REITs and Rent Dynamics

Understanding the Impact on Montréal's Housing Market

Canada

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Author: Sean Nash, Senior Specialist, Housing Research

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Abstract

This study examines rental market dynamics in Montréal, focusing on rent differences between real estate investment trust (REIT)-owned and non-REIT units. Analysis shows REIT-owned units command higher rents, with an 25% differential. However, using a mixed-effects model, we find that controlling for geographic variance, strategic investment, and operational characteristics eliminates this difference. REIT properties are strategically clustered in neighbourhoods showing early signs of gentrification. Our findings suggest REITs are unlikely to be causal agents of gentrification but are highly reactive to these demographic changes. We estimate that geographic variability and investment strategy explain approximately 77% of rent differences, with operational factors like utility inclusion accounting for an additional 14%. We find REIT-owned properties are more likely to undergo major renovations, but those appear to be aimed at reducing operational costs rather than at increasing rents. The study concludes that higher rents in REIT units result from strategic investment and operational differences and shows that non-REIT owners that mirror the same behaviors have statistically similar rent prices. This research highlights the nuanced impact of institutional investments on Montréal's housing market and underscores the need for further study on the relationship between REIT investments and gentrification.

Executive Summary

This study investigates the rental market dynamics in Montréal, focusing on the differences in rent between real estate investment trust (REIT)-owned units and non-REIT units. The analysis reveals that REIT-owned units command higher rents, with a differential of 25% in Montréal. However, using a mixed-effects model approach, we find that, when controlling for geographic variance and strategic investment activity and operational characteristics (the inclusion of utilities in rent and capital investments), this observed difference in rent price dissipates.

We find that REIT properties are often clustered in specific neighbourhoods that appear to be selected strategically. In Montréal, we show that REITs' acquisitions favour neighbourhoods showing early signs of demographic change indicative of gentrification, while long-term holdings are more likely to be in neighbourhoods having experienced gentrification for an extended period. Our findings suggest that REITs are averse to highly speculative areas and wait for clear signs of demographic changes before making purchases, suggesting they are reacting to the presence of gentrification as opposed to being causal agents of it. When combined, controls for geographic variance in rent and investment strategy explain 77.3% of the difference in mean rent price between the owner types in our model.

We also find that operational differences contribute to rent differences. In Montréal, 82% of REIT-owned units include utilities in their asking rent, compared to 20% of non-REIT-owned units, accounting for an additional 13.8% of the rent variance. REIT properties in Montréal are also found to be more likely to undergo major renovation, and that such renovation has minimal impact on rent, suggesting reduced operational costs are the goal of renovations.

The findings suggest that higher rents in REIT units are primarily due to the use of geographically driven investment strategies and operational differences that result in higher-than-average gains in rent over time. The result is that long-term holdings of REITs in Montréal tend to be in more expensive neighbourhoods than non-REIT units, creating the impression of a rent premium. We show that non-REIT owners that mirror the same behavior as REIT owners have statistically similar rent prices. This research contributes to the understanding of the impacts of institutional investment on the housing market, highlighting that REITs do not inherently charge higher rents, but that they employ strategies that may lead to better gains over time. Our findings do, however, suggest a correlation between gentrification and REIT investment and emphasize the need for further study on the potential impacts of such investments in neighbourhoods undergoing such change and on the residents that live there.

The findings in this work help inform the discussion around the role that institutional investors have in the housing system. Large institutional investors bring significant capital to bear that helps maintain aging infrastructure and secure necessary financing for ongoing development in the purpose-built rental markets, making them an important part of the solution for Canada's future housing system. Understanding the impacts of such investments on rent prices and identifying the ways such forms of investment can have unintended consequences allows for the development of appropriate policy to mitigate effects, ensuring that the housing supply existing stock are maintained.

Résumé

Cette étude examine la dynamique du marché locatif de Montréal en se concentrant particulièrement sur les différences entre les loyers des logements appartenant aux fiducies de placement immobilier (FPI) et ceux des logements appartenant à d'autres types de propriétaires. Les analyses révèlent que les logements appartenant aux FPI ont des loyers plus élevés, et qu'à Montréal, l'écart atteint les 25 %. Cependant, l'utilisation d'une approche fondée sur un modèle à effets mixtes nous permet de constater que cet écart disparaît lorsqu'on tient compte des variations géographiques, des investissements stratégiques et des caractéristiques opérationnelles (les investissements en capital et l'inclusion des services publics dans les loyers).

Nous constatons que les logements appartenant aux FPI sont souvent concentrés dans des quartiers précis qui semblent faire l'objet d'une sélection stratégique. Nous montrons qu'à Montréal, les FPI, lorsqu'elles cherchent à acquérir des propriétés, visent surtout des quartiers montrant des signes précoces de changements démographiques indiquant l'embourgeoisement, et que les propriétés qu'elles détiennent à long terme sont plus susceptibles de se trouver dans des quartiers qui s'embourgeoisent depuis un certain temps. Nos résultats semblent montrer que les FPI évitent les régions où les investissements seraient hautement spéculatifs et attendent plutôt des signes clairs de changements démographiques avant de faire des acquisitions. Cela indique qu'elles ne sont pas des agents responsables de l'embourgeoisement, mais plutôt qu'elles réagissent à l'embourgeoisement lorsqu'il est déjà en cours. Ensemble, les variations géographiques des loyers et les stratégies d'investissement sont responsables de 77,3 % de l'écart entre les loyers moyens des types de propriétaires de notre modèle.

Nous constatons aussi que les différences opérationnelles contribuent aux écarts entre les loyers. À Montréal, 82 % des logements appartenant aux FPI incluent le coût des services publics dans les loyers demandés, contre 20 % des logements appartenant à d'autres types de propriétaires. Cette différence est responsable d'un autre 13,8 % de l'écart entre les loyers moyens. De plus, nous avons constaté que les logements des FPI à Montréal sont plus susceptibles de faire l'objet de rénovations majeures et que les améliorations qui en résultent ont un effet minime sur les loyers. Cela laisse croire que le but des rénovations est plutôt de réduire les coûts opérationnels.

Les résultats indiquent que les loyers plus élevés des logements appartenant aux FPI sont surtout attribuables aux stratégies d'investissement fondées sur des considérations géographiques ainsi qu'aux différences opérationnelles qui donnent lieu à des augmentations de loyer supérieures à la moyenne au fil du temps. Ainsi, les propriétés détenues à long terme par les FPI à Montréal ont tendance à être situées dans des quartiers plus chers que les propriétés appartenant à d'autres propriétaires, ce qui donne l'impression que les FPI exigent intrinsèquement des loyers plus élevés. Nous démontrons que les autres propriétaires qui ont les mêmes comportements que les FPI exigent des loyers statistiquement semblables. Cette recherche nous permet de mieux comprendre les effets des investissements institutionnels sur le marché de l'habitation et montre que les FPI n'exigent pas de manière intrinsèque des loyers plus élevés, mais qu'elles emploient plutôt des stratégies qui pourraient mener à de meilleurs résultats avec le temps. Cependant, nos résultats de recherche laissent entrevoir une corrélation entre l'embourgeoisement et les investissements faits par les FPI, soulignant la nécessité d'approfondir la recherche sur les effets potentiels de ce genre d'investissement sur les quartiers en voie de changement et sur les gens qui y résident.

Nos résultats contribuent à enrichir le débat sur le rôle des investisseurs institutionnels dans le système de logement. Les grands investisseurs institutionnels déploient des investissements importants en capital qui aident à entretenir des infrastructures vieillissantes et à obtenir le financement nécessaire à la construction de logements destinés à la location. Ils joueront alors un rôle important dans l'avenir du système de logement du Canada. Comprendre les conséquences inattendues de leurs investissements et les effets de ces investissements sur les loyers nous permettrait de concevoir des politiques appropriées pour les atténuer et, ainsi, de nous assurer que l'offre de logements et le parc de logements existant sont maintenus.

Introduction

The impact of residential real estate investment trusts (REITs) on the rental market, particularly on rent prices, has long been debated. Much of the literature has focused on the potential negative impacts on rent prices due to large institutional investors. It is argued that the financialization of housing markets has led REITs to prioritize rental properties as financial vehicles, relegating the role of housing as shelter to a secondary concern. Qualitative research has identified potential harm to tenants when REITs seek to maximize returns for investors at the expense of tenants (Aalbers, 2016; August, 2020; Hayes, 2021).

Research into the effects of REITs on rental markets suggests that rents increase significantly following the acquisition of properties (Hayes, 2021). Authors indicate that REITs employ various tactics to improve the financial return of properties, such as vacancy decontrol. This practice allows landlords to increase the rent of a vacant unit by any amount upon turnover in units that were under rent control. Vacancy decontrol is particularly profitable when a property is purchased with a high proportion of existing long-term tenants where recently vacated units can, upon turnover, command significantly higher rents than they currently generate (August & Walks, 2017). This is even more true in neighbourhoods that may be experiencing changes in demand.

Increasing tenant turnover is often coupled with the renovation and repositioning of units, which subsequently raises rents further (August & Walks, 2017; Hayes, 2021). Such capital investments may also justify above-guideline increases (AGIs) in rent for tenants who remain in rent-controlled units if the investments in the properties are significant enough. These practices have been suggested as means through which financialized landlords "squeeze" tenants in rent-controlled units (August, 2020; August & Walks, 2017; Fields, 2015).

This form of carefully considered action is collectively referred to as "predatory equity," a term that gained prominence in New York City when community organizations identified it as a crisis exacerbated by weakened rent control laws and a tight rental market (Fields, 2015). These activities, often referred to as "repositioning strategies," are commonly proposed as the driving force behind changes in rent prices associated with institutional investors. Cases of predatory equity identified in the literature highlight a common theme in the existing body of research exploring the impacts of REITs. These impacts are often determined using case studies involving specific properties, neighbourhoods, and property owners, such as those in New York or the Herongate community in Ottawa (Crosby, 2020; Fields, 2015).

Much of the existing research on the impact of institutional investment in rental markets has been qualitative in nature. While these studies, based on case studies and interviews, provide essential insights into the direct effects such investment can have on tenants' lives, they lack the ability to demonstrate the presence or absence of system impacts in this space or adequately delineate causal relationships. While studying particularly egregious cases of predatory equity is essential for ensuring we fully and adequately understand how institutional investment may go wrong, these cases cannot be considered as representative of the system effects of investments in the housing system where inappropriate activities took place. Moreover, it is nearly impossible to clearly indicate that such behaviors are specific to REITs and are not also employed, albeit on a much smaller scale, by smaller independent investors and even "mom and pop" landlords. Determining this would require a systemic look at rent prices in REIT-owned units combined with a direct comparison between institutional investors and their peers.

In this regard, the literature is comparatively limited, and findings have been highly varied. Using a series of hedonic pricing models (Hardin et al., 2009) found that REIT property owners demonstrate higher operational performance and produce higher effective rents than others owner types in Atlanta. This was true even after controlling for operational scale, branding, and characteristics of the properties themselves; however, the controls for geographic variation were somewhat limited. The authors suggest that the primary factors driving these differences are efficiencies generated in the management of properties and a more sophisticated understanding of market conditions that translate into more timely transition to market rent and a better understanding of the state of local housing supply (Hardin et al., 2009). These findings indicate that increased revenue in REIT-owned properties is not generated only through increasing rents but can also come through decreased operating costs and improved efficiency, which can provide benefits to both tenants and owners over time.

Some limited work has been done comparing property performance between REIT and non-REIT owners as well as the potential impacts of market power. A study of REIT-owned and non-REIT-owned hotels in San Antonio found that, when controlling for local geography and the market segments of properties purchased by REITs, there was no statistical difference in revenue per available room (REVPAR) in REIT-owned and non-REIT-owned properties, despite the statistically higher REVPAR between the two in the market as a whole (Brady & Conlin, 2004). The authors indicate that REIT investments were primarily in the mid and high-end market segments; both of which were shown to have achieved higher-than-average gains over the period of the study, suggesting that investment strategy may be playing a significant role in the observed outcomes and needs to be considered (Brady & Conlin, 2004). While the markets are different (hotel vs. housing), the relevance of this study remains, as it speaks to the sophistication of REIT investment strategy, which is likely applied regardless of the sector a REIT chooses to invest its capital in.

Others still have found that market power may play a role in observed differences in REIT rent prices. Gurun et al. (2022) found that post-merger gains in scale and market share result in moderate rent increases, suggesting that institutional landlords can leverage local market power to raise listed prices immediately after mergers. Utilizing property-level regressions with a "difference-in-difference" specification to evaluate the interaction between neighbourhoods both pre- and post-merger over time, they found that significant effects on rent emerge in cases where pre-merger portfolios from the two merging firms overlap with each other. This suggests that the cumulative localized market power that resulted from the merger may have provided the new entity enough leverage on localized rent prices and does suggest a potential means by which REITs can directly impact rent prices (Gurun et al. 2022).

Evidence for such spatial clustering is consistently reported throughout the literature, including in the Canadian context. In Montréal, St-Hilaire et al. (2023) identified signs of spatial clustering of financialized rental housing ownership in Montréal that was coupled with varying neighbourhood composition (St-Hilaire, Brunila, & Wachsmuth, 2023). Chilton et al (2018) identified similar patterns in the single-family REIT (SFR) market in Nashville as well, where they found SFR properties tend to cluster in distinct areas, particularly in neighbourhoods with newer homes, higher levels of educational attainment, and middle to upper-middle incomes. Hardin et al. (2009) also find spatial clustering in their models, with purchases strategically located to optimize performance, and clustering influenced by factors such as property age and amenities. The consistency of clustering behavior suggests that at least part of the investment strategies employed by REITs are related to geographic location and that any analysis of the impacts of REITs on rents must carefully consider the effects of local geography.

In summary, assessing the systemic effect of REITs on rent prices requires a complete and comprehensive approach. The literature shows that, in the worst-case scenarios, REITs have the potential to negatively impact tenants through vacancy decontrol and large-scale capital investment that may "reposition" previously affordable units out of the affordable range. This level of investment may also potentially encourage or facilitate the process of gentrification, as it increases the price of properties over time. However, there is little to no evidence to suggest that such outcomes are specifically attributable to REIT investment. Findings do indicate that REITs may leverage localized market power to increase rents, but generally do not generate excessively high revenue per unit relative to peers. REITs may also generate revenue through improved operating efficiency as opposed to increased rents. Consistent signs of spatial clustering further emphasize the importance of geography in REIT investments and may hint at underlying strategic purchasing decisions. This report seeks to expand on the findings of research done in the area by exploring the impact of REIT properties on rent prices in the Canadian city of Montréal. More specifically, we assess if purpose-built rental units owned by REITs charge higher rents than those owned by non-REIT property owners. The goal is to identify how REITs have impacted rent prices while controlling for potentially confounding factors that may produce rent difference between the two groups.

Data and Methods

Identifying Property Ownership

In this project, we examine whether rent price of purpose-built rental units varies among different types of property owners. We identify four groups of owners: REITs, corporations, individuals, and partnerships. Natually, different property owners in the same market are expected to compete with each other, and for this reason differences in rents are expected to reflect specific attributes of the rental units, buildings themselves that differentiate one property from another (building quality, management, location, etc.). The literature also makes it clear that it is important to account for the effects of local geography (including the effects of local amenities and natural market segmentation) and characteristics of the property owners themselves as well, such as investment strategies and potential operational differences, as these may significantly impact rent prices.

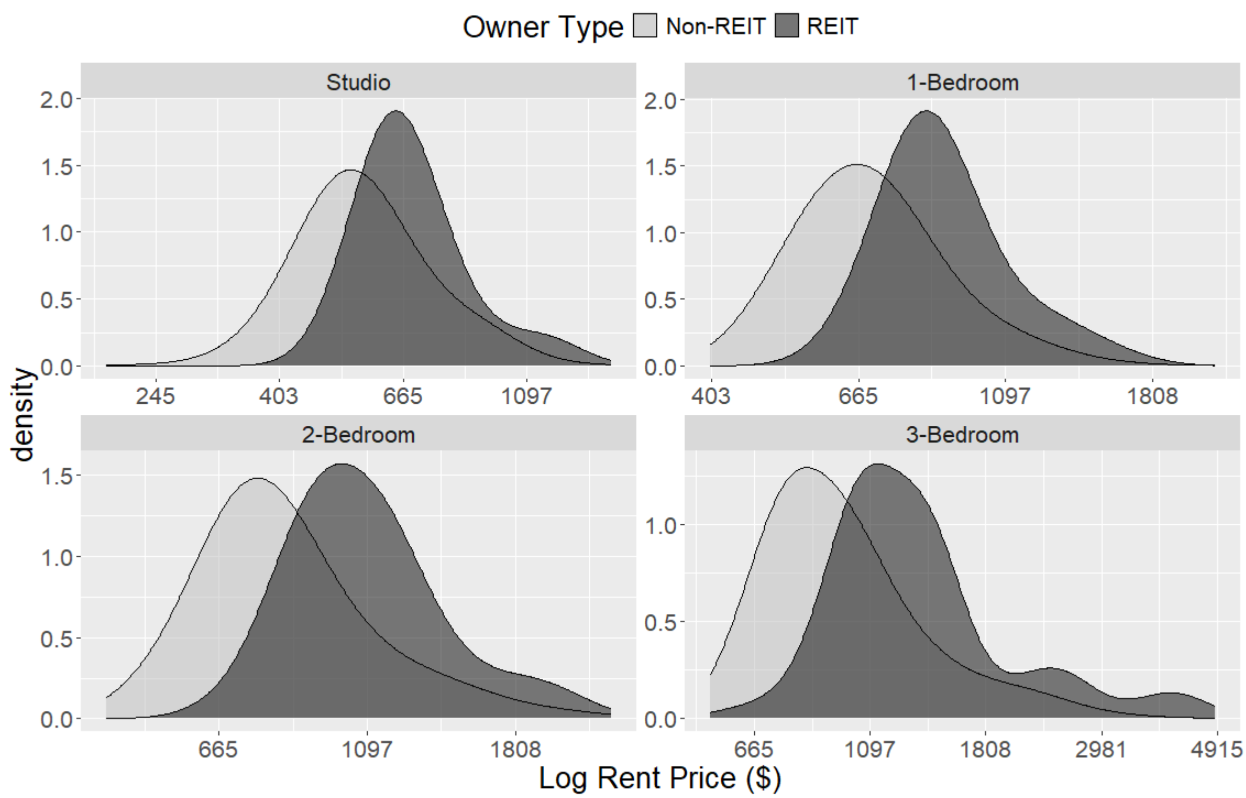

Figure 1: Rent price by bedroom size and owner type in Montreal between 2015-2019

We use data from the Rental Market Survey (RMS) and supplement it with ownership information from the land registry and a rental property transaction database. Our sample contains annual observations on purpose-built rental properties in the Montréal census metropolitan area (CMA) for the period from 2015 to 2019. Overall, we find that REITs have a relatively small market share in the Montréal CMA in terms of both the number of buildings and the number of units. During our sample period, the number of units owned by REITs increased from about 4%, in 2010, to over 6%, in 2019. Our initial explorations of difference in rent prices among REIT and Non-REIT properties suggest the presence of a rent premium between REIT and Non-REIT properties that persists through bedroom size of on average approximately 25% suggesting that a significant rent differential does indeed exist between rental units owned by REITs vs Non-REIT in Montreal (Figure 1). The purpose of this paper is to explore potential causal factors that may explain this observed difference in rent prices, and identify the degree with which they can be specifically attributed to owner type. There may be many possible causes for such a rent difference. For example, we find that buildings owned by REITs tend to own larger properties, with more floors and units and also tend toward specific neighbourhoods. To fully account for the differences in rent between these owner types and accommodate their potential effects on rent price is essential, as different preferences in our chasing (such as building age, location, state-of-repair) can all play major roles in the final prices asked by each owner type. What is clear from the literature is that the effects of REIT investment on local markets appears to be highly varied and market dependent. Overall findings suggest that controlling for individual property characteristics, as well as geographic and operational components, is essential.

Our analysis is focused exclusively on the purpose-built rental market, where in-property amenities are generally minimal. Thus, our analysis includes variables that describe characteristics of each property that may influence its rent price in the market. Another key consideration is to provide a means for controlling potential confounding effects that may affect gains in effective rent over time. These could include property-specific characteristics, but also operational differences, differential investment levels and even variations in investment strategy which may result in higher rent gains over time. The next section of the paper will discuss these potential variables in detail.

Variable Groups

Property Characteristics

Given the nature of purpose-built rental properties in Canada and the general lack of property-specific amenities, our analysis is limited to those characteristics that are most likely to have a direct impact on the perceived value of the property and translate into rent. We include the age of the structure, the size of the property, the proportional annual turnover rates, the number of bedrooms in the unit, whether the property was sold during the period of our study, and, of course, the owner type of the property. Owner types were aggregated into REITs and non-REITs.

Owner Investment

Controlling for owner investment in the property is essential, as differential rates of property investment can translate directly into changes in rent prices. Capital investments such as renovations can significantly impact rent prices, and as identified in the literature, make up part of the REIT investment strategy of “repositioning” a property. Property-level data regarding capital investment was also collected in the form of building permits. Publicly available building permit data was collected through the City of Montréal, and these data were linked by address to our dataset. This allowed for a time-based count of the number of building permits granted to a property in a year for each year of our dataset (2015–2019). Building permit data will deliver insight into large-scale renovations and can act as a general proxy for willingness to invest in the maintenance/improvement in a property. It is, however, an incomplete view of capital investment, as unit-level renovations do not require building permits but almost certainly represent significant investments that likely translate into changes in rent price. Unfortunately, we could not identify a way to reliably identify unit-level renovations in the data we have.

Table 1: Building permits granted by owner type.

	No
Corporations	94.28%
Investor-Owners/Sole Proprietorship	98.79%
Partnerships	99.58%
REITs	90.38%

There is, however, evidence of significant differences in property investments according to our building permit data. Table 1 shows that REITs are significantly more likely to have been granted building permits in our data, which may translate to significant differences in rent prices.

Operation Differences

An important observation identified in initial exploratory analysis of our data was that REIT property owners in Montréal were significantly more likely to include various utilities in the cost of their rent. This is an operation difference that can significantly affect reported rent prices, as REITs are significantly more likely to have the costs included in their reported rent in Montréal (Figure 2). The RMS reports such inclusions as three dummy variables for specific utilities but does not collect direct information on the prices associated with each of these components. While it is possible to include these dummy variables directly in the model, significant multicollinearity between the dummies makes it difficult to assess the marginal effect of each, and different combinations of utility inclusions can have different estimated impacts and errors. To address this, we chose to excise the effect of utility prices directly from the reported rent price using the following process:

$$\mathcal{R} = \begin{cases} r - \mu * \nu_i & \text{if } i = 1 \\ r & \text{otherwise} \end{cases}$$

where: $r =$ unadjusted rent;
$\mu =$ average utility cost in Montréal; and
$\nu_i =$ proportional contribution of specific utility

In this approach, we extract the average inflation-adjusted utility cost in Montréal for each specific flagged component from posted rent price. The advantage of this approach is that error is constant and equally applied across all properties, regardless of the combination of utilities included in rents. The result is a new dependent variable we call "utility-adjusted rent."

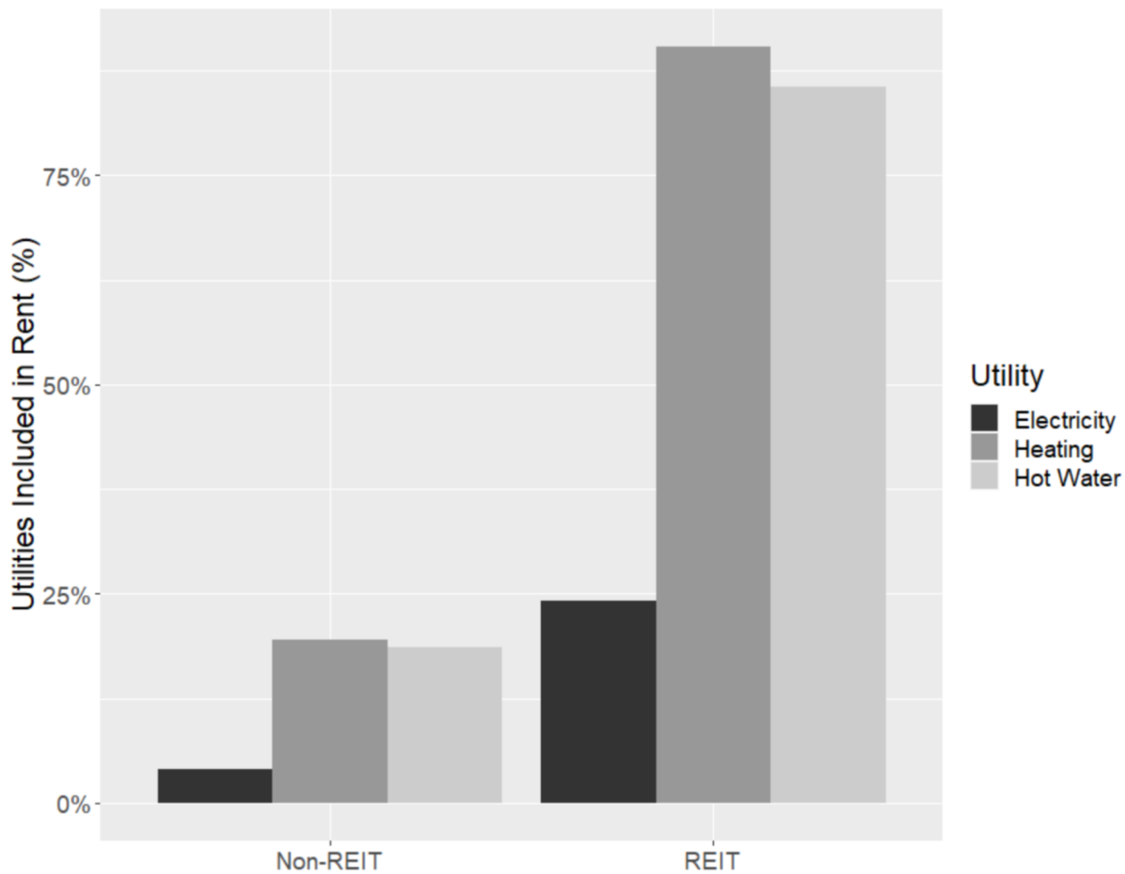

Figure 2: Variance in REIT and non-REIT utility charges.

Investment Strategy

The literature also suggest that REIT operational and investment strategies may also play a role in observed differences in rent prices. It is reasonable to believe that—owing to their financial nature—REITs may employ investment strategies similar to those employed in stock market purchasing, where informed speculation is used to pre-empt stock movements. In the stock market, informed speculation involves making educated guesses about stock price movements based on a combination of available data, expert analysis, and market trends. This process requires analyzing financial reports, economic indicators, and other relevant information to predict future stock performance and make strategic investment decisions. Logically deducing how to translate such a strategy into rental property purchasing can give insight into the sort of variables we may use to better understand the investment strategies being employed by REITs. The physical characteristics of a property, such as its current state of repair or building style, have simple relationships with time with predictable trajectories, making these characteristics of little value for speculation.

The same can be said for a property's physical location, as it is fixed and cannot change over time. The characteristics of the surrounding neighbourhood however *are* highly variable and can change considerably over time, making neighbourhood characteristics a potentially viable avenue for speculative decision making. For example, Neighbourhoods can experience changes in investment and infrastructure such as the construction of new transit line, or the collapse of key industries which can directly or indirectly effect demand and drive demographic change over time. The process of gentrification is the prototypical example of this process, where changes in the demographics of a neighbourhood can have significant impacts on the land value, rent prices, and demand for housing in a neighbourhood. A sophisticated investor with insight into the trends of gentrification and sufficient capital for investment could produce greater medium-to-long-term rent gains by purchasing in neighbourhoods showing early signs of gentrification. We hypothesize that this may present a path for informed speculation that may be employed by REITs and, if done accurately, may produce marginally higher rent prices than those owner types that do not participate in such an investment strategy.

Geography

Any attempt to isolate the effects of ownership type will have to account for the potentially confounding effects of geography on observed prices. Literature exploring the relationship between land price, rents and the local environment is rich and clearly identifies the importance of geographic factors such as the relative location of a property, the socioeconomic characteristics of a neighbourhood, and the availability of local amenities in the determination of land value and rent prices (Alouy 2015; Eli et al., 2018; Shiliang et al., 2021). Controlling for these effects in our analysis is especially important given that literature identifies a trend of geographic clustering in REIT purchasing behavior, which would serve to further amplify the confounding effects of geography, particularly given that our non-REIT properties have an explicitly un-clustered distribution.

Controlling for these effects can be achieved by adding covariates describing the presence and access to such geographic characteristics in our models. However, doing so comprehensively is extremely difficult, given the depth and breadth of geographic features that can potentially impact rent prices. Alternatively, we may address the confounding effects of geography through the use of a different model structure.

When a landlord determines the rent price for a unit, they do so in such a manner that naturally accounts for many factors, including the geographic considerations discussed above. Rental listings frequently advertise features such as proximity to transit, grocery stores, schools, etc., as features that increase the appeal (and thus the rent) of a unit. Economists refer to this process as "price discovery," and the result is that rent price can effectively be considered a manifest variable, where the latent characteristics of the local geography play a role in the determination of rent price and are directly *incorporated* into the variance of local rent prices. Since these are neighbourhood-specific characteristics, it is reasonable to assume that all properties in the same neighbourhood will be subject to the same geographic effects. This feature of rent price allows us to control for the effects of geography indirectly by ensuring that rent comparisons are limited to those properties in the same neighbourhood. We can do this through the use of a mixed-effects model.

Table 2: Variables used in the analysis.

Variable Group	Variable	Model(s)
Property characteristics	Property age (RMS)	1,2,3,4,5
	Number of bedrooms (RMS)	1,2,3,4,5
	Tenant turnover (RMS)	1,2,3,4,5
	Number of floors (RMS)	1,2,3,4,5
	Building purchased during study period	1,2,3,4,5
	Owner type	1,2,3,4,5

	First two digits of forward sortation area	1
Owner investment	Building permits issued (City of Montréal)	4,5
Operational differences	Utility charges (RMS)	3,4,5
Demographics (gentrification index, investment strategy)	Race (2016 & 2021 censuses)	5
	Median income (2016 & 2021 censuses)	5
	Median rent (2016 & 2021 censuses)	5
	Census tract	5
	Population age 20–34 (2016 & 2021 censuses)	5

Model Specifications

A mixed-effects model is a model that includes both fixed and random effects. This form of model specification allows the inclusion of both fixed and random effects as part of its specification. In this case, census tracts are used as a random intercept in our model, allowing for unobserved effects on rent price that are attributed to geography to be controlled for by varying the model intercept to include the average local rent price for each census tract in the city. This allows us to control for variance in rent price associated with characteristics of the local census tract without having to explain the source of this variance. All remaining variables are included in the model as fixed effects.

Analysis and Results

Exploring Gentrification Potential and Investment Strategy

To study gentrification and its possible use as an investment strategy by real estate investors, we employ a small area index of gentrification used by (Johnson et al., 2022) to identify the presence of gentrification in a given census tract. The index uses the changes in five specific sociodemographic variables across two-census periods and, through the use of principal component analysis, allows for the disentanglement of components that best reflect those of gentrification.

PCA is a statistical technique that transforms the input data into a set of n completely uncorrelated (orthogonal) vectors called principal components based on the covariance matrix of the original data (where n = the number of variables in the original data). The resulting set of components represent an ordered set of vectors of maximized variance, with the first component describing the greatest overall amount of variance and subsequent components progressively less. Component loadings are then generated, which are essentially the correlation of each component with the scaled units of the original variables. These loadings allow us to interpret how the components relate back to our variables and allow for a more direct interpretation of the variance being described by each component. The loadings can also be used as weights to calculate scores for individual census tracts, which allows us to evaluate the magnitude and direction of a specific tract's relationship with each component. In this way, we can produce an objective index of gentrification by isolating those components that best reflect the changes we would expect with gentrification and, using the magnitudes of the scores, evaluate the strength of the effects between the last two censuses. For more details on the methods, please see the appendix.

Spatial Smoothing

Results from our PCA can produce unrealistically sharp changes in component scores between neighbouring census tracts. These sharp changes between neighbouring units are unlikely to reflect the reality on the ground where, in the absence of hard physical boundaries, such as rivers, changes are likely to be gradual in nature and thus correlated with distance. This effect is largely due to the modifiable areal unit problem (MAUP), an unavoidable artifact that arises from data sampling and aggregation using arbitrarily modifiable administrative boundaries such as census tracts. To address this, a Bayesian conditional autoregressive (CAR) model is used to smooth neighbourhood scores based on empirically estimated spatial correlations between neighbouring census tracts. The result of this step is a spatially smoothed estimate for each of our scores for each census tract. For more details on the methods, please see the appendix.

Interpreting the Components

Interpretation of component loadings is facilitated by the visual inspection of the correlative structure of our component loadings, followed by the logical interpretation of each component's correlations with the input variables. Figure 3 shows the component loadings for each of the original variables used in our PCA.

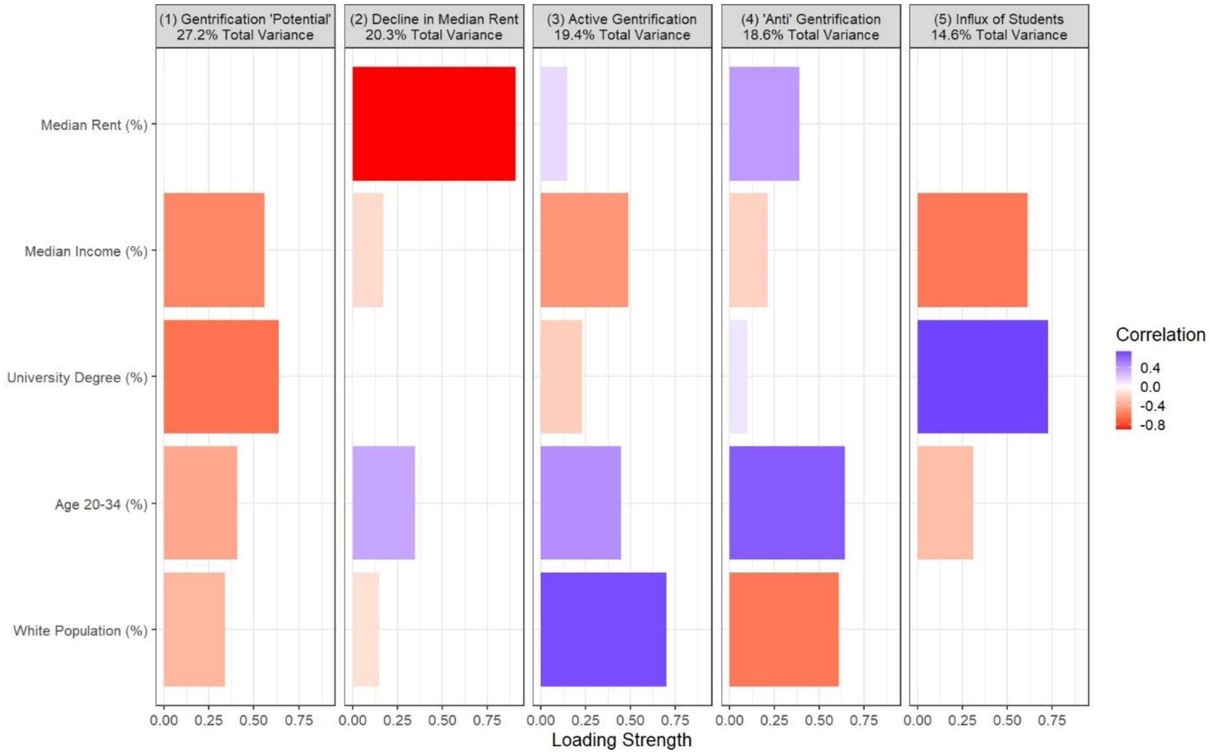

Figure 3: This plot visualizes the PCA loadings as a measure of correlation. Red bars indicate negative correlation and blue bars indicate positive, while the size of the bar indicates magnitude. The header contains the total variance explained by each component.

Component 1 (Gentrification Potential) – Component 1 describes the greatest portion of the variance in our data and shows a negative correlation with four of the five variables in our dataset. Interpreting this at an individual census tract level suggests that, as the score for this component increases, education, income, proportion of people aged 20–34 and proportion of white people declines. All of these variables taken together are all hallmark characteristics of gentrification, suggesting that, as a census tract's component 1 score increases, so does its "potential" as a neighbourhood that may experience gentrification, as it would suggest that the tract's income and education levels have dropped, ethnic diversity has increased and its young adult population has declined.

Component 2 (Decline in Median Rent) – This component was primarily negatively correlated with median rent and had a slight positive correlation with young population; as such, we interpreted this factor as describing a decline in median rent.

Component 3 (Active Gentrification) – We interpret component 3 as "active gentrification," as it demonstrates a strong positive correlation with young population, white population and increases in median rent. However, it does show a negative correlation with income and education levels, suggesting that this component's connection to gentrification is an imperfect one.

Component 4 (Anti-Gentrification) – Component 4 shows striking similarity to "Active Gentrification," with the exception of a sign reversal in the ethnicity variable. Given that components are orthogonal and, as such, are completely uncorrelated, the convergence of these two components suggests that these two forms demographic change that mirror the signs of gentrification are present in Montréal and are divided primarily by their ethnicity components. Given that it is a slight deviation from otherwise typical gentrification, we label this component "Anti-Gentrification."

Component 5 (Influx of Students) – Finally, the significant correlation of an increasing student population and declining income suggests that component 5 measures the number of students moving into an area.

Identifying Differences in Investment Strategy

Intuitively, the interaction between gentrification potential and active gentrification provides the most reasonable means for identifying speculative activity. Logically, the interaction of these two components in particular provides a conceptual framework for evaluating speculative potential. Plotting the scores for these two components allows us to demonstrate how the interaction of these two effects can be used to elucidate the potential strategies that may be employed by investors as part of their purchasing (Figure 4). Segmenting the plot into four quadrants allows us to differentiate between which tracts may be the least/most valuable from a speculative investment viewpoint and then approximate REIT strategy by exploring those tracts in which they have chosen to purchase properties. The list below describes the characteristics of each quadrant and how they would hypothetically relate to speculative value.

High gentrification activity and lower potential (upper left of Figure 3):

- Likely areas that have experienced gentrification for a longer time.
- Over time, potential declines as neighbourhood demographics change, resulting in decline in potential, but present activity.
- These areas would have low speculative value, as much of the possible rent price increase has likely already been realized.

High potential and high activity (upper right of Figure 3):

- Likely areas that have recently begun showing signs of gentrification.
- High activity level, but potential has not yet dropped, indicating that gentrification is likely in the early stages.
- These areas would be of high speculative value, as signs of gentrification are just starting, and there is potential for above-average returns over time. Ideal tracts for an agent who could not "seed" gentrification.

Low activity but high potential (bottom right of Figure 3):

- High potential for gentrification, but little evidence of active gentrification.
- Extremely high speculative value for an agent who could "seed" gentrification, as these tracts would allow for the maximum possible return.

Low potential and low activity (bottom left of figure 3):

- Little potential for gentrification and no signs of it actively occurring.
- These areas would be of the least interest to speculators looking for gentrification.

Applying this framework to REIT and non-REIT properties and looking for significant differences in property locations allows for insights into the different purchasing strategies employed by owner types. Including these variables in our model may provide insights into how these differences in strategy may translate into difference in rent prices. Visual inspection of Figure 4 already shows REIT properties significantly lean toward higher active gentrification and toward the recently gentrifying quadrant of the graph.

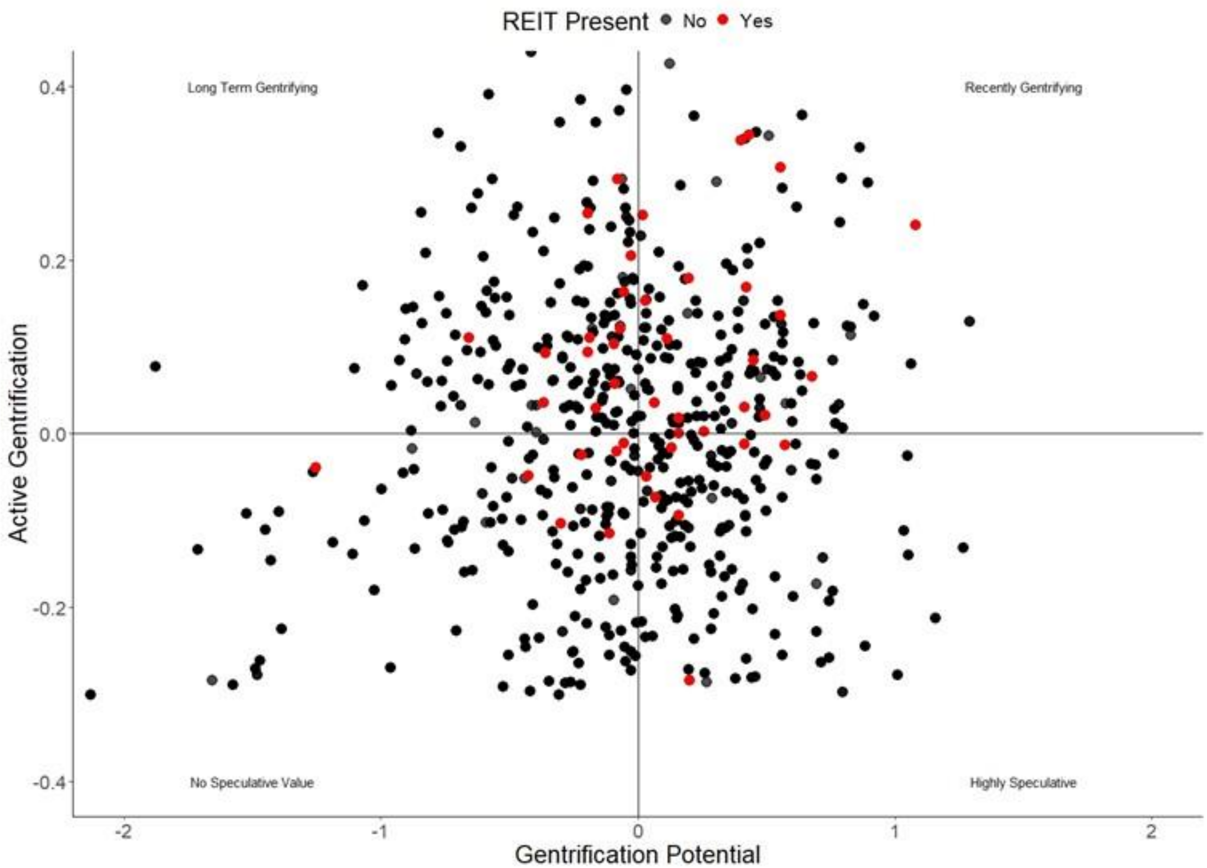

Figure 4: Scatter plot of showing census tracts by their gentrification potential and active gentrification scores. Census tracts with REIT presence are coloured red, while those without are coloured black.

Differences in Purchasing Strategy

To facilitate this analysis, the scores for each component are binned into quintiles. In this manner, the highest quantile (> 80th percentile) is labelled "very high" and the lowest quantile (< 20th percentile) is labelled "very low" according to how they affirm the presence of the component. In this case, we justify the binning of scores not only because they facilitate interpretation, but also because such bins are likely to better reflect the way such investment decisions would be made in the real world. It is probable that many of the decisions about neighbourhoods REITs choose to purchase in are being informed not only analytically, but also by real estate professionals who have intuitive understandings of changes taking place in their respective territories. In this sense, decision makers may indirectly intuit the effects of gentrification through less tangible factors such as word of mouth, experience and historic precedence. These lend themselves better to a binned decision-making process as opposed to a continuous scale, which is much less intuitive.

Identification of variability in investment strategy was determined by generating crosstabulations of ownership type and the quintiles for each of our five components. A third dimension was added, exploring whether properties were recent acquisitions or "long-term" holdings based on whether they were purchased during the five-year period of our study. This dimension can provide insight into differences in the neighbourhood characteristics in recent purchases—which are more likely to reflect current speculation—relative to properties that have been held—which are more likely to have *realized* the results of past speculation. Simple chi-square tests were performed to identify significant differences between the two groups in each case.

The results strongly indicate that there are significantly different investment strategies being employed by REITs relative to non-REIT owners. REIT acquisitions are significantly more likely to be in areas of high gentrification potential, while non-REIT owners show no insight into gentrification potential at all ($P < .001$) (Figure 5).

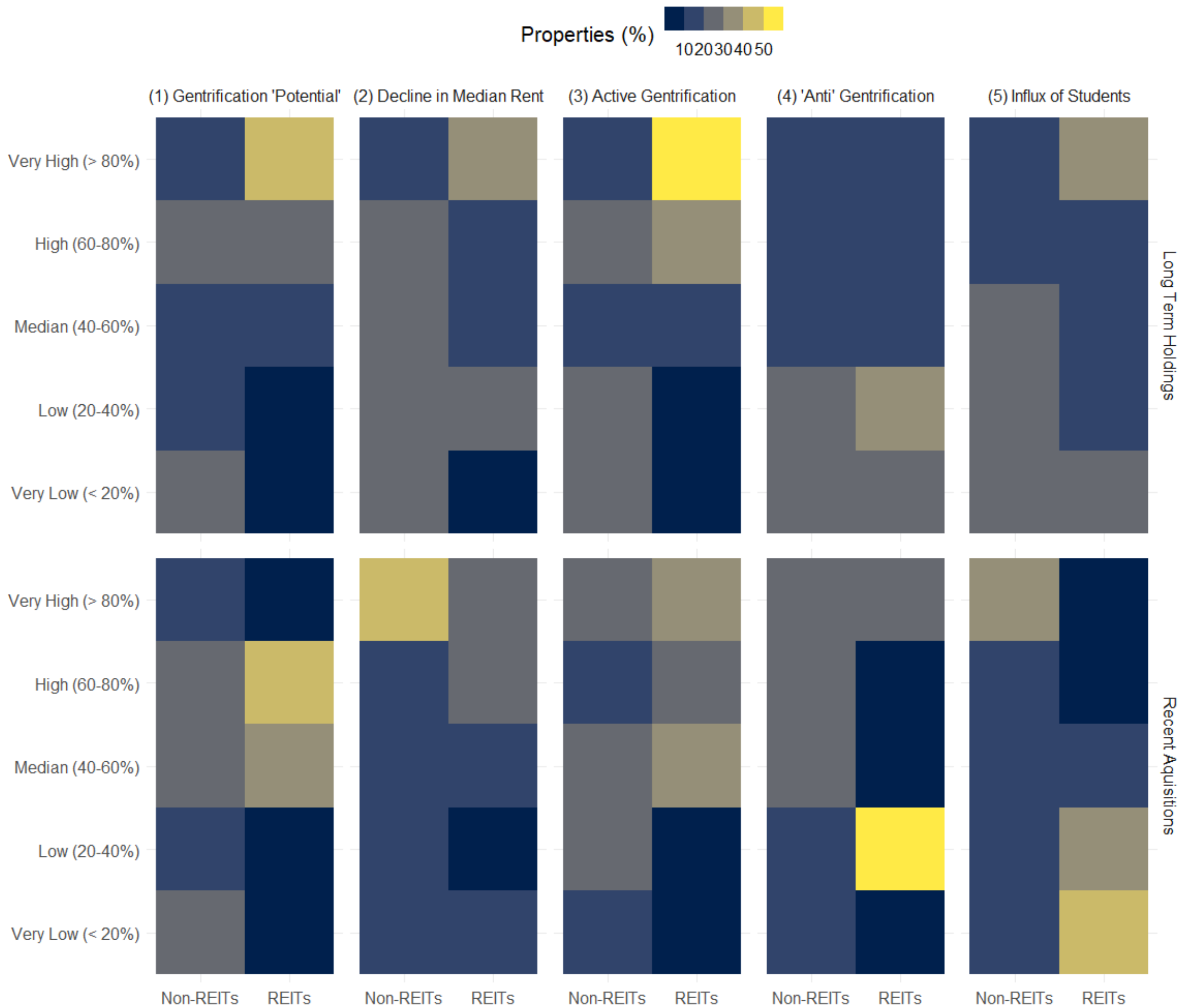

Figure 5: Differential investment strategies and PCA components. Colours reference the proportion of properties.

REIT acquisitions, and specifically their long-term holdings, are also significantly more likely to be showing signs of active gentrification than non-REIT purchases ($P < .001$). This effect appears to translate quite strongly into long-term holdings, where nearly 90% are in areas experiencing active gentrification – well over double the proportion of non-REIT properties ($P < .001$). This may indicate that recent speculative purchases are more likely to translate into actualized outcomes (Figure 5).

Recent acquisitions for non-REIT owners were heavily focused in areas where census tracts saw declines in median rent, while REIT acquisitions show a slight leaning in the opposite direction, with median rents rising (*P* <.001). This may indicate that non-REIT owners may be seeking better immediate deals in neighbourhoods where prices may be dropping. Conversely, recent acquisitions for REITs appear to focus heavily on those areas where rent prices are showing signs of rising; a potential indication of early gentrification activity (Figure 5).

Non-REIT owners' acquisitions are also more likely to be in areas showing an influx of students which, coupled with these owners' inclination to purchase in areas with declining rent prices, may indicate that their primary strategy is focused on student housing. Again, REITs' activity is the exact opposite of that of non-REIT owners, in that REITs actively avoid areas with increasing student populations (*P* <.001) (Figure 5). This result is somewhat surprising, given that students are a highly mobile/seasonal tenant base, and frequent turnover would ensure that units are reset to market value on a regular basis, something much of the literature suggests is highly important to REITs. While we cannot say for certain why REITs seem to be avoiding student housing, it is possible that REITs are instead choosing investments with more stable cashflows at the expense of reduced overall revenue over time. The high turnover and seasonality of student housing may increase the volatility of cashflows over the year, making it more difficult for REITs to leverage cashflow for financing and possibly creating a source of concern from shareholders. Regardless of why this is the case, this finding suggests that the relationship between REITs and vacancy decontrol is more complex than much of the literature suggests and may not be a primary goal of REITs when they invest in a property.

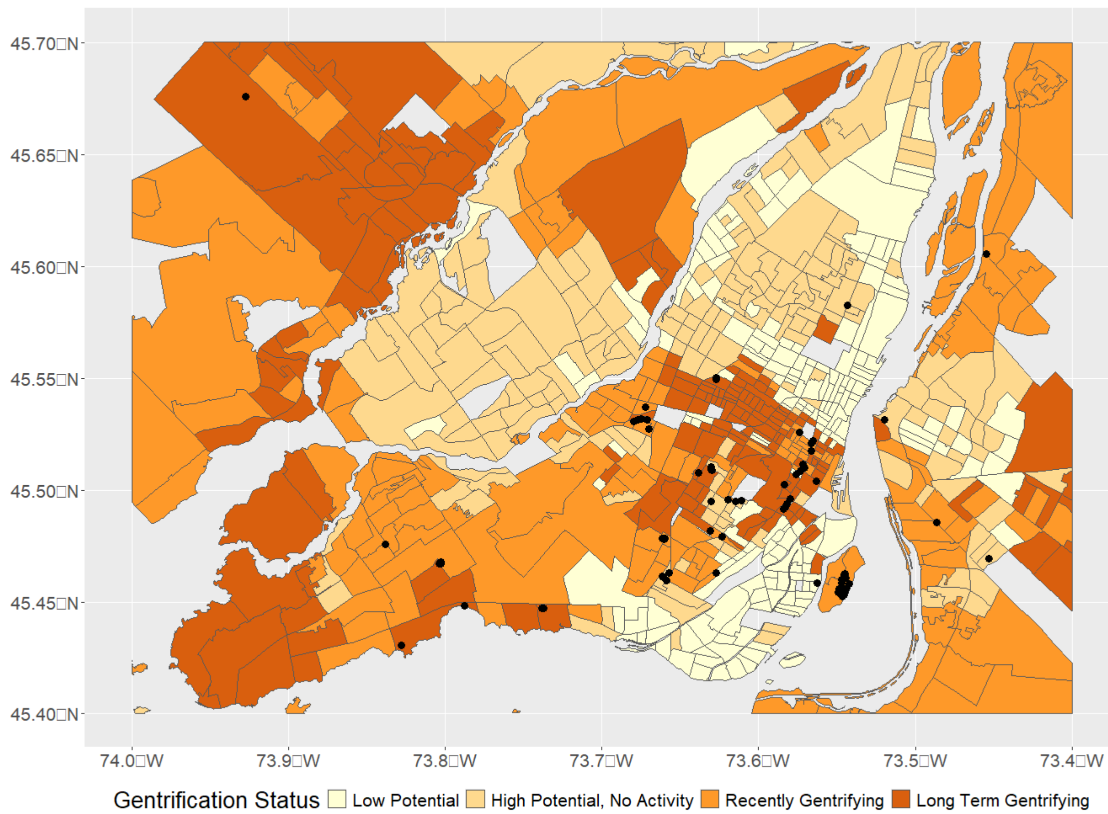

Figure 6: Map showing the estimated gentrification potential/activity of census tracts in Montreal. Note the spatial clustering and neighbourhood selection patterns of REIT properties

Overall, these results strongly indicate that REITs' investment strategies are significantly different than those of non-REIT owners. Mapping the segments of our index with the positions of REIT properties identified in our data shows that the process of gentrification is – intentionally or unintentionally – playing a role of some sort in the selection of properties purchased by REITs given the clear preference for being in or directly adjacent to neighbourhoods showing signs of activity. Given the link between gentrification and changing rent prices over time, it is possible that such a strategy could translate to increased overall gains in rent over time.

Correlations between rising rents and recent acquisitions by REITs do raise questions about the direction of causality. Do increases in REIT acquisition within a census tract raise prices, or are price increases drawing REIT investment? To a limited extent, we can speak to this by considering how REIT purchases in other areas relate to those areas showing signs of recent gentrification. Specifically, those areas with high potential for gentrification but low signs of activity. From an investment perspective, the ideal space for acquisition would be properties in areas of high potential for gentrification, but very low signs of activity. Investing in these areas would allow REITs to maximize their return, as they would realize the most gain as rent prices increase, but would also require that they actively "kickstart" the process of gentrification. What we find when looking at Figure 3 is that, rather than being drawn to such areas, REITs appear to be quite averse to them. This finding provides some insight into the causal order, as it would appear that REITs wait for signs of active gentrification (including increases in rent) before investing. It also suggests that REITs are not likely acting as "seeders" of gentrification but are rather responding to its presence after it begins. In fact, only 11% of REIT properties in our dataset are found in "Highly Speculative" neighbourhoods relative to nearly 27.8% Non-REIT properties. In fact, over 80% of REIT properties identified in our dataset are in a Census Tract showing at least minimal signs of recent or long-term active gentrification (Figure 3).

Modelling Rent Prices

To identify the effects of REIT ownership on unit-level rent prices in the context of the framework of variables established above, we fit a series of five models, including one linear OLS model and four linear mixed-effects models, using log rent price as the dependant variable. We begin with our base model, a standard linear model which provides the foundation for our conditional comparisons and includes our basic property characteristic variables, and the first two digits of the forward sortation area as our geographic variable (2). The purpose of the base model is to identify the effect of REITs on rent prices when controlling only for property characteristics and gross geographic variations. Subsequent models sequentially add individual components, allowing us to identify the effects of specific factors on the differences in REIT and non-REIT rent prices; Model 2 controls for the effect of geography by specifying a random intercept; Model 3 corrects for operational differences by substituting our "utility-adjusted" dependant variable; Model 4 adds our owner investment variable in the form of the number of building permits per year; Model 5 includes our gentrification variables to explore the effects of investment strategy. This includes a three-way interaction between owner type and each of the investment strategy variables so as to account for the observation that different owner types apply the strategies in different ways identified in the previous section. REIT purchasing behavior is highly averse to very low scores in active gentrification, with significantly lower than expected properties in the highly speculative and no speculative value quadrants of the index (Table). Details of the methods used can be found in the appendix.

Table 3: Proportion of total units by owner type and their quadrant in the gentrification index plot. Non-REIT property owners have a near uniform distribution in their holdings, while REITs show a clear tendency towards census tracts showing signs of gentrification and an aversion for highly speculative neighbourhoods.

	Highly Speculative	No Speculative Value	Long-Term Gentrifying	Recently Gentrifying
Non-REIT	27.8%	22.0%	27.5%	22.8%
REIT	11.5%	8.2%	20.7%	59.5%

Modelling Results

To model the effects of these variables, we fit a total of five models, each consecutively incorporating a new component discussed above. The composition of these models can be seen in Table, and the final results can be found in Table 4. Significance estimation is a known weak point in mixed-effects modelling, as there is considerable debate over how to identify the appropriate degrees of freedom in the model. The Kenward-Roger approximation is used to estimate the degrees of freedom needed to make significance estimates for our fixed effects. The use of a continuous response variable and the relatively large sample size of our study increased our confidence in the overall estimates using this relatively conservative approach; however, significance should always be taken with caution in the analysis of such models.

In addition to variable significance, an important consideration in assessing model results in this analysis will be in conditional estimation. Given the purpose of this study is to identify whether REIT owners charge higher rent prices while controlling for the presence of confounding factors, a conditional approach to model estimation is better suited, as we are looking not for population-level approximation, but instead estimates of the effects at the individual property level. This approach is especially important in our case, as we have clearly identified significant differences in the strategies employed by REITs and non-REIT owners. Conditional estimates are generated for each model and can be used to assess the overall explanatory power of each added component in describing the observed difference in rent price (Figure 7).

Base Model

As anticipated, the effects of basic property characteristics are consistently significant. Property age, turnover rate, and number of bedrooms have consistent positive effects on rent price across all five models. The effect of turnover increases very slightly once we control for geographic variations, but remains mostly consistent. Geographic variation in our base model was estimated using forward sortation areas (FSAs). Estimates were calculated using effect coding as opposed to dummy coding for contrasts, as comparison to the grand mean (average rent) is more informative than comparison to a reference location. The results show clear evidence for spatial variation in rent price relative to the city average, with five of the 14 two-digit FSAs demonstrating significantly higher-than-average rents. The large areas covered by two-digit FSAs likely smooth variance, suggesting that the effects are likely even larger in reality. The first two digits of the FSA are simply too large to allow us to properly accommodate for neighbourhood-specific variances in rent, particularly in a dense urban area where rent may vary considerably between neighbourhoods that are geographically not very distant. In our base model, the effect of REIT ownership is highly significant and very large, suggesting that REIT ownership carries with it a significant rent premium. This result suggests that, marginally, REITs have higher rent prices than non-REIT owners and that property characteristics play a very small role in determining this outcome. Figure 7 shows that conditional estimates are substantial as well, verifying that individual property characteristics can do little to describe the observed variance in rent.

Geography Control Model

Our second model introduces our random effect controlling for geography, shifting our model structure to that of a mixed-effects model. Removing the two-digit FSA and replacing it with a random intercept allows us to drop the geographic aggregation level down to the census tract, a geographic level much more in line with the sorts of amenities and characteristics that may influence rent prices. Conditional R^2 estimates for the linear mixed-effects model – refer to the variance described by the random and fixed effects of the model combined – are in line with that of the base model. Marginal R^2 (the component of variance explained by our fixed effects) is estimated at 0.077, suggesting that geography accounts for nearly ¾ of the variance in rents observed in our model.

Coefficients for age, year, and whether a property was sold remain consistent, suggesting limited correlation with geography. The effects of turnover and number of bedrooms see marginal increases, but the change isn't likely sufficient to warrant interpretation. The effect of REIT properties, however, while still significant, declines by nearly 50%, suggesting that, while controlling for geography in this manner doesn't substantially improve the variance described by rents, it does appear to significantly reduce the observed component that is attributed to REIT ownership. The decline in the effect of REITs in this model likely reflects the geographically clustered nature of REIT purchases and indicates that REIT purchases tend to be in neighbourhoods with higher rents than non-REIT properties, as controlling for these baseline geographic variations decreases the effect of REIT ownership on rents. Visual exploration of REIT properties confirms this clustering, with REIT properties focusing their purchasing in specific neighbourhoods in the city. This finding is mirrored by the findings of St. Hilare et al. (2024) in their exploration of Montréal's REIT landscape, where they found that REIT purchases showed a dichotomous clustering pattern with properties being in either high- or low-price neighbourhoods.

Figure 7 demonstrates the importance of this effect, where the estimated difference in REIT and non-REIT prices converge significantly relative to our base model. In the context of mixed-effects modelling, the random components of the model are fixed to value of 0. In this way, we control for the effect of geography by effectively excising its contribution to the fixed effects, which is reflected in the changing coefficient for REIT ownership.

Operational Effects

The third model represents a change in dependant variable to one where the average costs of utilities are removed from rent prices in units that are flagged as including such costs. Fixed and random effects of this model are identical to that of Model 2. The only coefficient to see any decline with the utility price adjustments is that of the effect of REITs, which drops from .186 to .154 but remains highly significant. Given the prevalence of REIT owners' inclusion of such utilities in the rent prices in Montréal, this effect is in line with expectations. Figure 7 shows a decline in monthly rent for both REIT and non-REIT owner types of approximately 12.2% and 9.4% respectively, reflecting the increased probability of REIT owners' including such costs in their rents in Montréal.

Owner Investments

The fourth model adds the owner investment variables in the form of building permits into our model. The results show a significant effect associated with the number of building permits and rent price. The size of the effect from building permits was unexpectedly small and suggests that this variable may not be able to properly account for the effects of renovation on rent prices contemporaneously due to the delay in the granting of a building permit and the realization of gains upon completion of the construction. This was tested using various lagged values of permits; however, the effect remained small and insignificant. The correlation between lagged values and rent prices never exceeded 0.1 and dropped slightly over time, suggesting that time may not be the limiting factor. However, the relatively limited range of our data severely limits our ability to explore the temporal effects of this variable.

Investment Strategy

The final model incorporates two of the five components generated by our small-area index of gentrification. Specifically, components one "Gentrification Potential" and three "Active Gentrification" were selected, as they showed the greatest variance between the owner types. These two variables may also provide insight into strategy when considered together, as gentrification potential may preclude active gentrification in a speculative sense. To explore this, and the variability in strategic approach between the owner types, a three-way interaction term is added between the two components and the owner types.

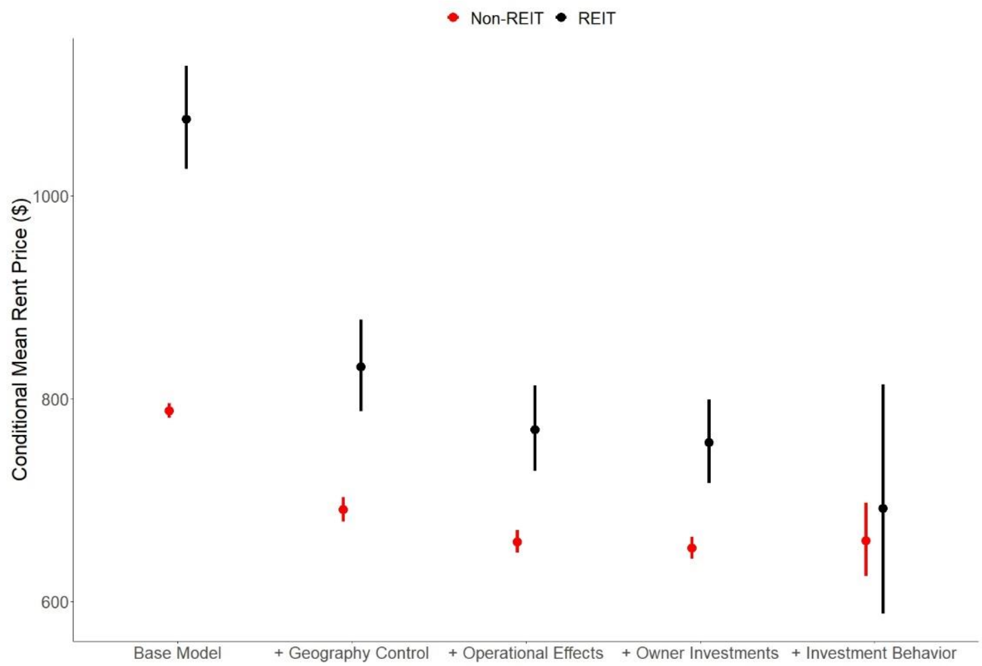

Figure 7: Conditional estimates of mean rent by owner type for each of our five models.

The results of this model strongly suggest that differences in REIT investment strategies play a role in the observed differences in rent price. Conditional price estimations of this model show further convergence in the mean rent prices charged by REIT and non-REIT owners. This convergence in the average, however, comes with a significant increase in the variance in rent estimates observed (Figure 7). Gentrification is inherently a geographic process and, as such, including it in our model as a fixed effect draws some of the variance captured by our random term back into our fixed effects. Marginal R^2 increases slightly, suggesting that our gentrification variables can explain some degree of the variance previously captured in the random effect.

The interaction term of the model is significant, suggesting that our three-way interaction is necessary to describe the effects of gentrification in relation to owner types. This suggests that the differences in investment strategies identified in our earlier analysis appear to translate into rent effects in some manner. Care must be taken in interpreting the coefficient for REIT ownership in this model, as it is part of an interaction term, meaning our estimate is the marginal effect with other terms set to their reference level of "High" for both scores, which represent the most common numerous groupings in our dataset. At this level, the effect of REIT ownership drops from .147 to .047 and is no longer significant, suggesting that, with respect to the most commonly observed combination of gentrification types, there is no statistically significant difference in observed rent prices between REIT and non-REIT units. This, of course, is not the same as a population-level estimate. Increased variance in rent price observed on inclusion of our interaction variables alone indicates that, in some combinations, REIT units may still have higher rent prices. Exploring the effect at various combinations of our interaction terms is important to ensure we fully appreciate the effect that investment strategies may be having on rent prices. A second conditional estimation plot, this time conditioned on owner type across our two gentrification measures gives insight into the effects across our levels (Figure 8). Only combinations that are observed in the data are shown, and those with insufficiently large sample sizes are marked with dashed lines.

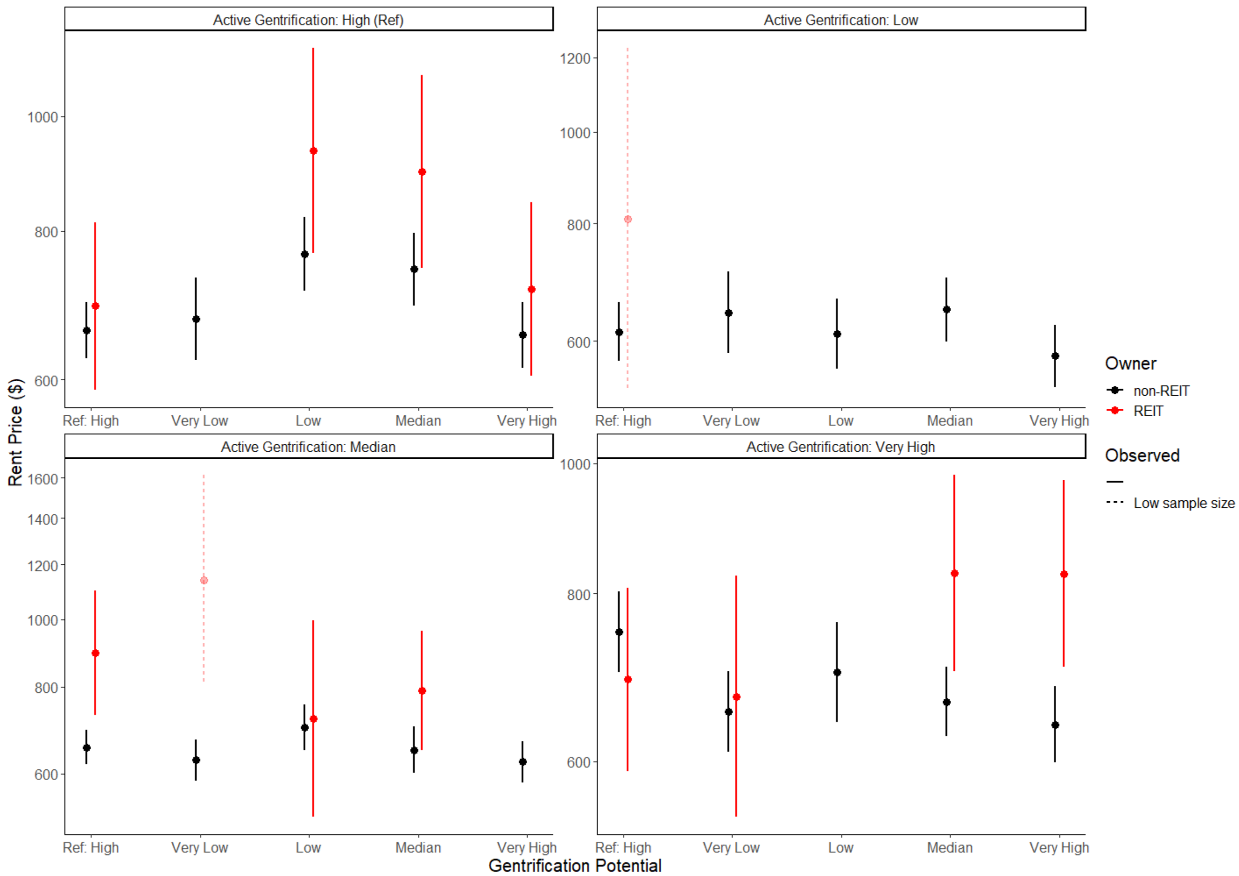

Figure 8: Conditional estimates by gentrification potential and activity. Dashed lines are unobserved levels in the data.

The plot shows that there are combinations of our gentrification measures that appear to produce differential rents by owner type. Our findings suggest that REIT properties do not begin to see conditional price premiums until scores for active gentrification reach the median levels, where neighbourhoods of "median" and "high" potential show higher REIT rent prices. These areas appear to hover around the border between the recent and long-term gentrifying areas, suggesting they may perhaps represent a mix of relatively mid-term holdings. Areas scoring "high" for active gentrification show significant premiums for REIT properties when combined with "low" and "median" scores for gentrification potential, placing these properties firmly in the long-term gentrification quadrant. These properties may represent long-term holdings that have already benefited from the effect of gentrification, which is likely to begin levelling out as potential declines. Finally, areas scoring very high in active gentrification and gentrification potential show significantly higher rent REIT estimates. These specific neighbourhoods also happen to represent the most common REIT properties identified in our dataset, with approximately one in three REIT properties being in these areas. These properties are very firmly in the recently gentrifying quadrant of our score, strongly suggesting they represent areas that have just recently started to undergo gentrification.

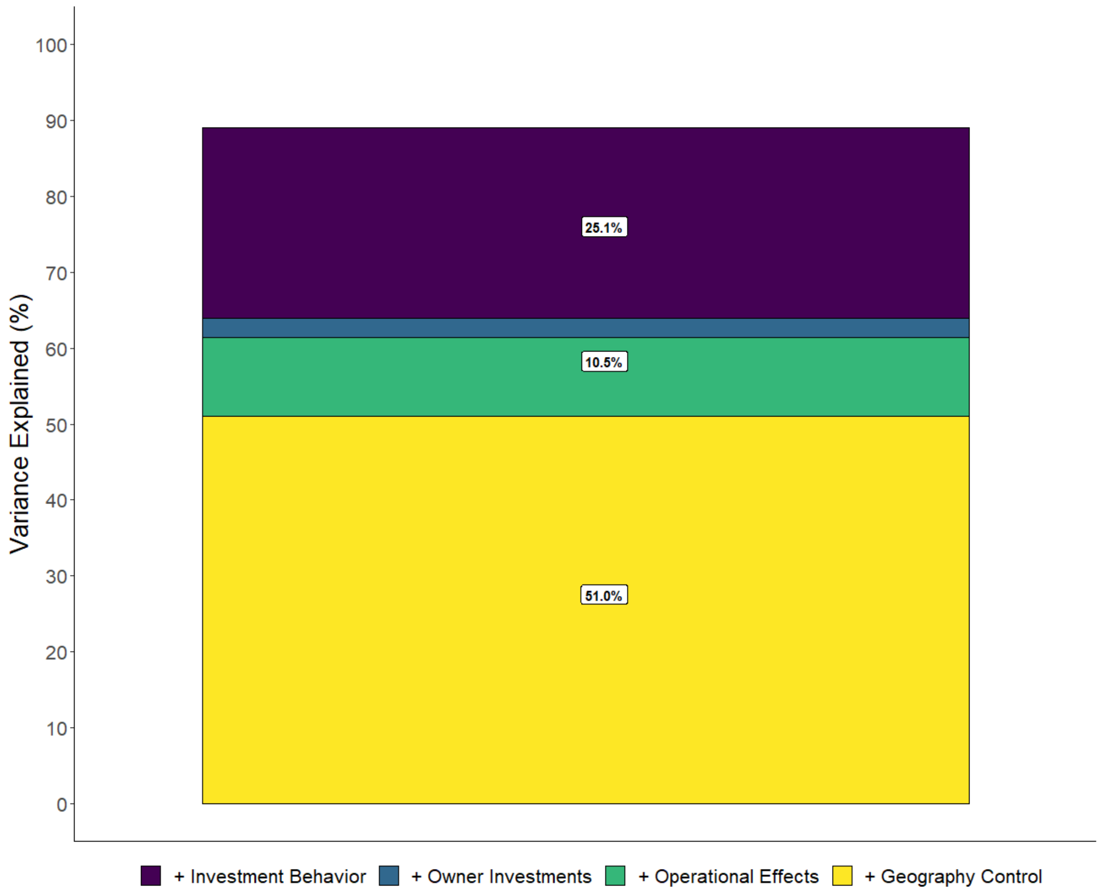

Figure 9: Difference in REIT and non-REIT mean rent price explained (%).

Discussion

The findings of this research suggest that real estate investment rusts (REITs) in Montréal do not directly charge higher rents than non-REIT owners. Rather, the higher rents observed in REIT-owned properties than in non-REIT properties are largely attributable to the purchasing strategies and operational decisions employed by REITs. Our findings show that, when we account for the geographic characteristics of neighbourhoods purchased in, significantly different investment strategies, and operational characteristics, we can explain almost 90% of the difference in mean rent prices observed between REIT-owned units and their non-REIT counterparts (Figure 8). Adequate control over geographic effects alone explains more than 50% of the observed difference in rent prices between the two groups. Using a locally estimated variable intercept decreases conditional rent estimates for REIT units while increasing them for non-REIT units, suggesting that REIT purchasing is spatially clustered, and REIT properties are more likely to be in higher-priced neighbourhoods. This finding is corroborated by St. Hilaire et al. (2024), who find similar spatial distributions using a web-scraping approach to identify REIT-owned properties.

Furthermore, purchasing strategy is found to play a significant role in rent price differences between REITs and non-REIT owners. Our findings indicate that REITs employ unique strategies that appear to result in above-average gains over time through the strategic purchasing of properties in neighbourhoods showing early signs of gentrification. Recent acquisitions by REITs, defined as those made in the last five years, are far more likely to occur in recently gentrifying neighbourhoods than acquisitions made by non-REIT counterparts. Additionally, REIT long-term holdings

– properties purchased more than five years ago – have the highest probability of being located in areas with prolonged periods of gentrification (Figures 3, 5).

The pattern here suggests that **REITs may be more apt in seeking out neighbourhoods that show signs of above-average future rent growth**. The prevalence of long-term holdings in neighbourhoods near the end of the gentrification process and suggests that REITs are doing so successfully. The implications for rent prices are straightforward: the earlier a property is purchased in a gentrifying neighbourhood, the longer it will experience above-average rent increases as gentrification progresses. This results in higher mean rents over the mid to long term. This effect is not exclusive to REITs; our conditional estimations show that non-REIT owners who adopt this approach achieve similar rent gains. REITs are just far more likely to utilize this strategy than other owner types.

The tendency of REITs to invest in neighbourhoods showing early signs of gentrification is not a new finding; however, our results may shed some new light on the relationship. Gentrification is frequently correlated in literature with financialization, with REITs often portrayed as playing a substantive role in it. For example, August and Walks (2018), explore the relationship between REIT purchases and demographic changes in Toronto where they "…coded each building by census tract, and analyzed the relationship between these locations and the characteristics of the local area." While their findings mirror ours – namely, that REITs tend to purchase in spatial clusters and that changes in neighbourhood demographics correlate with REIT purchases – they draw the conclusion that REITs are a driving force behind these demographic changes (August & Walks, 2018). Our findings suggest otherwise. Rather than acting as initiators of gentrification, REITs in Montréal appear to have an extreme *aversion* to highly speculative investments that would be ideal for an entity with the ability to seed gentrification. Instead, REITs actively wait for signs of the process of gentrification to be observed before making their purchase. This finding indicates that the causal link between gentrification and REIT investment appears to be relatively weak. Furthermore, we demonstrate that non-REIT owners the exhibit similar behaviors have statistically indistinguishable rent prices, suggesting that this isn't a REIT specific phenomena.

Limitations and Future Work

These findings cannot allow us to conclude that REIT investment has no impact on how the process of gentrification unfolds. Multiple studies have noted that REITs may *augment* the process of gentrification, as the influx of capital may exacerbate or accelerate the effects associated with the process and reduce the time tenants and residents have to respond to such changes. However, this study suggests that such effects do not appear to be unique to REIT investment, but are more likely a side of effect of *any* form of capital investment in a neighbourhood showing signs of such demographic change. This study also cannot speak to the effects of local market power on raising rent prices, a phenomenon that has not only been shown to occur in literature, but may be a factor in Montréal due to REITs' tendency to spatially cluster. The effect of increased market power would be effectively "invisible" to our models, as price increases through market power are likely to spill over to local non-REIT units, since a significant part of rental price discovery is related to comparable local rent prices. The result would be a neighbourhood-wide increase in rent prices that would be invisible to models conditioning their estimates on owner type. The development of more complete datasets on REIT ownership would be necessary to ensure accurate estimates of true local market power and identify the presence of such effects. This is the focus of future work in this area.

Appendix

Gentrification Index

The gentrification index was created using a principal component analysis. The following outlines the processes used to generate these components.

To begin, a covariance matrix is estimated using standardized values using the following formula

$$\mathbf{C} = \frac{1}{n-1}\mathbf{Z}^{\top}\mathbf{Z}$$

where:

$$\mathbf{Z} = \frac{\mathbf{X} - \mathbf{1}\boldsymbol{\mu}^{\top}}{\boldsymbol{\sigma}}$$

- $\mathbf{1}$ is an $n \times 1$ column vector of ones.
- $\boldsymbol{\mu}$ is a $p \times 1$ vector of the means of each variable.
- $\boldsymbol{\sigma}$ is a $p \times 1$ vector of the standard deviations of each variable.

From here, you perform an eigen decomposition of the covariance matrix

$$\mathbf{CV} = \mathbf{V\Lambda}$$

where:

- $\mathbf{V}$ is the $p \times p$ matrix of eigenvectors.
- $\boldsymbol{\Lambda}$ is the $p \times p$ diagonal matrix of eigenvalues.

The factor loadings (or simply loadings) are calculated by scaling the eigenvectors by the square roots of their corresponding eigenvalues. These loadings effectively represent the correlation between each component and the original variable, allowing for interpretation of the component. The loadings matrix $\mathbf{L}$ is given by:

$$\mathbf{L} = \mathbf{V}\boldsymbol{\Lambda}^{1/2}$$

These loadings can then be used to generate scores for each observation by multiplying the loadings matrix with the standardized data inputs.

$$\mathbf{F} = \mathbf{ZL}$$

These scores effectively map individual census tracts to the new coordinate system of our principal components. This allows us to evaluate where a specific tract aligns with a specific component relative to all others.

Spatial Smoothing

Extending these scores spatially requires an additional step. The results of the principal component analysis can produce sharp changes in scores in neighbouring geographies largely due to the modifiable areal unit problem

(MAUP). This requires some form of geographically aware smoothing to be done to ensure that estimates account for the results in the surrounding census tracts. To address this, Johnson et al. (2022) use a Bayesian Conditional Autoregressive model, and we adopted the same approach for our study.

Bayesian Conditional Autoregressive (CAR) Model

Model setup for the spatial smoothing component of the analysis is as follows:

Let Y_i be the response variable for the i-th spatial unit.

The linear predictor for the i-th spatial unit is:

$$\eta_i = \boldsymbol{\beta} + \phi_i$$

where:

- $\boldsymbol{\beta}$ is a global mean
- ϕ_i is the spatial random effect for the i-th spatial unit.

Assuming a Gaussian likelihood, the response Y_i given the linear predictor η_i is:

$$Y_i \mid \eta_i \sim \text{Normal}(\eta_i, \sigma^2)$$

Priors are set as the following according to the Leroux CAR prior:

$$\boldsymbol{\beta} \sim \text{Normal}(0, 10^5)$$

$\sigma^2 \sim Gamma^{-1}(1, 0.01)$Spatial random effects $\boldsymbol{\phi} = (\phi_1, \phi_2, \ldots, \phi_n)$ are modeled using the Leroux CAR prior:

$$\phi_i \mid \boldsymbol{\phi}_{-i}, \tau^2, \text{p} \sim \text{Normal}\left(\frac{\sum_{j\in\partial i} w_{ij}\,\phi_j}{\sum_{j\in\partial i} w_{ij} + 1 - p}, \frac{\tau^2}{\sum_{j \in\partial i} w_{ij} + 1 - p}\right)$$

where:

- $\boldsymbol{\phi}_{-i}$ denotes the vector of random effects excluding ϕ_i.
- ∂i denotes the set of neighbours of the i-th spatial unit.
- w_{ij} is the binary weight between units i and j (Shared vertex = 1, otherwise = 0).
- τ^2 is the variance parameter for the spatial random effects
- $p[0,1]$ is a measure of spacial dependance, with 0 being equivelent to independance

With the hyperpriors for τ^2 and p are set to:

$$\tau^2 \sim Gamma^{-1}(1, 0.01)$$

$$p \sim Uniform(0,1)$$

According to the specification used by Johnson et al. (2022) in their determination of the small area index of gentrification in New York. Similarly, all iteration and burn in parameters mirror the specification from Johnson et al. (2022).

Model Specification

A mixed-effects model with a single random effect in matrix notation can be represented as:

$$\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \mathbf{Z}\mathbf{b} + \boldsymbol{\epsilon}$$

where:

- $\mathbf{y}$ is the $n \times 1$ vector of observed log rents in Montréal. Model 3 introduces a utility-adjusted $\mathbf{y}$.
- $\mathbf{X}$ is the $n \times p$ design matrix of property characteristics and demographic change variables.
- $\boldsymbol{\beta}$ is the $p \times 1$ vector of fixed-effect coefficients.
- $\mathbf{Z}$ is the $n \times 1$ design matrix for the single random effect.
- $\mathbf{b}$ is the scalar (1 × 1 vector) random-effect coefficient.
- $\boldsymbol{\epsilon}$ is the $n \times 1$ vector of residual errors.

Assuming:

$$\mathbf{b} \sim \mathcal{N}(0, \sigma_b^2)$$

where σ_b^2 is the variance of the rent prices by census tract, and

$$\boldsymbol{\epsilon} \sim \mathcal{N}(\mathbf{0}, \sigma^2 \mathbf{I})$$

where $\sigma^2\mathbf{I}$ is the covariance matrix of the residuals, assuming independent and identically distributed (i.i.d.) errors.

Combining the fixed and random effects and assuming independence between them:

$$\mathbf{y} \sim \mathcal{N}\left(\mathbf{X}\boldsymbol{\beta}, \mathbf{Z}\sigma_b^2\mathbf{Z}^\top + \sigma^2\mathbf{I}\right)$$

The observed data $\mathbf{y}$ follows a multivariate normal distribution with mean $\mathbf{X}\boldsymbol{\beta}$ and variance-covariance $\mathbf{Z}\sigma_b^2\mathbf{Z}^\top + \sigma^2\mathbf{I}$.

Model specifications for our five models are as follows:

Table 4: Regression results

	Dependent variable:				
	log Rent		log Rent (corrected for utilities)		
	OLS	*linear mixed-effects*	*linear mixed-effects*		
	Base Model	Geography Control	Utility Correction	Owner Investment	Investor Activity
Age	-0.009*** ($3.74x10^{-4}$)	-0.008*** ($3.64x10^{-4}$)	-0.009*** ($3.61x10^{-4}$)	-0.009*** ($3.82x10^{-4}$)	-0.009*** ($3.81x10^{-4}$)
Age Quadratic	0.0001*** ($2.77x10^{-6}$)	0.0001*** ($2.84x10^{-6}$)	0.0001*** ($2.71x10^{-6}$)	0.0001*** ($2.61x10^{-6}$)	0.0001*** ($2.75x10^{-6}$)
Number of Bedrooms	0.203*** (0.003)	0.212*** (0.002)	0.217*** (0.003)	0.218*** (0.003)	0.218*** (0.003)
REIT	0.311*** (0.024)	0.186*** (0.027)	0.156*** (0.027)	0.147*** (0.027)	0.047 (0.080)
Unit Turnover (%)	0.061*** (0.008)	0.083*** (0.007)	0.081*** (0.007)	0.079*** (0.007)	0.078*** (0.007)
Year	0.033*** (0.002)	0.032*** (0.002)	0.032*** (0.002)	0.032*** (0.002)	0.032*** (0.002)
Property Sold (0|1)	-0.007 (0.016)	0.016 (0.014)	-0.002 (0.014)	-0.006 (0.014)	-0.004 (0.014)
Two Digits Forward Sortation Area: H1	0.040 (0.105)				
FSA: H2	-0.009 (0.011)				
FSA: H3	-0.006 (0.010)				
FSA: H4	0.026** (0.012)				
FSA: H7	-0.007 (0.012)				
FSA: H8	-0.009 (0.014)				
FSA: H9	0.006 (0.015)				
FSA: J2	0.037** (0.016)				
FSA: J3	0.128*** (0.026)				
FSA: J4	0.069*** (0.022)				
FSA: J5	-0.132*** (0.014)				
FSA: J6	0.012 (0.046)				
FSA: J7	-0.033 (0.036)				
Building Permits Issued (year)				0.048*** (0.007)	0.050*** (0.007)
Potential for Gentrification: Very Low					0.022 (0.050)
Potential for Gentrification: Low					0.148*** (0.046)
Potential for Gentrification: Median					0.118** (0.046)
Potential for Gentrification: Very High					-0.009 (0.043)
Active Gentrification: Low					-0.073 (0.046)
Active Gentrification: Median					-0.009 (0.040)
Active Gentrification: Very High					0.126*** (0.045)
REIT | Potential for Gentrification: Very Low					0.108 (0.126)

REIT | Potential for Gentrification: Low					0.153 (0.125)
REIT | Potential for Gentrification: Median					0.143 (0.124)
REIT | Potential for Gentrification: Very High					0.043 (0.118)
REIT | Active Gentrification: Low					0.229 (0.228)
REIT | Active Gentrification: Median					**0.268** (0.130)**
REIT | Active Gentrification: Very High					-0.128 (0.111)
Potential for Gentrification: Very Low | Active Gentrification: Low					0.026 (0.080)
Potential for Gentrification: Low | Active Gentrification: Low					**-0.152** (0.073)**
Potential for Gentrification: Median | Active Gentrification: Low					-0.063 (0.071)
Potential for Gentrification: Very High | Active Gentrification: Low					-0.050 (0.069)
Potential for Gentrification: Very Low | Active Gentrification: Median					-0.064 (0.067)
Potential for Gentrification: Low | Active Gentrification: Median					-0.082 (0.067)
Potential for Gentrification: Median | Active Gentrification: Median					**-0.126* (0.067)**
Potential for Gentrification: Very High | Active Gentrification: Median					-0.039 (0.062)
Potential for Gentrification: Very Low | Active Gentrification: Very High					**-0.159** (0.070)**
Potential for Gentrification: Low | Active Gentrification: Very High					**-0.218*** (0.072)**
Potential for Gentrification: Median | Active Gentrification: Very High					**-0.238*** (0.065)**
Potential for Gentrification: Very High | Active Gentrification: Very High					**-0.150** (0.065)**
REIT | Potential for Gentrification: Very Low | Active Gentrification: Median					0.174 (0.240)
REIT | Potential for Gentrification: Low | Active Gentrification: Median					**-0.438* (0.230)**
REIT | Potential for Gentrification: Median | Active Gentrification: Median					-0.261 (0.187)
REIT | Potential for Gentrification: Median | Active Gentrification: Very High					0.160 (0.169)
REIT | Potential for Gentrification: Very High | Active Gentrification: Very High					**0.297* (0.164)**
Constant	**6.431*** (0.016)**	**6.403*** (0.016)**	**6.370*** (0.016)**	**6.369*** (0.016)**	**6.365*** (0.031)**
Random Effect Statistics:					
Number of Census Tracts		551	551	551	551
sd(Census Tract)		0.181	0.172	0.169	0.159

R^2 (Conditional)	0.255	0.249	0.232	0.230	0.24
R^2 (Marginal)		0.12	0.124	0.125	0.148
RMSE	149.23	103.911	102.242	103.1	102.223
N obs	10800	10800	10800	10800	10800

Note: *p**p***p<0.01

Significance estimates use the Kenward-Roger approximation for degrees of freedom

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