adjust up the RS Means cost data by 1.56. For the year 2018, Table 1 reports the adjusted average and marginal cost for each CMA.

Altus also reports per square cost estimate range for several building heights. Like the RSMeans data, Altus do not include land costs in their estimates. However, unlike the RSMeans costs they report as costs for net floor space. Further, they do not include the soft costs that the RSMeans data accounts for. RSMeans includes factors to scale the RSmeans prices to be conformable with the Altus prices. Altus reports an average for all types of construction at roughly 20 story intervals. However, when the RS Means data are made conformable with the Altus data, they tend to fall near or above the upper range of the Altus ranges for each city. Given the indirect nature of the analysis, a conservative measure for cost is desirable. Conservative in this context means that it will generate a result with a lower value of the ratio, making it less likely to report that a market has frictions. Industry consultations suggest that the Altus numbers can be low, so the RSMeans numbers coming in on the high end also bodes well for their accuracy.

In 2015, RSMeans changed the six styles of building that they reported in Canada. This change occurred to reflect more accurately the types of buildings that built in Canada. Since the RSMeans data is meaningfully different from 2007 to 2014, we back cast the data for those years using a historical building price index provided by RSMeans. Specifically, we multiply the last year of data by the inverse of the inflation rate from between that year and the previous year. The construction costs are adjusted to real prices with the all items CPI for each Census Metropolitan Area (CMA) (Statistics Canada 2019). The CPI is rebased so that 2018 is the base year. Adjusting the price data uses the same method.

Sale Prices and Characteristics

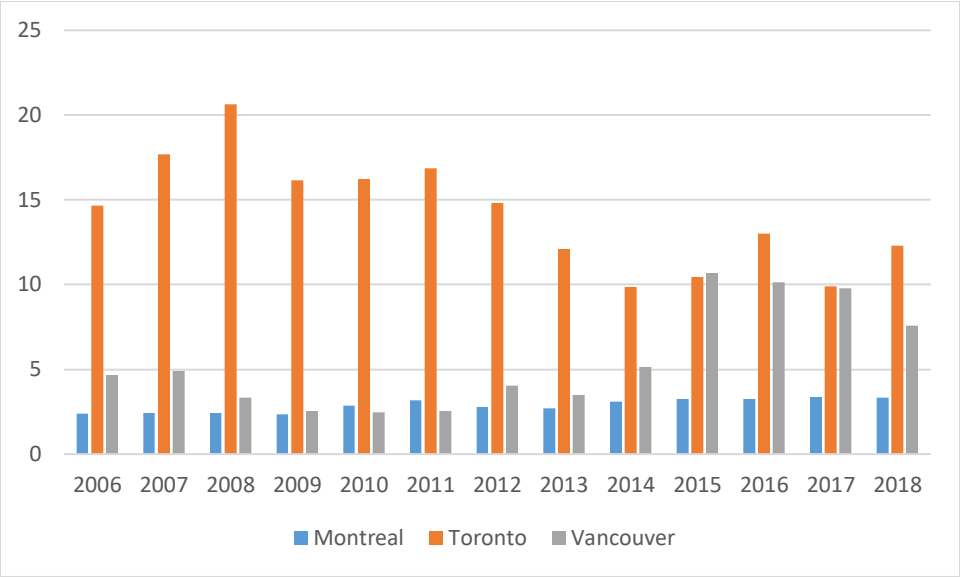
This analysis uses two sources for sale price data: The MLS® HPI Benchmark Apartment Price[9] for each CMA and data retrieved from our CMHC's Property Sales and Assessment Database (PSAD). The HPI Benchmark for prices is a monthly price series that uses a hybrid of the Case-Shiller and hedonic regression methods to assess the price of a typical condominium unit in a particular city as predicted by the average size and characteristics (Canadian Real Estate Association 2019). Since the price is monthly and our construction cost data is annual, we aggregate the price series.

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, and age. The data for Montreal that we have internally does not cover all required information, so we purchased data for Montreal from Centris. To build a useable data set, we removed observations without a sale price, with more than ten bedrooms or bathrooms, larger than 10,000 square meters, or duplicate entries. Then, we trimmed the dataset to remove further outliers by excluding the top and bottom 1% priced entries. We then collect the average size of units for units in the area. This is used to convert the HPI Benchmark price into a per square foot measure to compare it to the construction costs. PSAD and the HPI conform since their underlying datasets are essentially identical, residential transactions within the specified real estate area, which is usually similar to the CMA definition. The HPI methodology also uses a similar data cleaning methodology to our own.

One deficiency of using the benchmark price is that it includes buildings that have existed for many years. This is of concern when new buildings have different characteristics than older buildings. One noted difference is that new units tend to be smaller than units built before the year 2000 are. When considering the difference between the marginal costs of units, it is worth considering the prices when only new units are included, as builders build and make profit from new units. Further, old units have depreciated, reducing their overall value while new units have not. Builders do not inherently care about depreciation when building new units. Thus, we use the PSAD database to calculate the average price and size of apartment units built at most five years before the date they sold.

[9] MLS® is a registered trademark of the Canadian Real Estate Association

Figure A: Average Stories per building



Source: CMHC Data and Calculations

cmhc.ca