Exploring the Local Impacts of Universities on Socioeconomic Characteristics and Housing Markets in Canadian Urban Regions, 1981-2016: A Spatial Panel Modelling Approach

Oussama Trabelsi, McGill University

Nick Revington, Institut national de la recherche scientifique

Cédric Brunelle, Institut national de la recherche scientifique

The Version of Record of this manuscript has been published and is available in *Journal of Urban Affairs* 08 December 2025
https://www.tandfonline.com/doi/full/10.1080/07352166.2025.2587142

Acknowledgements

The authors would like to thank Liliana Espinosa for research assistance as well as the editor and anonymous reviewers for their suggestions to improve the paper. Errors or omissions remain the authors' responsibility.

Funding

This work was supported by the Social Sciences and Humanities Research Council of Canada [430-2021-00757].

Exploring the Local Impacts of Universities on Socioeconomic Characteristics and Housing Markets in Canadian Urban Regions, 1981-2016: A Spatial Panel Modelling Approach

Abstract

This study examines the spatiotemporal economic and social transformations associated with proximity to major university campuses in Canada's eight largest urban regions from 1981 to 2016. Using quinquennial census data, we develop spatial panel regression models to analyze four dimensions of neighborhood change at the census tract level: rents, young adult populations, immigrant populations, and bachelor's degree holders. Our findings reveal that census tracts closer to universities exhibit significantly higher average rents, larger young adult populations, greater immigrant populations, and a higher proportion of university-educated residents. However, we find that these relationships vary greatly over time, indicating more complex dynamics than previously understood. The concentration of young adults, immigrants, and educated individuals near universities has only emerged since the 1980s, while rents in these areas have increased more slowly compared to other metropolitan regions, suggesting convergence rather than gentrification. Additionally, the growing proximity of the immigrant population to universities reflects a longstanding trend rather than a recent development associated with international student enrollment. These results highlight the dynamic nature of university-neighborhoods' relationships and underscore the significance of these institutions in shaping the economic and social geographies of Canadian urban regions.

Keywords: gentrification, spatial panel models, studentification, universities, youthification

Introduction

The role of universities in regional economic development is well studied. Less well understood is universities' role in shaping the metropolitan social geography. Many universities engage in urban development projects, not only to meet growing needs for offices, classrooms, labs, and student accommodations, but also sometimes with the explicit objective of "improving" the character of the surrounding area to attract faculty, staff and students and protect the value of their spatially fixed real estate assets (Baldwin, 2021; Bose, 2015; Perry & Wiewel, 2005). Meanwhile, as both the domestic population participating in higher education in North America and international student mobility have increased alongside the rise of the knowledge economy (Moos et al., 2019), it is likely that so too have the local neighborhood impacts of these institutions, even in the absence of specific urban development initiatives on the part of universities.

These impacts are likely to be multifaceted, affecting socioeconomic and housing market characteristics at the relatively fine intra-metropolitan scale of near-campus neighborhoods, compared to the relatively diffuse impacts of universities on economic development across entire urban regions (Drucker, 2016). Yet while relatively few studies have considered these local *social* impacts of universities, emerging research on this theme typically draws on individual case studies, or quantitative analyses that are either based on simple correlations, or only consider cases of explicit university initiatives or other narrow subsets of urban regions, and do not account for spatial autocorrelations.

In this study, we contribute to the burgeoning literature on the local socio-spatial impacts of urban universities by mobilizing a spatial panel approach to analyse urban change across four dimensions, each proxied through a census variable, across the eight largest metropolitan areas in Canada over the 35-year period 1981-2016. These variables (dimensions) are average rent (housing markets), percentage of the population aged 20-34 (population age), percentage of immigrants (social diversity), and percentage of the population with a bachelor's degree or higher (education and labor). We find that overall, rent, the young adult population, the immigrant population, and the university-educated population are all higher in census tracts closer to universities. However, exploiting the temporal dimension of our data, we find that the relationships between the proximity to universities and young adult populations, immigration, and holders of bachelor's degrees have emerged over time; these relationships either did not exist, or were reversed at the beginning of the study period. Rents, meanwhile, appear to have increased more slowly in proximity to universities than elsewhere in the metropolitan areas, suggesting a trend of convergence rather than one of gentrification. These findings highlight the important role of universities in contributing not only to the economic development of urban regions, but to their social geographies as well.

We begin by reviewing the existing literature on the urban impacts of universities, with a special focus on neighborhood rather than regional dynamics of urban change. We then describe our data and spatial panel modelling approach, before presenting the results of our four models and examining the temporal evolution of the coefficients of interest. In the final section, we interpret these results and their salience for understanding the role of universities in contemporary urban change.

Literature Review

The urban impacts of universities have long been an important topic of study in urban and regional research, with considerable interest placed on the role of these institutions in economic development at the regional scale. Indeed, the role of universities in innovation, technology transfer, education, talent attraction, and local spending has been shown to have important, positive economic impacts at this scale (Bagchi-Sen & Lawton Smith, 2012; Drucker, 2016; Goldstein & Drucker, 2006; Goldstein & Renault, 2004). In this light, policies in a variety of contexts have sought to privilege the role of universities as key actors in regional development (Trippl et al., 2015), despite the reservations of some scholars about the utility of such development models in all geographical circumstances (Goddard et al., 2014; Pugh, 2017). As a result, research has sought to understand both the evolving role of universities in the governance of regional economic development (Pugh et al., 2016; Harrison et al., 2017) and the causal dynamics at play, for instance in the formation of industrial clusters (Bramwell et al., 2008).

Some scholars have also highlighted more localized benefits of universities for communities. In the 1990s, in response to the urban crisis in American cities, including crime and deteriorating infrastructure, many universities began to change their approach to surrounding neighborhoods (O'Mara, 2012). If many had increasingly turned inward to isolate themselves from the city at large, at this point, some began to take a greater role in local community development, viewing universities as "anchor institutions" tied to place, and whose largesse could be put to service for the benefit of local communities (Adams, 2003). Yet while motivations included a philosophical commitment to civic engagement and community-engaged "service learning" (Ehlenz, 2018), this greater role of universities in community development was not rooted exclusively in altruism. Urban universities, with their large real estate holdings and a desire to recruit top students, staff, and faculty, have a vested material interest in the conditions of their surroundings (Bromley & Kent, 2006). Some have even suggested that universities adopting anchor institution strategies have tended to place greater emphasis on physical rather than social aspects of community development (Ehlenz, 2018).

Meanwhile, public universities have faced funding cuts, leading them to adopt a more entrepreneurial posture. Increased reliance on tuition, higher rates of educational attainment among the millennial generation (Hawkins, 2019) and greater international student mobility (Buckner et al., 2022) have driven enrolment increases, while universities limit their outlays for new residences and take a more market-oriented approach to real estate development, including public-private partnerships (Ehlenz et al., 2024; Evans & Sotomayor, 2023; Pillai et al., 2024). Whatever positive local benefits universities may provide, their role as urban developer has often generated political tension and conflict with other communities, being implicated in the gentrification of near-campus neighborhoods and the attendant displacement of low-income and often racialized populations (Baldwin, 2021; Bose, 2015; Jolivet et al., 2023).

As greater numbers of students live off-campus, private developers have sought to compensate for the lack of student housing supply, with private purpose-built student accommodation (PBSA) backed by institutional investors emerging in the early 2010s in Canada (Revington & August, 2020). In the US, Mawhorter and Ehlenz (2024) found that neighborhoods near growing research-intensive universities with limited dormitory expansion have experienced considerable rental housing construction, whether in PBSA or otherwise, a phenomenon observed in at least some Canadian cities (Revington & Wray, 2024). Based on these trends, universities would seemingly have an increasingly outsized role in shaping the local urban social geography (Foote, 2017).

Indeed, research emerging in Britain but now spanning a diversity of contexts has shown how the "studentification" of neighborhoods has resulted in the displacement of low-income populations by undergraduate students (Jolivet et al., 2023; Sage et al., 2012;

Smith, 2005). Studentification is also frequently associated with disruptive behaviours that may incite other existing residents to leave the neighborhood (Hubbard, 2008; Munro & Livingston, 2012; Woldoff & Weiss, 2018). Given its role in reshaping neighborhood housing markets, studentification is often linked with gentrification (Smith & Holt, 2007). In Canada, growth in the international student population over recent decades has contributed to novel configurations of studentification (Sotomayor & Zheng, 2024), but many international students experience profound housing challenges in the country (Calder et al., 2016; Pottie-Sherman et al., 2024), making it problematic to conflate studentification entirely with gentrification.

The work of Moos et al. (2019) also links universities to a process of "youthification", or the concentration of young adults who are nonetheless older than typical undergraduates (see also Revington et al., 2023). For Moos (2016), youthification is driven by the restructuring of the urban economy since the 1980s, resulting in increasingly precarious housing and labor markets for young adults, pushing them to denser residential locations with more economical housing options and better public transit service, in parallel with the attractive role of urban revitalization schemes. Conceptually, universities are linked to the youthification process via the knowledge economy, drawing graduate students as well as young professionals working in nearby tech firms, and via the vibrant urban milieu provided by many near campus neighborhoods (Ma et al., 2018; Revington, 2022).

While much of the research on universities and urban change adopts qualitative methods and single-city case studies that unveil a rich spectrum of perspectives and uncover deep insights about causal mechanisms, only a handful of studies conduct quantitative analyses that scale across multiple cases. Foote (2017) uses a cluster analysis to examine neighborhood change in ten mid-sized "knowledge nodes," or metropolitan areas with the presence of important research universities driving strong economic growth. Work by Moos et al. (2019) in Canada's three largest metropolitan areas (Toronto, Montreal, and Vancouver) and by Revington et al. (2023) in five American metropolitan areas with a legacy of urban decline rely on correlational analysis to link interrelated processes of gentrification, studentification, and youthification in proximity to universities. However, more exhaustive analyses are vital to adjust for other potential factors influencing these relationships.

Other studies have more specifically examined the impacts of US universities' deliberate anchor institution activities, using causal difference-in-differences models. Ehlenz (2019) found that neighborhoods with anchor institution interventions saw housing market indicators converge with other neighborhoods, while socioeconomic characteristics did not. Contradicting other critical scholars (e.g., Baldwin, 2021), Garton's (2023) findings suggest that anchor institution interventions slow gentrification; further analysis decomposing the results by the type of intervention, however, indicate that *physical* interventions (i.e., campus expansion) may accelerate gentrification. While these studies provide valuable insights for understanding the specific impacts of specific university interventions, they tell us little about how and whether neighborhoods near universities might have evolved differently from others in the absence of such interventions. Because they rely on spatial data, these can also be problematic since they may overlook spatial autocorrelation between variables, while their performance can also vary across geographic regions (Anselin, 1988; Apparicio et al., 2007). This study aims to overcome these limitations by employing a spatial panel data modeling approach, which controls for both spatial and temporal dependencies, providing more accurate and reliable estimates. This method accounts for spatial autocorrelation and heterogeneity, thereby reducing biases that could otherwise distort the results. Additionally, it accounts for the spatial and temporal processes taking place across regions, making it a robust tool for analyzing the local impacts of universities.

Methods

Data

The objective of this study is to assess the impact of universities on nearby neighborhoods – as represented by census tracts – in the eight largest Census Metropolitan Areas (CMAs) in Canada, over the period 1981-2016 (Table 1). Specifically, we focus on four dimensions: 1) housing markets, 2) population age, 3) social diversity, and 4) education and labor. Variables related to each of these dimensions – and derived from the 1981 to 2016 Censuses and 2011 National Household Survey – are listed in Table 2.[1] These variables are conceptually aligned with those used in prior research on gentrification and other urban change processes (Ley, 1996; Meligrana & Skaburskis, 2005; Moos et al., 2019; Walks & Maaranen, 2008). Data from each year were standardized to 2016 census tract boundaries using the Canadian Longitudinal Census Tract Database (Allen & Taylor, 2018). We use average rent and average income as variables in our analysis; while it would be preferable to use medians, the

[1] Due to changes made to the 2011 National Household Survey, three variables were missing for that year: percentage of single-detached houses; percentage of apartments in buildings of five stories or more; and the percentage of 1-person households. An imputation method based on the values from the census years 2006 and 2016 was used to ensure balanced databases and models. Additional Census-derived variables were not included due to changes in definition over time (e.g., sector of employment) or because they did not exist for all time periods (e.g., visible minority population).

apportionment method proposed by Allen and Taylor (2018) to create consistent tract boundaries cannot be used with medians, since the underlying distribution of observations remains unknown. We opted to exclude 2021 Census data because they were collected during the COVID-19 pandemic, during which most university programs were offered exclusively online and are therefore likely to include significant anomalies in near-campus neighborhoods with respect to the long-term trends we are interested in. While more recent data may be available for some variables from other sources, only the Census provides a breadth of sociodemographic data with consistent definitions between metropolitan areas and over time necessary for our analysis. Although our data limits the extent to which we can speak to recent changes in international student recruitment policy in Canada, the ability to analyze the role of universities in urban social change over a 35-year period is nonetheless an important contribution of our study.

Table 1: The eight largest Census Metropolitan Areas in Canada, included in the analysis

Census Metropolitan Area	Population (2016)	Census Tracts (2016)	Total Observations (1981-2016)
Toronto	5,928,040	1151	9208
Montreal	4,098,927	970	7760
Vancouver	2,463,431	478	3824
Calgary	1,392,609	253	2024
Ottawa - Gatineau	1,323,783	277	2216
Edmonton	1,321,426	272	2176
Quebec City	800,296	181	1448
Winnipeg	778,489	174	1392
Total	*18,107,001**	*3756*	*30,048*

Note: * This figure represents 51.5% of the total Canadian population in 2016.

Table 2: Census-derived variables included in the analysis

Dimension	Variables
Housing Market	• Average rent cost in constant 2016 dollars • Population density • % of apartments in buildings of 5 stories or more • Homeownership rate • % of households consisting of a single person
Age of the Population	• % of the population aged 20 to 34 years • % of the population over 65 years old
Social Diversity	• % of immigrants. • % of recent immigrants (within the last 5 years)
Education and Labor	• % of the population with a bachelor's degree or higher • Average annual household income • Labor force participation rate

We create models for one variable related to each of the four dimensions, namely average rent in constant 2016 dollars (housing markets), percentage of the population aged 20-34 (population age), percentage of immigrants (social diversity), and percentage of the population with a bachelor's degree or higher (education and labor). We focus on these dependent variables because of their conceptual salience to phenomena highlighted in existing work on the social impact of universities: concentrations of young adults are associated with studentification and youthification, and educational attainment is associated with gentrification, as are increasingly expensive housing markets. We focus on rent rather than dwelling values given that students are much more likely to be renters than owners, and therefore rental market dynamics are of particular interest. However, it is important to note that it is not our objective to measure gentrification, studentification or youthification as such. We consider immigration because it is a central feature of the Canadian urban reality (Preston & Kobayashi, 2020), but its link to universities is unclear. For example, while some scholars document how university-led gentrification has displaced immigrant communities (Jolivet et al., 2023), studentification may also be driven by the arrival of international students, who may subsequently become permanent residents (Sotomayor & Zheng, 2024). The remainder of the variables listed in Table 2 are included as control variables.

Our main independent variable of interest is the distance of each census tract to a university, calculated as the road network distance from the population-weighted centroid of each tract, derived from the tract's constituent dissemination areas. Importantly, this technique allows the distance variable for each tract to change from one panel year to the next (even though the location of universities and census tracts do not physically change), which is essential to our use of spatial panel models since it avoids the multicollinearity that would arise from the use of static (time-invariant) distance variables. We consider only primary university campuses within the eight CMAs, with a small number of exceptions, to limit our analysis to universities of a sufficient size to have a notable impact on their surroundings. We include select secondary campuses, such as the Scarborough and Mississauga campuses of the University of Toronto, and the Loyola campus of Concordia University in Montreal, due to their size. We otherwise exclude universities and branch or satellite campuses with estimated enrolments under 5000, as these institutions are likely to exert less influence on their environs than their larger peers. These criteria resulted in a final list of 24 campuses. Point locations of the campuses were obtained from DMTI Spatial Canada.

Also serving as a control variable is the distance from each census tract to the city centre, to distinguish the impact of universities on urban change from the effects of centrality. The city centre is represented by the location of the city hall of the primary city in each CMA, and distances are again calculated based on population-weighted tract centroids and road network distance.

Modelling approach

Our objective is to model variables related to four dimensions of urban change over time and across multiple metropolitan areas as a function of distance from a primary university campus, while controlling for confounding variables. Although selecting the correct model for this task is technically complex, the overall approach is simple. It is necessary to select a model that can control for spatial dependencies or "spillover" effects in the data to reduce bias in the model's estimates and to avoid artificially low standard errors, which would risk unduly identifying some estimates as significant. It is also necessary to control for both unobserved, time-invariant differences between regions and period shocks common to all regions, to align the model with the mechanism studied, namely localized, time-evolving effects of university proximity rather than cross-sectional comparisons of very different places. Spatial panel models are designed for this purpose, of which there are several types.

The first step in selecting the appropriate spatial panel model is to discern the type of effects present – fixed effects (FE), random effects (RE), or pooled – as these different models may result in significant variations in the coefficient estimation and they treat spatial dependencies differently (Elhorst, 2014). A structured method, inspired by Gaboriault-Boudreau et al. (2019), helps in this selection, employing Breusch-Pagan Lagrangian Multiplier (LM), Hausman and F-tests to first identify the most the most appropriate non-spatial model (Figure 1).

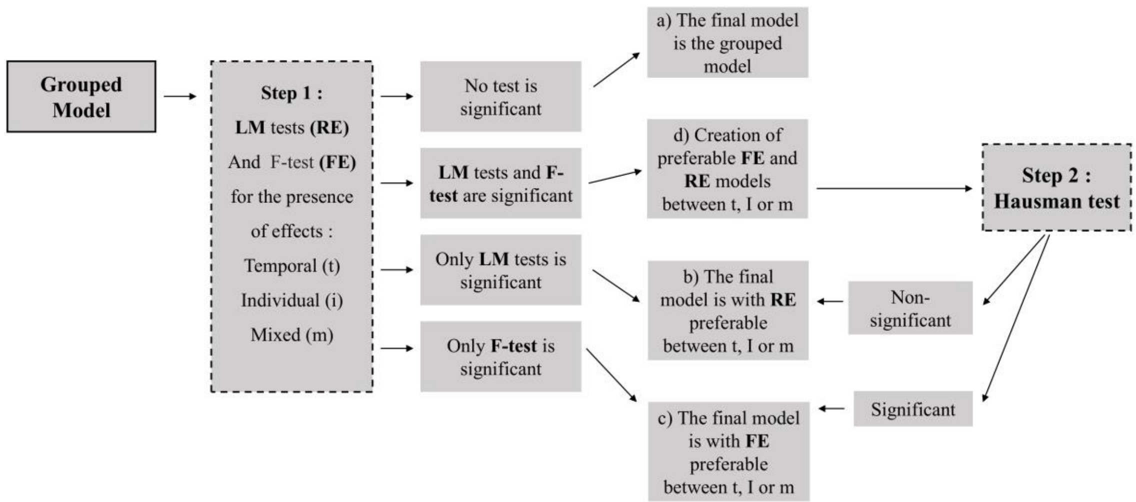

Figure 1: Decision tree for choosing the non-spatial panel model (adapted from Gaboriault-Boudreau et al., 2019).

However, the accuracy of a regression model heavily depends on its residuals (the differences between model-predicted values and actual observations). With spatial data, it is important to consider the independence of these residuals in spatial terms. Any signs of spatial autocorrelation are a problem, highlighting spatial dependence issues (Lesage & Pace, 2009). Even a model that seemingly checks all boxes might still need a spatial twist due to factors like spatial heterogeneity (Dubé et al., 2014). Unlike traditional panel models that see each individual as an independent entity, spatial panel models account for possible spatial interdependencies (Bouayad Agha et al., 2018; Qian & Zhao, 2018). An array of spatial autoregressive models, including Anselin (1988), have been proposed to capture these nuances. Elhorst (2014) introduced seven spatial models but also cautioned against their potential over-specification. Of these, three stand out: Spatial Lag Panel

Data Model (SLPDM)[2], Spatial Error Panel Data Model (SEPDM)[3], and Spatial Durbin Panel Data Model (SDPDM).[4]

Choosing among these spatial models again requires a robust method, and Elhorst (2012) provides just that (Figure 2). In Step 1, LM tests are performed to check for spatial dependence in the dependent variable (LM-lag) and in the error term (LM-error). If neither LM test is significant, a non-spatial model is chosen (Figure 2.a). If one of the LM tests is significant, the process moves to Step 2. In Step 2, the robust version of the significant LM test (RLM-lag or RLM-error) is calculated. The SLPDM is chosen if the RLM-lag is significant, or the SEPDM if the RLM-error is significant (Figure 2.b or 2.c). If both robust tests are significant, the SDPDM is selected as the final model (Figure 2.d). If the robust tests are not significant, all three models (SLPDM, SEPDM, SDPDM) are estimated in Step 3 and LR tests are used to determine the most appropriate model. If neither robust test is significant or if results are inconclusive or conflicting, the SDPDM is preferred due to its inclusivity. Once this choice is made, final touches are added by checking if effects are fixed or random, using tools like the Hausman test (Elhorst, 2009).

---

[2] Incorporates spatially lagged dependent variable, indicating that the value in one spatial unit depends on neighboring units' values.
[3] Accounts for spatial correlation in the error terms, meaning errors in one unit are correlated with errors in neighboring units.
[4] Combines features of spatial lag and spatial error models, including both spatially lagged dependent variable and spatially lagged independent variables.

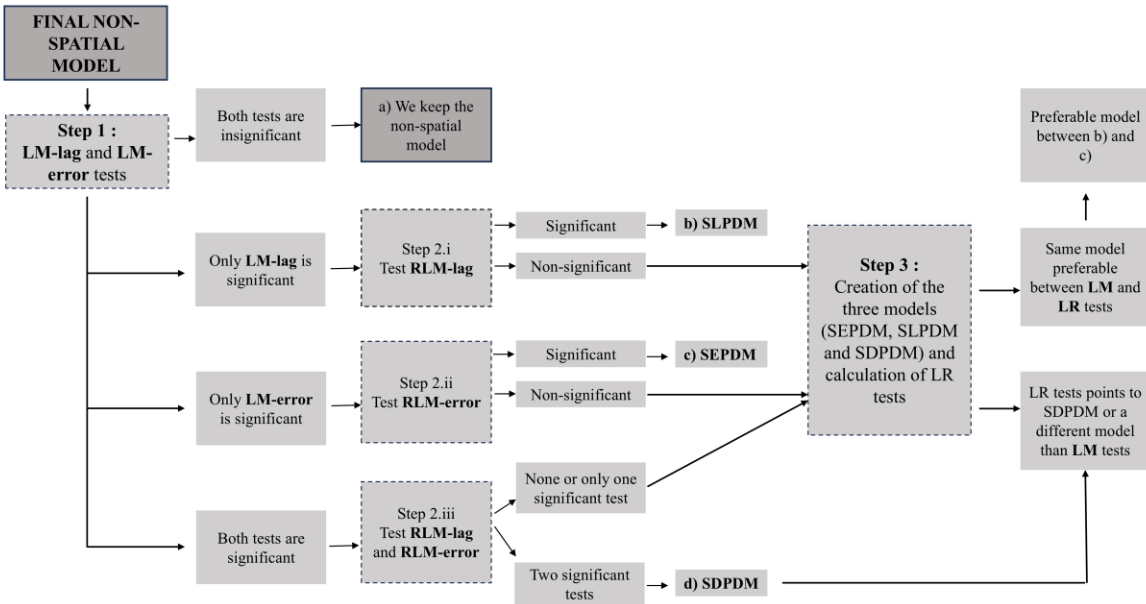

Figure 2: Decision tree for choosing the spatial panel model (adapted from Gaboriault-Boudreau et al., 2019).

Applying this selection approach to our models, F and LM tests consistently indicated a preference for mixed effects models over basic pooled models. Specifically, the Hausman test suggested a mixed effects model as the most suitable choice. Across all analyses, there was a recurring observation of spatial autocorrelation, confirmed by LM and robust LM (RLM) tests. Consistent with Elhorst's (2012) method, the SDPDM was identified as the best fit for each scenario examined. Notably, the spatial models consistently resulted in R^2 values much higher than the non-spatial model; among spatial models, this value was highest in the SDPDM in three of four scenarios and the SDPDM consistently recorded the lowest Akaike Information Criterion (AIC) score. In general, coefficients of the independent variables tended to be of larger magnitude in the non-spatial models compared to their counterparts in the spatial models, suggesting potential spatial dependence resulting in over-estimation; the higher R^2 and lower AIC of the

SDPDM support this explanation. Throughout our analysis, variance inflation factor (VIF) tests returned results below the threshold of 5, confirming the lack of significant multicollinearity among independent variables. For simplicity, only the final models (SDPDM) are presented in Table 3, and the results of these models are described in greater detail in the following section. Further details on the other models tested are available in Trabelsi (2024).

Table 3: Spatial Durbin Panel Data Models of average rent, young adult population, immigrant share of the population, and share of the population with a bachelor's degree or higher

	Model 1 Average rent in 2016 dollars	**Model 2** % Aged 20-34	**Model 3** % Immigrants	**Model 4** % Bachelor's degree +
Spatial coefficients (W_y)	0.232***	0.317***	0.320***	0,301***
Independent variables				
Distance to university	-5.072**	-0.117***	-0.105***	-0,181***
Distance to downtown	5.357**	0.077*	0.063*	0,123**
Population/km^2	0.004***	0.0001***	0.0001**	0,0003***
% Apartments 5+ storeys	0.670***	0.014***	0.016***	0,051***
Homeownership rate	2.939***	-0.070***	0.076***	0,122***
% Single households	-1.001**	-0.025***	-0.005	-0,053***
% Recent immigrants	7.980***	0.149***		0,210***
% Population 65+	-2.059***		-0.215***	-0,133***
Avg. household income	0.001***	-0.00002***	0.0001***	0,00002***
Lab. participation rate	1.801	0.272***	0.168***	0,159***
Census year dummies (base=1981)				
1986	40.484***	-0.431***	0.137	1,331***
1991	40.694***	-2.075***	-1.128***	2,607***
1996	-20.474**	-3.631***	-2.462***	4,427***
2001	-40.909***	-4.740***	-3.354***	7,521***
2006	-54.533***	-5.123***	-3.456***	9,776***
2011	-17.945	-4.682***	-2.869***	11,279***
2016	43.617***	-4.438***	-2.426***	13,391***
Spatially lagged independent variables				
W x Distance to university	-4.822	-0.079	-0.048	0,028
W x Distance to downtown	3.642	0.026	-0.005	-0,062
W x Population/km^2	-0.0002	-0.00001	-0.0001	-0,00007*
W x % Aparts. 5+ storeys	-0.440	0.0007	0.005	-0,020**
W x Homeownership rate	-1.171***	-0.022***	0.018**	-0,014***
W x % Single households	1.295**	0.018**	-0.030***	0,015
W x % Recent immigrants	1.009	0.033*		-0,042*
W x % Population 65+	0.912		0.001	-0,119***
W x Avg. household income	0.0005***	0.000006**	0.0001***	-0,00002***
W x Lab. participation rate	0.162	-0.030**	-0.038***	-0,054***
Model statistics				
R^2	0.746	0.834	0.836	0,919
Log-likelihood	196 406	76 477	76 240	83 066
Akaike Information Criterion	392 867	153 007	152 532	166 188
Note: Significance: *** p<0.001, ** p<0.01, * p<0.05				

Results

Model 1: Average rent

The first column of Table 3 presents the results of our model where the census tract's average monthly rent in constant 2016 dollars serves as the dependent variable. For all years except 2011, census year dummy variables display significant coefficients when contrasted with the base year of 1981. For instance, 2016 witnessed a marked increase in rental costs, ascending by $43.61 compared to 1981. A profound insight emerges from the spatial parameter Wy, suggesting that a one dollar increase in rent in an adjacent census tract translates to an upswing of 0.232 dollars in that same tract. This indicates a positive spatial spillover effect, where changes in one area's rent influence neighboring areas. All independent variables are statistically significant ($p<0.001$), except for the labor force participation rate. The correlation with recent immigrants stands out as notably robust (7.980; $p<0.001$). However, it is imperative to emphasize that the central aim of this study is not to identify the predominant variables influencing rents but to explore the relationship between university proximity and rents. There is a significant negative correlation between the distance from a university and rental costs, as shown in the SDPDM (-5.072; $p<0.01$). Put simply, the closer a property is to a university, the higher its rent tends to be, and vice versa.

Model 2: Percentage of the population aged 20-34

The second column of Table 3 presents the model of the share of the census tract population aged 20-34. This model reveals a decline in the percentage of individuals aged 20 to 34, relative to 1981, ranging from -0.431% in 1986 to -5.123% in 2006. The spatial parameter Wy suggests that a one percentage point increase in the share of the population aged between 20 and 34 in the vicinity of a census tract increases by 0.317 percentage points the share of people aged between 20 and 34 in this same tract. The correlation between the young adult population and recent immigrants seems to underline the substantial contribution of international students – many of whom remain in Canada after their studies – in shaping the urban social geography. Indeed, our results indicate the influential role of universities in this dynamic, finding a significant negative coefficient of -0.117 ($p<0.001$), suggesting a decline in this age bracket as distance from a university increases. This result confirms, in a more rigorous way, earlier work linking universities to processes of youthification and studentification concentrating young adults in their vicinity (Moos et al., 2019; Revington et al., 2023).

Model 3: Immigrant share of the population

The model of the percentage of the census tract population who are immigrants is presented in the third column of Table 3. Census year dummy variable coefficients highlight interesting trends in Canada's urban immigrant population from 1981 to 2016. While the non-spatial model and to a lesser extent the SEPDM and SLPDM (not shown for brevity) illustrated a rise in the immigrant percentage from 1986 to 2016 compared to 1981, the SDPDM, which accounts for spatial dependence of both the dependent (Wy) and explanatory variables (Wx), unveils several negative coefficients, indicating a reduction in the immigrant population share compared to 1981. Such outcomes underline the pivotal role of spatial interdependencies in the geography of the immigrant population within Canada's CMAs. The notably significant spatial parameter Wy suggests a 0.320 percentage point increase in the studied sector for every one percentage point rise in adjacent sectors. All independent variable coefficients are significant, excluding the percentage of single-person households.

Our results suggest a notable link between universities proximity and the percentage of immigrants. The coefficient for this variable is -0.105 ($p<0.001$). Thus, for every additional kilometre away from a university, the share of the immigrant population diminishes by 0.105 percentage points. As universities often serve as centres for research, innovation, and education, they draw not only international students, but also researchers and other professionals. Surrounding areas may offer diverse job opportunities and services tailored to foreign populations, enhancing their allure to immigrants. However, our models are not causal, and it is possible that other mediating factors are at play that have led to universities being in immigrant-rich areas.

Model 4: Percentage of the population with a bachelor's degree or higher

Finally, the last column of Table 3 presents the model of the percentage of the census tract population with at least a bachelor's degree. When assessing dummy variables related to years, each year highlights significant coefficients when compared to the reference year, 1981. The percentage of those with a bachelor's degree or higher has consistently risen since 1981. For instance, in 2011 and 2016, this share was 11.279 and 13.391 percentage points higher, respectively, compared to 1981 in the eight CMAs studied. Such an upswing can be attributed to the expansion of post-secondary institutions and the burgeoning knowledge economy. The notably significant spatial parameter Wy suggests that a one percentage point increase in the share holding a bachelor's degree or higher in a neighboring tract leads to a 0.301 percentage point augmentation in the target tract. All independent variable coefficients are significant. To conclude, our investigation highlights a significant correlation between proximity to universities and the percentage of holders of a bachelor's degree or higher. This variable's coefficient of -0.181 ($p<0.001$), indicates that for each additional kilometre from a university, the percentage of individuals with a bachelor's degree or higher drops by 0.181 percentage points.

Spatiotemporal evolution

So far, our analysis has underutilized the temporal dimension of our data, limiting our understanding of how the role of university proximity may have evolved over time. To address this, we have enhanced our final model, the SDPDM, for each of our dimensions of urban change by adding interactions between census years and the distance to a university, including their spatially lagged versions. These models are shown in Table 4, and the interacted coefficients of distance to a university from each model are presented graphically in Figure 3.

The interacted model for rent indicates that in 1986, the effect of university proximity was no different than in 1981. However, by 1991, the interaction coefficient was significantly positive, beginning a generally upward trend (despite some fluctuation) until 2016. This indicates that relative to 1981, rents increased more, over time, with greater distance from a university. Recall that in the non-interacted model, rents declined with distance from a university, which is equally true for the non-interacted distance variable in the spatiotemporal interaction model. This result suggests a weakening of this relationship over time, such that rents are converging between tracts nearer to and farther from a university.

Table 4: SDPDM with interactions between census years and distance to university

	Model 5 Average rent in 2016 dollars	**Model 6** % Aged 20-34	**Model 7** % Immigrants	**Model 8** % Bachelor's degree +
Spatial coefficients (W_y)	0.229***	0.296***	0.301***	0.253***
Independent variables				
Distance to university	-7.089***	0.001	0.006	0.060***
Distance to downtown	5.26**	0.086**	0.074*	0.149***
Population/km^2	0.004***	0.00006***	0.00005***	0.0003***
% Apartments 5+ storeys	0.661***	0.012***	0.014***	0.049***
Homeownership rate	2.936***	-0.072***	-0.076***	0.120***
% Single households	-1.257***	-0.018***	0.001	-0.034***
% Recent immigrants	8.392***	0.128***		0.173***
% Population 65+	-2.48***		-0.194***	-0.083***
Avg. household income	0.001***	-0.00002***	-0.00002***	0.00005***
Lab. participation rate	1.374***	0.282***	0.189***	0.202***
Interactions between census years (base=1981) and distance to university				
1986 x Dist. to univ.	0.137	-0.063***	-0.058***	-0.071***
1991 x Dist. to univ.	1.764***	-0.101***	-0.097***	-0.124***
1996 x Dist. to univ.	2.113***	-0.101***	-0.103***	-0.174***
2001 x Dist. to univ.	1.546***	-0.138***	-0.133***	-0.250***
2006 x Dist. to univ.	2.599***	-0.127***	-0.121***	-0.303***
2011 x Dist. to univ.	3.783***	-0.143***	-0.141***	-0.341***
2016 x Dist. to univ.	2.993***	-0.139***	-0.125***	-0.350***
Census year dummies (base=1981)				
1986	42.679***	0.509**	0.669***	2.151***
1991	30.168**	-0.896***	-0.230	4.143***
1996	-51.754***	-2.227***	-1.289***	6.744***
2001	-61.324***	-2.928***	-1.908***	10.638***
2006	-81.588***	-3.137***	-1.927***	13.765***
2011	-47.829***	-2.697***	-1.251***	15.617***
2016	16.737	-2.414***	-1.094***	17.761***
Spatially lagged independent variables				
W x Distance to university	-3.829	-0.092	-0.072	-0.067
W x Distance to downtown	2.692	0.064	0.040	0.041
W x Population/km^2	-0.0005	-0.00001	-0.00002	-0.00004
W x % Aparts. 5+ storeys	-0.383	-0.001	0.002	-0.022***
W x Homeownership rate	-0.953**	0.010	0.008	-0.028***
W x % Single households	1.424**	-0.016*	-0.028***	0.012
W x % Recent immigrants	1.359	0.0147		-0.057*
W x % Population 65+	0.318		0.031*	-0.067***
W x Avg. household income	0.0004***	0.000007**	0.000007**	-0.00001***
W x Lab. participation rate	0.138	-0.035***	-0.027*	-0.048***
W x 1986	-0.163	-0.011	-0.011	0.001
W x 1991	-0.799	0.010	0.011	0.001
W x 1996	0.232	-0.002	-0.0003	0.015
W x 2001	0.128	-0.002	-0.002	0.028
W x 2006	-0.392	-0.025	-0.025	0.023
W x 2011	-1.262	-0.011	-0.014	0.031
W x 2016	-0.502	-0.020	-0.017	0.026
R^2	0.837	0.832	0.840	0.926
Note: Significance: *** p<0.001, ** p<0.01, * p<0.05				

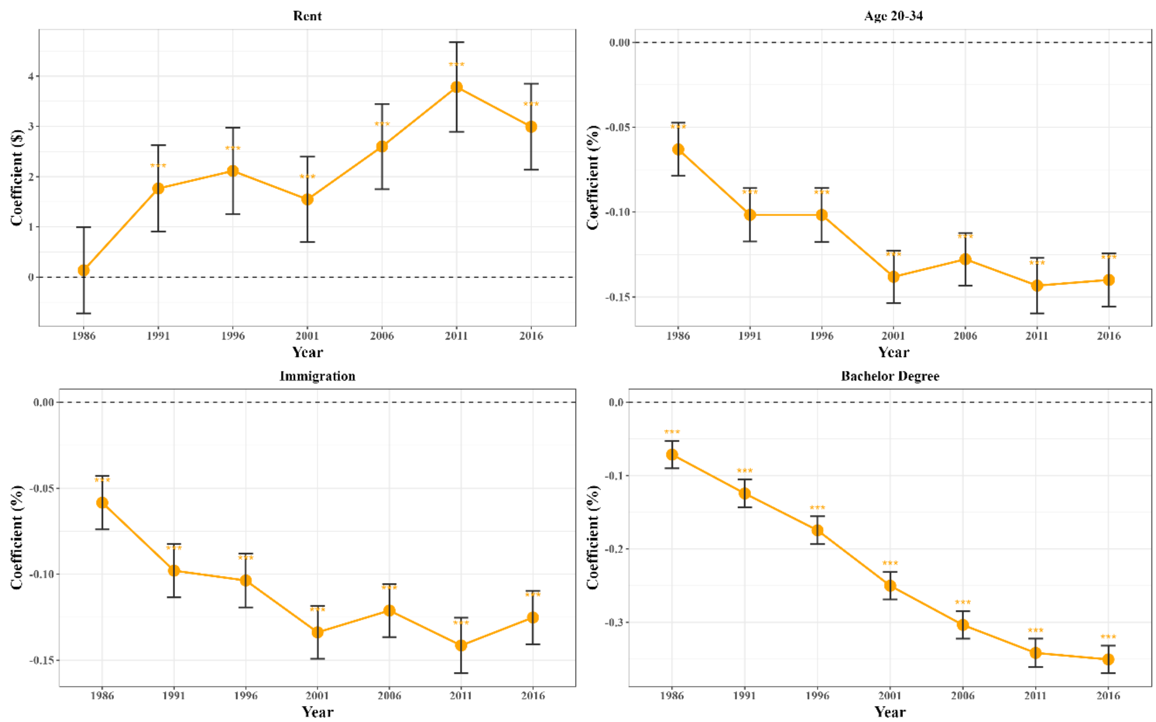

Figure 3: Model coefficients of interactions between distance and year.

Meanwhile, with respect to the population aged 20 to 34, the interaction term between distance to a university and census years is negative and significant for all years relative to 1981, becoming increasingly negative up to 2001 and then roughly stable thereafter. While our non-interacted model found that the share of the young adult population declined with distance from a university, this spatiotemporal analysis finds that this relationship has emerged over time. (The non-interacted distance variable in the interaction model is small and insignificant.)

Turning to the immigrant share of the population, the interaction term between distance to a university and census years follows a similar pattern to that observed in the model for the young adult share of the population. That is, the coefficient is negative and significant for all years relative to 1981, increasing in magnitude from 1986 to 2001, before fluctuating around this value up to 2016. Again, while in our non-interacted model, the immigrant population declined with distance from the university, the interacted model reveals that this relationship has developed over time, with the non-interacted distance coefficient once again small and insignificant. This result would seem to confirm the increasing importance of international students in immigration to Canada (Buckner et al., 2022), driving immigrant settlement patterns in the eight largest CMAs, although of course other forms of immigration remain important.

Finally, regarding the share of the population with a bachelor's degree or higher, we find that the interactions between distance to a university and census years are all negative and significant relative to 1981, and consistently increase in magnitude over time (albeit at what appears to be a slowing rate since 2001). This shows that the negative relationship between distance and degree holders observed previously has also emerged over time. In fact, the non-interacted distance variable is *positive* and significant in the interacted model, suggesting that in the base year (1981), the relationship was inverted: the share of the population with a bachelor's degree or higher increased with distance from a university.

Discussion

Spatial panel models have provided us with an appropriate method for examining the social dimensions of university impacts on urban regions, both over a long (35-year) time horizon, and across multiple urban regions simultaneously, by controlling for spatial relationships within the data, time-invariant differences between regions, and temporal changes affecting all regions. This approach provides more accurate and reliable model estimates by reducing the bias caused by spatial dependencies in the data and identifying within-area changes over time rather than cross-sectional differences between places. Given the limited existing, comprehensive research on the social impacts of urban universities, this allows us to address an important empirical gap, while also addressing methodological issues with prior studies, reflecting a methodological innovation in this field. To our knowledge, this is the first multi-region application of a spatial panel framework to evaluate university proximity effects. Rent, the young adult population, the immigrant population, and the share of the population with at least a bachelor's degree are all higher in census tracts closer to universities in Canada's eight largest Census Metropolitan Areas. However, a major contribution of this research is to observe the timing of urban change with respect to the presence of universities.

We find that the link between proximity to universities and the young adult population has emerged since 1981. This finding confirms earlier research suggesting that youthification emerged sometime between the 1980s and early 2000s, linked to the restructuring of the urban economy towards a knowledge economy (Moos, 2016; Moos et al., 2019; Revington et al., 2023). Our results suggest that, more precisely, youthification saw the greatest relative increases over the 1980s, and from 1996 to 2001, but has been comparatively stable since. Youthification seems less an effect of recent urban revitalization initiatives of the early 21st century and more a driver thereof. Universities have come to rely on increasing enrolments – including by international and other non-local students – and young adults pursue higher education in greater proportion and for longer, meaning more students need a place to live close to the university, at a time when dormitory provision has stagnated (Ehlenz et al., 2024). Meanwhile, universities' entrepreneurial reorientation to promote economic spinoffs and foster a desirable urban milieu likely attracts young professionals to nearby employment opportunities (Bramwell et al., 2008; Evans & Sotomayor, 2023; Ma et al., 2018; Revington, 2022). These trends have made universities a centralizing force for the young adult population.

While this trend would seem to point to the gentrification of university neighborhoods, our results suggest some nuance, bearing in mind that it is not our objective to identify gentrification as such. Instead, we have modelled the census tract share of the population with at least a bachelor's degree and average rents, which foundational urban research has linked to gentrification (Ley, 1996; Meligrana & Skaburskis, 2005; Walks & Maaranen, 2008). The concentration of the highly educated population in proximity to universities has indeed emerged over time, and in fact represents an inversion of the reality in the base year of 1981, when the share of degree holders was positively correlated with distance from a university. This trend could point to a reversal of inner city decline and the suburbanization of the educated middle class via the gentrification of urban neighborhoods near universities from the 1980s to the present (Ley, 1996), although it is important to keep in mind that many of the major campuses considered in our analyses are not located in central areas (such as Simon Fraser University in Vancouver's suburb of Burnaby, or the University of Toronto campuses in Mississauga and Scarborough). However, it also likely points to growth in enrollment in graduate degrees, as graduate students – by definition – must hold a bachelor's degree; most graduate students also fall within the age range we have considered for young adults. With most existing on-campus housing oriented to undergraduates even as universities have expanded graduate programs as a function of national research policy since the 1980s (Jones & Gopaul, 2012), graduate students must often turn to the private rental market in near-campus neighborhoods – another way institutional shifts are implicated in neighborhood change.

On the other hand, while we find that rents are higher in proximity to universities, they have increased more, over time, farther from universities, suggesting a weakening of the relationship over time. This is not what we would expect if universities were implicated in a widespread, ongoing gentrification of their surroundings in Canada's largest metropolitan regions. This differs from the US case, which is peculiar (but nonetheless dominates academic literature) in the way central urban neighborhoods experienced relatively acute disinvestment due to anti-Black racism, creating a context in which university-led redevelopment is particularly susceptible to cause increases in rent through subsequent gentrification (Baldwin, 2021; Ehlenz, 2019). However, universities have also contributed to urban "revitalization" in response to deindustrialization in European cities, in some cases seeming to drive gentrification (Cenere et al., 2023), in other cases spurring more modest forms of redevelopment (Zasina & Jakubiak, 2024).

It may be that insofar as gentrification of university neighborhoods in Canada has taken place, it is of the variety driven by in-movers with low economic capital (limiting how much rents can rise) and high cultural capital, or that where it has occurred, it has been in a piecemeal manner that is "averaged out" in our models. The low economic capital, high cultural capital explanation is also consistent with studentification, given students' typically low incomes but middle-class backgrounds or aspirations (Smith, 2005; Smith & Holt, 2007). It is also possible that near-campus neighborhoods in Canadian cities have experienced increases in rental housing supply, comparable to those observed in the US (Mawhorter & Ehlenz, 2024), which may have mitigated rent increases in proximity to universities. Private PBSA would appear to have a limited role in this trend, underway since the 1990s, as it only emerged meaningfully in Canada after 2012 (Revington & August, 2020), just before the final year of our panel in 2016. Instead, rental supply might have increased through the subdivision of existing housing, as is frequently observed with studentification (Smith, 2005). Meanwhile, the meteoric rise in Canadian housing prices (and therefore rents) has made housing expensive everywhere. However, student housing represents a distinct submarket (Revington, 2021): while the limited supply of housing near universities has always been appealing to students, pushing up rents (and in some cases pushing students to seek housing farther afield [Sotomayor et al., 2022]), these studentified areas may be less appealing to other market segments, insulating them somewhat from generalized increases in rent across the Canadian urban system.

Regardless of whether these trends are qualified as gentrification, there is nonetheless an important potential for exclusion. This is primarily in the form of age segregation, as households with children and older adults are pushed out from or prevented from moving into near-campus neighborhoods, whether due to direct competition with students and other young adults in the rental market, or because of a desire to avoid nuisances frequently associated with studentification (Smith, 2005; Woldoff & Weiss, 2018). Moreover, as childless young adults concentrate in a neighborhood, local schools may be forced to close due to declining enrolment, resulting in a self-perpetuating cycle as the area thereby becomes less attractive to households with children (Sage et al., 2012). However, in other respects, near-campus neighborhoods often feature many amenities from which other households may be excluded (Revington, 2022).

That said, the negative association between a census tract's distance to a university and the immigrant share of the population has also emerged over time, especially up to 2001, pointing to an increasing concentration of immigrants near Canadian universities. This timing is notable, because substantial increases in international enrolment in Canada have occurred after 2016 (the end of our study period) and have become a contemporary media flashpoint, maligned by some commentators for contributing to the current housing crisis (Phillips, 2024), resulting in a recent cap on international student enrolment. Yet an important consolidation of the immigrant population in proximity to universities appears to have taken place over the 1980s and 1990s in Canada's largest urban regions and is therefore a longstanding phenomenon. While our data do not allow us to disaggregate these numbers and identify other characteristics of these immigrants, it is likely that a large share are international students.

However, in the absence of more detailed immigration data, the association between proximity to universities and the presence of immigrants should not necessarily be taken to mean greater and more beneficial social mixity in university neighborhoods. Long-established immigrant communities from European countries may differ considerably from more recent, racialized immigrant groups from Africa, Asia, or the Caribbean, and the reality of those who come to Canada on a study permit may also be vastly different from those who arrive through other immigration channels. Prior research in Canada has shown how existing immigrant communities may be displaced by university-driven urban change (Jolivet et al., 2023), sometimes by the more recent arrival of international students from the same cultural origin, as with the displacement of longtime residents from Toronto's Chinatown by the recent influx of Chinese international students (Sotomayor & Zheng, 2024). At the same time, many international students struggle with the high cost of housing in Canada and may themselves be priced out of near-campus neighborhoods (Calder et al., 2016; Pottie-Sherman et al., 2024).

Conclusion

Our models indicate an important role of universities in shaping the urban social geography since the 1980s, coinciding with various institutional and market changes as public universities, facing budget constraints, have increasingly relied on increasing enrolment of domestic and international students with limited expansion of on-campus housing and have undertaken a more entrepreneurial role in urban development (Ehlenz & Mawhorter, 2024; Evans & Sotomayor, 2023; Jolivet et al., 2023; Pillai et al., 2024). Rent, the young adult population, the immigrant population, and the share of the population with at least a bachelor's degree are all higher in census tracts closer to universities across Canada's eight largest CMAs, controlling for other factors including spatial dependencies. However, this relationship has not been static over time. The concentration of young adults, immigrants, and the highly educated population near campuses has emerged since the 1980s, whereas rents have increased more slowly in proximity to universities over time, weakening the relationship between proximity to universities and higher rents. Whether the latter trend is due to increased rental supply or subdivision of units near universities, a general increase in housing costs across Canadian cities, or some other factor remains unclear. Nonetheless, these findings reinforce and nuance those of previous studies that associate universities with studentification, youthification and gentrification of their surrounding neighborhoods (Ehlenz, 2019; Garton, 2023; Moos et al., 2019; Revington et al., 2023). Considering trends in a wider set of cities, over a long (35-year) period, and using a consistent method (as opposed to an ad hoc comparison of separate case studies), our results are consistent with emerging processes of studentification and youthification but point to a more ambiguous relationship between universities and gentrification.

This study points to several directions for future research, including updating the analyses once 2026 Census data are available. One particularly rich avenue of enquiry might be to adopt a difference-in-difference modeling approach, which could elucidate the causal interplays between universities and urban change. By deconstructing how various urban features intersect with the influence of universities, it would be possible to gain a more granular picture of their effects on rents, property values, and socio-demographic dynamics. Second, the observed concentration of immigrants near universities demands greater attention, as the supposed role of international students in Canada's contemporary housing crisis has become a hotly debated public policy item. Specifically, it is necessary to parse out the extent to which this concentration is driven by international students and other highly trained knowledge economy workers who are attracted by the presence of universities, and other immigrants already in place who may be displaced by their arrival, something that is not possible with the data and methods used here. As this is not a straightforward task given the (lack of) data available, qualitative research into the diversity of experiences, aspirations, and challenges facing immigrants in near-campus neighborhoods would be particularly valuable to this line of inquiry. Building on the present study, this research agenda would contribute to a clearer picture of the varied urban social impacts of universities.

References

Adams, C. (2003). The meds and eds in urban economic development. *Journal of Urban Affairs*, 25(5), 571-588.

Allen, J. & Taylor, Z. (2018). A new tool for neighbourhood change research: The Canadian Longitudinal Census Tract Database, 1971-2016. *The Canadian Geographer*, 62(4), 575-588.

Anselin, L. (1988). *Spatial Econometrics: Methods and Models*. Dordrecht: Kluwer.

Apparicio, P., Séguin, A.-M. & Leloup, X. (2007). Modélisation spatiale de la pauvreté à Montréal : apport méthodologique de la régression géographiquement pondérée. *Le géographe canadien*, 51(4), 412-427.

Bagchi-Sen, S. & Lawton Smith, H. (2012). The Role of the University as an Agent of Regional Economic Development. *Geography Compass*, 6(7), 439-453.

Baldwin, D. L. (2021). *In the Shadow of the Ivory Tower: How Universities are Plundering Our Cities*. New York: Bold Type Books.

Bose, S. (2015). Universities and the redevelopment politics of the neoliberal city. *Urban Studies*, 52(14), 2616-2632.

Bramwell, A., Nelles, J. & Wolfe, D. A. (2008). Knowledge, Innovation and Institutions: Global and Local Dimensions of the ICT Cluster in Waterloo, Canada. *Regional Studies*, 42(1), 101-116.

Bromley, R. & Kent, R. B. (2006). Integrating Beyond the Campus: Ohio's Urban Public Universities and Neighborhood Revitalisation. *Planning, Practice & Research*, 21(1), 45-78.

Buckner, E., Zhang, Y. & Blanco, G. L. (2022). The impact of COVID-19 on international student enrolments in North America: Comparing Canada and the United States. *Higher Education Quarterly*, 76, 328-342.

Calder, M. J., Richter, S., Mao, Y., Kovacs Burns, K., Mogale, R. S. & Danko, M. (2016). International Students Attending Canadian Universities: Their Experiences with Housing, Finances, and Other Issues. *Canadian Journal of Higher Education*, 46(2), 92-110.

Cenere, S., Mangione, E., Santangelo, M. & Servillo, L. (2023). Setting up a university city. Geographies of exclusion in North Turin. *Tijdschrift voor Economische en Sociale Geografie*, 114(5), 400-414.

Drucker, J. (2016). Reconsidering the Regional Economic Development Impacts of Higher Education Institutions in the United States. *Regional Studies*, 50(7), 1185-1202.

Dubé, J., Legros, D., Thériault, M. & Des Rosiers, F. (2014). A spatial differences-in-differences estimator to evaluate the effect of change in public mass transit systems on house prices. *Transportation Research Part B*, 64, 24-40.

Ehlenz, M. M. (2018). Defining University Anchor Institution Strategies: Comparing Theory to Practice. *Planning Theory & Practice*, 19(1), 74-92.

Ehlenz, M. M. (2019). Gown, Town, and Neighborhood Change: An Examination of Urban Neighborhoods with University Revitalization Efforts. *Journal of Planning Education and Research*, 39(3), 285-299.

Ehlenz, M. M., Mawhorter, S. L. & Pendall, R. (2024). The Complexities of Student Housing. *Housing Policy Debate*, 34(5), 603-619.

Elhorst, J. P. (2009) Spatial panel data models. In M. M. Fischer et A. Getis (eds.), *Handbook of applied spatial analysis: Software tools, methods and applications* (pp. 377-407). Berlin: Springer Science & Business Media.

Elhorst, J. P. (2012). Matlab software for spatial panels. *International Regional Science Review*, 37(3), 389-405.

Elhorst, J. P. (2014). *Spatial econometrics: From cross-sectional data to spatial panels*. New York: Springer Publishing.

Evans, A. & Sotomayor, L. (2023). Towards plush new digs in Toronto's *in-between* city: the changing governance of student housing in Canada. *Urban Geography*, 44(2), 402-429.

Foote, N. S. (2017). Beyond studentification in United States College Towns: Neighborhood change in the knowledge nodes, 1980-2010. *Environment and Planning A*, 49(6), 1341-1360.

Gaboriault-Boudreau, M., Apparicio, P. & Brunelle, C. (2019). Modélisation de la pauvreté urbaine dans la région métropolitaine de Montréal entre 1986 et 2016 : Apport des régressions spatiales par panel. *Cahiers de géographie du Québec*, 63(179), 165-182.

Garton, P. M. (2023). Universities and Gentrification: The Effects of Anchor Institution Initiatives on Rates of Neighborhood Change. *Research in Higher Education*. Online early. DOI: 10.1007/s11162-023-09733-y

Goddard, J., Coombes, M., Kempton, L. & Vallance, P. (2014). Universities as anchor institutions in cities in a turbulent funding environment: vulnerable institutions and vulnerable places in England. *Cambridge Journal of Regions, Economy and Society*, 7(2), 307-325.

Goldstein, H. & Drucker, J. (2006). The Economic Development Impacts of Universities on Regions: Do Size and Distance Matter? *Economic Development Quarterly*, 20(1), 22-43.

Goldstein, H. & Renault, C. (2004). Contributions of Universities to Regional Economic Development: A Quasi-experimental Approach. *Regional Studies*, 38(7), 733-746.

Harrison, J., Smith, D. P. & Kinton, C. (2017). Relational regions 'in the making': institutionalizing new regional geographies of higher education. *Regional Studies*, 51(7), 1020-1034.

Hawkins, J. (2019). *Millennials: The Most Educated Generation?* Berkeley Institute for the Future of Young Americans. Retrieved 31 May 2024 from https://youngamericans.berkeley.edu/wp-content/uploads/2020/01/College-Attainment-Issue-Brief.pdf

Hubbard, P. (2008). Regulating the social impacts of studentification: a Loughborough case study. *Environment and Planning A*, 40, 323-341.

Jolivet, V., Reiser, C., Baumann, Y. & Gonzalès, R. (2023). Before displacement: studentification, campus-led gentrification and rental market transformation in a multiethnic neighbourhood (Parc-Extension, Montréal). *Urban Geography*, 44(5), 983-1002.

Jones, G. A. & Gopaul, B. (2012). Doctoral Education and the Global University: Student Mobility, Hierarchy, and Canadian Government Policy. In A.R. Nelson & I.P. Wei (eds.), *The Global University*. New York: Palgrave Macmillan.

LeSage, J. & Pace, R. K. (2009). *Introduction to spatial econometrics*. New York: Chapman and Hall/CRC.

Ley, D. (1996). *The New Middle Class and the Remaking of the Central City*. Toronto: Oxford University Press.

Ma, Z., Chenggu, L., Liu, Y & Zhang, J. (2018). The transformation of traditional commercial blocks in China: Characteristics and mechanisms of youthification. *City, Culture and Society*, 14, 56-63.

Mawhorter, S. L. & Ehlenz, M. M. (2024). The Urban Context of Rental Housing Developments near Major U.S. Universities. *Journal of Planning Education and Research*. Online early. DOI: 10.1177/0739456X241264284

Meligrana, J. & Skaburskis, A. (2005). Extent, Location and Profiles of Continuing Gentrification in Canadian Metropolitan Areas, 1981-2001. *Urban Studies*, 42(9), 1569-1592.

Moos, M. (2016). From gentrification to youthification? The increasing importance of young age in delineating high-density living. *Urban Studies*, 53(14), 2903-2920.

Moos, M., Revington, N., Wilkin, T. & Andrey, J. (2019). The knowledge economy city: Gentrification, studentification and youthification, and their connections to universities. *Urban Studies*, 56(6), 1075-1092.

Munro, M. & Livingston, M. (2012). Student Impacts on Urban Neighbourhoods: Policy Approaches, Discourses and Dilemmas. *Urban Studies*, 49(8), 1679-1694.

O'Mara, M. P. (2012). Beyond town and gown: university economic engagement and the legacy of the urban crisis. *Journal of Technology Transfer*, 37, 234-250.

Perry, D. C. & Wiewel, W. (2005). *The University as Urban Developer: Case Studies and Analysis*. Armonk, NY: M.E. Sharpe.

Phillips, A. (2024). International students latest villain in Canada's failed housing strategy. *The Toronto Star*, 19 January. Retrieved 31 May 2024 from https://www.thestar.com/opinion/star-columnists/international-students-latest-villain-in-canadas-failed-housing-strategy/article_2326d940-b619-11ee-b607-8f5816f301af.html

Pillai, A. K., Vieta, M. A. & Sotomayor, L. (2024). University Student Housing as Business Proposition and Entrepreneurial Activity: The Canadian Case. *Housing Policy Debate*, 34(5), 644-667.

Pottie-Sherman, Y., Christensen, J., Foroutan, M. & Zhou, S. (2024). Navigating the housing crisis: A comparison of international students and other newcomers in a mid-sized Canadian city. *Canadian Geographies*, 68(1), 44-56.

Preston, V. & Kobayashi, A. (2020). International Migration and Immigration: Remaking the Multicultural Canadian City. In M. Moos, T. Vinodrai & R. Walker (eds.), *Canadian Cities in Transition: Understanding Contemporary Urbanism* (6th ed.). Toronto: Oxford University Press.

Pugh, R. (2017). Universities and economic development in lagging regions: 'triple helix' policy in Wales. *Regional Studies*, 51(7), 982-993.

Pugh, R., Hamilton, E., Jack, S. & Gibbons, A. (2016). A step into the unknown: universities and the governance of regional economic development. *European Planning Studies*, 24(7), 1357-1373.

Qian, H. & Zhao, C. (2018). Space-time analysis of high technology entrepreneurship: A comparison of California and New England. *Applied Geography*, 95, 111-119.

Revington, N. (2021). Age Segregation, Intergenerationality, and Class Monopoly Rent in the Student Housing Submarket. *Antipode*, 53(4), 1228-1250.

Revington, N. (2022). Post-studentification? Promises and pitfalls of a near-campus urban intensification strategy. *Urban Studies*, 59(7), 1424-1442.

Revington, N. & August, M. (2020). Making a market for itself: The emergent financialization of student housing in Canada. *Environment and Planning A*, 52(5), 856-877.

Revington, N. & Wray, A. J. D. (2024). Land-Use Planning Approaches to Near-Campus Neighborhoods and Student Housing Development Patterns in Ontario, Canada. *Housing Policy Debate*, 34(5), 668-694.

Revington, N., Zwick, A., Hartt, M. & Schlosser, J. (2023). Universities and urban social structure: gentrification, studentification, and youthification in five United States legacy cities. *Urban Geography*, 44(1), 83-104.

Sage, J., Smith, D. & Hubbard, P. (2012). The Diverse Geographies of Studentification: Living Alongside People *Not* Like Us. *Housing Studies*, 27(8), 1057-1078.

Smith, D. P. (2005). Studentification: the gentrification factory. In R. Atkinson & G. Bridge (eds.), *The New Urban Colonialism: Gentrification in a global context*. New York: Routledge.

Smith, D. P. & Holt, L. (2007). Studentification and 'apprentice' gentrifiers within Britain's provincial towns and cities: extending the meaning of gentrification. *Environment and Planning A*, 39, 142-161.

Sotomayor, L. & Zheng, C. (2024). Who Drinks Bubble Tea? Coethnic Studentification in Toronto's Chinatown. *Housing Policy Debate*, 34(5), 695-721.

Trabelsi, O. (2024). *Exploration de la relation entre la proximité géographique des universités et la transformation des quartiers dans les agglomérations canadiennes entre 1981 et 2016 : une analyse par régressions spatiales par panel* [Master's thesis, Institut national de la recherche scientifique]. Espace INRS. https://espace.inrs.ca/id/eprint/15888/

Trippl, M., Sinozic, T. & Lawton Smith, H. (2015). The Role of Universities in Regional Development: Conceptual Models and Policy Institutions in the UK, Sweden and Austria. *European Planning Studies*, 23(9), 1722-1740.

Walks, R. A., & Maaranen, R. (2008). Gentrification, social mix, and social polarization: Testing the linkages in large Canadian cities. *Urban Geography*, 29(4), 293-326.

Woldoff, R. A. & Weiss, K. G. (2018). Studentification and Disorder in a College Town. *City & Community*, 17(1), 259-275.

Zasina, J. & Jakubiak, W. (2024). Studentification, youthification, and gentrification, all at once? New-builds, newcomers, and near-campus change in a post-industrial city. *Bulletin of Geography. Socio-economic Series*, 64, 87-101.