Filtering in the Canadian Housing Sector

An Empirical Evaluation

Canada

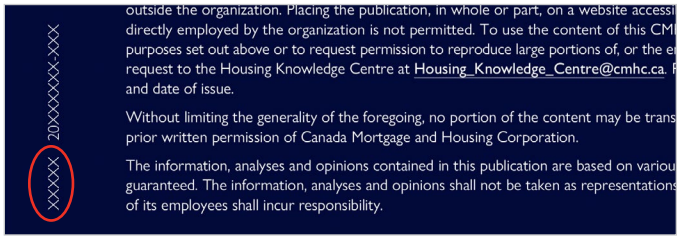
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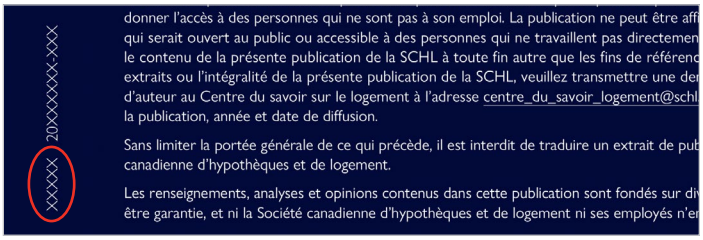
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Filtering in the Canadian Housing Sector: An Empirical Evaluation

A Report for the Canadian Mortgage and Housing Corporation

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This version: August 20, 2025

Abstract

We evaluate how new housing "filters" into affordability in Canadian CMAs through three channels. First, Rental Market Survey microdata show that as buildings age, rents fall relative to other buildings in the same CMA. We find that rents flatten after 15-30 years. Depreciation varies by market: same-building rents in Toronto decline the most (over 15% after 10 years; 35% after 30) and Montreal the least (15% over 30). Second, completion of new multi-family rentals can reduce nearby rents by adding local supply and relatively depreciating older neighbours; we find 2–4% effects in some specifications, but results are inconsistent. Third, while new homes tend to have high rents, through "vacancy chains" they may lead to vacancies in affordable homes. Simulations, based on the persistence of neighbourhood rents among Longitudinal Ad- ministrative Databank movers, indicate that in Montreal and Vancouver a new multi-family unit has a 45-50% chance, via an unbroken series of local moves, of inducing a vacancy at the 25th-percentile of neighbourhood rent. In a 100-unit new building, roughly 50 such "affordable" vacancies arise. The probability of a directly induced vacancy at or below median rent is 60%.

Keywords: Rental housing, filtering, housing supply JEL Classification:

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1 Introduction

Our aim in this study is to characterize the extent to which new multi-family housing, which is typically expensive relative to existing units, provides affordability benefits through various "filtering" channels. First, we estimate how units in individual buildings become more affordable as the building ages: affordable housing is older housing. The second channel is the effect new buildings have on rents in nearby existing buildings, which can occur through changes in a neighbourhood's supply/demand balance, or through the relative depreciation of the existing older rental buildings. Finally, we estimate the extent to which new market-rate housing generates vacancies in more affordable existing housing units through "vacancy chains."

The recent coincident booms in immigration and housing costs have renewed attention to an insufficient growth rate of new housing units relative to the estimated growth in housing demand (see, e.g. CMHC (2022)). The economist's solution, more supply, has met with criticism in the popular and political arenas by those who claim high-priced new units provide no benefits to lower income households. Reflecting these concerns, policies at all levels of government have been undertaken to provide bonuses in the form of density or financing for developers that agree to set aside some housing units as below-market rentals. In Vancouver, new rental projects often are required to provide below market housing, and the B.C. government has budgeted for affordable home ownership options in select developments. Similarly, there is no GST on new homes priced under $450,000 and both the Liberal and Conservative parties have proposed expansions of the exemption that target lower price points or first-time buyers.[1]

Buying down rents or prices in new housing units by subsidizing or imposing requirements for the inclusion of affordable units is expensive and commonly deemed inefficient (see, e.g. Soltas (2024)) mechanisms to providing new units. It is important, then, to know the extent to which new market-rate housing, even when priced well above median rents and prices, provides affordability benefits to households that would not be able to rent or purchase those new units.[2]

Conditions in the housing market affect the flow of households in and out of local housing markets through migration, immigration, and rates of household formation.[3] The population flows introduce other possible outcomes, including where new construction does worsen affordability.

[1] See *https://globalnews.ca/news/11098997/canada-election-gst-cut-on-new-homes/*.

[2] Costly redistribution of new units is might be a more rational response if the equilibrium benefits of new housing construction are highly concentrated at the top of the income and wealth distribution and produces much smaller or no spillovers that benefit less well-off households.

[3] See Aura and Davidoff (2008) for a calibration.

Nathanson (2019) demonstrates that if new high quality homes induce immigration of affluent households both directly, by providing the types of homes for which the affluent outbid local households, and indirectly through gentrification of neighbourhoods, then this can worsen housing conditions for the less well off as the immigration induced increase in households offsets the gain in new supply. The effects of new construction on housing affordability thus depend on the nature of both supply and demand.

If all housing units were identical, then new housing units are an expansion of the supply curve, which yields lower equilibrium rents and prices that benefit all households. But housing is highly heterogeneous. Housing units vary significantly by location, size, and quality.[4] As well, households vary by income, wealth, and preferences for attributes, quantity, quality, and location, as well as by tenure type. Thus immediate effects of new housing have to transmit through housing sub-market cross-elasticities and sizes. New housing completions in large cities are a small percentage of the overall stock of housing and thus potentially a slow mechanism to solve affordability on its own. These factors in combination with the high cost to change quantity, quality, and characteristics of the existing stock, mean that aggregate supply is dominated by housing that existed in previous periods. Understanding how the existing housing stock evolves to match the financial situations of lower income households is thus essential for addressing affordability challenges.

A more realistic treatment of housing requires modelling a heterogeneous durable good with heterogeneous households, who differ by both preferences and income. Beginning with Sweeney (1974), economists have framed markets to recognize that new high quality homes do not provide a direct benefit to lower income households, treating housing as a series of related sub-markets, that vary by quality, quantity, and location. New higher quality (more expensive) units can immediately benefit lower income households indirectly, by changing the supply/demand balance in the high-quality sub-market in ways that reduce housing costs in the lower-quality sub-market, where generally quality translates to price and income.[5] Over time, this new construction yields benefits in lower income housing sub-markets as it depreciates in quality and its per unit price declines.

In this paper, we evaluate filtering in Canadian cities to assess the likely effects of new multi-family construction on housing affordability. We explore the three primary channels through which the existing literature has argued that new housing would generate affordability benefits. First, how new construction becomes more affordable over time, as a building declines in quality with

[4]See the discussion below and see, e.g. Weicher and Thibodeau (1988).

[5]Briefly, more units in the higher-quality sub-market lower prices there relative to the lower quality sub-market, reducing prices for those remaining there as demand in the sub-market.

age causing relative rents to decline. Second, the micro-neighbourhood effects of new multi-family rental construction. By providing a supply shock to the local supply/demand balance and reducing the return to maintenance, new construction puts downward pressure on rents in nearby buildings. Finally, through "vacancy chains," where new supply triggers a series of moves by existing households that eventually creates new vacancies in more affordable buildings.

In section 3, we use CMHC Rental Market Survey (RMS) data to estimate census metropolitan area (CMA)-level regressions of log rent in a given apartment on building age, calendar year x neighbourhood dummies, and unit number of bedrooms. We find that buildings become relatively more affordable with age. The decline in rents is fairly smooth over the first 10-20 years or so of a building's life, and depending on the metro area it flattens out after 20-30 years. The total decline in rents with age ranges from a low of approximately 15% in Montreal to a over 35% in Toronto. Mean depreciation rates in rents per year of are between 0.22 and 0.44% per year, except for a faster 0.66% in Ottawa, with the age elasticity of rent ranging from a low of 0.06 to 0.15 depending on the CMA.

In section 4, we mimic analysis of new buildings' impact on neighbouring rent that has been done with U.S. data, but in the Canadian context. To the extent that consumers have strong preferences for housing in a tightly circumscribed geography, the presence of a new building should add supply and relatively depreciate existing neighbours. In contrast, the more consumers are flexible in their location preference within a metropolitan area, the less likely close neighbours of new rental buildings would see reductions in rent or price after new buildings are put in place. We find some evidence (with magnitudes between 2 and 8%) that highly localized rents decline, and they are more likely to do so when market vacancy rates are elevated. Rents for higher quality (more expensive) neighbouring units are more likely to decline following the completion of a nearby rental building. While the results are inconsistent in support of finding clear rent declines, they do not show evidence of increases in local area rents.

Section 5 analyzes the depth of "vacancy chains" in Canadian markets. Using the Longitudinal Administrative Databank (LAD), we evaluate the extent to which taxpaying households that move into a given postal code originate from the same CMA. And for those who move within the same CMA, the persistence of postal code median rent between origination and destination postal codes, i.e. do households move from lower to higher rent areas. Under some assumptions, we map from the within-CMA share of moves, the persistence versus mean-reversion of the origination vs destination mean postal code rents. Additionally, we map the probability that a vacancy in a new building

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at a given rent will give rise to a vacancy in a housing unit at some target level of affordability without a break in the chain of successive moves. A break in the chain occurs if a housing unit becomes occupied by a household not vacating a local housing unit in the same CMA. We find that Canadian vacancy chains operate at an extent on the high end of estimates for the U.S. by Mast, 2021 and Finland by Bratu, Harjunen, and Saarimaa, 2023.

2 Literature Review

What follows is a review of the extant empirical academic literature on the three filtering channels we explore empirically below. First, in 2.1, papers that estimate the effect on rent as buildings age. Then in 2.2, work that identifies the effects of the construction of new rental multi-family buildings on rents in nearby buildings. Section 2.3 assesses research on vacancy chains, tracing out the series of interlinking household moves tracing back from occupants moving into a new building.

The basic filtering model from Sweeney's seminal work characterizes housing markets as a series sub-markets organized into a quality hierarchy. Housing units and households move between these sub-markets. With depreciation, housing units decline in quality and transition down the quality ladder. Renovation moves units up the ladder. Units are held in place, or their decline slowed, through maintenance expenditure, with marginal costs of maintaining current quality increasing with age. When marginal renovation costs are more per unit of quality than the marginal cost of quality in new construction, new units will be built at higher quality tiers and then older homes that have deteriorated in quality form the supply at lower quality rungs of the quality ladder, where each rungs can be though of as a distinct sub-market. Prices in quality sub-markets reflect supply and demand in them, with households allocating themselves based on income and preferences.

When demand for quantity and quality are jointly determined, the predictions of the Sweeney model are more complex. For instance, when land prices are high, new supply may be primarily apartments replacing single family homes. In North America, apartments are typically smaller, so it changes mix of households in the geography. A common assumption made for analytical simplicity in spatial models of housing quality dynamics is that units are infinitely divisible (Arnott, Davidson, and Pines (1983)) or fixed in size (Brueckner and Rosenthal (2009)), so square feet per unit is not affected by price per square foot. That of course is importantly untrue in practice. High prices per square foot can lead to low incomes within markets, because bid rent curves reflect both the valuation of housing quality and demand for more space. For example, von Bergmann

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(2019) shows that within Greater Vancouver, census tracts that saw relatively more new housing units built between 2006 and 2016 also saw relatively more growth in the number of low-income households.[6]

2.1 Filtering through depreciation of once-new homes over time

A long literature explores the impact of housing supply on prices and rents at the metropolitan level. Two relatively recent papers that consider repeated measures of housing costs, as we do, are Rosenthal (2014) and Liu, McManus, and Yannopoulos (2022).

Rosenthal (2014) uses a Case and Shiller (1989) repeated sale-like method to determine the average annual change in occupant income among owner and renter homes in the American Housing Survey. Rosenthal finds that relative to average U.S. incomes, the change in occupant income at turnover in renters is -2.96% per year between tenancies, and -1.57% for owner occupied units. In inflation-adjusted terms (adjusted for national income changes), the declines are roughly -3.0% per year between occupancies for rental tenant income and -0.5% per year for owner income (owners have longer tenancies). Using hedonic regressions with controls, Rosenthal finds that price and rent appreciation are slower than the rate of change in occupant income. Relative to new homes' appreciation rate, within markets, on average, a year of building age reduces price by 0.3% per year and reduces rent by 0.7% per year. These facts are consistent with more significant depreciation in rental units, possibly due to contracting frictions concerning both maintenance and tenant care.

A similar exercise to Rosenthal (2014) is Liu, McManus, and Yannopoulos (2022). The latter authors have access to a very large set of single family home transactions and are able to estimate filtering rates separately for each of 180 U.S. metropolitan areas. In inflation adjusted terms, they find that a 0.5% decline in owner income per year, similar to Rosenthal's American Housing Survey results. They find that filtering rates range from -1.61% per year in Topeka, KS, to +0.71% per year in San Francisco, California. The latter reflects gentrification or a preference for inner metro area locations, where the income of buyers of older homes is greater than the income of buyers of newer homes. Generally, they find that filtering rates are more positive (upward filtering and at the neighbourhood level gentrification) in markets where supply is constrained by strict land use regulation. In those markets, homes in desirable locations are not easily replicated, and hence may

[6] von Bergmann (2019) (https://doodles.mountainmath.ca/blog/2019/09/02/low-income-vs-new-dwellings/). We cannot rule out that the von Bergmann (2019) findings may also reflect the distribution of new social housing, that apartment dwellers have lower incomes than occupants of the since demolished single family units, and inclusionary zoning or incentives in some jurisdictions that results in some fraction of affordable rentals in the new high-rise market buildings.

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grow in value and hence owner income over time. Consistent with such an interpretation, Liu et al. find that neighbourhoods close to central districts are more likely to see positive filtering.

2.2 Effects of newly built homes on rents for nearby homes

Four recent papers consider the question of how the construction of new housing in a neighbourhood affects housing cost and neighbourhood composition nearby and guide our approach to estimating this effect in Canadian cities. Li (2022) estimates several effects using a staggered difference-in-differences approach, using variation in the timing of when different neighbourhoods are exposed to a newly constructed apartment. First, she uses an event study panel to assess rent levels in a building after a new multi-family rental property had been completed within 500 feet (within 150m) compared with three years prior to the completion. Five years after, rents are approximately four percent lower, controlling for overall market appreciation. She goes on to estimate elasticities, comparing the number of new units relative to the estimated existing rental stock in the same 500' radial definition of neighbourhood. In these estimates, Li finds that a 10% increase in housing stock in a small area reduces nearby sales prices over time by roughly 1%, and a new rental building reduces rents by roughly 1%. Effects on rents appear to be concentrated on high rent and moderate rent neighbour's more than nearby low rent buildings. This is likely due to a combination of weaker substitution chains from market rental buildings to low rent buildings and due to small sample size for low rent buildings near new market buildings. Li observes that new buildings draw restaurants. One complication, with her work, as with others is the absence of controls for building renovation is common.

Asquith, Mast, and Reed (2023) use data from RCA, Zillow, and Infutor Data Solutions to investigate highly localized impacts of new buildings in lower income central city neighbourhoods. They use several specifications for identification. First, a difference in differences (DiD) methodology for rents in existing buildings very close (within 250 meters) to a new multi-family building compared to rents in buildings somewhat farther away (250-600 meters distant). Second, DiD, where treated are rents after a nearby completion in 2014/15 and the control is units nearby ($0 <$ 250 meters) other locations where there will be a new multi-family rental building completed four-five years later. Finally a triple difference from combining both of these identification strategies. They get a range of effects of new market construction in lower income neighbourhoods on existing nearby rents ranging from 5 to 7 percent. To this they add migration results, showing that the income level of origin locations for in-migrants to homes nearby the new construction falls by about

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two percent, consistent with new units freeing up affordable vacant units. The ease of substituting across neighbourhoods suggests that elasticities of rent with respect to quantity should be larger when metropolitan areas or cities see similar (roughly 15%) increases in quantity.

Singh (2020) finds different results from Asquith, Mast, and Reed (2023) and from Li (2022). Singh instruments the number of new units developed within 150 meters of an apartment by the baseline number of vacant parcels available in that radius. Vacancy is associated with new construction over Singh's sample period (around 2006) due to a tax incentive program intended to spur development of vacant sites. Consistent with a stronger gentrification effect than a local supply effect, Singh finds that the presence of new buildings increased rents in nearby buildings by 2.3%. Using CoStar data for Minneapolis rental buildings between 2000 and 2018, Damiano and Frenier (2020) consider differential impacts of new rental buildings on nearby (300 meters or less) high- moderate- and low-rent buildings. They find on average no effect of new buildings. And in contrast to Asquith et al., they find that rents rise 6.6 on average in low-rent buildings, offset in the aggregate by declines higher rent rental buildings.

Mense (2020) uses construction delays generated by rainfall to estimate the impact of new housing units on rents at a broad (district) level in Germany. Mense finds that a one percent increase in the housing stock generates a short-run reduction in rents of .4% to .7%.

2.3 Filtering through moving chains: do new market rate units induce vacancy in more affordable units?

The two best-known studies of vacancy chains to date are Mast (2021) and Bratu, Harjunen, and Saarimaa (2023) (BHS). Mast considers 686 new market rate buildings in 12 large US cities. Data on migration is from Infutor, a very large panel of U.S. resident address histories. It appears that these units may include some low-income units through programs such as the Low Income Housing Tax Credit, but the study is confined to units within five miles of the metropolitan central business district in census tracts with above-median income. Generally, Mast finds that there is considerable migration across census tracts such that in terms of both median income and median rent origin and destinations tracts are not the same. Households that move into tracts in the top decile of income have an origin income decile with an inter-quartile range of 7 to 10, and the comparable statistic for median rents is a range of 4 to 10. Mast concludes that this implies that even top and bottom decile tracts can be connected through a short series of common moves.

With respect to the actual new buildings in high rent neighbourhoods, Mast finds that both

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high-income and middle-income are well represented by those who move into new units in affluent tracts, but low-income neighbourhoods are not well-represented. Mast then identifies through five additional rounds the origins of those who moved into the units vacated by the households moving into the new units. Mast terminates a chain for an individual apartment when a household moved from outside a given metropolitan area or is a student. From the perspective of an individual city, migrants into the city do not vacate housing units, but from the perspective of a national housing entity, affordability in origin metropolitan areas does matter. Any immigrant or newly formed household with high probability would have inhabited another unit without the new housing having been built. The Mast work cannot account for those movers, which introduces uncertainty into the vacancy chain methodology, which to date has not been resolved in other work.

Through the six-round vacancy chain, Mast finds that above-median tracts are over-represented, ranging from over 50% of origins in the first round to a low of 40% by the final round. Tracts below the 20th percentile also decline over rounds from roughly 25% (adjusting for income statistic prevalence) to approximately 20%. Middle income tracts thus gain some prevalence over rounds of vacancy chains.

Informed by the vacancy chain results, Mast performs an exercise to compute the probability that a vacancy arises in different types of tracts before the chain is terminated by an immigrant or newly formed household. The result is that it is expected that 100 new units in an above-median income tract would create 70 vacancies in below-median tracts among which are 39.6 units created in tracts below the 25th percentile of median income. The time for these effects to arise is estimated based on U.S. migration patterns to be 2-5 years. Mast finds that vacancy chains create newly built units to generate vacated units in low-income neighbourhoods.

BHS use very rich Finnish administrative data from Finland to perform an exercise very similar to Mast's. Their use of administrative data gives them more complete and consistent coverage across the income distribution than Mast is able to achieve with his data. With this more complete data, they find relatively similar probabilities; with a probability of 60%, a vacancy chain that starts with a move into a newly constructed apartment near the central business district of Helsinki reaches to a postal code in the bottom half of the metropolitan income distribution. Into the lower quartile the probability is 29%.

Mense (2020) provides evidence that vacancy chains are critical to the nature of quantity effects on different submarket in the German setting. In panel data, movers into owner housing of mixed quality and into high-end rental units often come from low-quality rental homes. This is rationalized

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by high moving costs, so that small steps up in quality are not worth taking, and is consistent with a finding that the price effects of new single-family housing on older rentals is negative throughout the quality distribution, not just among closer substitutes to single-family homes at the higher end.

A related literature takes a different approach to the same question of mobility. As opposed to using households as the unit of analysis, this work uses neighbourhoods, looking at their dynamics up or down the income distribution. This question is how stable are neighbourhood income ranks over time within metropolitan areas, or alternatively is there a systematic pattern for a given neighbourhood in its movement over time in the distribution of neighbourhoods by mean income. Rosenthal (2008) finds that neighbourhoods are mobile in median income rankings over long cycles, but of course exhibit considerable persistence in the short run. The typical U.S. census tract moves up or down by roughly 13 percentiles over the course of a decade in median income rankings within a metropolitan area. Lee and Lin (2017) find that metropolitan areas with focal features that are anchors for more affluent families, such as water and hills, feature greater persistence of income over time.

3 Building Age and Rent

This section investigates the extent to which Canadian rental apartment buildings become more affordable as they age. The characteristic result of a Sweeney (1974) filtering model is that newly constructed buildings come in at higher quality and thus rent levels. Affordable (below median rent) buildings are older structures. Without expenditure on maintenance, buildings deteriorate in quality as they age. If the marginal benefit of maintenance expenditures on quality declines with building age (more expensive to maintain an older building) and the marginal effect of building quality on rent does not increase "too" much with building age, then buildings will decline in quality and rent over time, until at some point they are abandoned or redeveloped. Aging buildings thus fall in the quality hierarchy, and as a result have lower rents.

Empirically, we estimate the equilibrium relationship between rents and building age separately for different Canadian CMAs. In our first regression specification, rent R is allowed to move non-parametrically in age, so for a given unit i, in building j, for year t, we estimate separately for each metropolitan area:

$$lnR_{ijt} = \alpha + \beta_1 Z_{jt} + \beta_2 X1_i + \beta_3 X2_j + \beta_4 Y_t + \epsilon_{it} \quad (1)$$

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.

Here rent depends on a vector of age fixed effects Z_{jt}, a vector of unit type (number of bedrooms) fixed effects $X1_i$, a vector of building fixed effects $X2-j$, and finally a vector of time fixed effects Y_t. In this specification we are interested in the vector β_0 of estimated coefficients on the age vector Z_{jt}. To allow a simple comparison across major Canadian metro areas we also estimate the following more parametric specification:

$$lnR_{ijt} = \alpha + \beta_1 a_{jt} + \beta_2 X1_i + \beta_3 X2_j + \beta_4 Y_t + \epsilon_{it} \quad (2)$$

.

In the empirical part of this section we demonstrate the characteristic negative convex shape of rent as a function of age. We find the rate of depreciation in rents ranges from 0.22% to 0.66% per year by city, with rents effectively flattening out after 30 years. The difference is that here we impose a log or semi-log parameterization so that log rents (lnR_{ijt}) are assumed to be linear in the log or level of building age (a_{jt}), which then enters as a continuous variable. We can then compare rates of depreciation β_1 across cities.

3.1 Data Description

The data to estimate the relationship between building age and rents comes from CMHC's Rental Market Survey (RMS). The RMS is an annual survey conducted in October that collects data on rents and vacancies in purpose built rental buildings (primary rental market) as well as units for rent in strata-title buildings (secondary market) across all urban areas with a minimum population of 10,000.

The set of buildings sampled in a given year is limited to those with at least 3 rental units. The survey is of "privately initiated" buildings, so excludes social and below market or affordable buildings and units. Though over time, the objective is to sample the entire universe of rental structures that meet the above criteria. In 2021 the survey universe for the RMS was 2.22M units. According to the 2021 Census there were approximately 3.07M units in multi-unit and row house buildings that were not condominiums.[7] The survey does not question residents, relying instead on building owners, managers, or superintendents.

From the RMS we use the micro-data from the annual survey for each of the six largest Canadian

[7]The census count is likely an over estimate as some row houses are not condominiums. The count excludes duplexes and single detached with a suite.

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cities covering the years 1990-2021. The unit of observation is average (occupied and listed) rent in a surveyed building at the date of the survey. We estimate equations (1) and (2) separately for each of Ottawa, Montreal, Toronto, Calgary, Edmonton, and Vancouver and present the results below.

3.2 Results

We initially present rent as a function of age, when we control for metropolitan area rent growth, the fixed aspects of an individual building, such as location and building amenities, and unit type.[8] The figures indicate the discount for a unit of a given number of bedrooms as a building ages relative to a the same unit type in a new building with the same location and characteristics. We present plots of the estimated coefficients for each year of building age from 1 to 50 found in the coefficient vector β_1 from equation (1), reflecting the effect of age on rent, relative to the rent of a new unit with age 0. Figures (1) - (6) show these for each of Ottawa, Montreal, Toronto, Calgary, Edmonton, and Vancouver.

The patterns are consistent across metropolitan areas, although the estimated extent of depreciation varies. For Ottawa (Figure 1), rents fall at a consistent percentage per year, so that rents in an 18 year old building are 30 percent below those in a new building. For the 20 years that follow, rents continue to decline, albeit at a very modest rate (an additional 5 percentage point decline over these 20 years). In contrast, for Montreal (Figure 2), rents in an 18 year old building are about 15 percent below those in a new building, and thereafter rents do not change with age. Toronto (Figure 3) looks more like Ottawa, though with much more uncertainty around estimated effects, especially for older buildings. In Toronto, the decline flattens at about 30 years of age with a total discount relative to a new building of close to 40 percent. Calgary and Edmonton (Figures 4 and 5) have very similar patterns. Like Ottawa and Toronto, rents decline more steeply than in Montreal.

In the two Alberta metros, rents fall by close to 20 percent over the first 8-10 years of a buildings age. In Calgary, the decline of rents with age slows and flattens out at a close to 30 percent lower rent for buildings 30 years and older. In Edmonton, rents reach their largest discount relative to rents in a new building at 20-25 years, like Calgary with a close to 30 percent rent differential compared to a new build. Finally, rents in Vancouver (Figure 6) stop their decline after 35 years,

[8]Specifically, by metropolitan area, with year fixed effects, building fixed effects, and number of bedrooms in a unit.

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at also close to a 30 percent difference in rents between those in a new building and those in a similar 35 year old building.

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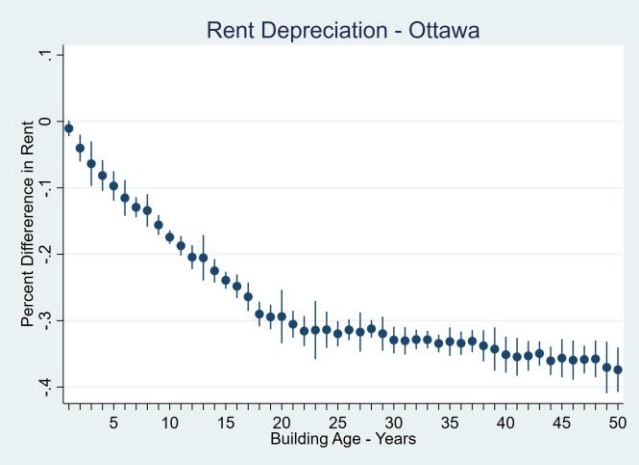


Figure 1: Rent by Building Age: Ottawa

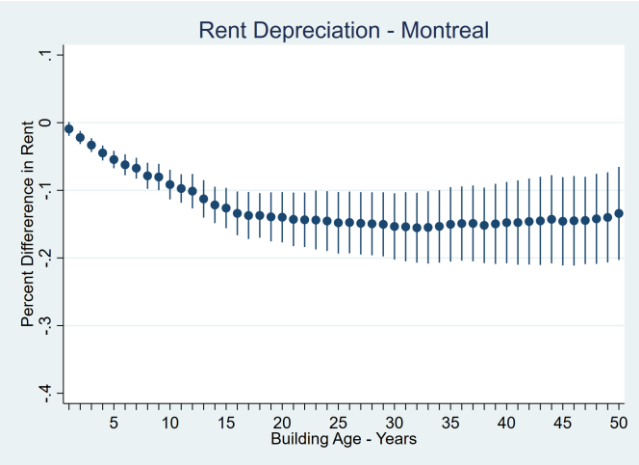


Figure 2: Rent by Building Age: Montreal

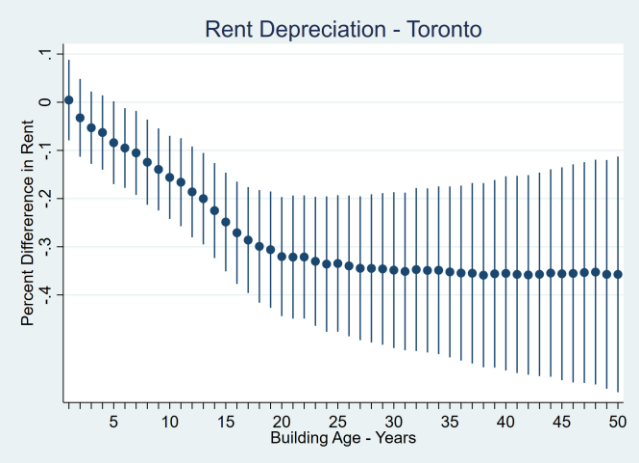


Figure 3: Rent by Building Age: Toronto

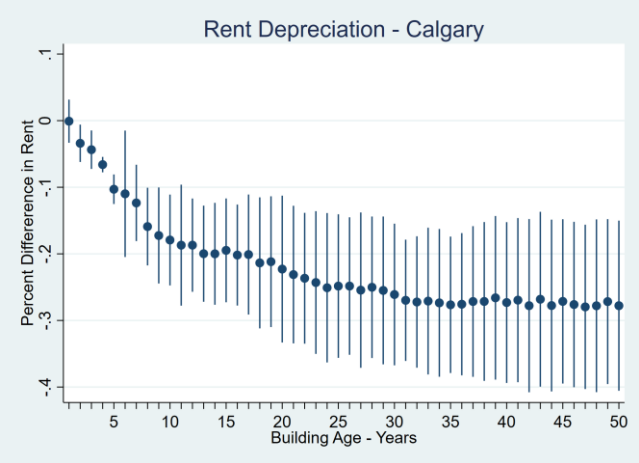


Figure 4: Rent by Building Age: Calgary

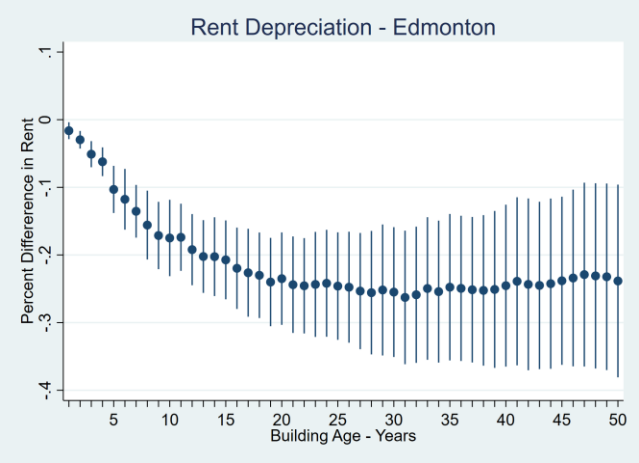


Figure 5: Rent by Building Age: Edmonton

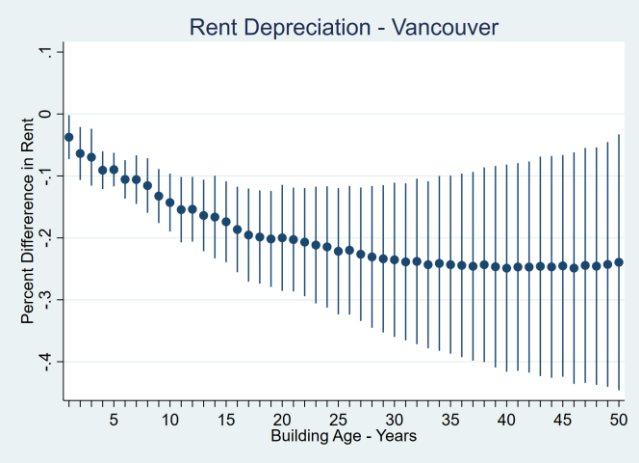


Figure 6: Rent by Building Age: Vancouver

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The figures impose no fixed relationship between age and rents. To better compare the patterns across the six metropolitan areas, we estimate equation (2) to specify a fixed percentage change in rent with each year a building ages. The estimated parameter value for β_1 from equation (2) are presented below in Table 1. The steep decline in rents with in Ottawa is reflected in the estimated coefficient value of 0.6 percent (so rents decline 0.6 percent per year as a building ages), about one-third higher than the rate in Toronto and Vancouver (0.44 percent). The decline in rents as a building ages is lowest in Montreal and Edmonton, half that of Toronto and Vancouver. In percentage terms, the bottom panel of Table 1 shows elasticities of rent in building age from .6% in Montreal to 15% in Toronto. The log-log specification fits the flattening of rents in age in later years better than the linear specification, but the log linear specification fits the early years better. The flattening late in building age could reflect that surviving buildings have unobservably high quality, or could reflect some kind of nonlinearity in building upgrades.

The change in log rents of roughly .4% per year is in line with the range of estimates of log income declines with building age among rentals in Rosenthal (2014).

Table 1: Log-Linear (top panel) and log-log (bottom panel) Depreciation Regressions

Panel A - Log Linear Specification

	Montreal	Toronto	Ottawa	Edmonton	Calgary	Vancouver
Age	-0.0022***	-.0044***	-.0060***	-.0021***	-.0033***	-.0044***
	(0.0001)	(0.0004)	(0.0004)	(0.0005)	(0.0007)	(0.0004)
# of Observations	129,730	61,967	23,929	45,859	28,758	51,079
Adj. R^2	0.89	0.84	0.89	0.90	0.82	0.90

Panel B - Log-Log Specification

	Montreal	Toronto	Ottawa	Edmonton	Calgary	Vancouver
ln(Age)	-0.0057***	-.1532***	-.1019***	-.0967***	-.0916***	-.0727***
	(0.0008)	(0.0027)	(0.0021)	(0.0022)	(0.0046)	(0.0019)
# of Observations	129,730	61,967	23,929	45,859	28,758	51,079
Adj. R^2	0.89	0.85	0.90	0.90	0.82	0.90

Note: The dependent variable is log(rent). Standard errors are in parentheses with statistically different from zero confidence: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$. All regressions include fixed effects for the building, # of bedrooms, and year.

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4 Effect of New Construction on Nearby Buildings

As described above, an existing literature studies the micro-neighbourhood effects of new construction. Most notably Asquith, Mast, and Reed (2023), Damiano and Frenier (2020), and Li (2022), all study how new residential developments affect rents in nearby existing buildings. They all re- port that new construction results in lower rents of between 3 and 7 percent, though for Damiano and Frenier (2020) this is only true for nearby higher priced rental units.[9] Asquith, et al. limit their analysis to buildings in low income areas, making their results more directly comparable to Damaino and Frenier. Here, we apply the methodologies used in these papers to test the effect of the construction of new rental buildings in Calgary and Vancouver on the rents reported in the RMS. These two metropolitan areas represent extremes in rental markets in Canada. British Columbia has the strictest provincial rent control laws, while Alberta's are the most free-market. The Vancouver metro area over our study period had vacancy rates that averaged 1.3 percent (on a range of 0.6 to 2.6 percent). In contrast, Calgary's vacancy rates averaged 3.2 percent on a range of 0.6 to 6.3 percent, reflecting the metro's much more volatile market.

We find very mixed results for the effect on new construction on rents in nearby units.

4.1 Methodology

There are a set of challenges in identifying the effect of new construction on local residents that is captured for with mixed effectiveness in the existing literature. The first is: what is the neighbourhood? This is a question of what area is the treated area for new construction effects and what is the control. The tension is the closer the control area is to the treated area the more we can assume unobserved variables are identical, but the weaker the argument that properties in the control area are unaffected by the new construction. The second challenge is that the timing and location new construction is unlikely to be entirely random, it typically will occur in areas that have higher demand, and thus higher or more rapidly increasing rents. Thus, a perverse effect that higher rents occur following new construction might be the effect of rising demand for the neighbourhood that attracted developers to that location in the first place. Li (2022) and Asquith, Mast, and Reed (2023) use different approaches to address these challenges. We will replicate the definition of control vs treated that they use by estimating a regression for each approach, but we

[9]The specific findings are between 3 and 4% decline after 5 years in Li (2022); a 5-7% decline in Asquith, Mast, and Reed (2023) depending on methodology; while Damiano and Frenier (2020) report mixed effects, with over 6% higher rents for nearby lower priced rental units and approximately 3% lower rents for nearby higher end rental units.

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use a different approach to address the endogeneity of new construction location with rent levels.

The literature presumes that the substitutability for a consumer is a negative function of distance, so there is an arbitrary distance that defines for closer properties that there is a new supply effect, which is then absent from a more distant ones. The assumption rests on a characterization of the variation in rents across geography reflecting primarily hyper local amenities. This ignores the extent to which more distant neighbourhoods may be viable substitutes for renters. For Li, using data from hyper-dense New York City this distance is 150m (500 feet), while for Asquith, et al, who use a panel of ten US cities, all of lower density, it is 250m (820 feet).

4.1.1 Li's Methodology

Li (2022) uses an event study approach for her estimation. The event window is three years prior to the completion of the new building within 150m (500') of the observation and the subsequent period extends up to 7 years, with individual coefficients for the years [-3,4] and one for 5 plus years after. She does not differentiate between units that are close to more than one new construction event, treating these as separate observations, even if the analysis periods overlap. To address endogeneity, she uses years since a building's permit approval, which predates new construction. This presumes that variation in building completion time is uncorrelated with its effect on local supply, which is problematic as larger buildings take longer to construct.

We make several changes to Li's approach in our replication of her work. First, rather than individual year coefficients for the before and after periods, we use only a before/after dummy (we also use only three pre- and three post- years, excluding the year of completion). Second, we exclude buildings that had more than one nearby (250 meters in our case) new builds in the [-3,3] analysis periods. Finally, for endogeneity, we use localized year fixed effects, i.e. forward sorting area (FSA) year fixed effects instead of the time since the building permit was issued variable. Our assumption is that the FSA-year fixed effects will capture the variation in local demand that drives development decisions and thus control for endogeneity between rents and new developments. The rationale is that for new residential construction, developers want to be in a neighborhood, which is well-approximated by an FSA.[10] The location they end up developing is a function of what they can buy and permit, as opposed to there being specific differences by micro-location.

Our estimating equation to replicate Li uses a dummy NB that is 0 for the three years [-3,-1]

[10]There are 35 FSAs in the Calgary CMA (an average of 14,350 households per FSA) and the Vancouver CMA has 85 FSAs (an average of 12,400 households per FSA).

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prior to completion of the nearby building and 1 for the three years post [1,3]. For building i, in neighbourhood (FSA) j, in year t, we estimate:

$$lnR_{ijt} = \alpha + \beta_1 NB_{it} + \beta_2 age_{it} + \beta_3 X1_i + \beta_3 F_{jt} + \epsilon_{ijt} \quad (3)$$

We have a vector of unit type (number of bedrooms) fixed effects $X1_i$, building age age, and the vector of FSA year fixed effects F : The estimated coefficient of interest is β_1, the mean effect of a new multi family rental project on rents in an existing building within 250m (820 feet). This is conditional on the controls: building age, number of bedrooms in the unit, building fixed effect, and year fixed effects for the FSA where the building is located.

4.1.2 Asquith et al.'s Methodology

Asquith et al. differ from Li in both the type of data and methodology. They use a ten metro area data set from the US, but look only at the effect of new market rental multi-family buildings constructed in low-income central city census tracts in 2015-16 or 2014-15 and had no other new rental buildings completed between 2010 and the treatment building's year of completion within 250m of the treatment building, yielding a very small sample of 96 new buildings. They use three different specifications in a DiD methodology to address the endogeneity problem. First, defining the treated group as those rental properties within 250m of a new rental building, with the control group those 250-600m (820 - 1,980 feet) away, imposing an assumption that, other than the new building both areas are affected by the same conditions. Second, they use properties near multi-family rental properties completed 2015-16 as the treated group, and those near properties developed in 2019 as the control. This approach assumes that market demand is similar for the two groups, and that demand is similar, so that the 2019 buildings develop later because of land assembly and regulatory delays, not different market conditions. Finally, they use a triple-difference adding the the two together. We replicate the first approach because our has significantly fewer treatment events (new multi-family rental buildings above the size thresholds) compared with Asquith et al. We estimate with similar notation to equation 3:

$$lnR_{ijt} = \alpha + \beta_1 NB_{it} + \beta_{DiD} NB_{it} * Post_{it} + \beta_2 age_{it} + \beta_3 X1_i + \beta_3 F_{jt} + \epsilon_{ijt} \quad (4)$$

.

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The dummy NB takes on the value of 1 for the control group (within 250m of the new build) and 0 for the control group (those 251-600m away from the new build). $Post_{it}$ is the dummy for the period years 1-3 after the completion of the new rental building. The parameter of interest is the estimated coefficient on the DiD interaction term β_{DiD}. The other controls are as in equation 3.

A perhaps more natural specification, that to our knowledge has not been estimated in the literature, would be to regress log change in individual building rent on the log change in the number of nearby buildings (with units weighted by distance). We found highly inconsistent results with that approach, featuring large standard errors and coefficient estimates highly dependent on weighting schemes.

4.2 Data Description

We use the CoStar database of multi-family rental buildings to identify new private, market rent, multi-family rental buildings constructed between 2000 and 2023. Similar to other authors we limit these to "large" buildings, in our case those with at least 4 floors and a minimum of 50 units.[11]. this approach yields a sample of 229 new rental projects in the Vancouver CMA, with an average height of 10.3 storeys (ranging from 4 to 45) and average 132 units per project (with a range of 50 to 593). For the Calgary CMA we have over the same period 139 new rental projects. These have an average height of 10.9 storeys (ranging from 4 to 59) and average unit count of 201 (range of 51 to 958).

Figures 7 and 8 show the distribution of these properties across census tracts, with the shading reflecting the percentage of housing units in the tract that are single family detached structures. While in both cases they are concentrated in the urban core of both CMAs, in both cases we have considerable development in more suburban areas. In the Vancouver CMA, these suburban locations still have relatively low shares of single family detached housing. By contrast, Calgary has more suburban developments and these tend to be in census tracts with a higher share of single family housing, at in comparison with the Vancouver CMA.

[11]Li (2022) limits her sample to buildings 7 stories and higher. Asquith, Mast, and Reed (2023) use buildings with a minimum of 50 units.

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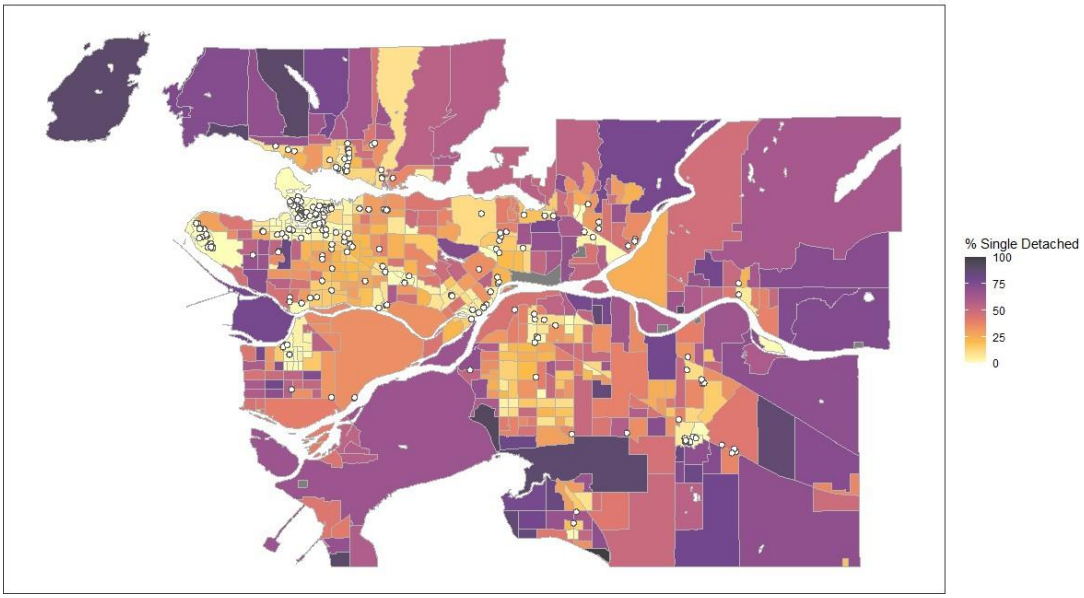


Figure 7: New Rental Buildings in Vancouver, Min. 4 Storeys, Min 50 Units

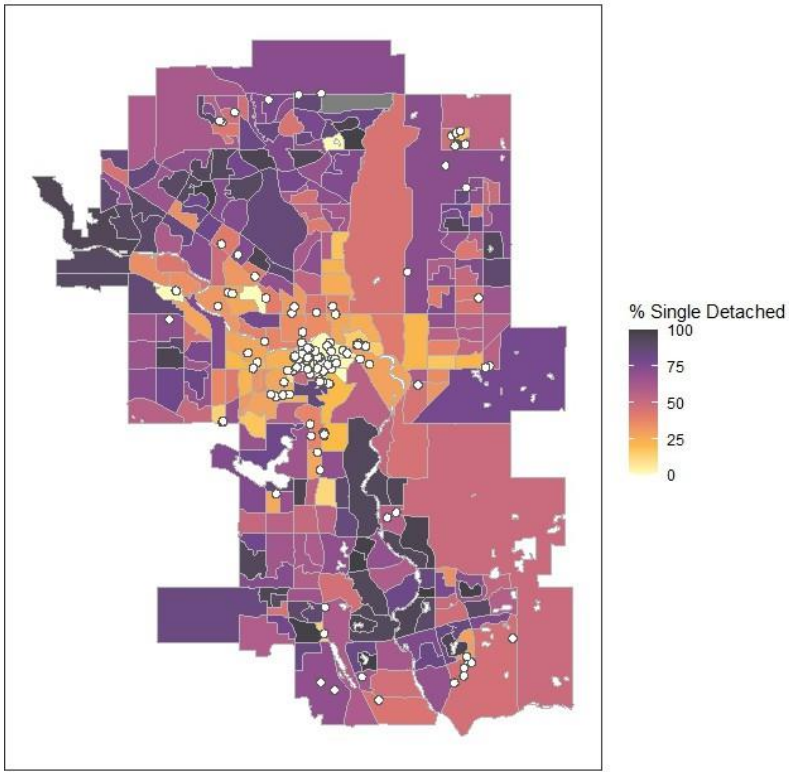


Figure 8: New Rental Buildings in Calgary, Min. 4 Storeys, Min 50 Units

For rents we relay on the RMS described above. The RMS reports rents for occupied units in a surveyed rental building, and more recently also rents for "vacant" units, where the later are listed rents in unoccupied units. The sample of the latter is notably smaller, as only a fraction of units turnover any year, i.e. the sample will only report on units vacant and listed for rent in October when the survey is done. In Vancouver, the strong provincial rent control regulations mean that reported rents are a function of rental market conditions when the tenant first signed a lease and their length of tenure. If tenants turnover at a constant exogenous rate, then the mean of these rents will rise with market rents, though their level will be lower. If however, the turnover rate is correlated with market conditions it will introduce bias. We report results separately for both the larger, and potentially biased "all rents" sample, and the smaller, and less prone to bias, "vacant rents". The latter should have more accurate point estimates, but suffer from larger standard errors.

4.3 Results

4.3.1 Results Using Li (2022)

We estimate equation 3 separately for both Calgary and Vancouver, both just as the basic event study methodology, and using interactions between the post new build variable and other measures to allow the effect of a new build to depend on market conditions (prevailing metropolitan area vacancy rate), whether the units is affordable or not (below or above the average rent in the FSA by year), or the size of the new construction (number of units in the new build). All regressions tables have the same form, a regression for each of Vancouver and Calgary, excluding building age (regressions (1) and (2)), and the same including building age as a control.

The first results for the baseline in Table 2 use the all units sample, both occupied and vacant units. In Table 3 we limit the sample to vacant units only. We presume the latter better reflect market conditions as the vacant units should be marked to market. This is particularly important in Vancouver where provincial rent control limits the allowed increase of rents in an occupied unit. Only when a tenancy ends can rents be re-adjusted to market levels. The point estimates, are only weakly significant, and only for Calgary, where after a new rental building is completed, rents in existing structures within 250m of the new build are 3-4% lower than prior to the completion of the new build, conditional on neighbourhood (FSA) rent levels by year. The Vancouver estimates are mostly within one standard deviation of zero, too imprecise for any inference.

We next consider that the effect of a new multi-family rental building on nearby existing rental

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	(Vancouver)	(Calgary)	(Vancouver)	(Calgary)
Post Period	0.013	-0.033^{**}	0.004	-0.027^{*}
	(0.017)	(0.014)	(0.016)	(0.015)
log(Building Age)			-0.151^{***}	-0.050^{***}
			(0.015)	(0.013)
# of Observations	10,812	11,310	10,812	11,281
Adj. R^2	0.819	0.767	0.823	0.766

The dependent variable is log(rent). Standard errors are in parentheses. Indicators of confidence in the statistical difference from zero are: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.
All regressions include fixed effects for the building, # of bedrooms, and fsa-year.
Post-Period is a dummy, =1 for years t=1...3 after new build completion.
The sample is all surveyed rental units, occupied and vacant.

Table 2: Li Baseline: All Rental Units

	(Vancouver)	(Calgary)	(Vancouver)	(Calgary)
Post Period	0.047	-0.039^{*}	0.038	−0.038
	(0.042)	(0.024)	(0.041)	(0.023)
log(Building Age)			-0.125^{***}	−0.014
			(0.026)	(0.030)
# of Observations	1,036	1,547	1,036	1,543
Adj. R^2	0.946	0.861	0.947	0.860

The dependent variable is log(rent). Standard errors are in parentheses. Indicators of confidence in the statistical difference from zero are: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.
All regressions include fixed effects for the building, # of bedrooms, and fsa-year.
Post-Period is a dummy, =1 for years t=1...3 after new build completion.
The sample is vacant rental units only.

Table 3: Li Baseline: Vacant Rental Units

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properties will vary with rental market conditions, as measured by market vacancy rates. We suggest that when vacancy rates are very low, so excess demand in the rental market, then the construction of a new rental building would have a diminished effect on the leasing decisions for a nearby existing building. The property manager of nearby property still finding prospective tenants are available in abundance. In contrast, if vacancy rates are high, and new tenants are scare, then the property manager of the new building is likely to be more aggressive in trying to get tenants, and the property managers of nearby buildings more likely to respond to the actual or perceived competition because they are already facing weaker demand.

In Table 4 the baseline effect of new construction is that rents in neighbouring (within 250m) existing buildings are lower relative to prior to the completion of the new multi-family rental building, but this effect is not statistically different from zero at with 90 percent confidence. The vacancy rate dummy interaction has an inconsistent effect, positive and against expectations for Vancouver, and negative and in-line with expectations for Calgary. Even in Vancouver, the net effect of the post period dummy and the interaction term (for when vacancy rates are above two percent) is negative.

For Table 5 we limit the sample to only vacant rental units, with the expectation that these rents better represent existing market conditions, especially in Vancouver. The point estimates are inconsistent, though their aggregate effects less so. In Vancouver, where Vacancy rates are quite low (mean rate of 1.3 percent in our sample), it is only when vacancy rates are higher that the aggregate effect of the nearby new build is for lower rents post construction (with a point estimate of -4.2 to -6.6%). In Calgary where vacancy rates are higher (average of 3.2 percent). The baseline is new construction results in lower rents in existing nearby buildings (with an improbably large magnitude of 13% lower). When Vacancy rates are above two percent (the norm) the aggregate effect is about -2.4%. However, this lower effect when vacancy rates are higher is inconsistent with our expectations.[12]

4.3.2 Results Using Asquith, Mast, and Reed (2023)

In this section we replicate Asquith, Mast, and Reed, 2023, focusing on their primary "near-near" specification. The treated group are rental units in properties within 250m of a newly built multi-

[12]Using a continuous vacancy rate yields a similar pattern of results, but given the differences in the vacancy rate ranges between Vancouver and Calgary is harder to compare the two cities.

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	(Vancouver)	(Calgary)	(Vancouver)	(Calgary)
Post Period	−0.016	−0.021	−0.020	−0.017
	(0.017)	(0.013)	(0.016)	(0.013)
Interaction: Post Period x Vacancy Rate	0.011	−0.003	0.005	−0.001
	(0.021)	(0.016)	(0.021)	(0.017)
log(Building Age)			−0.112***	−0.031***
			(0.014)	(0.010)
# of Observations	10,812	11,310	10,812	11,281
Adj. R^2	0.880	0.837	0.883	0.836

The dependent variable is log(rent). Standard errors are in parentheses. Indicators of confidence in the statistical difference from zero are: *p<0.1; **p<0.05; ***p<0.01. All regressions include fixed effects for the building, # of bedrooms, and FSA-year. *Post-Period* is a dummy, =1 for years t=1...3 after new build completion. *Vacancy Rate* is a dummy, = 1 when vacancy rate > 2%.This dummy drops as it is co-linear with the FSA-year FE. The sample is all surveyed rental units.

Table 4: Li with Post x Vacancy Rate Interaction: All Rental Units

	(Vancouver)	(Calgary)	(Vancouver)	(Calgary)
Post Period	0.069	−0.130***	0.063	−0.129***
	(0.045)	(0.049)	(0.044)	(0.048)
Interaction: Post Period x Vacancy Rate	−0.111**	0.105**	−0.129**	0.106**
	(0.054)	(0.050)	(0.054)	(0.050)
log(Building Age)			−0.132***	−0.016
			(0.026)	(0.029)
# of Observations	10,812	11,310	10,812	11,281
Adj. R^2	0.946	0.861	0.947	0.861

The dependent variable is log(rent). Standard errors are in parentheses. Indicators of confidence in the statistical difference from zero are: *p<0.1; **p<0.05; ***p<0.01. All regressions include fixed effects for the building, # of bedrooms, and FSA-year. *Post-Period* is a dummy, =1 for years t=1...3 after new build completion. *Vacancy Rate* is a dummy, = 1 when vacancy rate > 2%.This dummy drops as it is co-linear with the FSA-year FE. The sample is vacant surveyed rental units only.

Table 5: Li with with Post x Vacancy Rate Interaction: Vacant Rental Units

family rental building and the controls are rental units in properties 251-600m away from the same new construction. The parameter of interest in these regression is the coefficient on the DiD term, the interaction between the post-new build completion and within 250m (treated) dummies. As with the replication of Li, 2022, we present results separately for all rental units (vacant and occupied) and vacant units only. We also present specifications whit and without building age.

In both cities and for both samples the results are similar: new construction does not have a statistically different effect on rents in existing structures post-completion on those within 0 to 250m of the new build, compared to those 250-600m away. Table 6 shows the regression results for the all units sample and Table 7 provides the same for the vacant units only sample.

	(Vancouver)	(Calgary)	(Vancouver)	(Calgary)
Post Period	0.035^{***}	-0.011	0.024^{**}	-0.012
	(0.011)	(0.015)	(0.012)	(0.015)
< 250m from New Build	-0.018	-0.009	-0.021^{*}	-0.010
	(0.013)	(0.012)	(0.012)	(0.012)
Interaction: Post x Treated	-0.006	0.002	-0.017	0.004
	(0.022)	(0.018)	(0.011)	(0.018)
log(Building Age)			-0.150^{***}	-0.028
			(0.021)	(0.022)
# of Observations	30,664	20,062	30,664	20,028
Adj. R^2	0.831	0.778	0.834	0.778

The dependent variable is log(rent). Standard errors are in parentheses. Indicators of confidence in the statistical difference from zero are: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$. All regressions include fixed effects for the building, # of bedrooms, and FSA-year. *Post-Period* is a dummy, =1 for years t=1...3 after new build completion. *Treated* is a dummy, =1 if unit < 250*m* from a new multi-family rental building. The sample is all surveyed rental units.

Table 6: Asquith et al. Baseline: All Rental Units

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	(Vancouver)	(Calgary)	(Vancouver)	(Calgary)
Post Period	0.067**	−0.010	0.064**	−0.009
	(0.027)	(0.030)	(0.026)	(0.029)
< 250m from New Build	−0.028	−0.025*	−0.030	−0.025*
	(0.022)	(0.014)	(0.022)	(0.014)
Interaction: Post x Treated	−0.019	0.001	−0.026	0.0002
	(0.024)	(0.031)	(0.024)	(0.031)
log(Building Age)			−0.102***	−0.044
			(0.017)	(0.042)
# of Observations	3,021	2,780	3,021	2,775
Adj. R^2	0.931	0.867	0.932	0.867

The dependent variable is log(rent). Standard errors are in parentheses. Indicators of confidence in the statistical difference from zero are: *p<0.1; **p<0.05; ***p<0.01. All regressions include fixed effects for the building, # of bedrooms, and FSA-year. *Post-Period* is a dummy, =1 for years t=1...3 after new build completion. *Treated* is a dummy, =1 if unit < 250*m* from a new multi-family rental building. The sample is vacant rental units only.

Table 7: Asquith et al. Baseline: Vacant Units

We next examine how market-wide vacancy levels change the spillover effects of a new multi-family rental building on neighbouring existing rental buildings. As above, we introduce an additional interaction with the metropolitan area vacancy rate, which in the Asquith et al. generates a triple-difference specification. We present the results below in Tables 8 and 5 for all rental units and vacant units only, respectively. We do not find clear consistent results, with differences between Vancouver and Calgary, and then again between all rental units and vacant unit only samples. Separate from the other overlapping interaction affects, the basic DiD measure of interest, treated (new build within 250m) by post completion, is negative in all cases, but the coefficient estimates are never statistically different from zero with 90 percent confidence.

For the effect of vacancy on all units (Table 10), in Vancouver, when vacancy rates exceed 2 percent, vacancy rates lower rents for the treated areas relative to not treated following the new construction by 9% (triple-difference coefficient estimate).[13] In contrast, in Calgary the point estimate of the effect is positive but never statistically different from zero. As well, for vacant units (Table 11) the triple difference estimates are essentially zero. Our expectation is that the vacant unit sample should be more reflective of contemporaneous market conditions, marginally

[13]As indicated above, in Vancouver vacancy rates have usually been below 2% (mean of 1.3%), while in Calgary the norm is the reverse (mean of 3.2%)

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so in Calgary but much more so in Vancouver as vacant units can be marked to market and not subject to rent controls.

	(Vancouver)	(Calgary)	(Vancouver)	(Calgary)
Post Period	0.034***	0.003	0.023*	0.002
	(0.012)	(0.021)	(0.013)	(0.021)
Treated: < 250m of New Build	−0.020	0.006	−0.023*	0.008
	(0.013)	(0.022)	(0.012)	(0.022)
Interaction: Post x Treated	−0.001	−0.036	−0.012	−0.038
	(0.022)	(0.032)	(0.011)	(0.031)
Interaction: Post x Vacancy Rate	0.045	−0.026	0.047	−0.024
	(0.032)	(0.030)	(0.031)	(0.030)
Interaction: Treated x Vacancy Rate	0.018	−0.020	0.019	−0.024
	(0.018)	(0.023)	(0.017)	(0.023)
Interaction: Post x Treated	−0.094***	0.056	−0.092***	0.061
x Vacancy Rate	(0.034)	(0.038)	(0.033)	(0.037)
log(Building Age)			−0.150***	−0.030
			(0.021)	(0.021)
# of Observations	30,664	20,062	30,664	20,028
Adj. R^2	0.832	0.778	0.834	0.779

The dependent variable is log(rent). Standard errors are in parentheses. Indicators of confidence in the statistical difference from zero are: *p<0.1; **p<0.05; ***p<0.01 All regressions include fixed effects for the building, # of bedrooms, and FSA-year. *Post-Period* is a dummy, =1 for years t=1...3 after newbuild completion. *Treated* is a dummy, =1 if unit < 250*m* from a new multi-family rental building. *Vacancy Rate* is a dummy, = 1 when vacancy rate > 2%. This dummy drops as it is co-linear with the FSA-year FE. The sample is all RMS rental units.

Table 8: Asquith et al. Vacancy Rate Dummy Interaction: All Rental Units

As per the theory surveyed above, new private market buildings come in at higher quality (rent) levels. Thus, in the short run, before vacancy chains analyzed below fully work their course, it may be the case that new construction increases the supply in the high-rent segment, but not in the low rent segment. Thus, we would expect differential impact on rents in nearby buildings, between those with higher rents, and those in lower rents. Below in Tables 10 and 11 for all and vacant units respectively.

For all units (Table 10), the triple difference point estimate is negative in all cases. In Vancouver, post-construction of a new building, for nearby buildings, there is downward pressure on rents of units that are above the average rent by bedrooms count-FSA-year on the order of 6-7%. For

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	(Vancouver)	(Calgary)	(Vancouver)	(Calgary)
Post Period	0.077***	−0.059	0.074***	−0.055
	(0.028)	(0.067)	(0.028)	(0.063)
Treated: < 250m of New Build	−0.030	−0.102***	−0.034	−0.100***
	(0.022)	(0.031)	(0.022)	(0.031)
Interaction: Post x Treated	−0.018	−0.019	−0.023	−0.036
	(0.024)	(0.080)	(0.024)	(0.075)
Interaction: Post x Vacancy Rate	−0.108**	0.064	−0.106**	0.062
	(0.052)	(0.076)	(0.053)	(0.073)
Interaction: Treated x Vacancy Rate	0.022	0.101***	0.027	0.098***
	(0.044)	(0.034)	(0.044)	(0.034)
Interaction: Post x Treated x Vacancy Rate	0.032	0.012	0.022	0.032
	(0.060)	(0.089)	(0.060)	(0.084)
log(Building Age)			−0.104***	−0.053
			(0.017)	(0.042)
# of Observations	3,021	2,780	3,021	2,775
Adj. R^2	0.932	0.869	0.932	0.869

The dependent variable is log(rent). Standard errors are in parentheses. Indicators of confidence in the statistical difference from zero are: *p<0.1; **p<0.05; ***p<0.01 All regressions include fixed effects for the building, # of bedrooms, and FSA-year. *Post-Period* is a dummy, =1 for years t=1...3 after newbuild completion. *Treated* is a dummy, =1 if unit < 250*m* from a new multi-family rental building. *Vacancy Rate* is a dummy, = 1 when vacancy rate > 2%. This dummy drops as it is co-linear with the FSA-year FE. The sample is RMS vacant rental units only.

Table 9: Asquith et al. Vacancy Rate Dummy Interaction: Vacant Units

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Calgary, we do not observe a differential in the effect by neighbouring build unit rent.

When we limit the sample to vacant units only, whose listed rent should be closer to market levels (Table 11), the results flip, so negative and statistically different from zero effects for Calgary on the order of 7-8%. For Vancouver, there is no difference in the effects of new construction for existing below or above average rent units.

	(Vancouver)	(Calgary)	(Vancouver)	(Calgary)
Post Period	-0.044^{***}	-0.004	-0.053^{***}	-0.004
	(0.013)	(0.011)	(0.013)	(0.011)
Treated: < 250m of New Build	-0.017	-0.010	-0.020	-0.010
	(0.013)	(0.011)	(0.013)	(0.011)
> Avg Rent	0.218^{***}	0.187^{***}	0.216^{***}	0.187^{***}
	(0.010)	(0.007)	(0.010)	(0.007)
Interaction: Post x Treated	0.038^{*}	0.007	0.034^{**}	0.008
	(0.021)	(0.014)	(0.017)	(0.014)
Interaction: Post x > Avg Rent	0.091^{***}	0.006	0.094^{***}	0.005
	(0.017)	(0.016)	(0.016)	(0.016)
Interaction: Treated x > Avg Rent	0.016	0.013	0.016	0.012
	(0.017)	(0.013)	(0.017)	(0.013)
Interaction: Post x Treated	-0.065^{**}	-0.018	-0.073^{***}	-0.017
x > Avg Rent	(0.028)	(0.023)	(0.028)	(0.023)
log(Building Age)			-0.108^{***}	-0.015
			(0.016)	(0.012)
# of Observations	30,664	20,062	30,664	20,028
Adj. R^2	0.898	0.864	0.899	0.864

The dependent variable is log(rent). Standard errors are in parentheses. Indicators of confidence in the statistical difference from zero are: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$ All regressions include fixed effects for the building, # of bedrooms, and FSA-year. *Post-Period* is a dummy, =1 for years t=1...3 after newbuild completion. *Treated* is a dummy, =1 if unit < 250*m* from a new multi-family rental building. > *Avg Rent* is a dummy, = 1 when the unit's rent is greater than the average rent by # of bedrooms - FSA - year. The sample is all RMS rental units.

Table 10: Asquith et al. > Avg Rent Interaction: All Rental Units

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	(Vancouver)	(Calgary)	(Vancouver)	(Calgary)
Post Period	0.026	−0.027	0.024	−0.024
	(0.024)	(0.028)	(0.025)	(0.026)
Treated: < 250m of New Build	−0.016	−0.022	−0.017	−0.021
	(0.020)	(0.015)	(0.020)	(0.016)
> Avg Rent	0.192***	0.152***	0.191***	0.154***
	(0.014)	(0.012)	(0.014)	(0.012)
Interaction: Post x Treated	−0.012	0.038	−0.015	0.036
	(0.025)	(0.030)	(0.025)	(0.030)
Interaction: Post x > Avg Rent	0.035*	0.055*	0.036*	0.053*
	(0.021)	(0.030)	(0.021)	(0.030)
Interaction: Treated x > Avg Rent	−0.026	0.014	−0.027	0.011
	(0.019)	(0.024)	(0.019)	(0.024)
Interaction: Post x Treated x > Avg Rent	0.008	−0.079**	0.006	−0.075*
	(0.033)	(0.039)	(0.033)	(0.039)
log(Building Age)			−0.065***	−0.051
			(0.020)	(0.037)
# of Observations	3,021	2,780	3,021	2,775
Adj. R^2	0.948	0.900	0.949	0.901

The dependent variable is log(rent). Standard errors are in parentheses. Indicators of confidence in the statistical difference from zero are: *p<0.1; **p<0.05; ***p<0.01 All regressions include fixed effects for the building, # of bedrooms, and FSA-year. *Post-Period* is a dummy, =1 for years t=1...3 after newbuild completion. *Treated* is a dummy, =1 if unit < 250*m* from a new multi-family rental building. > *Avg Rent* is a dummy, = 1 when the unit's rent is greater than the average rent by # of bedrooms - FSA - year. The sample is RMS vacant rental units.

Table 11: Asquith et al. > Avg Rent Interaction: Vacant Units

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5 Vacancy Chains

A vacancy chain is the sequence of vacancies that arise following a move out of one unit and into another. Starting from a given unit ("unit 1") being vacant, a household ("household 1") chooses to exit their existing unit ("unit 2") to move into that initially vacant unit (unit 1). This move is round 1. The second round occurs when household 1's vacated unit (unit 2, is occupied by a second household (household 2) that elects to move out of their own unit (unit 3) and into the unit vacated by household 1. This continues as a chain series of moves, the vacancy chain.

An important question with respect to the filtering of a vacant new housing is: how likely is it that the associated vacancy chain will yield a vacancy in a home at some level of affordability before the chain is broken? For this study, the question is of particular interest when the initial vacancy is in a new housing unit, because the question has been raised as to whether new housing units contribute to affordability, which would occur if the chain of vacancies reaches down into affordable units. The chain is "broken" if a vacant home becomes occupied by someone not vacating a unit that can be occupied by a successor household. In the example above this would occur if the second-round (household 2) is newly formed, e.g. comes from a parent's home or splits off from housemates, or alternatively if they originate from out of the study area, either migrants or immigrants. In these cases, their occupancy of unit 1does not yield a vacancy in the origin market (unless one counts the possibility of a mover from some other market eventually triggering a move into that other market from the original market, a possibility we ignore statistically).

Of course, the fact that a vacant unit may be occupied by a household other than an incumbent local does not mean that the vacancy does not contribute to affordability. If a newly formed or immigrant household did not move into the vacant unit in question, they would likely have moved into some other vacant unit, breaking the chain associated with that unit. And out-of-town buyers create vacancy elsewhere, improving affordability in that locale. Our interest here, however, is in approximating the likelihood that a home at some level of affordability in the same metropolitan area is opened up directly through a chain starting with a new housing unit.

The best way to measure vacancy chains is to observe the entire chain of moves. This is feasible in Finland, where registries are likely to capture every move, address by address, per Bratu, Harjunen, and Saarimaa (2023). With incomplete data, as in the Canadian context, there are key characteristics to estimate. Vacancy chains will terminate sooner, and hence be less likely to result in a target level of affordability, if moves from out-of-town into vacant units are more

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common. Naturally, if homes in new multi-family housing are unusually expensive, it will take a longer chain, in expectation, to achieve affordability. Another critical determinant of vacancy chain success in hitting target affordability levels is the extent to which households commonly move from lower valued to higher valued homes; if vacated units cost is highly correlated with newly occupied units cost, then it will require a longer unbroken chain to hit target affordability. If there is weak correlation between current and past rent among movers, a shorter chain is likely to attain any designated threshold rent level.

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5.1 Data Description and Methodology

The Longitudinal Administrative Databank (LAD) is a roughly 20% sample of taxpayers who are followed as long as they complete tax form T1s. We observe filers' postal code, but generally not other housing variables (other than first-time homebuyer credits when applicable). We assume that a change in postal code reflects a move and hence a vacancy in the origin postal code. This tends to overstate the vacancy chain moves as we include exits from parents' home if taxes have been

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filed from that parental address, a possibility we address below.

From homes' postal codes, we can observe census tract median rents from merges with the Postal Code Conversion File and from the 2021 Census. We take these local average rents as measures of the cost of new housing units and as the targets for rental affordability. As emphasized by Mast (2021) and Bratu, Harjunen, and Saarimaa (2023), this will understate the persistence of rent levels between origin and destination homes, to the extent that households that move from an inexpensive to an expensive tract likely move from units drawn from the higher end of the rent distribution in the less expensive origin tract(and hence overstate the extent of filtering). In fact, Bratu, Harjunen, and Saarimaa (2023) find this is the case in first-round moves into new homes, but that the opposite is true in later rounds. That is, in moves further down in the vacancy chain, vacated units tend to have rents below neighbourhood means. This suggests that there should be offsetting biases with net indeterminate sign in our estimates of interest.

We observe the postal codes of new multi-family housing in Calgary, Montreal, and Vancouver through opportunistic use of two data sources. Using data from CoStar, we have for the Vancouver and Calgary CMAs the postal code and construction completion date for the covered universe of large multi-family rental apartment buildings. Using city and provincial tax assessment records, for the Agglomeration of Montreal and for the Greater Vancouver metropolitan area, we have postal codes and completion dates for all multi-family buildings, rental or purpose-built.[14]

We take two approaches to investigating the extent to which new apartments (rental and/or condo) "trickle down" into vacancies in apartments of some level of affordability. The first assumes characteristics of moves along vacancy chains are identical with respect to key parameters, as described below. The second approach is to check whether the characteristics shown for all moves appear consistent with moves into new buildings, the first step in the vacancy chain.

5.1.1 General approach

There are a few key factors that determine how deep a vacancy chain will reach before terminating with a new household formation or a move into a vacant unit from a migrant into the CMA. We develop a parsimonious model that provides parameters governing this depth, by quantifying key factors.

1. The probability that any vacant housing unit (new or old) is occupied by someone exiting

[14]For Montreal, the source is *https://donnees.montreal.ca/dataset/unites-evaluation-fonciere*. For Vancouver, we use BC Assessment data shared via the UBC library.

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a housing unit within the same CMA. This is assumed a constant λ that is independent of the characteristics of the vacant unit. The closer is λ to zero, the less likely that a chain will reach a target depth, because the chain will likely break after a small number of steps.

2. The extent to which vacant units are occupied by movers from homes in similar neighbourhoods, or instead if renters into all units are drawn from the a pool that looks like the general population. In the former case, vacancy chains will take many steps to get from an expensive newly built unit to affordable vacancies; in the latter case, vacancy chains are likelier to hit affordability in fewer steps. We assume this issue is identified from two parameters:

   (a) The similarity of median log rents in vacated units to the median rent in occupied units. This parameter is θ. The closer is θ to zero, the less similar are rents.

   (b) How heterogeneous the pool of movers into a given unit are. This parameter is σ. The larger is σ, the more heterogeneous the pool of movers, and the more likely that a vacancy chain will hit a target rent level in relatively few steps.

   We assume that the median log rent y in the neighbourhood of a unit that is vacated by the new occupant of a new or vacant unit in a neighbourhood with median log rent y_0 is distributed normally with standard deviation σ and mean:

$$E(y|y_0, 1) = \alpha + \theta y_0. \tag{5}$$

The fraction of individuals observed moving into postal codes within a given CMA from a different postal code in the same postal code in LAD between 2012 and 2019 (to avoid COVID effects) is used to estimate λ. That is, out of the universe of LAD respondents identified as moving (changing 6-digit postal code) to a postal code situated within CMA m in year t, λ is calculated as the fraction that reported a different postal code in the same CMA in year $t-1$. We modify that fraction for two reasons. First, some movers do not form households, so we use a Census estimate of the fraction of movers that are moving with the purpose of newly forming a household to reduce λ proportionally. Also, some movers are from outside Canada and do not fill in T1 forms. Given that the Public Use Microdata File for the 2021 census shows that over half of movers who report having lived outside of Canada in the past year are permanent residents (who likely would file a T1), we further reduce λ by half the fraction of movers identified in Census 2021 as external migrants and hence not represented statistically in the LAD.

Summarizing, λ for CMA m is computed as:

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1. The fraction of (a) LAD individuals among the 2012 through 2019 waves who live in a postal code p in m in year t, but do not live in p in year $t-1$ who (b) live in a different postal code $p^{\wedge}$ within m in $t-1$.

2. This times 0.9, which reflects the roughly 10% of movers who are forming a new household. We derive this from "Indicators related to moving", Statistics Canada Table 46-10-0061-01, which identifies 35% of households moving in the past five year, and 3.6% forming a new household in doing so.[15]

3. These two times 1 - (0.5 times the fraction of movers from outside Canada in CMA m). The later from Census 2021 Table 98-10-0366-01).

Equation (5) is estimated using LAD merged with census tract median rents from Census 2021. We observe the postal codes into which and from which moves occur. The unit of observation is an individual in the LAD survey with their postal code merged into a census tract median rent (identified through a merge with postal code and census tract from the PCCF). We then regress log 2021 median rents in the census tract encompassing the postal code from which movers originated on log median rent in their destination code. There will be downward bias (through attenuation) in the θ estimate to the extent that the ratios of rents in tracts i and j within a given CMA vary between 2012 and 2019, as we assume the same log rents in origins and destinations for observations in each of these years.[16]

In Appendix A, we show how these estimated paramters are used to compute probabilities that a vacancy chain starting with a new multi-family rental unit will yield a vacancy in a home at or below a target (25th or 50th) percentile of the distribution of rents in the CMA, starting from a vacancy at the 75th percentile of rents in the CMA or from the actual census tract percentiles in which new buildings are located.

5.2 Results

In Table 12 we present the parameter values λ, θ, and σ that determine vacancy chain depth for each large Canadian CMA and the associated probability of reaching the 25th percentile of rents. The first numerical column is the raw estimate of λ, the fraction of individuals (including potentially multiple members of the same household) who report moving from one postal code to

[15]Release date September 10, 2024.

[16]This measurement error problem could relate to an endogeneity problem if moves between tracts are correlated with unobserved convergence in rents.

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another who move from within the same CMA in LAD between 2012 and 2019. The complement of λ is movers from elsewhere.[17] There is variation across CMAs, but typical values are roughly .8.

The second numerical column in Table 12 is the fraction of residents of CMA *m* who moved in the past year that report moving from outside Canada.

The third numerical column, $\hat{\lambda}$ in Table 12 adjusts the raw values of λ to reflect the fact that we describe above that some moves (e.g. moves out of a bedroom in a parents' home, or in some cases, divorce or breakups or leaving housemates) do not generate a corresponding vacancy. Recognizing both that some of those household formers may have created a vacancy (e.g. in a shared living environment) and also that some movers for other reasons (e.g. first-time buyers) may have also failed to create a vacancy, we assume that the effective value $\hat{\lambda}$ is the initial value multiplied by .9 and then multiplied again times one minus the foreign column value.

The fourth, fifth, and sixth numerical columns of Table 12 report low values of θ in most metropolitan areas, typically ranging from 0.15 to 0.25, with Ottawa-Gatineau a notably high outlier. These modest θ values, notably similar to the root variance of errors σ, suggest that there should be relatively rapid convergence of vacancies along a chain to the overall distribution across census tracts. Vancouver and Toronto, notoriously expensive markets of particular interest, have highly similar parameters. In both cities, roughy 90% of LAD movers come from the same CMA. The values of the regression intercept α, autoregressive coefficient θ and standard deviation σ are 5.39, 0.26, and 0.3 for Vancouver and 5.19, 0.3, and 0.33 for Toronto. Smaller metropolitan areas, particularly at the fringes of larger CMAs, not surprisingly, have lower values of λ, but also commonly lower foreign fractions than their larger counterparts.

The final column of Table 12 presents the probability that a vacancy at the 75th percentile of census tract median rents yields, through an unbroken chain of moves within the same CMA, a vacancy in a census tract at the 25th percentile or lower by the 20th round of the chain. A typical $\hat{\lambda}$ value of 0.5 raised to the 20th power is approximately 1 millionth, so truncating at round 20 should have little effect on the estimated probability. There is a downward bias in that a chain of moves that involves both a move out of the CMA in one step, and then a subsequent step back into the CMA is possible in practice, but excluded from the count in column 75*to*25. The 75th percentile is of interest because the median census tract rents for new building postal codes in both the Montreal and Vancouver CMAs are close to the 75th percentile of those distributions. For Montreal and Vancouver, the 75th percentile rent is replaced with the mean among tracts where

[17]By considering individuals as the unit of analysis in LAD, we effectively weight larger housing units more.

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CMA	λ	foreign	$\hat{\lambda}$	α	θ	σ	75 to 25
Abbotsford–Mission	0.58	0.06	0.51	6.35	0.11	0.26	0.18
Barrie	0.58	0.03	0.52	5.58	0.24	0.26	0.2
Belleville	0.72	0.02	0.64	6.17	0.11	0.2	0.36
Brantford	0.74	0.03	0.66	5.98	0.15	0.26	0.31
Calgary	0.83	0.07	0.72	6.12	0.15	0.22	0.42
Edmonton	0.82	0.05	0.72	5.79	0.19	0.22	0.37
Greater Sudbury	0.83	0.03	0.73	6.11	0.12	0.26	0.44
Guelph	0.66	0.05	0.58	6.08	0.15	0.32	0.29
Halifax	0.81	0.06	0.71	5.21	0.26	0.24	0.33
Hamilton	0.74	0.05	0.65	5.3	0.26	0.32	0.26
Kelowna	0.69	0.04	0.61	6.17	0.16	0.22	0.24
Kingston	0.73	0.05	0.64	4.82	0.33	0.26	0.22
Kitchener–Cambridge–Waterloo	0.78	0.08	0.68	5.8	0.19	0.24	0.27
Lethbridge	0.79	0.03	0.7	5.85	0.17	0.2	0.34
London	0.83	0.07	0.72	5.18	0.26	0.3	0.35
Moncton	0.77	0.06	0.67	5.15	0.25	0.2	0.31
Montreal	0.94	0.08	0.81	4.9	0.28	0.2	0.49
Oshawa	0.6	0.04	0.53	5.41	0.25	0.3	0.21
Ottawa–Gatineau	0.84	0.07	0.73	3.74	0.47	0.3	0.29
Peterborough	0.74	0.02	0.66	6.04	0.15	0.24	0.28
Quebec	0.87	0.05	0.77	5.29	0.21	0.22	0.49
Regina	0.84	0.07	0.73	5.96	0.15	0.2	0.41
Saguenay	0.85	0.03	0.75	4.93	0.24	0.17	0.41
Saint John	0.85	0.04	0.75	5.09	0.24	0.17	0.48
Saskatoon	0.8	0.06	0.7	6.09	0.13	0.22	0.41
Sherbrooke	0.81	0.03	0.72	4.94	0.24	0.17	0.43
St. Catharines–Niagara	0.82	0.04	0.72	5.84	0.16	0.26	0.44
St. John's	0.84	0.04	0.74	6.02	0.12	0.2	0.49
Thunder Bay	0.84	0.04	0.74	6.15	0.11	0.22	0.43
Toronto	0.91	0.11	0.77	5.19	0.3	0.33	0.36
Trois-Rivieres	0.82	0.04	0.73	4.78	0.26	0.17	0.33
Vancouver	0.91	0.12	0.77	5.39	0.26	0.3	0.46
Victoria	0.74	0.06	0.65	6.33	0.12	0.2	0.35
Windsor	0.86	0.08	0.74	5.5	0.2	0.26	0.49
Winnipeg	0.92	0.07	0.8	5.3	0.24	0.26	0.51

Estimates of the share of Longitudinal Administrative Databank movers that originate from that CMA (λ) by CMA: fraction of movers originating in same CMA. Foreign is is the fraction of movers in the last year originating from outside Canada, per Census Table 98-10-0366-0 from 2021. $\hat{\lambda}$ is a 10% reduction in the first-column estimates to reflect moves for household formation or other purposes that do not create a vacancy times one minus the CMA-specific fraction of movers from outside Canada reported in Census Table 98-10-0366-01. Regression parameters α, θ, and σ from LAD movers' census tract median rents as described above. The final column "75 to 25" represents the estimated probability that an uninterrupted vacancy chain of within-CMA moves starting with a vacancy in a census tract at the 75th percentile of CMA rents results in a vacancy at the 25th percentile.

Table 12: Mover Model Parameters by CMA

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new buildings are located in our LAD-assessment data merged sample.

Table 13 presents median 2021 rent (a) among all postal codes to which individuals move, (b) among the new postal codes to which they have moved, and (c) among the postal codes out of which they have moved to new units. Montreal is for all new multi-family; Calgary, new rentals only; Vancouver first new rentals only, then all new multi-family. This set of choices were made based on the ability to identify new buildings date of construction and postal code, which varies across these CMAs. For each list of construction date and postal code, we consider first the mean median rent among all postal codes in the CMA, weighted by observations.[18]

The second column of Table 13 shows the mean median 2021 rent among census tracts with new buildings. Not surprisingly, we see by comparing the third and fourth rows that census tracts with condos in Vancouver have higher rents than those with purpose-built rentals. Unlike in Vancouver, purpose-built rentals in Calgary have notably higher rents than the overall average (which includes townhome and single-family rentals). The universe of observations here is LAD individuals who move into a postal code in the year of, or the year after, construction. Given that postal codes are small, and sometimes are restricted to a single large building, it is highly probably that households moving into a postal code in the year of or after completion of a new building are moving into that new building, as opposed to an existing building in the same postal code. Their lagged postal code medians should thus be a reasonable approximation of actual medians of movers (although per Mast (2021) possibly an upward bias of actual rents paid in those tracts by movers).

The third column of Table 13 presents the mean median census tract rent among the postal codes from which the occupants of new buildings in the second column originated, if those origin postal codes are in the same CMA. For Montreal, we see that half of the difference (980 minus 920) between mean 2021 rents in postal codes with new buildings and all CMA rents has disappeared by the first round of the vacancy chain. Comparing to Table 12, expected rent in the first round of a vacancy chain would be (ignoring curvature induced by the log and possibly non-trivial rounding error, and the likelihood that the new building rents are higher than census tract medians):

$$E(\log \text{rent} \mid \log 980) = 4.9 + .28 \times \log 980 = \log 924. \tag{6}$$

In this way, we see that in Montreal's first round moves, the reversion to the mean is not as fast as predicted by the autoregressive model. By contrast, among Calgary PBRs, there is

[18]A small difference in the universe for Vancouver PBR and all units is that there are missing years for Vancouver PBR with too small of a sample to consider.

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"overshooting" in that origination postal codes have lower median rents than the CMA average.[19] Vancouver purpose-built rental tracts have the same mean median rent as all units, so there is no scope for mean reversion. For all Vancouver multi-family, we see considerable mean reversion, but again less than predicted by the autoregressive parameters.

CMA	meanAllCMA	mean New Destination	mean Origin	Weighted Obs.
Montreal (All multi)	920	980	950	7,150
Calgary (PBR only)	1,370	1,580	1,330	330
Vancouver (PBR only)	1,580	1,580	1,570	310
Vancouver (All multi)	1,570	1,710	1,670	10,270

Table 13: Median Census Tract Rents by Unit: All, New, and Vacated

Combining results from Tables 12 and 13, Figure 9 plots the cumulative probability that a vacancy chain that starts with a move into a new typical new building (with average median census tract rents of $980 and $1,710 per column 3) generates a vacancy at the 25th percentile of census tract median rents across CMA tracts ($785 in Montreal and $1,240 in Vancouver). The probability is cumulative across rounds of the vacancy chains using the process outlined above. We consider 20 rounds, but the probability asymptotes starting much earlier. Not surprisingly given the similar values for λ and regression parameters in Vancouver and Montreal, the curves look similar, with Montreal's probabilities higher in later rounds due to Vancouver's larger foreign share bringing down $\hat{\lambda}$ and reducing to near zero the probability of a chain's duration to late rounds. In Vancouver, the probability reaches 40% by round 4 4 and 5, and flattens to 46.5% with almost no increase after round 10. For Montreal, the similarly exceeds 40% by the fourth step of the vacancy chain, and nears its peak value of 49% by the 9th step.

Notably, the LAD fraction of movers into postal codes with new buildings that originate within the same CMA is very similar to the overall fraction, at 95% for all multi-family in Montreal, 75% for purpose-built rental in Calgary, 87% for Vancouver purpose-built rental and 91% for all multi-family (rental and condo) in Vancouver. Thus, while the autoregressive parameters may overstate mean reversion in origin rents for new properties, the λ estimates for the general population appear applicable. When the target affordability level is the median of census tract median rents, rather than the 25th percentile, filtering probabilities naturally increase. For Montreal and Vancouver, these increase to 61% and 60% respectively.

[19]Mean median rents are rounded to the nearest 10 pursuant to LAD release rules.

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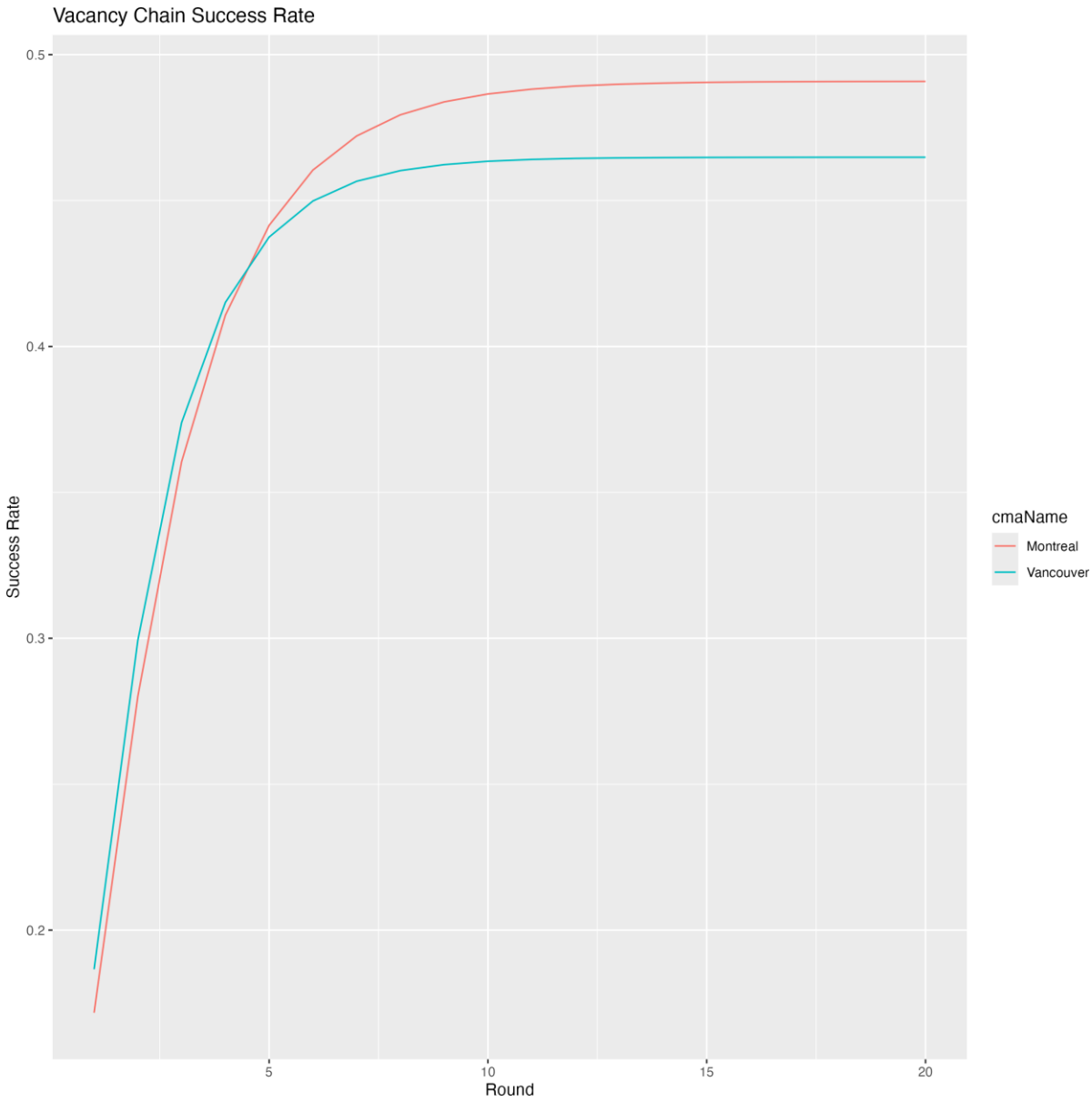


Figure 9: Cumulative Probability of a new multifamily housing unit's vacancy chain yielding a vacancy in a home in the 25th percentile of CMA rents, by round

6 Conclusion

In this report we study filtering in major Canadian cities. We assess three channels through which new rental construction may affect rental housing affordability. Given the debate on whether higher value new construction benefits lower income households or not, understanding the filtering process is necessary to provide clearer guidance for housing policy. We find significant filtering effects through building depreciation and vacancy chains. However, we do not consistently find effects of new rental multi-family construction on the rents of existing nearby rental buildings that are statistically different from zero.

A familiar way in which filtering occurs is that expensive housing becomes affordable housing as once-new housing units deteriorate in absolute or relative quality over time. For each of the six largest CMAs we find that rents decline with building age. In our data, rents fall by roughly 1 per year percent per year over the first roughly 20 years of buildings lives, relative to other apartment buildings of constant age in the same metropolitan area, though with some variation in this rate by CMA. This relationship flattens out for buildings that survive to older ages; after 30 years in all cases. While that effect is shared across Canadian CMAs, the magnitudes of total depreciation vary, from modest depreciation in Montreal (15% in total), to deeper affordability effects in Toronto and Ottawa (over 35%).

Several research papers have found that new rental construction results in a decline in rents in nearby existing rental buildings. These effects can be hyper-local, ending in as little as 150m in Li, 2022 for Manhattan. This work relies on low cross-elasticities of demand across even nearby geographic rental sub-markets. Using data from the Vancouver CMA, a market with strong rent control, and the Calgary CMA, a market without rent control, we find only very weak support for these new building effects, with low magnitudes of effect: less 3% lower rents in neighbouring buildings following new nearby rental construction, and only in Calgary. These effects are larger when vacancy is higher in Vancouver, and higher for more expensive existing rental units. But the results are not statically different than zero with enough consistency to be persuasive. However, there is no support for the argument that new rental construction raises sub-market rents.

New buildings create vacancies in older, more affordable buildings not only through their aging process, but also through vacancy chains. Most movers in Canada move within the same CMA. Census tracts with new buildings generally feature higher rents than other tracts in the same CMA. However, individuals who move into postal codes with newly constructed buildings (likely

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occupants of the buildings themselves), come from postal codes with rents closer to CMA mean levels. Generally, moves within CMAs feature strong reversion to the mean from destination rents to origin rents. Allowing for 10% of within-CMA moves to be such that there is no vacancy created, and recognizing that LAD misses some movers from outside Canada, we estimate that new multi-family buildings in Vancouver and Montreal create between 45% and 49% as many vacancies in census tracts with median rents below the CMA 25th percentile as there are units in the building.

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References

Arnott, Richard, Russell Davidson, and David Pines (1983). "Housing Quality, Maintenance and Rehabilitation". In: *The Review of Economic Studies* 50.3, pp. 467–494. url: https://doi.org/10.2307/2297676.

Asquith, Brian J, Evan Mast, and Davin Reed (2023). "Local Effects of Large New Apartment Buildings in Low-Income Areas". In: *The Review of Economics and Statistics* 105.2, pp. 359–375. url: https://doi.org/10.1162/rest_a_01055.

Aura, Saku and Thomas Davidoff (land use regulations, housing supply 2008). "Supply Constraints and Housing Prices". In: *Economics Letters* 99.2, pp. 275–277.

Bratu, Cristina, Oskari Harjunen, and Tuukka Saarimaa (2023). "City-wide effects of new housing supply: Evidence from moving chains". In: *Journal ofUrban Economics* 133. url: https://doi.org/10.1016/j.jue.2022.103528.

Brueckner, Jan K. and Stuart S. Rosenthal (2009). "Gentrification and Neighborhood Housing Cycles: Will America's Future Downtowns Be Rich?" In: *The Review of Economics and Statistics* 91.4, pp. 725–743.

Case, Karl E. and Robert J. Shiller (Mar. 1989). "The Efficiency of the Market for Single-Family Homes". In: *The American Economic Review* 79.1, pp. 125–137.

CMHC (2022). *Canada's Housing Supply Shortages: Estimating what is needed to solve Canada's housing affordability crisis by 2030*.

Damiano, Anthony and Chris Frenier (2020). *Build Baby Build?: Housing Submarkets and the Effects of New Construction on Existing Rents*. Working Paper. University of Minnesota, Center for Urban Affairs.

Lee, Sanghoon and Jeffrey Lin (Mar. 2017). "Natural Amenities, Neighbourhood Dynamics, and Persistence in the Spatial Distribution of Income". In: *The Review of Economic Studies* 85.1, pp. 663–694.

Li, Xiaodi (2022). "Do New Housing Units in Your Backyard Raise Your Rents?" In: *Journal of Economic Geography* 22, pp. 1309–1352. url: https://doi.org/10.1093/jeg/lbab034.

Liu, Liyi, Doug McManus, and Elias Yannopoulos (2022). "Geographic and Temporal Variation in Housing Filtering Rates". In: *Regional Science and Urban Economics* 93. url: https://doi.org/10.1016/j.regsciurbeco.2021.103758.

Mast, Evan (2021). "The Effect of New Market-Rate Housing Construction on the Low-Income Housing Market". In: *Journal of Urban Economics*. url: https://doi.org/10.1016/j.jue.2021.103383.

Mense, Andreas (2020). *The Impact of New Housing Supply on the Distribution of Rents*. Tech. rep. This version: February 26, 2020; first version: January 10, 2020. School of Business and Economics, University of Erlangen-Nuremberg. url: https://andreas-mense.de/wp-content/uploads/2020/02/Mense-2020-New-Housing-Supply-Rents.pdf.

Nathanson, Charles G. (2019). *Trickle-down housing economics*. Working Paper. Northwestern University.

Rosenthal, Stuart S. (2008). "Old Homes, Externalities, and Poor Neighborhoods. A Model of Urban Decline and Renewal". In: *Journal of Urban Economics* 63.3, pp. 816–840. url: https://doi.org/10.1016/j.jue.2007.06.003.

— (2014). "Are Private Markets and Filtering a Viable Source of Low-Income Housing? Estimates from a 'Repeat Income' Model". In: *American Economic Review* 104.2, pp. 687–706.

Singh, Divya (Jan. 2020). *Do Property Tax Incentives for New Construction Spur Gentrification? Evidence from New York City*. Job Market Paper. url: https://ideas.repec.org/p/jmp/jm2020/psi856.html.

Soltas, Evan J. (2024). "The Price of Inclusion: Evidence from Housing Developer Behavior". In: *The Review of Economics and Statistics* 106.6, pp. 1588–1606.

Sweeney, James L. (1974). "A Commodity Hierarchy Model of the Rental Housing Market". In: *Journal of Urban Economics* 1.3, pp. 288–323. url: https://doi.org/10.1016/0094-1190(74)90010-2.

von Bergmann, Jens (2019). *Low Income vs New Dwellings*. url: https://doodles.mountainmath.ca/blog/2019/09/02/low-income-vs-new-dwellings.

Weicher, John C. and Thomas G. Thibodeau (1988). "Filtering and Housing Markets: An Empirical Analysis". In: *Journal of Urban Economics* 23.1, pp. 21–40. url: https://doi.org/10.1016/0094-1190(88)90003-4.

A Vacancy Chain Analysis

The probability that a target level $y^{\wedge}$ is vacated in the first round after a new apartment with neighbourhood rent y_0 is:

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$$Pr(\hat{y}|\mathfrak{y}\ ,\ 1) = \lambda\Phi\ \ \frac{y\hat{}\ -\ \alpha\ -\ \theta y_0}{\sigma}\ \ . \tag{7}$$

This probability, holding the target rent $y\hat{}$ constant, is:

- Increasing in λ, the probability that a vacancy is filled by a within-CMA mover.
- Increasing in the target rent level $y\hat{}$.
- Decreasing in α, the rent intercept from the regression (5).
- Increasing in σ^2, the variance of rent conditional on lagged rent (assuming the target rent $y\hat{}$ is less than the expectation $\alpha + \theta y_0$).

The probability that $y\hat{}$ is achieved by either the first or second move is the complement of the probability that such a rent is not achieved in either the first or second round. The probability of failure in the second round is 1 minus λ times the CDF of $y\hat{}$ conditional on failure in the first round. That CDF is for a truncated normal, with truncation below at $y\hat{}$ (the second round move here is conditional on failure to achieve $y\hat{}$ or below in the first round).

These probabilities become progressively more difficult to show in closed form after the first round due to this truncation.[20]

[20]The expected rent (5), truncated at $y\hat{}$ is:

$$E(y|y_0, y > y\hat{}, 1) = \alpha + \theta\bar{y} + \frac{\phi\ \frac{y\hat{}-\alpha-\theta y_0}{\sigma}}{1-\Phi\ \frac{y\hat{}-\alpha-\theta y_0}{\sigma}} \tag{8}$$

The variance of the truncated rent is:

$$Var(y|y_0, y > y\hat{}, 1) \equiv V_1 = \sigma^2\left[1 + \frac{\frac{y\hat{}-\alpha-\theta y_0}{\sigma}\phi\ \frac{y\hat{}-\alpha-\theta y_0}{\sigma}}{1-\Phi\ \frac{y\hat{}-\alpha-\theta y_0}{\sigma}} - \left(\frac{\phi\ \frac{y\hat{}-\alpha-\theta y_0}{\sigma}}{1-\Phi\ \frac{y\hat{}-\alpha-\theta y_0}{\sigma}}\right)^2\right] \tag{9}$$

The expected rent and period 2 conditional on failing to attain $y\hat{}$ in period 1 is thus:

$$E(y|y_0, y_1 > y\hat{}, 2) = \alpha + \theta\left[\alpha + \theta y_0 + \frac{\phi\ \frac{y\hat{}-\alpha-\theta y_0}{\sigma}}{1-\Phi\ \frac{y\hat{}-\alpha-\theta y_0}{\sigma}}\right] \tag{10}$$

The CDF of rents in round 2 can be computed numerically:

$$Pr(y_2 \leq y\hat{}|y_0, y_1 > y\hat{}) = Pr(\alpha + \theta[\alpha + \theta y_0 + \epsilon_1] + \epsilon_2 \leq y\hat{}|\alpha + \theta y_0 + \epsilon_1 > y\hat{}) \tag{11}$$

$$= \int_{-\infty}^{y\hat{}-\alpha-\theta[\alpha+\theta y_0+\epsilon_1]} \int_{y\hat{}-\alpha-\theta y_0}^{\infty} \phi(\epsilon_1; 0, \sigma)\phi(\epsilon_2; 0, \sigma)d\epsilon_1 d\epsilon_2. \tag{12}$$

A.0.1 Specific numerical estimation

However, a numerical algorithm for estimating the probability that a vacancy at a given rent occurs within k steps is relatively straightforward to implement:

- The probability that an individual moving into a tract with median rent y_0 originates in a tract with rent no greater than $y^\wedge$, is as in (7). This can be verified by drawing a large sample of normally distributed log rents with mean $\alpha + \theta y_0$ and standard deviation σ. Call the outcome vector r_1 and the associated probability p_1

$$p_1 = \lambda \times \text{mean}\,(r_1 < y^\wedge) \tag{13}$$

- In the second round, draw a new normally distributed sample with mean $\alpha + \theta \hat{r}_1$ and standard deviation σ, where $r^\wedge_1$ is the portion of the random vector r_1 where the originating rent was greater than $y^\wedge$ The probability of success in the second round, conditional on failure in round 1 is the fraction of the observations with value: $r_2 < y^\wedge$. The probability of success in either round 1 or round 2 is then

$$p(2) = \lambda \times \text{mean}\,(r_1 < y^\wedge) + \lambda^2 \times [1 - p(1)] \times \text{mean}\,(r_2 < y^\wedge), \tag{14}$$

$$r_2 = \alpha + \theta r^\wedge_1 + \epsilon_2 \tag{15}$$

- $r^\wedge_2$ is the list of round 2 random variables that are greater than $y^\wedge$. r_3, the list of simulated tract median rents in round 3 of the vacancy chain is given by:

$$r_3 = \alpha + \theta r^\wedge_2 + \epsilon_3. \tag{16}$$

- Generally, with ϵ_k distributed with mean zero and standard deviation σ

$$r_k = \alpha + \theta r^\wedge_{k-1} + \epsilon_k, \tag{17}$$

$$p(k) = p(k-1) + \lambda^k \times [1 - p(k-1)] \times \text{mean}(r_k < y^\wedge) \tag{18}$$

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