McGill UNIVERSITY

Supervised Research Project Submitted in Partial Fulfillment of the Requirements for Degree of Master of Urban Planning

A preliminary analysis of population and employment dynamics within the Greater Toronto Area, the Greater Montreal Area, and the Greater Vancouver Area between 2006 and 2016 in relation to customized accessibility geography

On the topics of the determinants of residential choice, gentrification, and sustainable urban growth

By Haoran Wu
Supervisor: Prof. Richard Shearmur
The School of Urban Planning, McGill University
2022/08/17

Acknowledgement

Completing my master's degree during a global pandemic was an incredible experience during which I confronted hardship stemming from remote learning, social isolation, health-related issues, and other personal endeavours. I would like to use this opportunity to acknowledge and extend my most profound gratitude to my family, friends, and colleagues for their emotional and spiritual support along the way.

Although there were many regrets associated with this experience, I am extremely fortunate to be blessed with heartfelt, lifelong friendships with my peers, as well as trusting colleagueship with faculty members and administrative personnel, especially Ms. Gladys Chan.

I want to especially thank Professor Richard Shearmur for his guidance, teaching, and encouragement throughout this supervised research project. Without his beneficial counsel and constructive critique, I wouldn't have been able to produce this final product that I am tremendously proud of.

"*McGill University is on land which has long served as a site of meeting and exchange amongst Indigenous peoples, including the Haudenosaunee and Anishinabeg nations. We acknowledge and thank the diverse Indigenous peoples whose presence marks this territory on which peoples of the world now gather."*

Abstract

Metropolitan areas are the epicentre of urban growth in the 21st Century. According to U.N-Habitat, over one-third of the world's population and two-thirds of the world's urban population now live and work in metropolitan areas. These ratios are predicted to expand at a rapid rate in the coming decades. Therefore, obtaining an in-depth understanding about the spatial structure of metropolitan areas, the internal distributions of population and economic activities, the factors that drive population and economic growth and their distributions, and the challenges they face in relation to managing growth is imperative to promote urban sustainability. This present research investigates these topics in the context of the three largest Canadian metropolitan regions: the Greater Toronto Area, the Greater Montreal Area, and the Greater Vancouver Area. Methodologically, using Statistics Canada's proximity measure database, we construct an aggregated accessibility geography for each metropolitan region based on a clustering model. On top of this geography, we overlay the 2006 and 2016 Labour Force Survey data at the place of residence and place of work to examine the location of different types of workers and employments as well as spatial dynamics during the decade. The outcomes of our analyses contribute to the following knowledge from the Canadian experience: 1) determinants of locational choice, especially for members of the creative class; 2) gentrification and displacement; 3) sustainable urban growth in relation to the 15-Minute City.

Les régions métropolitaines sont l'épicentre de l'urbanisation au XXIe siècle. Selon U.N. Habitat, plus d'un tiers de la population mondiale et deux tiers de la population urbaine mondiale vivent et travaillent dans des zones métropolitaines. Ces ratios devraient s'accroître à un rythme rapide au cours des prochaines décennies. Par conséquent, pour promouvoir la durabilité urbaine, il est primordial d'acquérir une connaissance approfondie de la structure et la organisation spatiale des régions métropolitaines, de la répartition interne de la population et des activités économiques, des facteurs qui stimulent la croissance démographique et économique et la répartition de ces croissances, ainsi que des défis auxquels elles sont confrontées en matière de gestion de croissance. La présente recherche étudie ces sujets dans le contexte des trois plus grandes régions métropolitaines canadiennes : la région du Grand Toronto, la région du Grand Montréal et la région du Grand Vancouver. La méthodologie utilisée consiste à utiliser la base de données des mesures de proximité de Statistique Canada pour construire une géographie agrégée de l'accessibilité pour chaque région métropolitaine selon un modèle de regroupement. Par-dessus cette géographie, nous superposons les données de l'Enquête sur la population de 2006 et 2016 au lieu de résidence et au lieu de travail afin d'examiner la localisation de différents types de travailleurs et d'emplois ainsi que la dynamique spatiale au cours de la décennie. Les résultats de nos analyses contribuent aux connaissances suivantes de l'expérience canadienne : 1) les déterminants du choix de localisation, en particulier pour les membres de la classe créative ; 2) la gentrification et le déplacement ; 3) la croissance urbaine durable en relation avec la ville en 1/4 heure.

Table of Contents

1. Introduction

According to a recent study published by the U.N-Habitat (UN-Habitat, 2020), over one-third of the world's population and two-third of the world's urban population live and work in metropolitan areas, which are economic regions composed of a principal city, smaller suburban municipalities, peripheral towns, as well as exurban communities whose economies and populations are heavily integrated into the regional economic networks. The report predicts that metropolitan areas will absorb a dominant share of global urban population growth. By the year 2035, over 50% of the world's population will live in metropolitan areas.

The urban centres are commonly recognized as the engine of economic and population growth for their respective metropolitan area thanks to the benefits of agglomeration economies. In Adam Smith's classical theory of urban economy (Smith 1776), the agglomeration of enterprises, industries, and skilled workers in cities reduces the costs associated with communication, transportation, as well as matching between firms and potential employees.

Another benefit of agglomeration economies includes what is known as 'knowledge spillover' or 'cross-pollination' effects where the concentration of highly skilled workers permits the diffusion of ideas and knowledge across different professions and industries. The exchange and cross-pollination of knowledge, ideas, and skills across different disciplines and the combination and recombination of human capital have been hypothesized as key processes that drive innovations and regional development in modern metropolises (Jacobs, 1969; Lucas, 1988). Empirically, a large body of research has noted the positive effects of industry and employment density on economic growth and regional development by running models on the metropolitan level across major city regions (e.g., Florida, 2002; Krugman, 1990; Porter, 2012).

Research on the economic impact of human capital accumulation on the metropolitan level is equally extensive and relevant studies have revealed a strong positive correlation between human capital density and regional economic performance across large metropolitan areas (eg. Berry & Glaeser, 2005; Florida et al., 2008; Rauch, 1993; Simon & Nardinelli, 1996; Simon, 1998).

More recently, a growing body of research has investigated the intra-metropolitan distribution of and competition for human capital and industries and their relevant effects on regional economic development (Kolenda & Liu, 2012; Florida et al., 2016; Kiuru & Inkinen 2017; Arauzo-Carod & Viladecans-Marsal, 2009; Frenkel, 2012). This literature posits that in addition to the overall level of human capital and industry concentration in a metropolitan region, their internal distribution across different components of the metropolitan region also affects regional economic development.

For example, in analyzing American metropolitan areas of varying sizes, Florida et al. (2016) discovered that both human capital in the city centre and human capital in the suburbs matter to the average income and housing value, two indicators of regional economic performance. They found that human capital in city centres is more strongly associated with economic performance in the largest American metropolitan areas. However, human capital in suburbs has a relatively stronger association with regional development across metropolitan areas of all sizes.

In the context of the Helsinki metropolitan area, Kiuru & Inkinen (2017) found that innovations primarily emerge in dense and mixed urban structures, i.e., the core of the principal city, where human capital concentration is the highest. Arauzo-Carod & Viladecans-Marsal (2009) identified a strong negative association between distance from the central city and the concentration of high-technology establishments, highlighting the role of the central city as the hub for the high-technology economy in their metropolitan region.

To help harness the benefits of agglomeration economies, research on the determinants of locational choice for individual firms and talents has been rapidly expanding in recent years. In post-industrial economies, creative and knowledge-based industries as well as their workforce rose to the centre of the spotlight. Specifically, creative industries refer to a range of economic activities that are concerned with the generation and commercialization of creativity, symbols, and ideas, which encompass design, music, publishing, architecture, film and video, and many others. Knowledge-based industries refer to a range of economic activities that are concerned with the production and reproduction of highly specialized knowledge and innovation of new technology, which encompass high-technology, finance, communications, education, pharmaceuticals, and many others.

There exist two divergent schools of thought in relation to the locational preferences of people and firms. In brief, the classical, utility-oriented model holds that all individuals and firms base their locational choice on the compromise between utility-oriented amenities and disamenities associated with a particular location. These utility factors can include land cost (Bell, 1968), job accessibility (Horner & Marans, 2005), natural amenity, travel time, life cycle, and others. The life cycle (e.g., Clark et al., 1984) is an important determinant of residential choice in the classical theory. People's needs and desires evolve through different stages of their life, which affects their locational preference.

The creative class location theory was proposed by Richard Florida in the early 2000s and gained instant popularity among urbanists and policymakers along with a fair share of criticisms. The creative class a somewhat of a misnomer because it lumps in elite occupational categories with high salaries and occupational categories directly linked with creativity that are not necessarily well-paid.

According to this theory, members of the creative class have a distinct desire for soft, bohemian amenities like social tolerance, cultural diversity, and cosmopolitan recreation (Florida 2002, McGranahan & Wojan 2007). These soft amenities take priority over utilitarian amenities in their residential decision-making, which propels them to cluster in urban centres of large metropolises where such amenities are abundantly afforded (Jacobs, 1964; Florida, 2005). Empirically, several studies noted a disproportionate prevalence of members of the creative class within the urban centre as opposed to elsewhere (e.g., Frenkel et al., 2013; Florida & Adler, 2018; Maré & Coleman, 2011; Smith et al., 2018). In the American context, Florida & Adler (2018) discovered salient residential segregation between the creative class and disadvantaged worker groups within metropolitan regions, a phenomenon they coined "patchwork metropolis" in post-industrial societies.

The determinants of the location of creative and knowledge-based firms are also debated in the literature. For instance, Guillain et al., (2006) and Spencer (2015) found that creative and knowledge-intensive firms appear to disproportionately cluster in the urban core. Conversely, Duvivier et al., (2018) and Shearmur (2012) discovered that suburban employment centres and office parks in Canadian cities harbour a large cluster of creative and knowledge-based firms.

The creative-class theory is intimately tied to the subject of gentrification where an increasing number of highly educated and highly skilled workers, i.e., the creative class, have flocked to urban centres in recent decades, changing the sociodemographic character of inner-city neighbourhoods. The gentrification literature particularly emphasizes the displacement of the less-advantaged residents from highly central and highly functional working-class neighbourhoods. Many have been forced to move out to urban fringes and degenerating suburbs because housing has become unaffordable (Atkinson & Easthope, 2009; Howell, 2005; Peck, 2005).

The final topic covered in this present research relates to promoting sustainable urban growth in metropolitan regions, which is an urgent and necessary task for contemporary urban policies. In light of the looming climate crisis, cities contribute to more than 60% of the world's greenhouse gas (GHG) emissions. We desperately need innovative sustainable urban models that involve deep decarbonization, particularly in urban transportation and supportive policies that reduce car dependency.

In this regard, an increasing number of urbanists (e.g., Abdelfattah et al., 2022; Azmi & Karim 2012; Capasso Da Silva et al., 2019; Duranton & Guerra, 2016; Moreno et al., 2021) have advocated a return to more human-centred urban environments where residents can access essential urban services and amenities using sustainable modes of transportation, such as walking and biking, thus leading to emission reduction.

In addition to environmental sustainability, human-centred urban models also promote social cohesion and vibrancy, traffic safety, economic vitality, general health and well-being, and equity. The COVID-19 pandemic unveiled the deeply rooted inequalities in urban mobility and by extension, inequity in access to essential amenities and services. During the peak of the viral outbreak, many cities implemented containment measures that included either complete suspension or serious reduction of transit services, which disproportionately impacted the mobility and access of low-income residents. Fortunately, as vehicular traffic calmed down, many cities seized the opportunity to convert vehicular spaces into pedestrian and cyclist spaces. Many of these temporary infrastructures became permanent due to high community demand.

In the context of sustainable development and post-COVID recovery, two spin-off models of human-centred urban design gained prominence in political discourse and popular media coverage, which include the 15-Minute City and Complete Communities. Both models strive to create neighbourhoods where the most basic urban services and amenities are accessible within a short walking or biking distance for everyone's home regardless of their socioeconomic background (Moreno et al., 2021). To effectively attain this goal, the built landscape of these neighbourhoods must comply with the following component, proximity, diversity, density, ubiquity, and digitalization.

This present paper incorporates these interrelated issues from different strands of geographical literature in our analyses of the spatial characteristics of intra-metropolitan population and employment dynamics in the three largest Canadian metropolitan regions during the decade of 2006 – 2016. Note that the population universe covered in this present research encompasses workers who were employed in the respective census years.

For each metropolitan region, these dynamics are mapped in relation to a customized accessibility-based cluster geography in which the entire metropolitan region is categorized into different smaller components with similar accessibility characteristics. Due to time and space restraints, only the last part of our analyses covers the employment dynamics from the perspective of sustainable urban growth.

Specifically, this present research is motivated by the following research questions:

1. Was there an association between essential accessibility and the residential sorting of different occupational groups within the three top-tier Canadian metropolitan regions in the year 2016?

2. Did residential segregation between elite and disadvantaged occupational groups exist in relation to the geography of accessibility for each metropolitan region? More importantly, did elite occupational groups disproportionately enjoy better accessibility outcomes than disadvantaged groups?

3. What were the characteristics of intra-metropolitan residential dynamics between 2006 and 2016 in relation to the geography of accessibility for each of the three Canadian metropolitan regions? What did they convey about changes in the socioeconomic character on various geographic scales, especially within well-built, highly accessible areas in the urban centres?

4. What were the patterns of population and employment growths between 2006 and 2016 in relation to the geography of accessibility for each metropolitan region? What challenges and opportunities do these patterns reveal in relation to promoting sustainable models of urban growth, such as the 15-Minute City or the Complete Communities, in Canada?

To orient our readers, the broad structure of this present paper is the following. The upcoming literature review section provides a summary of concepts, theories, and research evidence related to the following themes: locational preference, class segregation, gentrification, neoliberal place-making policy, and accessibility-based urban design. The descriptions of our research data, research questions, methodological development, and specific analytical methods come next. This is followed by the presentation of our analysis outcomes and pertinent discussions in three interconnected chapters. In the conclusion, we highlight the key findings from the three analysis chapters and discuss the implications for future policymaking.

2. Literature review

2.1 Determinants of locational choice

There exists a large body of literature on the locational preferences of individuals, households, and firms. Relevant studies share a common interest in determining the locational characteristics responsible for attracting human capital as well as industries to certain localities. Many studies have been conducted on the scale of cities and city regions because they are the focal points of human settlement and economic activities, acting as the growth engine in their country of belonging.

However, the location of people and jobs within cities is also of critical importance to the extent that their relative location can either facilitate or hinder the functioning of labour markets as well as economic productivity. Thus, deciphering the location factors within cities that drive residences and jobs is critical for crafting effective urban policies to promote local or subregional development. Since residential dynamics is the focus of this present research, we will focus our review on the determinants of residential locations.

It is generally accepted in this literature that the locational choice of individuals and firms is the outcome of a rational decision-making process that involves evaluating the amenities and dis-amenities associated with a particular location against their particular needs and preferences (e.g., Alonso, 1964; Clark & Huang, 2003; Florida, 2002; Lawton et al. 2013; Meloche, 2020; Roback, 1982). For people, these needs and preferences will evolve over their life course (e.g., Mieszkowski & Mills, 1993). This is not to say that people strive for the optimal location according to a closed set of weighted criteria fed into an iterative algorithm. Instead, they look for a satisfactory location that meets a set of minimum criteria. Frequently, this decision-making process involves trade-offs and compromises.

Broadly, there exist two opposing traditions in the literature on the determinants of residential location: the classical utility-oriented theory and the lifestyle-oriented theory or more commonly known as the creative class location theory. The main point of contention between these two traditions concerns the differences between different occupational classes in relation to the order of priority they assign to utilitarian amenities and soft amenities in choosing their residential location.

2.1.1 Classical location choice theory

According to the classical location theory (Alonso, 1964; Bourne, 1981; Rossi, 1955), people's residential locations within a metropolitan area are influenced by economic factors, including income, housing cost, and commute cost, and demographic factors, including life cycle and household characteristics, which influence the amount of utility they derive from different urban amenities. For firms, the basic economic and amenity considerations also apply.

The classical location theory has been enriched throughout the decades as cities and their urban form evolved; however, the focus on utility has remained. In the early, simplified conceptualization of the monocentric city model (Alonso, 1964; Muth, 1961), employment and commercial activities are assumed to concentrate in the city centre. As a result of land use intensity, the land rent is the highest in the city centre and peters out with distance into the periphery. The opposite is true for commute cost, which increases with distance to the city centre. On the very elementary level of analysis, people choose their residential location in a city based on the trade-off between land rent and travel cost within the constraint of their budget (Muth, 1961). This equation gets more sophisticated when additional utility inputs and attractor points, such as parks, shops, health clinics, and schools, are incorporated (e.g., Mieszkowski & Mills, 1993; Roback 1982).

Another critical determinant in the classical location theory is one's lifecycle, which regulates the relative importance associated with each utility input in individual households' residential equation (Meloche, 2020). For example, on one hand, a young professional is more inclined to trade dwelling space for greater employment accessibility or proximity to more entertainment destinations, which gravitates them towards residential locations in dense city centres (Clark & Huang, 2003; Clark et al., 1984; Lawton et al., 2013; Prashker et al., 2008).

On the other hand, a family household behaves with a larger emphasis on proximity to childcare, schools, greenspaces, and recreational facilities for children, leading them to choose suburban residences (Hur & Morrow-Jones, 2008; Karsten, 2007; Kim et al., 2005). Once the child has grown up and moved out of the family dwelling, the parents may wish to downsize in exchange for living closer to facilities that cater to their new needs (Luborsky et al., 2011).

However, not every individual or household conforms to this lifecycle hypothesis. Research in the Netherlands (Boterman et al. 2007; Karsten 2003), the United States (Cucchiara and Horvat 2009) and the United Kingdom (Butler & Robson, 2003) shows that many middle-class families with children, who should, according to the classical utility-oriented theory, have a proclivity for detached houses in the suburbs, are increasingly choosing to remain in the city centre, demonstrating a commitment to city living.

For instance, in an interesting case study in Boston, the research participants of middle-class family households became heavily involved in local school-related affairs after having children to improve the quality of local schooling so that they can maintain their urban residences (Billingham & Kimelberg, 2013). Closely associated with the middle class in post-industrial economics is a category of highly skilled, talented, and creative professionals, known as the creative class. This group's locational preference is at the centre of debate with much research indicating that their locational choice is primarily motivated by soft, human environment factors as opposed to classical utilitarian factors (e.g., Clark et al., 2002; Florida, 2002, 2005). Moreover, lifecycle has a relatively minor effect on their residential location since they are committed to urban living. The next subsection examines the conjectures of this recent controversial thesis and relevant research outcomes.

2.1.2 Creative class location choice theory

Members of the creative class comprise highly educated professionals in scientific and technological industries, intellectuals, artists, and designers of various disciplines (e.g., writers, musicians, visual designers, architects), and many other occupations whose job is to create "new ideas, new technology, and new content" (Florida, 2002 & 2005).

Based on both anecdotal and some empirical evidence, creative class theorists challenge the applicability of the classical utility-oriented theory to explain the residential choice of the creative class. Instead, creative class theorists, particularly the original author Richard Florida, posit that members of this class ubiquitously exhibit an avidity for soft and lifestyle-oriented amenities, including social tolerance, cultural diversity, and cosmopolitan forms of entertainment, which take precedence over the importance of utilitarian amenities. As a result, they choose to cluster in urban neighbourhoods of large metropolitan areas where these lifestyle-oriented amenities are abundant, which has been shown in various studies (Clark et al., 2002; Florida, 2002; Jacobs, 1964; Ley, 2003; Lucas, 1988; Wojan et al., 2007; Smith et al., 2020).

Moreover, compared to the rest of the population, the location of the creative class is more loosely restricted by hard factors like housing costs, employment availability, and lifecycle, which are essential determinants of residential location in the classical theory. This thesis (Florida, 2002) suggests that economic growth in post-industries cities is centred on the 3 T's – talent, tolerance, and technology. To attract creative talents, cities should invest in soft, bohemian amenities, such as social tolerance, cultural diversity, public art, and so on.

Despite its wide acceptance and popularity in the political environment and popular media, the creative class location theory is subject to many critiques on various fronts. The very classification of the creative class is debated in the relevant literature. In his original theorization, Florida describes the "creative class" as comprising professionals in a wide range of occupations whose main job function involves the creation of new ideas, new technology, and creative content (Florida, 2002, p. 328). The "super creative core" encompasses occupations related to science, engineering, education, design, arts, and entertainment. Occupations in knowledge-intensive industries, such as finance, management, and healthcare, form the peripheral composite of the creative class. (Florida, 2002).

This rather broad categorization of the creative class into a core and peripheral group without substantive grounds to support this hierarchical division has been disputed in the literature. Accordingly, the overgeneralization that all members of the creative class share identical lifestyle-based residential preferences, such as social tolerance and acceptance, cultural diversity, and coolness, has also been met with serious critiques (Alfken et al., 2015; Asheim & Hanson, 2009; Lawton et al. 2013; Markusen, 2006; McGranahan & Wojan, 2007; Storper & Scott, 2009).

Asheim & Hanson (2009) proposed an alternative classification of the creative class into three horizontal groups based on the nature of knowledge and activities associated with their work. According to this framework, creative workers in scientific industries perform predominantly "analytic activities", which require specialized knowledge of formal models and codification systems. Another group of creative workers, such as engineers, perform primarily "synthetic activities", which involve applying existing knowledge in new ways to solve specific problems. The last type of knowledge base is symbolic, which is concerned with the creation of meaning and desire, as well as new ideas and aesthetics. It is employed in cultural, media, and entertainment industries.

Asheim & Hanson (2009) and McGranahan & Wojan (2007) also noted that the knowledge base that a specific group of creative workers relies on in their work affects the relative importance they assign to lifestyle factors vis-à-vis classical factors. They discovered that in the context of Swedish metropolitan areas, the residential location of creative workers who engage with symbolic and analytical types of creative work is more strongly associated with bohemian and cultural amenities. Whereas the residential location of synthetic workers is more strongly associated with classical factors. Overall, these papers identified obvious diversity and complexity among the residential preferences of artist populations.

Even though most relevant research has been conducted on the scale of metropolitan regions, there is a small growing body of literature examining the location of the creative class within cities and metropolitan areas. These studies also identified conspicuous diversity within the creative class in relation to locational preference. While the location of younger creative professionals within metropolitan regions exhibits a positive correlation with lifestyle amenities, the continued importance of classical factors for family households was noted in numerous papers (Brown & Mczyski, 2009; Bontje & Musterd, 2005; Frenkel et al., 2013; Lawton et al., 2013; Baum et al., 2007).

Overall, the two strands of theory on the determinants of location choice provide valid evidence to support the importance of both utilitarian and lifestyle factors in the residential sorting of individuals and individual households. The fact that neither theory can perfectly explain the residential location of middle-class and creative-class families depicts the vast diversity across individuals in relation to what locational factors they prioritize over others. However, it appears that central locations exert a stronger attraction on particular components of the creative class, if not all its members.

The analysis featured in this research is more in alignment with the classical location theory where we investigate the possible correlation between the location of workers belonging to two distinct occupational groups that fall within the creative class and accessibility characteristics in relation to essential, utilitarian urban amenities.

2.2 Inner-city gentrification, patchwork metropolis, inequity in accessibility

2.2.1 Gentrification and gentrifiers in post-industrial cities

Florida's creative class theory is closely related to the phenomenon of inner-city gentrification in post-industrial cities. Highly educated and highly skilled workers, who correlate strongly to Florida's classification of the creative class (Glaeser, 2005), are often seen as the "gentrifiers" of working-class neighbourhoods in city centres due to the popularization of Florida's ideas. Recent research seems to support this phenomenon, noting a steady increase in the clustering of workers who occupy elite professional jobs in city centres (e.g., Clark et al., 2002; Edlund et al., 2015; Ehrenhalt, 2013, Florida, 2002 & 2005; Florida & Adler 2018; Smith et al., 2020).

Through a sociological lens, gentrification describes a change in the sociodemographic structure of neighbourhoods due to an influx of wealthier residents. Gentrification often coincides with displacement, which describes an outward migration of households of lower socioeconomic status from gentrifying neighbourhoods as a result of land value uplift. Economically, gentrification involves increased commodification and reinvestment in impoverished, disadvantaged, and neglected neighbourhoods in city centres, bringing them into a state of renewal and revitalization (Ley, 2003). Research has shown that in major US cities, single-family residences within a 10-mile distance from the city centre have become more expensive than those outside a 10-mile distance, an interesting reversal since the 1980s (Edlund et al., 2015).

It has been posited that the inner-city gentrification process is often commenced by the artist populations (Hackworth & Smith, 2001; Ley, 1996; Ley, 2003). This strand of literature articulates a notion of gentrification being consisted of successive waves or phases characterized by the profile of current gentrifiers, starting with artists who are drawn to the unordered, authentic, and affordable qualities in the marginal spaces of central cities. Moreover, because of their more precarious income, housing and studio affordability in these relatively impoverished inner-city neighbourhoods is another important attractor. The evidence of the association between the role of artists as pioneer gentrifiers, the subsequent creation of artist spaces, and the consecutive nature of gentrification is plentiful in the relevant literature in the post-industrial context (Cole, 1987, Davidson & Lee, 2005; Hackworth & Smith 2001; Hamnett, 2003; Ley, 2003; Wyly & Hammel, 2004).

For Ley (2003) and Wojan et al. (2007), because artistic creation heavily draws inspiration from experiences in the artist's life, including interactions with the living environment, the attributes of the locality they reside in become an important source of prompts, signs, and symbols. Their arts reflect versions of localities that bear the artist's subjective interpretations of space and place. As their arts become recognized by local and regional audiences, the imagined localities upon which their artwork depend also become popularized. In this manner, artists engage in the aestheticization of inner-city neighbourhoods, creating and commodifying a bohemian neighbourhood image or a lifestyle that appeals to the rest of the creative class (Ley, 2003; Markusen, 2006; Mathews, 2010). For instance, the artists in SoHo, New York and other post-industrial cities created massive popularity around the aesthetic of industrial chic when they took up residences in old, vacant industrial buildings, which has been rebranded as a chic lifestyle around loft-style condominiums targeting the middle and upper-class audience (Zukin, 1982).

Finally, gentrification literature often speaks of population displacement in these working-class neighbourhoods as the negative externality of gentrification. Forced population displacement is a popular and touchy subject in public and political discourses, but its validity in the literature remains ambivalent and controversial. We argue that many writers fail to grapple with the fact the "working-class" in western cities has been disappearing and many of its members have been observed and integrated into other economic sectors.

Hamnett (2003) posited that the working class has not so much been displaced as has disappeared in western cities. Structural economic changes associated with de-industrialization led to a massive disappearance of large factories, which entails fewer and fewer working-class occupations. Naturally, one also identifies a decline in working-class households in western cities, which has no connection to displacement. However, this does not mean low-income status and vulnerability ceased to exist in the population. In fact, the dominant service-based economy in post-industrial cities employs a massive number of temporary and gig workers who have a vulnerable income status in juxtaposition to knowledge-based professionals. Furthermore, it is likely that workers who previously occupy blue-collar jobs transferred into the service-based economy.

Another critical perspective in alignment with the classical location theory highlights the fact that many people are still attracted to more spacious suburban (town)houses and want to live closer to work. It is possible that because of land value uplift in urban centre, blue-collar workers who always wanted to live in the suburbs close to their work but are outpriced financially finally got to sell their apartments for an equivalent price of a suburban house. In this scenario, blue-collar workers are far from victims of forced displacement; instead, they are powerful consumers seeking to maximize the utility of their housing consumption.

This is not to say that forced displacement of communities does not happen at all. Instead, what we advocate is a more critical and holistic approach to examine whether lower-income communities have in fact been forcefully displaced. Thus, our analysis focusing on gentrification and displacement combines blue-collar workers with sales & service workers into a single population with lower-income status based on the assumption of labour transfer. Moreover, because of its negative connotation, we purposefully avoid using the term, gentrification, in describing our results. Instead, we adopt a more neutral expression, "change in socioeconomic character", to describe the effect associated with structural sociodemographic changes.

2.2.2 Residential segregation and the Patchwork Metropolis

The gentrification literature stresses the underlying reality that cities are divided spaces, and the spatial structure of residential geography is frequently segregated along the line of income and social status. Waston (2009) has noted that class segregation along the line of income worsened in the majority of American metropolises between the 1970s and 2009. Other research has noted the disappearance and erosion of middle-class neighbourhoods and an expansion of lower-income areas in Canadian metropolitan regions (Hulchanski, 2010; Ley & Lynch, 2012). This evidence suggests that de-industrialization has coupled with an increased spatial divide between the rich and the poor and the erosion of middle-class neighbourhoods (Florida, 2016).

In the classical depiction of residential geography in industrial cities (e.g., Alonso, 1964; Bourne, 1981), lower-income families occupy areas of the urban core that are troubled by a high concentration of poverty, crime, pollution, and other disadvantages. Outside the urban core, one finds concentric rings of affluent suburbs where the upper- and middle-class families reside. However, recent research in the American context has noted a phenomenon whereby highly skilled and educated professionals with high salaries, who used to concentrate in the suburbs, have been increasingly flocking to the city centre. This phenomenon is popularly coined the "Great Inversion" or "Back to the City Movement" (Ehrenhalt, 2013). However, readers should note that while an increased prevalence of elite professionals in city centres is also pervasive in European countries, the city centres in Europe have been consistently associated with wealth and prestige and relatively unaffected by racial tensions in residential geography. Whereas racial tensions in residential geography had been extremely salient in American cities, causing the post-war White Flight. Thus, the spatial manifestation of the "Great Inversion" is uniquely an American phenomenon.

As a result of a large in-migration of elite professionals with high salaries, the neighbourhood character of previously working-class neighbourhoods becomes gentrified with the opening of new high-end shops that cater to the consumption patterns of these wealthier residents and improvement of the housing stock. Such commercial and real-estate reinvestments drive up land value and living costs, making these inner-city neighbourhoods no longer affordable to lower-income households. In this context, the residential geography of post-industrial cities becomes increasingly segregated.

For example, Smith et al. (2020) have noted an unrefutably obvious pattern of residential segregation between the professional classes and low-order classes in the Greater London Area (GLA) in the year 2011. Moreover, they found that between 2006 and 2016, the population of professional classes has grown considerably in the inner GLA. Whereas the population of lower-order classes grew disproportionately in the outer region. Similarly, Travers et al., (2016) identified an increasing suburbanization of low-income populations in London.

The spatial patterns of residential segregation appear to be more complex than a binary division between the city centre and the rest of the metropolitan region. Florida & Adler (2018) has identified concentrated advantages and disadvantaged in patchwork patterns spanning the entire metropolitan areas in the United States, which they refer to as "patchwork metropolis". This concept highlights that class- and income-based residential divides span both the city and suburb where the advantaged classes occupy and cluster around the urban core and suburban areas that are the most economically functional, aesthetic, and amenity-rich on the one hand. On the other hand, the relatively disadvantaged classes are pushed out toward the leftover, undesired edge spaces in city centres and suburban areas.

2.2.3 Practical implications of residential segregation: inequity in access to opportunities

A serious implication of worsening residential segregation along the line of social status and income is the widening inequality in access to opportunities from one's home. These include employment and essential urban services and commodities.

Historically, lower-income individuals and households had adequate accessibility outcomes despite having low car ownership because their residences in the urban centre provide short distances to key destinations, which could be fulfilled by walking, biking, or transit. However, because the forces of gentrification have shunted them into underserved and underserviced parts of the city and suburbs that are designed around the automobile, their accessibility outcomes have eroded drastically.

A limited amount of research has examined accessibility outcomes for different income or occupational classes (e.g., Florida & Adler 2018; Smith et al. 2020). For instance, Florida & Adler (2018) found that the advantaged class of knowledge, professional, and creative workers have a high level of accessibilities to the CBD, educational and other knowledge-based institutions, transit services, and natural amenities across the metropolitan areas.

Smith et al. (2020) found that professional classes in the GLA benefit from significant employment accessibility advantages for all travel modes, particularly public transit and active transportation. On the contrary, the lower-order classes are more reliant on cars and have lower accessibility to more affordable travel modes like walking and transit. People with occupations in the sales & service-related sectors are the most disadvantaged in relation to mobility because they concentrate in the outer GLA served by very limited services.

2.3: Urban growth policy: place-making and the Fifteen-Minute City

2.3.1 Place-making through arts, culture, and lifestyle-related amenities

While academic debates around the extent of land value uplift and gentrification in inner-city areas and the link to the "back-to-the-city" movement among the creative class remain inconclusive (Edlund et al., 2015; Kolko, 2016), the wide range of literature on this topic conveys broadening recognition and reflection about the failure of urban public policymaking to protect the rights of lower-income residents and merchants to access or remain in central city neighbourhoods. Unfortunately, as many scholars noted and criticized, a recent popular trend in urban policy is entrained in Florida's creative vision; framed around "interurban competition, gentrification, middle-class consumption, and place-making"; and intertwined with neoliberal capitalism and entrepreneurialism (Peck, 2005).

Florida's creative class thesis, which claims that contemporary economic growth of cities and metropolitan regions rely on their ability to attract an influx of creative and knowledge workers, emphasizes the importance for cities to invest in "soft amenities", cultural activities, and lifestyle factors that are desired by these workers. This message has been welcomed and accepted by a strikingly large number of urban policymakers across the world (McCann & Ward, 2010; O'Callaghan, 2010; Peck & Theodore, 2010; Shearmur, 2007; Zimmerman, 2008). Specifically, it translated into the popularization of infusing arts, culture, and lifestyle considerations in urban place-making to compete for creative talents and industries (Mathews, 2010).

Cities around the world have raced each other to subsidize and implement various kinds of image-building or place-making strategies in collaboration with local partners to promote themselves as the vibrant locus of knowledge and creativity that is open, diverse, dynamic, and cool (Bontje & Crok, 2006; Peck, 2005; Zimmerman, 2008). Examples of soft, socially oriented initiatives can take the form of regular discussion salons and cultural encounters for creative workers and business owners in the case of Creative TampaBay in Tampa Bay, Florida. Another example is in Memphis, TN, where the local chamber of commerce and public agencies collectively commissioned extensive studies on potential strategies, including improvement of city image, to increase their position on Florida's Creativity Index (Peck, 2005). Moreover, the State of Michigan has implemented a "Cool Cities" program across the state to attract and retain those urban pioneers and young creative workers (Peck, 2005).

Another frequently implemented strategy includes heavy transformations of urban spaces along the line of arts, culture, and authenticity. Examples include building new large landmarks and physical facilities for the arts, such as galleries, museums, and concert halls; transforming streets into festival and event spaces; rehabilitating old factory buildings into housing; and installing public arts across the city (Hall & Robertson, 2001, Mathews, 2010, Peck, 2005). For instance, Yigitcanlar (2010) found that knowledge-based urban development (KBUD) planning policies in Australian cities pervasively cater to the amenity taste of the creative class. The ongoing transformation of central Dublin areas has been noted to be largely driven by entrepreneurial policies with a focus on 'soft amenity' factors (Fox-Rogers et.al, 2011; Lawton et al., 2010).

Research has emphasized the neoliberal, entrepreneurial spirit behind these city-planning initiatives, which manifests as fierce inter-urban contests in the form of experimentation with new policies, designs, and initiatives that aim to outperform one another on comparative metrics of creative cities inspired by Florida (e.g., Peck, 2005; Zimmerman, 2008; Yigitcanlar 2010). It can be argued that city planners and designers at large have been complicit in the gentrification of central neighbourhoods by enacting policies and programs that have largely benefited the privileged classes as well as the real estate, tourism, and high-tech industry interests. These policies showed little equity consideration for the disadvantaged as evidenced in the widespread displacement of lower-income residents and businesses through inner-city gentrification.

Another critical vantage point concerns the effectiveness of the above-mentioned urban policies to attract creative talents and industries, as well as the effectiveness of these policies to catalyze urban or regional growth (Peck, 2005; Shearmur 2007). Compared to large physical infrastructures, like highways and bridges, investments in soft infrastructures of arts and culture are usually cheaper, less labour-intensive, and less politically challenging. Therefore, it is reasonable that many cities were spurred into action after listening to Florida's seemingly convincing sales speech on investing in lifestyle factors that attract and retain creative people who are instrumental to the knowledge-based economy.

However, as Shearmur (2007) convincingly argued through a synthesis of relevant literature and empirical evidence, urban and regional growth is connected with a plethora of factors other than human capital. These factors include industrial structure, access to major markets, local culture, and agglomeration economies. His empirical regression results from Canada show that educated people move towards regions that grow the fastest, challenging the direction of causality between human capital and growth. Several studies featuring comparative analyses of creative human capital on various geographic scales have also recorded difficulties with Florida's conjecture about the locational attractors for the creative class.

For instance, Scott (2006) found that when choosing between two cities, employment availability is the paramount factor for people, including creative individuals. Glaeser (2005) drew parallels between the locational preference of creative people and that of most well-off people — "big suburban lots with easy commutes by automobile and safe streets and good schools and low taxes (Peck 2005).

In Niedomysl & Hansen, (2010), one's position in their lifecycle was found to exert significant influence over their residential outcome. Lawton et al., (2013) observed that creative individuals in Dublin appear to base their residential choice predominantly on classical factors, including housing costs and commute distance to work rather than lifestyle factors like proximity to bars and nightclubs. Overall, clusters of highly skilled, creative professionals are still prevalent in the suburbs of most cities (Couture & Handbury 2015; Edlund et al. 2015; Florida et al., 2016).

In regard to the link between a city's bohemian ranking and its economic performance, Malanga (2004) posited that tax rates and business-friendliness in a city are more strongly correlated to development indicators, such as the rate of employment and formation of high-growth businesses, compared to Florida's 3 T's. This paper also criticizes the strong linkage of Florida's ideas to liberal cultural politics and exhortations for urban intervention, which prevents cities from providing what residents really want (Malanga, 2004). Las Vegas has been used as a counterfactual case of high-growth cities despite exhibiting lousy culture, severe urban sprawl, and a lack of authenticity (Peck 2004). On the intra-urban scale, Kotkin & Siegel (2004) drew attention to the continuation of high economic and demographic growth in less fashionable but more livable suburban locales following the bust of the internet economy bubble.

In a 2016 publication, Florida et al. (2016) confirmed the continued presence of concentrated human capital in traditional, homogenous suburbs. More importantly, their research noted that suburban human capital (e.g creative and knowledge-based professionals) is more strongly correlated to economic performance and regional development than their counterparts in central city neighbourhoods.

2.3.2 Accessibility: Complete Neighbourhoods and 15-Minute City

Not only is growth itself of concern to urbanists and policymakers, the manner in which cities and regions grow and the location of growth are equally critical, especially from the environmental and equity perspective. Recently, there has been a growing interest and demand in both academia and real-world policymaking circles for placing accessibility in the centre of urban policymaking to stimulate and regulate urban and regional in a more sustainable manner (Anderson et al., 2013; Duranton & Guerra, 2016; Geurs & Van wee 2004). Research evidence regarding positive economic externalities associated with accessibility (e.g., Litman, 2003; Ozbay et al., 2003; Rauterkus & Miller, 2011; Rokicki & Stępniak, 2018) constitutes a convincing argument for (re)directing municipal resources toward localized regulatory reforms related to zoning and land-use controls, as well as strategic infrastructural or capital projects to catalyze urban and regional growth.

The overall literature on accessibility is extensive and covers different angles that intersect transportation, land use, and economic development, which is beyond the scope of this present research. While this present research does not systematically engage with accessibility literature, readers should be aware that:

1. Generally, accessibility is conceived as the nexus between land use and transportation – the top two primary consumption goods in the urban context. Accessibility is also believed to emerge from the spatial congregation of all different urban actors (residents, firms, and institutions), which is contingent on the local land-use policies (Duranton & Guerra, 2016).

2. An expanding body of research has identified empirical evidence of a positive relationship between economic growth & labour productivity enhancement and accessibility improvement due to investments in transportation infrastructure, particularly highways and airports (e.g., Jiao et al., 2016; Melo et al., 2017; Ozbay et al., 2003; Rokicki & Stępniak, 2018).

3. In addition to automobile accessibility, there is a growing interest in the intersection of land use and transportation planning literature regarding accessibility by alternative modes of transport, particularly walkable accessibility or simply walkability, and its relation to economic growth and regional development. Overall, relevant research indicated positive economic benefits associated with walkable accessibility or walkability, including increases in residential land value, development density, and labour productivity (Gilderbloom et al., 2015; Litman, 2003; Rauterkus & Miller, 2011; Sohn et al., 2012; Hartgen et al., 2009).

4. When conducting research related to accessibility, researchers must be cognizant and cautious about the fact that there is still abundant ambivalence in the accessibility-based literature surrounding how accessibility should be measured, for whom, and for what purposes (e.g., El-Geneidy & Levinson, 2006; Handy & Niemeier 1997, Páez et al., 2012; Saraiva & Pereira, 2016). More importantly, it is essential to understand and make explicit the research design and the underlying assumptions in order to draw accurate conclusions from the empirical outcomes.

In practice, the principle of accessibility is foundational to several related urban planning and urban design concepts that have recently gained traction amongst professionals in the field as well as politicians, especially in the wake of the COVID-19 pandemic where citizens' mobility has been seriously circumscribed by different forms of travel restrictions. The two trending concepts that advocate the importance of proximity to essential urban services and amenities include Complete Communities and the 15-Minute City. The former is thought to capture a hyper-local radius of a 5-minute travel distance. It also has a broader range of concerns and aspirations including housing and demographic diversity and inclusivity. The latter, as its name suggests, measures a larger radius of 15-minute travel distance, which can be understood as a spatial scale that is between neighbourhood and region.

The 15-Minute City was first introduced by Carlos Moreno in 2016 and it became rose to international fame and recognition after being featured as one of Paris' Mayor's 2020 re-election campaign promises. A prestigious international urban thinktank, C40 Cities Climate Leadership Group, implemented the concept of the 15-Minute City in creating a framework for its 97 member cities to envision, plan, and accomplish their recovery from the COVID-19 pandemic under the slogan of "build back better".

The COVID-19 pandemic unexpectedly exposed the deep-rooted vulnerabilities and inequalities in the social and economic spheres of cities that took root in car-dependent planning and design. With the complete shutdown or serious cutback of transit services in many cities during the height of the pandemic, many low-income urban residents struggled to cope and continue with their basic activities, including getting food and basic household supplies. Given this contemporary context, the 15-Minute City and Complete Communities also emerged as an alternative planning approach to increase the resilience of urban dwellers and urban economies against future pandemics and the imminent climate crisis that will bring about increased occurrences of extreme weather events, such as heatwaves, during which people want to stay closer to home or protected shelters.

Although these two concepts since frequently appeared in the media, official development plans, policy directions, and speeches given by politicians, there is not a singular, universal definition or set of standards in the literature or in practice by which planners and designers can implement in conceiving the appropriate transformation of urban neighbourhoods. In fact, the literature directly addressing these two concepts is very limited.

Moreno et al. (2021) made an attempt to enrich the definition and understanding of the 15-Minute City concept in relation to its origin, intent, and future development. As outlined in this paper, it is typically accepted that this concept is rooted in the organic planning of the 60s (e.g., Jacobs 1964). Fundamentally, it rejects the modern planning paradigm of organizing the urban form of cities around the automobile because it has caused many negative urban sociological and environmental impacts. Instead, the 15-Minute City advocates a return to human-oriented urban designs around active modes of transportation, especially walking and biking, that enable residents to effectively fulfill six essential urban social functions: 1) living, 2) working, 3) commerce, 4) healthcare, 5) education and 6) entertainment within a 15-minute travel distance from one's home. The Complete Communities concept shares similar aspirations of adding essential amenities and services in every neighbourhood so that residents can fulfill their most basic needs within an even shorter, 5-minute commute on foot or by bike.

In summary, these two concepts depict a geography and lifestyle where "locals are able to access all of their basic essentials at distances that would not take them more than 15 mins by foot or by bicycle" (Moreno et al. 2021).

Moreover, although these concepts have gained a favourable eye among policymaking circles and lay audiences, they have also been met with criticisms. As with the underlying principle of accessibility, "complete communities" confront similar controversies surrounding what services and amenities and what travel mode should be included in their conceptual and operational frameworks. For example, it is impossible to provide access to highly specialized healthcare facilities or higher education institutions for every resident within 15-minute walking or biking distance from their home. It is equally unrealistic to expect every resident to live within 15-minute walking or biking distance away from their workplace. Since different amenities and services carry a varying degree of importance to different sectors of the population, it is impossible to construct a single 15-Minute City that simultaneously meets the needs of everyone.

Furthermore, some people question if public transit should be considered an acceptable travel mode in these concepts, particularly in relation to accessing highly specialized services and workplaces (Moreno et al. 2021; Capasso et al., 2019). Others are alerted by the fact that these concepts fall in line with real estate strategies to marketize pedestrian-oriented and carbon-free urban districts that are highly expensive and mainly geared toward the urban elites (Abdelfattah et al., 2022). There are also concerns in relation to their focus on distance, which condenses walkability to a two-dimensional diagram that omits the importance of the quality of the walking environment – being safety and enjoyment (Moreno et al., 2021).

Despite their limitations and criticisms, the Complete Communities and the 15-Minute City are useful frameworks for guiding future sustainable and smart urban growth. They create a range of benefits for all urban residents regardless of their sociodemographic backgrounds, such as reduction in air pollution and GHG emission, improvement of traffic safety, stronger social cohesion and sense of community, enhancement of health and wellbeing, protection of greenspaces and biodiversity, and bridging socioeconomic inequalities in access and mobility.

Therefore, urbanists have a unique opportunity to enrich, refine, and reconcile the meaning of the 15-Minute City and to develop innovative methodologies for evaluating the performance of different cities or different neighbourhoods with respect to the 15-Minute City model to aid policymaking. For instance, Abdelfattah et al., (2022) implemented a fully-fledged mapping of accessibility in relation to 9 predefined essential services that support daily life activities in the City of Milan to identify the existence of 15-Minute City characteristics in different neighbourhoods. They found that areas located in the urban centre of Milan have the highest accessibility scores, and they are more likely to enable residents to fulfill most of their essential needs within a 15-minute walk.

This present research has a unique opportunity to produce insights into the extent to which the urban form of the three Canadian metropolises in 2019 conformed to the 15-Minute City model and the efficacy of different components of the metropolitan region in meeting the most basic population demands. Moreover, we also analyze the locations of population and employment growths in relation to the customized accessibility geographies to investigate the attractiveness of locations with 15-Minute City characteristics to populations and businesses.

2.4 Summary of theories and concepts

In this literature review section, we engaged with a wide range of concepts and theories arising from four stands of interconnected literature and their policy implications to the best of our ability within the context of this supervised research paper.

To summarize, on the determinants of residential choice and residential preferences, we systematically discussed the two opposing theories in terms of their claims, criticisms, and shortcomings. Fundamentally, both camps hold that one's location choice is an outcome of evaluating the amenities and dis-amenities associated with different locations against their needs and preferences. However, they do not agree on the relative importance that various types of amenities carry for certain populations.

On the one hand, the classical theory emphasizes the importance of utilitarian amenities, such as housing cost, employment access, mobility and transportation, on all people's decision-making about where they want to live. Additionally, lifecycle regulates the order of priority individuals assign to these utilitarian amenities in different life stages. On the other hand, the creative class location theory claims that soft, lifestyle-oriented amenities take the priority over utilitarian amenities for members of the creative class in deciding where they want to live, and the lifecycle has a minimal effect. Both theories encounter discrepancies in terms of empirical evidence, which depicts the complexity and uniqueness of people's locational choices.

The second topic we touched on includes urban gentrification and its effects, especially in the city centre, as a result of changing taste and class structure and its effect on the residential geography of post-industrial cities. There exists abundant research evidence depicting an increasing in-migration of elite professionals in well-built, off-centre neighbourhoods in the urban centre, driving a change in the local sociodemographic character and the neighbourhood image. This phenomenon has been especially salient in American cities that had a history of white flight from the urban centre due to racial tension. While many gentrification writers talk about the displacement of working-class families in gentrifying neighbourhoods, we advocate a more critical lens that incorporates considerations of structural economic changes leading to the disappearance of blue-collar occupations and workers. This means we should extend the scope of analysis to all financially vulnerable communities, which include sales & service workers, instead of focusing on blue-collar workers alone.

Moreover, because of the movement of wealthier residents within metropolitan regions, there emerged new patterns of residential segregation along socioeconomic status. The concept, "Patchwork Metropolis", depicts divided residential geography where elite professionals disproportionately occupy the most functional and desirable locations in the urban core and the suburbs, shunting lower-income people to the remaining, poorly serviced locations. These patterns create urban inequity in terms of accessibility to amenities and opportunities along the line of income and social status.

Finally, we discussed the current trends in urban growth policy in connection with these theoretical backgrounds. Richard Florida's creative class thesis has been received with great enthusiasm among urbanists (urban planners and urban designers) and policymakers partially because it sends a flattering message to the increasingly knowledge-based workforce. Moreover, the pertinent interventions are relatively easy to implement. We called attention to the neoliberal, entrepreneurial, and elitist spirit behind these city-building and place-making strategies and programs that cater to the cultural consumption of the urban elites. We also highlighted the naiveness and simplicity behind the belief that attracting talents stimulates urban and regional growth.

In the context of the 21st century, urban and regional growth needs to be sustainable from the social, economic, and environmental perspectives. Car dependency in cities has a plethora of negative externalities in all three pillars that hinder urban sustainability. Accessibility by active modes of transportation, including walking, biking, and transit, emerges as an urgent focus for sustainable urban policy. The 15-Minute City and Complete Communities are two trending urban design concepts in line with accessibility, which gained international popularity in wake of the COVID-19 pandemic where inequalities terms of access and mobility were highlighted. Essentially, these two design concepts depict a geography in which residents can reach the most basic urban services and amenities within a convenient walking or biking distance, thus, eliminating the need for cars in daily essential trips. Despite their limitations and critiques, these innovative models may be effective tools for guiding sustainable and smart urban growth. Our research has a unique opportunity to provide evidence from the Canadian experience.

3. Research data

3.1 Description of research data

This current study relies on the consolidated versions of three large datasets we obtained from Statistics Canada for the three largest Canadian metropolises: Toronto, Montreal, and Vancouver.

The national accessibility data can be downloaded on the Proximity Measures Database (PMD) webpage released in April 2020. This dataset includes ten accessibility indices recorded in the year 2019 whose values describe the potential for the residents in Census Dissemination Blocks (DBs) across the whole country to reach various kinds of essential destinations within a distance parameter (Table 1). This type of cumulative location-based measure (Formula 1), which sum up the available amenities and services within fixed cost threshold (i.e., distance or commute time by mode), is one of more common methodologies for conceptualizing and quantifying accessibility in existing research (e.g., Boisjoly and El-Geneidy, 2017; Pereira et al., 2018) because it enables objective comparisons to be made across locations based purely on numeric values.

Moreover, several previous research has adopted similar location-based approaches to study the differences in accessibility for socio-economic groups (Shen, 1998; Smith et al., 2020, Wachs & Kumagai, 1973), which is one of the main components in this present research. The values in this dataset are normalized as indices ranging between 0 and 1, making possible comparative analyses across the nation. For interested readers, Alasia et al. (2021) provides a comprehensive explanation about the methodological development behind the database as well as detailed instructions about interpreting the indices.

Service / amenity variable	Measure of Mass[1]	Network Distance Parameter	Travel Mode
Employment	Non-uniform weighting based on the number of employees	10 km	Driving
Grocery stores	Non-uniform weighting based on annual revenue	1 km	Walking
Pharmacies	Uniform	1 km	Walking
Health care facilities	Non-uniform weighting based on the number of employees	3 km	Driving
Childcare facilities	Uniform	1.5 km	Walking
Primary schools	Uniform	1.5 km	Walking
Secondary schools	Uniform	1.5 km	Walking
Public transit services	Non-uniform weighting based on number of bus lines accessible	1 km	Walking
Neighbourhood parks	Uniform	1 km	Walking
Libraries	Uniform	1.5 km	Walking

1. A binary weighting scheme, non-uniform and a uniform weighting, is implemented for quantifying the mass of a service or amenity, which is determined by whether the fundamental service provided is expected to scale with revenue, number of employees, or other sizing measures. A non-uniform weighting based on annual avenue was used to stratify different types of grocery vendors. The assumption is that a large supermarket offers a much larger and more diverse selection of commodities than a small grocer, leading to a greater accessibility outcome, hence, a higher measure value, associated with large stores. On the other hand, a uniform weighting was applied in calculating the accessibility potential in the case of pharmacies and schools because the authors assumed that the size of these facilities does not considerably impact the availability and quality of fundamental goods and services that are offered.

Table 1 Description of the variables included in Statsitic Canada's Proximity Measure Dadabase; source: Alasia et al. (2021)

$$\mathrm{PL}_i = \sum_{j \in J} \frac{\mathrm{Mass}_j}{\mathrm{Dist}_{i,j}}$$

$$\mathrm{Dist}_{i,j} = \max\left(\sqrt{\frac{\mathrm{Area}_i}{\pi}}, \sqrt{\frac{\mathrm{Area}_j}{\pi}}, 100 \right)$$

$$\mathrm{Dist}_{i,j} < \max\left(\sqrt{\frac{\mathrm{Area}_i}{\pi}}, \sqrt{\frac{\mathrm{Area}_j}{\pi}}, 100 \right).$$

$$\mathrm{PI}_i = \frac{\mathrm{PL}_i - \min(\mathrm{PL})}{\max(\mathrm{PL}) - \min(\mathrm{PL})}$$

Formula 1: The formula of a gravitational model that Statistics Canada employed to measure accessibility to the 10 different destinations; source: Alasia et al. (2021)

Here, we acknowledge that defining accessibility based on physical proximity is not entirely accurate because other factors, notably sociodemographic background, have an important role in shaping the true experience and outcome associated with accessibility (Duranton & Guerra, 2016). For instance, being near a butcher shop carries "zero" significance for a vegan family in their evaluation of the local accessibility of food. The accessibility experience or outcome for a person with serious mobility impairments can be drastically different from an able-bodied person living in the exact same residential location. Nevertheless, this simple proximity-based conceptualization and quantification of accessibility is a useful methodology for conducting large-scale population-level analyses, as in the case of this present research, because the effect of individual experiences is minimized.

The second dataset depicts disaggregated population data pertaining to the residential locations of employed workers by occupational belonging in 2006 and 2016. This information is collected by the National Household Survey at the place of residence. The variables in this dataset include a total of 40 two-digit major occupational groups according to National Occupational Classification (NOC). The 2-digit NOC variables relate to the type of tasks, responsibilities, and duties workers in jobs perform. We emphasize that this population dataset collects the occupational and locational information of a specific demographic universe – the population of employed workers in the year of 2006 and 2016. From here on, readers should be aware that the word, *"population",* and all other relevant words and expressions, such as "residents", "people", and "residential population", in their appearance throughout this research imply the precondition of being employed in an occupation.

The third dataset depicts disaggregated employment data pertaining to the locations of jobs by industry belonging in 2006 and 2016. This information is also collected by the National Household Survey, but at the place of work geography. The variables in this dataset include a total of 20 two-digit major economic sectors classified in accordance with the North American Industry Classification System (NAICS). The 2-digit NAICS variables describe the type of economic activities in which similar businesses are engaged.

3.2. Data cleaning and preparation procedures

The raw data in the accessibility dataset contains non-numerical symbols that need to be interpreted and appropriately cleaned (Alasia et al. 2021, p.5). For instance, according to the user instruction, highly unreliable values are denoted by the letter *"F".* These cells, which were associated with a negligible quantity of DBs that make up each of the three metropolises, were omitted from the following preparation procedures altogether. Recall that the measures in the original accessibility dataset are expressed in relative terms as normalized indices. Hence, a zero value in the original dataset indicates that a locality has comparatively the lowest accessibility potential, which is not the same as having none of such service or amenity nearby. Instead, the symbol of two dots, *".."*, in the original dataset represents true zero accessibility or the total absence of a service or an amenity within the fixed radius from the geographic centroid of a DB. To distinguish the true zeroes from relative zeros, a small epsilon of 0.1 (i.e 10%) was added to all numeric values in the original accessibility dataset, which is a common practice to transform relative zeros. As a result, each relative zero became a value of 0.1. Following this step, the cells originally containing the ".." symbol were transformed to zeros, that is true “zeros”.

The second important step to prepare the accessibility data for further manipulation involves constituting its original geography, being the 2016 DB geography, into the 2006 CT geography so that consistent comparisons of population and employment statistics can be made across the two census years. The below formulae (Formulae 2 & 3) describe this simple spatial aggregation methodology using non-weighted averages. One can argue that a serious shortcoming of this simple, non-weighted method of aggregation is that it focuses on the definition of accessibility as an outcome of physical land use characteristics associated with a locality that exists in a vacuum and neglects the human experience. This is not a significant concern of this present research because our main interest relates to the attractiveness of the physical characteristics of neighbourhoods. We want to also acknowledge here that this procedure conspicuously assumes that accessibility characteristics across the geography of each metropolitan area had not changed between 2006 and 2016, which is impossible. However, it is equally impossible for us to construct a 2006 version using the same methodology as Alasia et al. (2021) due to constraints of time and information access.

In the end, the processed accessibility dataset includes ten accessibility indices for each CT location (i.e., 2006 geography) whose values range from 0 to 1.1 where a value of '0' represents the total absence of a service or an amenity in proximity.

$$aCT16 = \frac{\sum_1^n aDB_1 + aDB_2 + \cdots + aDB_n}{n}$$

Where;

1. $aCT16$ denotes the CT-level service- or amenity-accessibility value according to the 2016 Census Tract Geography
2. aDB denotes the DB-level service- or amenity-accessibility index value according to the 2016 Census Dissemination Block Geography in the original PMD database

$$aCT06 = \frac{\sum_1^n aCT16_1 + aCT16_2 + \cdots + aCT06_n}{n}$$

Where;

1. $aCT06$ denotes the CT-level service- or amenity-accessibility value according to the 2006 Census Tract Geography

Formulae 2 & 3: The formulae for aggregating the accessibility values measured in the 2016 Census Dissemination Block geography to the 2006 Census Tract Geography

For the population and employment datasets, the main issue is dealing with missing data in a small percentage of census tracts that make up the metropolitan areas due to confidentiality practices on the part of Statistics Canada to protect the identity of respondents residing in sparsely populated areas. Given that the information cannot be obtained elsewhere, these census tracts were removed altogether from the datasets.

Secondly, we constructed broad occupational and industry groupings from the NAICS variables and NOC variables based on group similarity. Note that previous research has implemented similar methods to conceptualize various socioeconomic classes based on occupational characteristics (Ley, 1986; Connelly et al., 2016; Erikson & Goldthorpe, 1992; Florida, 2002; Florida & Adler, 2018; Frenkel et al., 2013; Smith et al., 2020; Wojan et al., 2007), as well as the order of economy and economic activities based on industry outputs (e.g., Duvivier et al., 2018).

The structures of broad occupational and industry groupings based on the disaggregated NAICS and NOC variables are depicted in Tables 2 & 3. Lastly, to make possible location-based analyses of population and employment dynamics across the two census years, the 2016 data was spatially reorganized according to the 2006 census tract geography in QGIS using a simple cumulative method.

Customized Broad Industry Groupings	2-digit NAICS variables	Definition
Creative	51, 71	The creative NAICS industry grouping consists of information and cultural industries, and industries related to arts, entertainment, and recreation
Knowledge-based	52,53,54,55	The knowledge-based NAICS industry grouping consists of finance and insurance, real estate and rental and leasing, professional, scientific and technical services, management of companies and enterprises
Goods-related	31-33, 41,48-49	The goods-related NAICS industry grouping is made up of Manufacturing, Wholesale trade, Transportation and warehousing
Sales & Services	44-45, 72, 81	The Sales & Services NAICS industry grouping is made up of retail trade, Accommodation and food services, and other services like repair and maintenance and personal and laundry services
Public services	61,62, 91	The public services NAICS industry grouping composes educational services, healthcare and social assistance, and public administration
Labour-intensive	11, 21, 22, 23, 56	The public services NAICS industry grouping composes agriculture, forestry, and fishing natural resources, utilities, construction, and administrative support

Table 2 Customized broad Industry groupings based on 2-digit Industry Sector codes in the North American Industry Classification (NAICS) System

Customized Broad Occupational Groupings	2-digit NOC variable	Definition
Creative	51, 52	The creative occupations consist of professional and technical occupations related to art, culture, recreation, and sport
Knowledge-based	00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 11, 12, 13, 14, 15, 21, 22, 40	Knowledge-based occupations consist of occupations related to management, business and finance, sciences, professional education services, office administration and coordination
Public and community service	30, 31, 32, 34, 41, 42, 43	Public service occupations are made up of occupations related to healthcare, law, frontline public protection, social services, and police, so on.
Sales & Services	44, 62, 63, 64, 65, 66, 67	Sales & Services occupations are composed of occupations related to retail sales workers, sales representatives, specialized service like butchers, chefs, and childcare and housekeeping.
Blue collar	72, 73, 74, 75, 76, 82, 84, 86, 92, 94, 95, 96	Blue-collar occupations are composed of non-management, technical occupations related to manufacturing, construction, utilities, agriculture, natural resources, specialized trades, operation of heavy equipment, transport operation, and so on.

Table 3: Customized broad occupational groupings based on 2-digit codes in the National Occupational Classification (NOC) System

4. Research Methodology

4.1 Creation of accessibility-based cluster geography

Before explaining the development of our methodology, it is important to note that regression models would have been ideal for formally establishing statistically significant associations between two or more variables. However, the presence of many null values associated with accessibility, employment, as well as occupation data in this research calls for alternative approaches to investigate potential associations between local service- and amenity-accessibilities and the spatial concentration of workers and jobs. A previous study (Frenkel et al., 2012) successfully implemented the clustering analysis method and concluded the existence of heterogeneity in the housing preferences of knowledge-workers in terms of homeownership, dwelling size, and location.

The foundational procedure in our methodological development involved aggregating the 2006 CT geography in the transformed accessibility dataset into larger geographic units based on the similarity of accessibility values across CTs, using the clustering analysis technique (e.g Frenkel et al., 2013). There exist several clustering models, such as K-Means, Hierarchical, and Density-based models, that operate under different assumptions and mechanisms.

Our decision was influenced by the following considerations. First, the model should serve the objectives of this research. The model should produce clusters that have distinct accessibility profiles. Second, it should enable us to easily understand, conceptualize, and map the relationships between each observation and each cluster. Third, it should produce results that best reflect reality. For example, in the context of this research, the model should be able to separate single-family residential zones into a different cluster from town centres or denser neighbourhoods. The hierarchical clustering model offers both conceptual and pragmatic advantages over the other models in the context of this research. It identifies and agglomerates pairs of similar observations through a continuous, stepwise process, as shown in the dendrogram. From the dendrogram, researchers can easily classify the degree of (dis)similarity between individual observations and between clusters.

The clustering analyses were completed in R studio. The "HC" function requires three inputs: data, the number of clusters to create, and the agglomeration method. We devised two hierarchical clustering models (M1 and M2) using two different data inputs. M1 incorporates the 10 proximity variables from the PMD dataset. The second hierarchical M2 incorporated an additional variable, 'distance to downtown', which describes the Euclidean distance from the centroid of each census tract to a reference point downtown. We standardized this variable using the same formula used by StatsCan to create the proximity indices. M2 assigns explicit importance to 'distance to downtown' in its agglomeration of similar census tracts.

However, it should be noted that distance already underlies the proximity measures. As one moves farther away from downtown, accessibility generally decreases as a result of lower population and land use density in the suburbs We suspected that including the additional distance variable may result in loss of more fine-grained difference in suburban and peripheral areas. Due to this reason, we rejected M2 from the outset. However, the 'distance to downtown' variable was still used in the subsequent analyses for the purpose of classifying resultant clusters.

The second step was to determine the appropriate number of clusters to create and the agglomeration criterion. To test the appropriate number of clusters, we performed an algorithmic analysis of the extent to which different cluster numbers explain the variations within a model (i.e. R^2) and the extent to which each additional cluster affects the R^2 value, using the Montreal accessibility data. Typically for a cluster model to be considered effective, the R^2 value should be above 0.5.

In Figure 1, points 4, 6, and 10 are interesting choices because as one moves from 'N-1' to 'N', the R^2 value of the model changes significantly. By convention, the appropriate cluster number for a model should correspond to the point near which the incremental change in the R^2 is the most pronounced, which roughly corresponds to point 4 in Figure 1. However, the outcomes from the cluster number must also reflect or resemble reality. In the context of this research, this can entail separating neighbourhoods that exhibit different urban forms. The greater the number of clusters, the more nuanced the (dis)similarity between each cluster, which is important for distinguishing subtle differences in accessibility within suburban or central areas. Hence, the choice of creating 10 or more clusters was deemed more appropriate to the metropolitan level analysis in this research.

The second input, the agglomeration criterion, determines how dissimilarity between pairs of singular or paired observations is calculated as a function of pairwise distances between observations. The choice of the agglomeration method is less obvious and often depends on the data and the type of research. In this study, we focused on two popular methods. 'Ward's Distance Squared' is one of the most used and understood agglomeration criterion in hierarchical clustering analyses. Essentially, Ward's criterion minimizes the total within-cluster variance by identifying and merging the most similar pair of clusters. Mathematically, this is achieved by finding pairs of observations/clusters with the least squared Euclidean distance from one another. The "Ward's Distance" method, on the other hand, minimizes only the Euclidean distance between pairs of observations or clusters.

In the end, after experimenting with many combinations of inputs, the one consisting of 11 clusters and the "Ward's Distance Squared" criterion produced the most fitting spatial agglomerations for all three metropolitan areas. For each cluster, we established its accessibility profile (i.e., 10 service and amenity-accessibility indices) by computing the mean value of each accessibility measure from its constituent CTs and correspondingly aggregated the occupation and employment statistics.

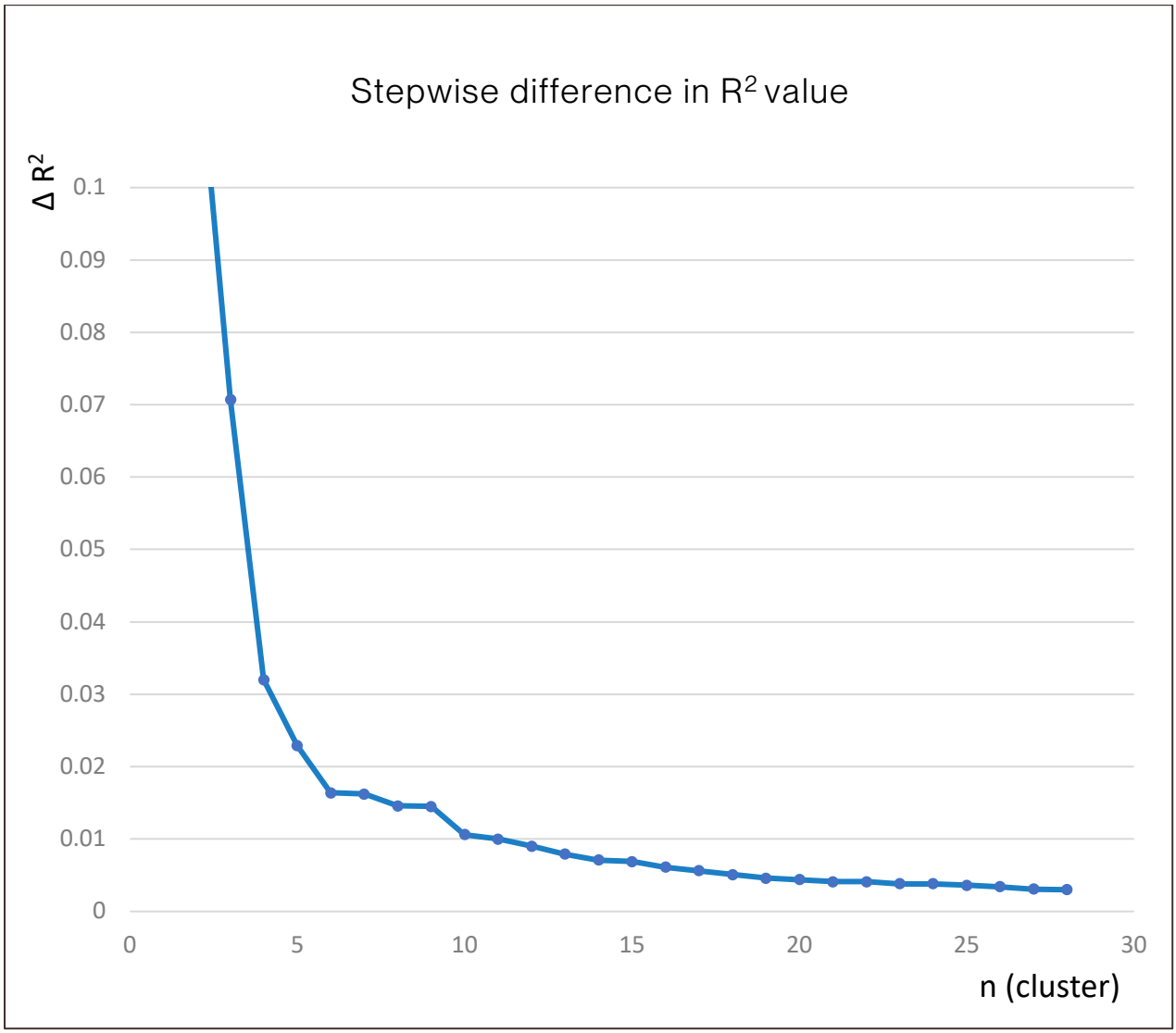

Figure 1 The effect of every additional number of clusters created on the degree of the clustering model to predict the variations between the disaggregated observations (i.e., census tracts) in relation to accessibility

These final reconstituted datasets in the customized cluster geography linking accessibility profile and occupation and employment data are examined methodically through various kinds of descriptive tables to generate conclusions for our research questions. It is worth mentioning that several existing research (Smith et al., 2020; Florida & Adler 2018) operationalized these analytical methods in analyzing higher-level aggregated population dynamics.

4.2 Analytical methods to answer our research questions

In the three analysis chapters, we implement several location-based analytical methods to generate insights that enable us to answer the following research questions:

1. Was there an association between essential accessibility and the residential sorting of different occupational groups within the three top-tier Canadian metropolitan regions in the year 2016?

2. Did residential segregation between elite and disadvantaged occupational groups exist in relation to the geography of accessibility for each metropolitan region? More importantly, did elite occupational groups disproportionately enjoy better accessibility outcomes than disadvantaged groups?

3. What were the characteristics of intra-metropolitan residential dynamics between 2006 and 2016 in relation to the geography of accessibility for each of the three Canadian metropolitan regions? What did they convey about changes in the socioeconomic character on various geographic scales, especially within well-built, highly accessible areas in the urban centres?

4. What were the patterns of population and employment growths between 2006 and 2016 in relation to the geography of accessibility for each metropolitan region? What challenges and opportunities do these patterns reveal in relation to promoting sustainable models of urban growth, such as the 15-Minute City or the Complete Communities, in Canada?

Note that the sociodemographic universe of this present research only encompasses four broad occupational-socioeconomic groups who have been the focus of similar research: 1) creative workers, 2) knowledge workers, 3) service & sales workers, and 4) blue-collar workers. The first two groups, creative and knowledge workers, are commonly classified as elite professional groups who have a high earning potential, although some artistic professions provide a rather precarious stream of income. The other two groups, sales & service and blue-collar workers, are commonly classified as disadvantaged workers who have a relatively lower income level in similar (e.g., Florida & Adler 2018; Smith et al. 2020). Finally, the occupations within the public and community services sector are more of a mixed bag relative to average pay rate. In other words, public and community service workers cannot be categorized into a single, unified socioeconomic standing, which is why they are excluded altogether in our analyses.

4.2.1 Analysis Chapter One

In Chapter One of our analysis, we deploy location quotients in combination with simple summary statistics to tackle the first and second questions. In essence, the location quotients method is an analytical tool that enables geographical researchers to investigate the concentration of a group of people, industries, or economic activities within a geographical unit (such as a subregion) relative to a larger geographical unit, such as a region (e.g., Miller et al., 1991). Patterns related to location quotients enable researchers to examine subjects like spatial segregation and division.

The formula for calculating location quotients is indicated in Formula 4. The value of location quotients in the context of this research should be interpreted as the following. A location quotient value above 1 indicates that an accessibility-based cluster has a relatively larger concentration of a socioeconomic group compared to elsewhere in the metropolitan region. A location value below 1 indicates the opposite. Moreover, the greater the value, the greater the concentration.

Finally, summary statistics capture the size of each group's local populations in raw numbers across each metropolitan region. While location quotients generate useful information about populational concentrations, such observations alone can be misleading. For example, a sparsely populated area can have a very high concentration of a certain socioeconomic group, but the actual group population is very low. Thus, we deem it important to present both sides of the story and distinguish their significance in our analyses.

$$LQ_{p,i} = \frac{X_{p,i}/\sum X_i}{N_p/\sum N}$$

Where:

- $LQ_{p,i}$ = Location quotient of *a socioeconomic group (p) in accessibility profile "i"*
- $X_{p,i}$ = The population of a socioeconomic group (p) in *accessibility profile* "i"
- $\sum X_i$ = The entire population of *accessibility profile* "i"
- N_i = the entire population of a socioeconomic group in a metropolitan area
- $\sum N$ = the entire population of the metropolitan area

Formula 4: the formula for calculating location quotients

4.2.2 Analysis Chapter Two

In Chapter Two of our analysis, we examine three measures depicting population change to investigate the intra-metropolitan residential dynamics of the four broad socioeconomic groups within each metropolitan region during the decade of 2006 – 2016. Our focus is on the residential dynamics within the inner-city area from the perspective of gentrification. According to the gentrification literature, the key characteristic associated with gentrification is a shift in resident structure due to an in-migration of wealthier residents who occupy high-paid jobs.

Accordingly, our first measure looks at changes in the resident proportion associated with the two elite and two disadvantaged groups. For this measure, there are two important considerations in relation to how we should interpret the individual values that must be addressed. Firstly, change in the resident proportion associated with one group may result from either change in its own population or change in other populations in a given area. As an example, *Table 4* depicts the various scenarios causing an increase in the resident proportion of creative workers in a given area. A decrease in the resident proportion can be explained by reserving the logic. Secondly, in order to accurately understand what the values of this measure signify, we must juxtapose the individual values for each accessibility profile to the metropolitan baseline value. For example, an area may record an increase in the resident proportion of an elite group, but the magnitude is smaller compared to the increase in their proportion on the regional scale. In this case, it is incorrect to conclude that the area has likely experienced gentrification.

As mentioned in the literature review, gentrification-related studies often draw attention to the displacement of lower-income residents in gentrifying neighbourhoods due to land value uplifts. As a result, the appearance of the term “gentrification” in public discourse is usually associated with a negative connotation implying that lower-income residents are pushed out. We are not convinced that this is not always the case. Therefore, in the context of this research, we prefer to use a more neutral term, specifically “change in local sociodemographic character”, to describe the effect of structural changes in local sociodemographic structure. If such changes are caused by an influx of elite professional groups, it means that the sociodemographic character becomes wealthier.

Moreover, to explore if gentrification was accompanied by the displacement of lower-income residents, we look at two additional measures that depict both relative and absolute change in lower-income populations across each metropolitan region.

Finally, in relation to the analytical method of examining population distribution, it is equally important to distinguish the significance of relative change from that of absolute change when we discuss population growth. For instance, a sparsely populated area may see a large population growth while the actual number of new residents is small. Table 5 provides a summary of these three chosen measures.

Scenario 1	An increase in the population of creative residents and a simultaneous decrease in or stagnation of other populations
Scenario 2	A disproportionately larger increase in the population of creative residents in relation to increases in other populations
Scenario 3	A disproportionate smaller decrease in the population of creative residents in relation to decreases in other populations

Table 4 Possible scenarios that may cause an increase in the resident proportion of creative workers in an area (i.e., accessibility profile)

Measure	Description
Δ proportion	"Δ proportion" measures absolute changes in the proportion of each broad socioeconomic group relative to the local resident structure within different clusters. Note that for this indicator, the cluster-level values are juxtaposed to the metropolitan baseline value.
Δ population	"Δ population" measures absolute changes in the residential population of each broad socioeconomic group within different clusters.
Δ population (%)	"Δ population (%)" measures changes in the residential population of each broad socioeconomic group relative to its original size within different clusters. Note that for this indicator, the cluster-level values are also juxtaposed to the metropolitan baseline value

Table 5 Measures depicting residential dynamics of different socioeconomic groups across each metropolitan region during the decade of 2006 – 2016, which are used to investigate inner-city gentrification

4.2.3 Analysis Chapter Three

In Chapter Three of our analysis, we investigate the patterns of population and employment dynamics within each metropolitan region during the decade of 2006 – 2016 in relation to the geography of the 15-Minute City. The goal is to explore whether essential accessibility is correlated with population and employment growth on various levels of analysis, which informs whether land-use policies pursuant to the 15-Minute City may enhance urban sustainability.

We narrow the focus of our analysis to four domains, three related to employment/jobs and one related to population. Regarding jobs, we look at both the entire economy and two specific industry sectors, which are the creative and knowledge-based industries. Regarding population, since our previous analyses on gentrification already covered the residential dynamics associated with creative and knowledge workers, the additional measures we look at here extend over to the entire population. For each domain, we look at a relative measure depicting the rate of change as well as an absolute measure depicting the raw changes. Table 6 describes these measures. To make sense of the outcomes, we contrast the individual values on the cluster level to the metropolitan baseline values.

Here, we emphasize the importance of distinguishing the significance of growth rate from that of absolute growth. In this regard, the context is important. In some instances, such as the subject of inflation, the rate at which prices of goods have increased may be considered more important. In other instances, the actual quantity of change may be considered more important. Either way, the choice of measure itself as well as its justifications must be made transparent so as not to mislead uninformed audiences. Additionally, it is favourable to use and report the results of both measures. As this chapter grapples with urban sustainability, we argue that absolute growth is a more relevant measure than growth rate in assessing if the metropolitan region grew in a sustainable manner because it is each person and not each percentage point that consumes resources and produces pollution. Nevertheless, growth rate is a useful complementary measure and may be considered as an indicator of growth trends.

We also acknowledge that there is an important practical limitation to our analyses of spatialized employment/job dynamics. As explained in our description of research data, the inputs that went into the construction of our accessibility geographies only include amenities and services that are mainly attractive to people. Other amenities that are known to be attractive to firms, such as highway nodes and airports, are excluded. As a result, we can expect less robustness for the correlation between accessibility geographies and job/employment dynamics.

Domain	Measure	Description
Population	Δ TOTAL_POP	"Δ TOTAL_POP" measures absolute changes in the total residential population within different clusters
	Δ TOTAL_POP (%)	"Δ TOTAL_POP" measures changes in the total residential population proportional to the original size within different cluster.
Employment	Δ TOTOAL_JOBS	"Δ TOTOAL_JOBS" measures absolute changes in the number of total jobs within different clusters
	Δ TOTAL_JOBS(%)	"TOTAL_JOBS(%)" measures changes in the number of total jobs proportional to the original size within different cluster.
	Δ CR_JOBS	"Δ CR_JOBS" measures absolute changes in the number of total creative jobs within different clusters
	Δ CR_JOBS (%)	"Δ CR_JOBS (%)" measures changes in the number of creative jobs proportional to the original size within different cluster.
	Δ KB_JOBS	"Δ KB_JOBS" measures absolute changes in the number of total knowledge-based jobs within different clusters
	Δ KB_JOBS (%)	"Δ KB_JOBS (%)" measures changes in the number of knowledge-based jobs proportional to the original size within different cluster.

Table 6 Relative and absolute measures deployed to evaluate the population and employment dynamics within each metropolitan region

5. Description of Cluster Geographies

Prior to presenting our analyses, this brief section familiarizes the readers with the accessibility-based cluster geographies for the Toronto, Vancouver, and Montreal Metropolitan Area, as well as the accessibility characteristics associated with individual clusters in the context of each metropolitan area.

To facilitate discussions, we named the constituent clusters of each metropolitan area based on unique locational characteristics – centrality and accessibility profile – in the context of their respective metropolitan area. This system yields a three-part codename for each cluster that is clear and self-explanatory. Specifically, we defined centrality based on the averaged distance from the centroid of each constituent CT to a predetermined central location in each metropolis.

The central reference locations we selected include the Place Ville Marie building for Montreal, the CN Tower for Toronto, and the Vancouver City Centre Station for Vancouver. Based on this measure of centrality, the clusters were categorized into four subregions, "DT", "Central", "SUB" and "PERI (see Table 7). Next, we classified the accessibility profile of each cluster based on the criteria set out stated in Table 8. Specifically ranked the top and bottom accessibility values for each accessibility measure and classified five accessibility levels according to the criteria. Where two or more clusters share the identical two-part code, a capitalized letter, such as "A" and "B", was added to differentiate their identity.

The final codenames in Table 9 convey the general geographic location of each cluster within the respective metropolitan area and its overall accessibility profile. Unsurprisingly, the codenames themselves reveal a general relationship between centrality and accessibility level where local accessibility appears to decrease further away from the city core.

Figures 2 – 4 depict the spatial composition of accessibility-based cluster geography for each metropolitan area. An interesting observation from the maps is that the spatial composition of the accessibility-based cluster geography within the three Canadian metropolitan areas, which approximates regional land-use patterns, is noticeably different from one place to another.

For instance, our clustering model distinguishes greater diversity in the accessibility potential across the periphery parts of the Vancouver metropolitan area, compared to Toronto and Montreal. In fact, the Vancouver Metropolitan Area (see Figure 4) appears to resemble a more polycentric urban form where accessible secondary commercial hubs and local town centres are common in sparsely developed suburban and peripheral municipalities. Examples include the Metrotown, Brentwood centre, and Lougheed Town Centre in Burnaby, Richmond Centre, Coquitlam Town Centre, Surrey Town Centre, and the waterfront area of North Vancouver.

In the case of the Toronto Metropolitan Area (Figure 2), our model detects relatively small differences in the accessibility potential across the peripheral, inland region. Interestingly, the model also detects a stark geographic split in the Toronto Metropolitan Area where the southern region appears to enjoy higher accessibilities than the northern inland region. Moreover, Figure 2 also highlights relatively more accessible, secondary centres and hubs within the suburban and peripheral municipalities of the Toronto Metropolitan areas, including North York, the University Heights, Oshawa, Mississauga, and Brampton.

Lastly, the accessibility geography of the Montreal Metropolitan Area in Figure 3 exhibits a similar regional land use composition as Toronto where essential daily amenities, goods, and services are concentrated in the central region of the metropolitan area and local accessibilities decline significantly outward. Though, an important distinction between Toronto and Montreal is that some of the most accessible neighbourhoods in Montreal are located just outside the downtown core.

Classification codes based on 'distance to downtown'	Conditions	#clusters in this class (Montreal)	#clusters in this class (Toronto)	#clusters in this class (Vancouver)
DT	d < 0.05	2	3	3
CENTRAL	0.05 < d < 0.1	3	2	1
SUB(urban)	0.1 < d < 0.3	3	4	2
PERI	d > 0.3	3	2	5

Table 7 Classification of the first-part codes for resultant clusters or accessibility profiles based on 'distance to downtown'

General accessibility level	Conditions
Very High	Must have more than 7 (>7) values that are amongst the top 3 in the respective proximity measure
High	Must have more than 3 (> 3) values that are amongst the top 3 in the respective proximity measure
Medium	Must have less than or equal to 3 (= < 3) values that are amongst the bottom 3 in the respective proximity measure
Low	Must have no more than 7 (= <7) values that are amongst the bottom 3 in the respective proximity measure
Very Low	Must have more than 7 (>7) values that are amongst the bottom 3 in the respective proximity measure

Table 8 Classification of the second-part codes for resultant clusters of accessibility profiles based on a ranking criteria

Complete classification codes that describe the spatial and amenity characteristics of constituent clusters in each CMA		
Montreal	Toronto	Vancouver
DT_VERYHIGH	DT_VERYHIGH_A	DT_VERYHIGH
DT_HIGH	DT_VERYHIGH_B	DT_HIGH_A
CENTRAL_HIGH	DT_HIGH	DT_HIGH_B
CENTRAL_MEDIUM	CENTRAL_HIGH	CENTRAL_HIGH
SUB_HIGH	CENTRAL_MEDIUM	SUB_MEDIUM_A
SUB_MEDIUM_A	SUB_MEDIUM_A	SUB_MEDIUM_B
SUB_MEDIUM_B	SUB_MEDIUM_B	PERI_MEDIUM_A
PERI_VERYLOW	SUB_LOW_A	PERI_MEDIUM_B
PERI_LOW_A	SUB_LOW_B	PERI_LOW
PERI_LOW_B	PERI_VERYLOW_A	PERI_VERYLOW

Table 9 Complete codenames capturing the spatial and amenity characteristics of the resulting clusters or accessibility profiles within each metropolitan area

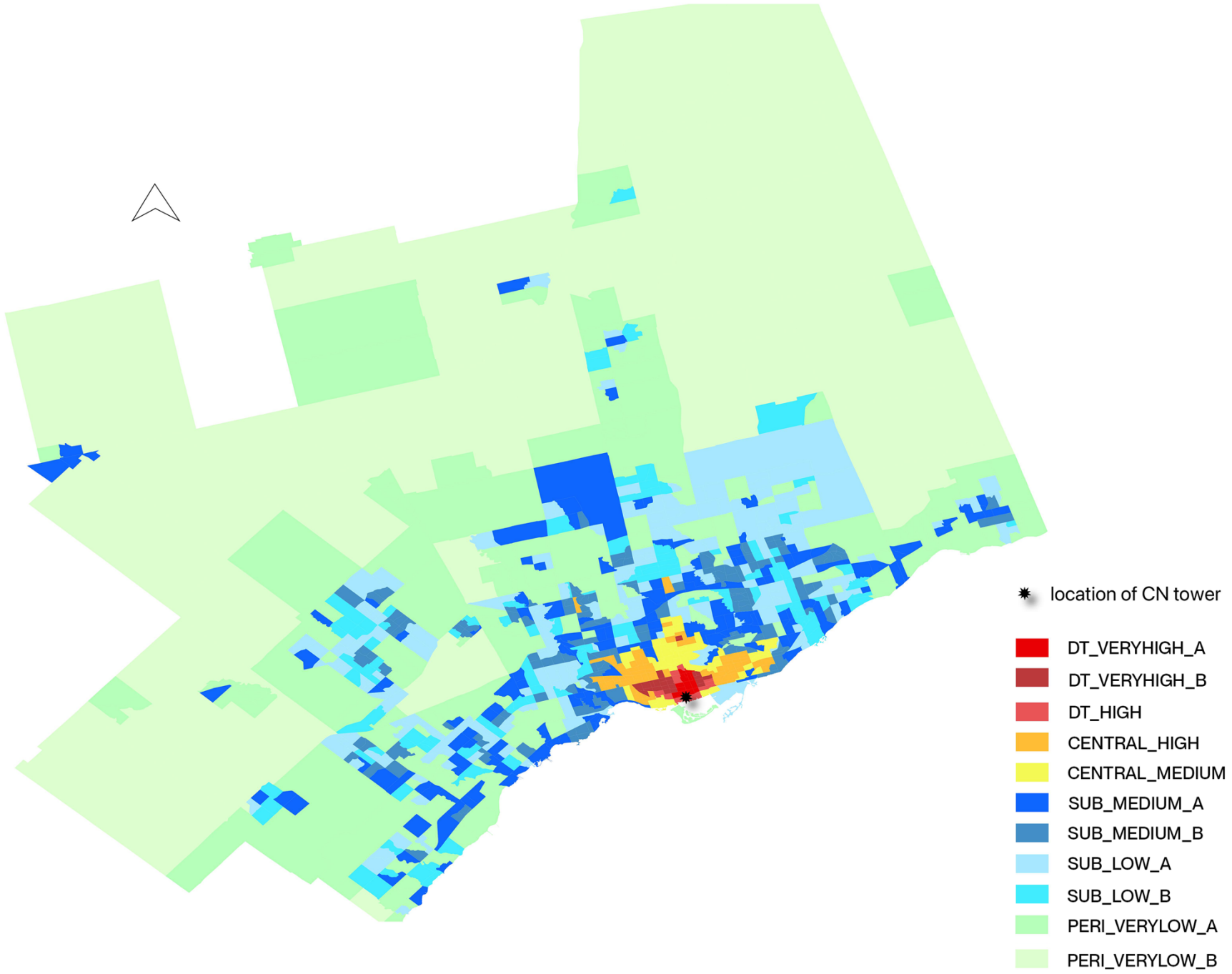

Figure 2 Accessibility-based cluster geography for the Greater Toronto Area; accessibility data source: Statistics Canada (2020) Proximity Measures Database– Early release

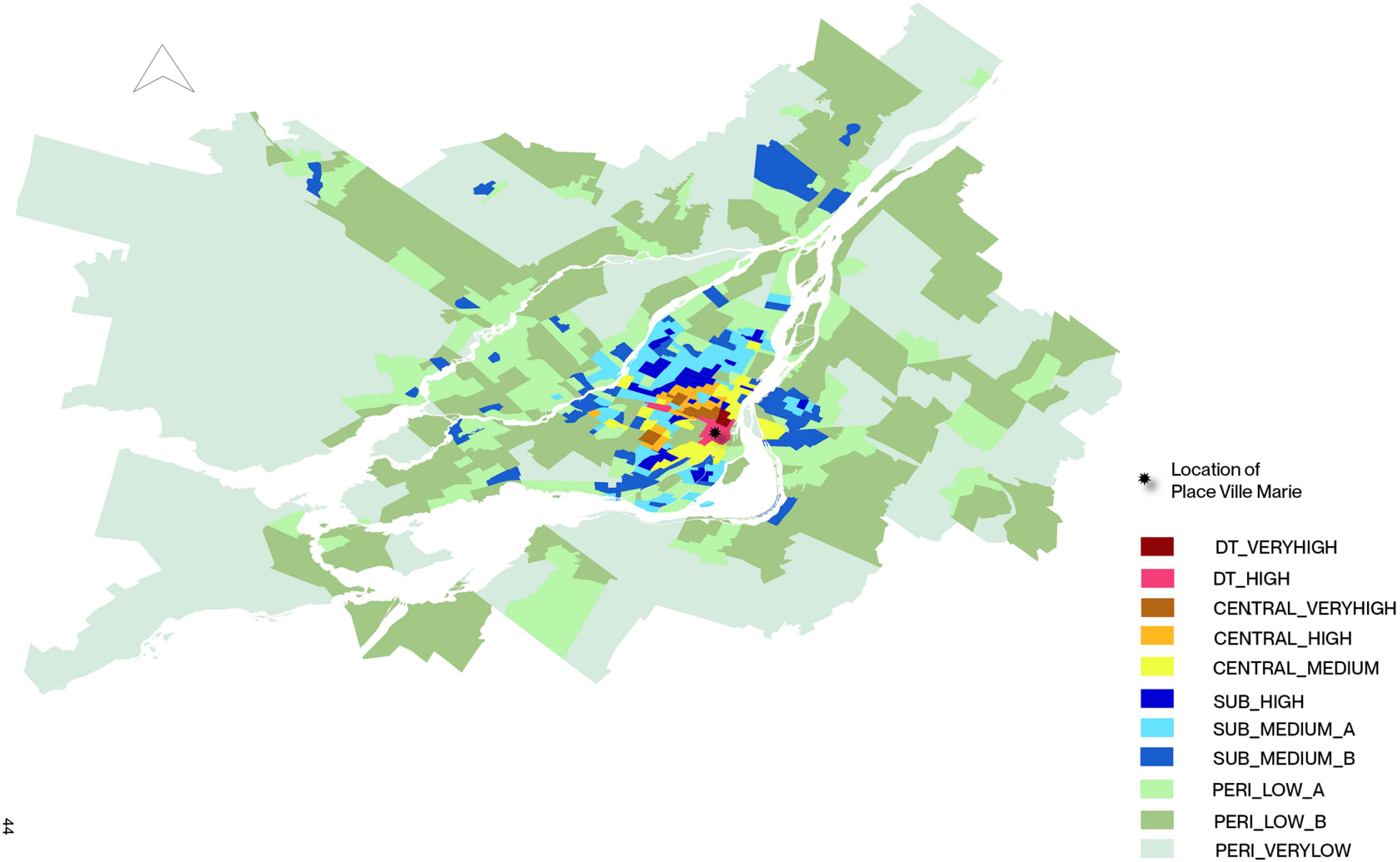

Figure 3 Accessibility-based cluster geography for the Greater Montreal Area; accessibility data source: Statistics Canada (2020) Proximity Measures Database – Early release

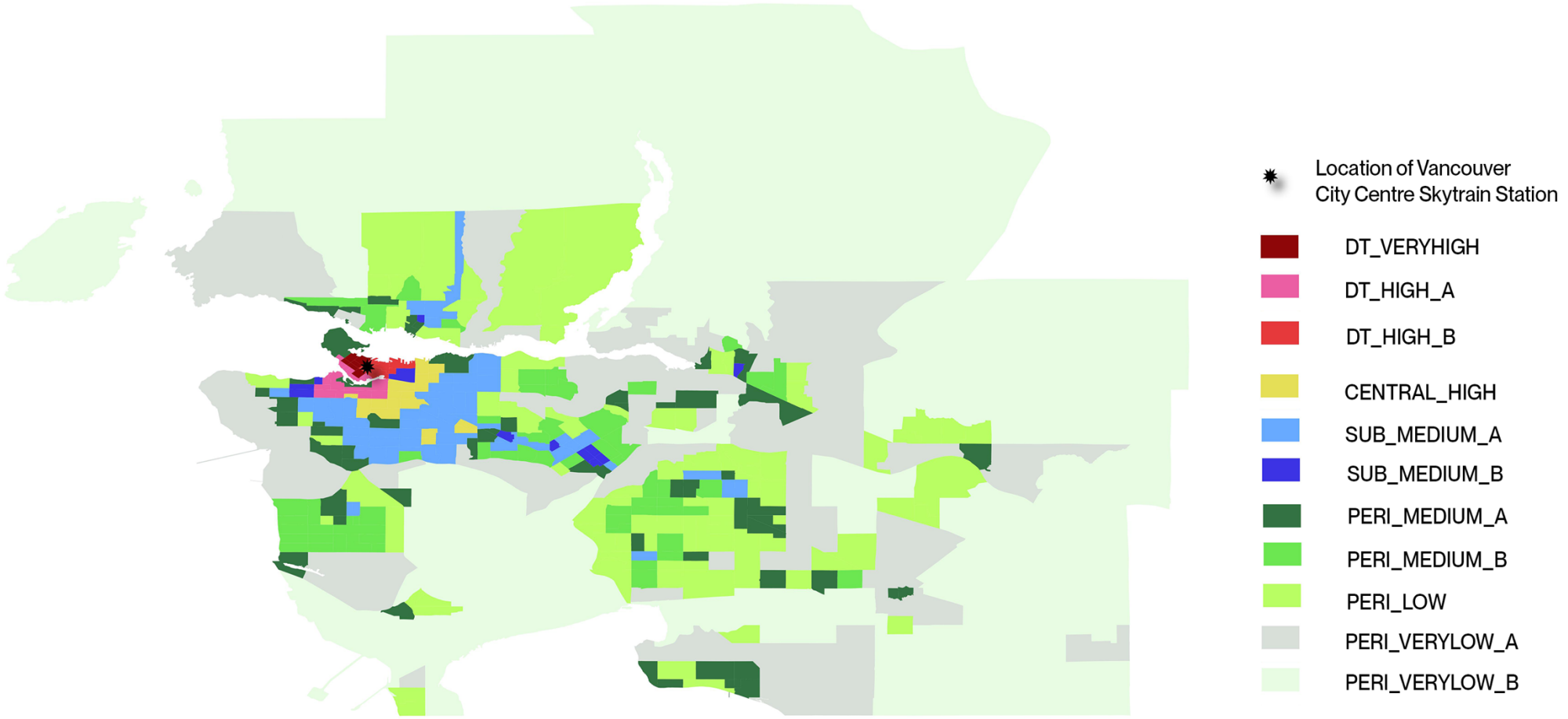

Figure 4 Accessibility-based cluster geography for the Greater Vancouver Area; accessibility data source: Statistics Canada (2020) Proximity Measures Database – Early release

6. Analysis Outcomes

In this section, we present the results of our analyses based on a collection of descriptive tables. Structurally, our analyses are divided into three interrelated chapters. Each chapter focuses on a particular subject or a set of interconnected themes featured in our research questions.

In the first chapter, we deploy location quotients to investigate the extent to which different socioeconomic groups geographically concentrate within each metropolitan region in the context of its accessibility-based cluster geography. In addition to location quotients, we also present summary statistics depicting the total population counts in composing clusters. Two interrelated research questions are addressed in this chapter. The first question relates to the association between accessibility to essential services and amenities and the residential sorting of various socioeconomic groups within each of the metropolitan regions. The second question concerns the presence of residential segregation along the line of socioeconomic status in each metropolitan region, as well as the resulting inequity in accessibility outcomes between the elite and the disadvantaged socioeconomic groups.

The second chapter investigates the characteristics of residential (population) dynamics associated with different socioeconomic groups between 2006 and 2016 in the context of the accessibility-based cluster geography for each metropolitan area. As described in the methodology section, we adopt three variables that enable us to explore various aspects of population dynamics. The analyses particularly focus on comparing the residential dynamics associated with elite social classes (i.e., creative and knowledge workers) to those associated with relatively disadvantaged classes (i.e., blue collar and service workers) to create insights about neighbourhood change and gentrification in each metropolitan region in this decade.

The final chapter examines whether a correlation exists between accessibility and population growth and between accessibility and employment growth within each metropolitan area. We adopt both a relative and an absolute measure in our evaluation of the overall population dynamics as well as both the overall and sectoral employment dynamics within different clusters and subregions of each metropolitan region.

In terms of the structure of each analysis chapter, the first chapter consists of a brief introduction section outlining key arguments in the existing literature and our analytical approach, as well as two consecutive analysis sections in which we describe the outcomes of our analysis tables. The end of each section features concluding remarks addressing the relevant research questions. The second and third chapters are structured in a slightly different fashion. Each consists of a brief introduction section in which we describe the main arguments in the existing literature and our analytical approach; three separate analysis sections in which we describe and interpret the outcomes of our analysis table for each metropolitan region; and finally, a conclusion section in which we summarize key findings that correspond to our research questions.

Before presenting our findings, it is important to define the geographic concepts as well as pertinent vocabularies we employ to describe our observations and subsequent conclusions based on the series of tables. We acknowledge that some of these concepts are by no means reflective of the geographical reality and some have little administrative meaning. To begin, the three metropolitan areas are referred to as the Greater Toronto Area or Greater Toronto, the Greater Montreal Area or Greater Montreal, and the Greater Vancouver Area or Greater Vancouver throughout this research.

The accessibility geography of each metropolitan area consists of 11 accessibility-based clusters, which are also referred to as accessibility profiles. They constitute the local level geography of each metropolitan region. These clusters are grouped into four subregions: the downtown (core), the central region, the suburban region (the suburbs), and the peripheral region. Additionally, we introduce an additional geographic unit, namely the "urban centre", to describe the geographical assemblage of the downtown core and central region in each metropolitan area. Moreover, depending on the specific metropolitan region, the "downtown core" is always located within the principal city, but the territory of the other three subregions may transcend administrative boundaries between the principal city and remote municipalities. Therefore, the three downtown cores are alternatively named "Downtown Toronto", "Downtown Montreal", and "Downtown Vancouver".

6.1 Residential location of occupational classes in 2016 in relation to accessibility geography

6.1.1 Introduction

As detailed in the literature review section, the creative class literature posits that in post-industrial economies, the super creative core consisting of creative and knowledge professionals demonstrate a distinct residential preference than the previous generation of middle-class. This is particularly prevalent in the North American context. Creative and knowledge professionals prefer to live in the urban centre of large metropolises to exploit uniquely urban amenities, such as an open, diverse, and tolerant social atmosphere and a high concentration of lifestyle-oriented destinations like cafés, restaurants, and art galleries. Thus, the urban centre has an elevated concentration of creative and knowledge workers (Clark et al. 2002; Florida, 2002; Florida, 2017; Jacobs, 1984; Smith et al., 2020).

One important implication of this phenomenon entails the widening inequity in relation to accessibility outcomes between privileged and disadvantaged classes. For instance, previous studies in the British and American context discovered that the privileged social classes disproportionately occupy the most desirable and functional areas where they benefit from high levels of accessibility to employment opportunities, transit services, natural amenities, and knowledge institutions (Florida & Adler 2018; Smith et al., 2020)

This chapter of our analyses examines the residential location quotients and the residential populations of the four broad occupational groups in each metropolitan region to investigate if their residential sorting is correlated with accessibility characteristics on various geographical scales. Our interpretations of the results have two theoretical implications. The first implication pertains to the creative class thesis on the residential preference of elite professionals. The second implication pertains to residential segregation by social class and the resulting inequity in accessibility outcomes between elite and disadvantaged groups.

The first columns on *Tables 10- 12* depict the location quotients (i.e., LQs) associated with the four broad occupational groups in relation to the accessibility geography of each metropolitan area. Recall that location quotient values in the context of this research represent the relative residential concentration of a socioeconomic group within an accessibility profile compared to the rest of the metropolitan area. The LQ cells are colour-coded in varying shades of red and blue to facilitate readers' comprehension. Specifically, the reds indicate a disproportionately higher concentration of a particular socioeconomic group within an accessibility profile relative to the metropolitan region. The blues indicate the opposite. The second columns on these tables depict the total population counts (i.e., POPs) of the four socioeconomic groups within each accessibility profile.

6.1.2 Residential location of the creative class

To begin, we draw the readers' attention to a few interesting observations based on the LQs associated with creative and knowledge workers in the three Canadian metropolises in the year of 2016. Instantly, the accessibility clusters that constitute the urban centre (i.e., downtown and central clusters) have higher accessibility to essential destinations than the remaining clusters (i.e., suburban and peripheral clusters clusters). The residences of creative workers overwhelmingly concentrated in the urban centre as conveyed by their high LQs values. The residences of knowledge workers were more evenly distributed across each metropolitan region, but they were also relatively more concentrated in clusters belonging to the urban centre. These findings suggest that compared to other groups, creative and knowledge workers were disproportionately more attracted to residences in urban centre that provide high levels of accessibility to essential destinations. Creative workers demonstrated a stronger preference for these locations than knowledge workers.

Given the above, we are inclined to support a more nuanced approach to separate the members of creative class into different sub-classes based on the nature of activities they engage with, especially in the context of theorizing the geography of the creative class. This approach was put forward in Asheim & Hanson (2009) and Wojan et al. (2007) based on their discovery in Nordic countries whereby creative individuals who engage with symbolic knowledge base demonstrate a stronger preference for residences in the urban centre.

However, while high LQs values associated with creative and knowledge workers were recorded in highly accessible clusters in the urban centre, the nature of this association is very coarse given that the urban centre has many other attractive locational and sociocultural advantages besides accessibility. Our second set of LQ analysis drills down to the local-level and examines if a positive association between accessibility and relative concentration of elite occupational groups existed in the context of each subregion.

Take the Greater Montreal Area as an example (Table 11). The LQs associated with creative workers demonstrate a positive correlation between the relative concentration of creative workers and accessibility within the different subregions. For instance, the central cluster in Greater Montreal with the highest overall accessibility profile (i.e., CENTRAL_VERYHIGH) had the highest relative concentration of creative workers. The relative concentration of creative workers in the other two central clusters declines gradually in relation to the accessibility level. An identical gradient pattern is also discernable within the downtown, suburban, and peripheral regions of Greater Montreal.

Such a positive association between the relative concentration of creative workers and accessibility level also existed in the different subregions of the Greater Toronto Area. However, this association did not hold in the case of the Greater Vancouver Area. Conversely, no association existed between accessibility and the relative concentration of knowledge workers on the subregional level in all three metropolitan regions.

While our analyses reveal that in Greater Montreal and Greater Toronto, the relative concentration of creative workers was correlated with the level of accessibility to essential destinations on the local cluster level, the results do not support causation. It is important to keep in mind that our analytical approach neglects the potential effect of other co-existing locational factors, including human environment factors in the creative class thesis, on the residential sorting of creative workers. As a matter of fact, we identify evidence supporting the effect of human environment factors on the residential sorting of creative workers in each metropolitan area based on their LQs values in 2016.

For example, in the Greater Montreal Area the highest relative concentration of creative workers was observed in the central clusters encompassing the cool and hip neighbourhoods known for being an artist bohemia, including the Mile-End and Plateau Mont-Royal. Whereas in the Greater Toronto Area the highest relative concentration of creative workers was found in the downtown core encompassing similar bohemian neighbourhoods like the Old Town, the Distillery District, and the Kensington Market. And in the Greater Vancouver Area the concentration of creative workers was relatively even across different parts of the urban centre, corresponding to the scattered locations of bohemian neighbourhoods, like Gastown, Yaletown, Kitsilano, and Commercial Drive.

In addition to LQs, we also examine the distribution of creative and knowledge workers in terms of the absolute size of local populations across the three metropolitan regions. Several noteworthy findings are highlighted here. Firstly, in all three metropolises, the downtown core and central region generally had a considerably smaller population of creative and knowledge workers than the suburban and peripheral regions. Secondly, the largest local clusters of creative and knowledge workers were found within the suburban and peripheral subregions. Finally, we fail to identify any association between accessibility level and population size for both creative and knowledge workers on all levels of analysis across all three metropolitan areas.

It is interesting to note that our findings based on total population counts convey drastically different information about the residential preference of creative and knowledge workers from our findings based on LQs. We argue that both approaches convey equally important and valid information about the locational preference of creative and knowledge workers depending on how the concept is defined and understood.

From an individual's standpoint, locational preference indicates a general liking for one location over others. In other words, we can assess the locational preference of individuals and individual groups based on their population counts in different locations. However, locational preference may also be applied in the context of cross-group comparisons. In this research, this comparative locational preference across occupational groups can be determined based on differences in their location quotients.

According to this latter approach, we argue that compared to blue-collar and sales & service workers, creative and knowledge workers in each Canadian metropolitan region disproportionately preferred to reside in the urban centre as opposed to the remote parts. Creative workers in the Greater Toronto and Greater Montreal Area demonstrated a noticeable preference for more accessible locations within subregions. However, we want to emphasize that the suburban and peripheral regions of Greater Toronto, Greater Montreal, and Greater Vancouver remain the major source of creative and knowledge workers. In fact, between urban and suburban/peripheral residences, individual members of these two groups gravitated more toward the latter in the year of 2016.

6.1.3 Residential segregation and inequity in essential accessibility outcomes

A large body of research has inquired about spatial segregation between different races and socioeconomic classes using relative indices like location quotients (e.g., Bauder & Sharpe 2002; Benassi et al., 2022; Cristaldi, 2002; Florida & Adler 2018). These studies identified pervasive class divisions in relation to residential geography between elite professionals who disproportionately occupy the most desirable and functional neighbourhoods in the city centre and disadvantaged social groups who disproportionately occupy more remote and inaccessible regions. As a result, the elite professionals disproportionately enjoy better accessibility outcomes in relation to transit services, employment opportunities, natural amenities, and knowledge institutions (Smith et al., 2020; Florida & Adler 2018).

Following this tradition, we inspect the patterns of residential segregation by socioeconomic status within the three Canadian metropolitan regions by comparing the LQs values associated with the two elite to the LQ values associated with two disadvantaged socioeconomic groups.

According to the LQ results, across the three metropolitan regions, creative and knowledge workers had higher relative concentrations within the urban centre. Conversely, blue-collar and sales & service workers had inflated relative concentrations within suburban and peripheral clusters. In relation to accessibility outcomes from their residential location, the elite professionals disproportionately occupied the desirable, amenity-rich areas inside the city centre that provide high levels of accessibility to essential destinations, such as grocery stores, health clinics, childcare facilities, and parks. Whereas the disadvantaged working-class groups disproportionately occupied the less accessible areas in remote parts of the metropolitan region. In other words, we discover that there existed a wide gap between the elite and disadvantaged groups and their families in terms of accessibility outcomes relating to essential amenities and services, which can have a meaningful impact on the quality of life and general life outcomes.

		Creative		Knowledge		Sales & services		Blue Collar	
Subregions	Cluster Profile	LQs	POPs	LQs	POPs	LQs	POPs	LQs	POPs
	DT_VERYHIGH_A	1.940	4365	1.266	31275	0.723	10290	0.135	1260
	DT_VERYHIGH_B	2.867	7195	0.939	25885	1.116	17725	0.446	4655
Downtown core	DT_HIGH	2.078	4480	1.295	30650	0.722	9855	0.203	1820
Subregional totals			*16040*		*87810*		*37870*		*7735*
	CENTRAL_HIGH	2.390	17835	1.014	83075	0.943	44545	0.597	18505
Central Region	CENTRAL_MEDIUM	2.102	11930	1.097	68375	0.880	31615	0.408	9625
Subregional totals			*29765*		*151450*		*76160*		*28130*
	SUB_MEDIUM_A	0.833	16385	1.007	217420	1.037	129105	0.961	78560
	SUB_MEDIUM_B	0.780	10315	0.883	128215	1.108	92780	1.230	67645
	SUB_LOW_A	0.699	16370	0.982	252500	1.026	152045	1.130	110050
Suburban region	SUB_LOW_B	0.705	9220	0.940	135030	1.079	89360	1.161	63145
Subregional totals			*52290*		*733165*		*463290*		*319400*
	PERI_VERYLOW_A	0.682	16760	1.035	279260	0.949	147590	1.112	113525
Peripheral Region	PERI_VERYLOW_B	0.746	2425	1.012	36105	0.847	17410	1.388	18740
Subregional totals			*19185*		*315365*		*165000*		*132265*

Table 10 Residential location quotients and population counts across the 11 accessibility-based clusters of Greater Toronto Area in 2016. Note: Reds indicate an elevated prevalence or an elevated local concentration of a certain socioeconomic group within a cluster relative to the region at large; blues indicate a relatively suppressed prevalence of a certain socioeconomic group within a cluster.

		Creative		Knowledge		Sales & services		Blue Collar	
Subregions	Cluster Profile	LQs	POPs	LQs	POPs	LQs	POPs	LQs	POPs
	DT_VERYHIGH	2.110	890	1.092	4600	1.088	2805	0.211	330
Downtown core	DT_HIGH	1.724	2910	1.189	20035	0.969	9995	0.440	2745
Subregional totals			*3800*		*24635*		*12800*		*3075*
	CENTRAL_VERYHIGH	2.909	5865	0.975	19615	1.002	12340	0.484	3610
	CENTRAL_HIGH	2.559	8790	1.031	35340	0.948	19895	0.499	6345
Central Region	CENTRAL_MEDIUM	1.988	8380	1.102	46350	0.943	24295	0.450	7015
Subregional totals			*23035*		*101305*		*56530*		*16970*
	SUB_HIGH	1.554	7230	0.946	43955	1.062	30205	0.826	14225
	SUB_MEDIUM_A	0.991	9005	0.916	83070	1.123	62350	0.998	33545
Suburban region	SUB_MEDIUM_B	0.851	5855	0.923	63370	1.081	45435	1.121	28530
Subregional totals			*22090*		*190395*		*137990*		*76300*
	PERI_LOW_A	0.651	14600	0.986	220900	1.020	139920	1.133	94085
	PERI_LOW_B	0.694	13585	1.067	208445	0.933	111620	1.019	73765
Peripheral Region	PERI_VERYLOW	0.609	4205	0.957	66030	0.902	38070	1.434	36660
Subregional totals			*32390*		*495375*		*289610*		*204510*

Table 11 Residential location quotients and population counts across the 11 accessibility-based clusters of Greater Montreal Area in 2016. Note: Reds indicate an elevated prevalence or an elevated local concentration of a certain socioeconomic group within a cluster relative to the region at large; blues indicate a relatively suppressed prevalence of a certain socioeconomic group within a cluster.

		Creative		Knowledge		Sales & services		Blue Collar	
Subregions	Cluster Profile	LQs	POPs	LQs	POPs	LQs	POPs	LQs	POPs
Downtown core (Downtown Vancouver)	DT_VERYHIGH	1.863	2555	1.219	14675	0.960	7685	0.272	1345
	DT_HIGH_A	2.123	5680	1.239	29085	0.733	11435	0.324	3120
	DT_HIGH_B	2.144	1880	1.259	9690	0.788	4030	0.323	1020
Subregional totals			*10115*		*53450*		*23150*		*5485*
Central region	CENTRAL_HIGH	2.059	5970	0.982	24980	0.978	16545	0.663	6920
Subregional totals			*5970*		*24980*		*16545*		*6920*
Suburban region	SUB_MEDIUM_A	0.906	7735	0.912	68335	1.193	59435	0.951	29210
	SUB_MEDIUM_B	1.377	2185	1.057	14725	0.977	9045	0.754	4305
Subregional totals			*9920*		*83060*		*68480*		*33515*
Peripheral region	PERI_MEDIUM_A	1.012	7915	0.997	68430	1.021	46590	0.974	27435
	PERI_MEDIUM_B	0.702	5460	0.953	65090	1.071	48630	1.168	32710
	PERI_LOW	0.738	9280	0.954	105340	0.981	72025	1.236	55960
	PERI_VERYLOW_A	0.796	7715	1.044	88745	0.938	53035	1.037	36145
	PERI_VERYLOW_B	0.770	1860	1.037	21980	0.804	11325	1.314	11425
Subregional totals			*32230*		*349585*		*231605*		*163675*

Table 12 Residential location quotients and population counts across the 11 accessibility-based clusters of Greater Vancouver Area in 2016. Note: Reds indicate an elevated prevalence or an elevated local concentration of a certain socioeconomic group within a cluster relative to the region at large; blues indicate a relatively suppressed prevalence of a certain socioeconomic group within a cluster

6.2 Change in socioeconomic character across between 2006 and 2016 in relation to accessibility geography

6.2.1 Introduction

As noted in a large body of literature (Andersson & Turner 2014; Carpenter & Lee 1995; Clark et al., 2002; Edlund et al., 2015; Ehrenhalt, 2013; Federal Reserve Bank of Cleveland, 2013; Florida & Adler, 2018; Hamnett, 2003; Lees, 2000; Ley, 2003; Smith et al., 2020), inner-city gentrification has been a prevalent phenomenon in Euro-American cities despite distinctions in the underlying political, social, and cultural forces unique to the context of each country. By popular definition, inner-city gentrification describes an uplift in the socioeconomic status of well-built, highly accessible yet low-priced inner-city neighbourhoods due to an influx of wealthier residents who occupy higher-paid jobs (i.e., creative and knowledge workers).

Moreover, several studies hypothesized that the process of gentrification is composed of several successive phases. These phases can be classified by the socio-occupational profile of the "gentrifies" (e.g., Hackworth & Smith, 2001; Ley, 2003). Specifically, the early onset of gentrification in inner-city neighbourhoods is usually triggered by an influx of artists and creative individuals. After the neighbourhood image becomes increasingly aestheticized through creative artwork and hip lifestyles, other elite groups, such as professional knowledge workers, start flocking to these neighbourhoods, which drives the second phase of gentrification. The latter phases involve capitalistic, profit-driven investors and enterprises who purchase residential units to convert them into Airbnb and other short-term rentals geared toward tourists.

Given the theoretical foundation, our subsequent analyses examine the residential population dynamics associated with four broad socioeconomic groups across each metropolitan region from 2006 to 2016. To do so, we develop an analytical method that consists of three measures that depict varying information about population changes in each cluster, as presented in Tables 13-15. Here, we emphasize that changes on the local level must be placed in the context of overall regional dynamics to understand their significance. To facilitate readers' comprehension, we employ a visualization tool in some incidences to depict the significance of individual values. Specifically,

For the first measure, "Δ proportion", we implement a bivariate, gradient colour scheme to signify the meaning of individual values relative to the region's overall value. Specifically, cells that are highlighted in red indicate a larger percentage increase or a smaller percentage decrease in relation to the resident proportion of a socioeconomic group within a given cluster compared to the whole metropolitan region. Whereas cells that are highlighted in blue indicate the opposite. As highlighted in the methodology section, changes in resident proportion may result from different scenarios, which are considered throughout our analysis.

For the second measure, "Δ population (%)", we also implement a bivariate, gradient colour scheme. Similarly, cells that are highlighted in red indicate either a larger percentage increase or a smaller percentage decrease relative to the residential population of a socioeconomic group within a given cluster compared to the whole metropolitan region. Whereas cells that are highlighted in blue indicate the opposite.

For the third measure, "Δ population", we simply present the raw number of population changes during the decade. We include this absolute measure because analysis based on percentage changes alone can lead to inaccurate, one-sided conclusions. For instance, an area with a small initial population of elite professionals may record an enormous growth rate even though the actual count of new arrivals is not significant.

Our analyses are structured as the following. In each ensuing subsection, we first introduce the overall population dynamics associated with the four groups on the metropolitan level as the baselines. After that, we feature the residential dynamics of different groups on the subregional and local levels and discuss what the interactions between them tell us about sociodemographic change and if this was associated with accessibility level. Finally, we wrap up by providing a short conclusion in which we highlight the key similarities and distinctions among the three metropolitan regions in relation to gentrification and discuss our reflections.

Before presenting our findings, we stress that the economy of each city region has become increasingly dependent on service-related sectors, and blue-collar employment has overall shrunken as the de-industrialization of the metropolitan economies progressed from 2006 to 2016 (source). Therefore, we expect to see a decrease in the size of blue-collar workers at the metropolitan level. However, it is unlikely that blue-collar workers who lost their job simply disappeared or relocated to other cities. Some of them may have taken up employment in the booming service-related sectors that do not require specialized knowledge, such as restaurant servers.

This means when we discuss changes in socioeconomic character and population displacement on the local level, we must consider this possible movement of population from one lower-income group to another. Our approach to grappling with this complexity is to consider the local dynamics of these two lower-income groups together when discussing these two subjects.

6.2.2 The Greater Toronto Area

In the Greater Toronto Area (*see Table 13),* the proportion of knowledge workers relative to the sociodemographic structure of the metropolitan population declined gently; however, their population became larger. The proportion of creative workers expanded by a marginal amount, which concurred with a population increase. The proportion of sales & service workers relative to the sociodemographic structure of the metropolitan population also expanded, and so did the size of their population. Finally, there was a decline in both the proportion and population of blue-collar workers.

Within Downtown Toronto, all three component clusters saw an improvement in the proportion of knowledge workers relative to the local sociodemographic structure. “DT_HIGH” recorded the largest increase in the resident proportion of knowledge workers. The increase was also highly elevated in “DT_VERYHIGH_A”. Furthermore, these two downtown clusters also had a highly inflated growth rate for knowledge workers. Conversely, the resident proportion of creative workers declined all over Downtown Toronto. The proportion of lower-income workers (i.e., sales & service workers and blue-collar workers together) also declined in Downtown Toronto; however, their population in Downtown Toronto had a net gain.

Regarding the central region of Greater Toronto, an increase in the proportion of both creative and knowledge workers relative to the local sociodemographic structure was recorded in the more accessible areas (i.e., “CENTRAL_HIGH”). This concurred with a net decrease in the resident proportion of lower-income workers and a net loss of lower-income workers, specifically blue-collar workers, in “CENTRAL_HIGH”. In “CENTRAL_MEDIUM”, there was a slight decrease in the resident proportion of both creative and knowledge workers. The resident proportion of lower-income workers shrank by a larger magnitude. However, the population of lower-income workers in “CENTRAL_MEDIUM” experienced a net increase.

In relation to the suburban region of Greater Toronto, the resident proportion of knowledge workers in each component cluster declined substantially in comparison to the metropolitan baseline, although not all clusters recorded a loss of knowledge workers. In fact, there was a small net increase in the suburban population of knowledge workers. The resident proportion of creative workers in each component cluster increased by a marginal amount. In contrast, there was a substantial increase in both the resident proportion and population of lower-income workers in each of the suburban clusters.

Finally, in the peripheral region of Greater Toronto, although the resident proportion of knowledge workers declined in “PERI_VERYLOW_A”, the knowledge population experienced enormous growth. In fact, “PERI_VERYLOW_A” recorded the largest absolute population growth in relation to all four groups. Overall, the resident proportions of elite professionals and lower-income groups in the peripheral region remained quite stable.

Based on the above observations, we conjecture that the socioeconomic character of Downtown Toronto became wealthier, particularly in the case of “DT_HIGH” and “DT_VERYHIGH_A”. Specifically, knowledge workers were responsible for this change in socioeconomic character within the downtown core. We also discover that the influx of wealthier knowledge professionals into Downtown Toronto did not cause a net loss of lower-income populations.

The most accessible parts of the central region (i.e., “CENTRAL_HIGH”) in Greater Toronto also became wealthier due to an influx of creative and knowledge workers. Moreover, this change in socioeconomic character correlated with a decrease in the total number of lower-income workers. In contrast, the socioeconomic character of the remaining central areas remained relatively unchanged over the decade.

The socioeconomic character of the suburban region became faintly less prestigious over the decade. Moreover, our results suggest that this sociodemographic shift in the suburban region was more likely caused by a disproportionate inflow of lower-income workers than an exodus of elite professionals.

Finally, the socioeconomic character of different parts of the peripheral region remained relatively stable over the decade.

		Creative			Knowledge-based			Sales & Services			Blue Collar		
Subregion	Cluster	Δ proportion	Δ population (%)	Δ population	Δ proportion	Δ population (%)	Δ population	Δ proportion	Δ population (%)	Δ population	Δ proportion	Δ population (%)	Δ population
Downtown core	DT_VERYHIGH_A	-1.71%	26%	895	1.58%	58.6%	11550	0.22%	56%	3690	-0.69%	17.2%	185
	DT_VERYHIGH_B	0.16%	11%	725	0.27%	10.4%	2435	2.85%	22%	3220	-4.81%	-34%	-2395
	DT_HIGH	-2.31%	51%	1520	5.12%	113.7%	16305	-0.40%	90%	4665	-3.10%	0.3%	5
Central Region	CENTRAL_HIGH	0.47%	15%	2340	1.36%	12.9%	9480	1.06%	15%	5660	-4.87%	-27%	-6870
	CENTRAL_MEDIUM	-0.26%	8%	925	-0.68%	10.2%	6330	2.69%	27%	6805	-2.54%	-19%	-2265
Suburban region	SUB_MEDIUM_A	0.23%	23%	3105	-2.54%	8.3%	16620	3.67%	34%	32485	-3.45%	-6%	-5030
	SUB_MEDIUM_B	0.05%	3%	260	-3.93%	-8.7%	-12175	4.96%	23%	17260	-2.78%	-11%	-8770
	SUB_LOW_A	0.19%	17%	2380	-3.56%	0.4%	1000	4.17%	30%	35180	-2.65%	-5%	-5565
	SUB_LOW_B	0.29%	18%	1380	-3.82%	-3.7%	-5175	3.88%	23%	16825	-2.63%	-7%	-5090
Peripheral Region	PERI_VERYLOW_A	0.07%	33%	4120	-2.64%	22.0%	x	2.28%	43%	44410	-1.43%	20%	18775
	PERI_VERYLOW_B	0.03%	6%	130	0.42%	5.7%	1955	1.14%	11%	1680	-3.42%	-9%	-1855
Metropolitan totals		-	-	***17780***	-	-	***98745***	-	-	***171880***	-	-	***-18875***
Metropolitan baselines		***0.1%***	***17.9%***	-	***-2.2%***	***8.3%***	-	***3.1%***	***30.1%***	-	***-3.0%***	***-3.7%***	-

Table 13 Residential dynamics associated with different socioeconomic groups across the 11 accessibility-based clusters of Greater Toronto Area between 2006 and 2016. Note that red cells indicate values that are above the metropolitan baselines; whereas blue cells indicate values that are below the metropolitan baseline.

6.2.3 The Greater Montreal Area

In the Greater Montreal Area (Table 14), the proportion of knowledge workers relative to the sociodemographic structure of the metropolitan population declined by a small amount; however, their population became larger. The proportion of creative workers improved by a marginal degree with a modest increase in their population. The proportion of sales & service workers relative to the metropolitan sociodemographic structure and the size of their population both expanded. Finally, there was a decline in both the population size and the proportion of blue-collar workers.

Within Downtown Montreal, the two component clusters both recorded an improvement in the resident proportion of knowledge workers. The improvement was especially sizeable in the case of "DT_HIGH". Furthermore, they both recorded a highly inflated growth rate for knowledge workers in comparison to the metropolitan baseline. Meanwhile, the resident proportion of creative workers declined in both clusters. In both clusters, there was a net gain in the local lower-income population. On one hand, "DT_HIGH" recorded a significant decline in the proportion of lower-income workers. On the other hand, "DT_VERYHIGH" had a slight increase in the proportion of lower-income workers.

In the central region, the most accessible cluster (i.e., CENTRAL_VERYHIGH) had negligible changes in the proportions of the four occupational groups. Whereas, the two remaining clusters, "CENTRAL_HIGH" and "CENTRAL_MEDIUM", reported a significant increase in the resident proportion of both elite groups that overlapped with an overall decrease in the proportion of lower-income workers. "CENTRAL_HIGH", in particular, reported a net loss of lower-income workers in its population.

In the suburban region, all three component clusters recorded a decline in the proportion of knowledge workers within the local sociodemographic structure. Moreover, two suburban clusters, "SUB_MEDIUM_A" and "SUB_MEDIUM_B", both recorded a sizeable decrease in the population of knowledge workers, which resulted in a net loss of suburban knowledge workers. Concurrently, the resident proportion of creative workers within each suburban cluster only improved marginally although the extent is above the metropolitan baseline. The proportion of lower-income workers in each suburban cluster also experienced a gentle decline.

In the peripheral region, there was a decline in the resident proportion of knowledge workers across all three peripheral clusters; however, the knowledge population in "PERI_LOW_B" grew by an enormous number. A decline in the resident proportion of lower-income workers was also observed across the peripheral region, although there was a net increase of lower-income workers in each peripheral cluster.

From the above, we can conclude that the less accessible parts of Downtown Montreal experienced an improvement in socioeconomic character due to knowledge workers moving in. Whereas the socioeconomic character of the more accessible parts persisted during the decade. In neither case did a displacement of lower-income residents occur.

In the central region of the Greater Montreal Area, the socioeconomic character of less accessible clusters experienced a slight improvement due to a substantial in-migration of elite professionals, especially knowledge workers. Moreover, this improvement correlated with an overall loss of lower-income residents. On the contrary, the socioeconomic character of the more accessible cluster remained relatively stable over this decade.

We are unable to characterize the nature of socioeconomic change within the suburban region of Greater Montreal. The results point to a rise of public and community service workers who are excluded from our analysis. A noteworthy observation is that the suburban region of Greater Montreal experienced a sizeable exodus of knowledge workers over this decade, which implies their loss of interest in the suburban lifestyle.

In the same vein as above, we are unable to characterize the impact of sociodemographic change in the peripheral region of Greater Montreal on socioeconomic character.

		Creative			Knowledge-based			Sales & Services			Blue Collar		
Subregion	Cluster	Δ proportion	Δ population (%)	Δ population	Δ proportion	Δ population (%)	Δ population	Δ proportion	Δ population (%)	Δ population	Δ proportion	Δ population (%)	Δ population
Downtown core	DT_VERYHIGH	-2.06%	0%	0	0.72%	25.7%	940	2.28%	35%	725	-1.73%	-20%	-80
	DT_HIGH	-0.04%	19%	470	3.75%	29.9%	4615	0.79%	24%	1935	-3.49%	-21%	-730
Central Region	CENTRAL_VERYHIGH	-0.30%	1%	70	-0.43%	2.7%	510	2.52%	15%	1635	-2.47%	-22%	-1030
	CENTRAL_HIGH	0.57%	10%	790	1.29%	7.2%	2375	1.66%	12%	2085	-3.22%	-27%	-2335
	CENTRAL_MEDIUM	0.38%	15%	1095	1.05%	12.3%	5070	1.25%	16%	3310	-2.58%	-20%	-1780
Suburban region	SUB_HIGH	0.53%	11%	745	-0.69%	0.5%	230	2.34%	12%	3250	-3.56%	-20%	-3600
	SUB_MEDIUM_A	0.19%	7%	560	-1.91%	-3.3%	-2830	2.96%	13%	7390	-3.16%	-16%	-6310
	SUB_MEDIUM_B	0.33%	8%	445	-2.52%	-8.1%	-5585	2.90%	10%	3990	-3.04%	-17%	-5740
Peripheral Region	PERI_LOW_A	0.03%	5%	660	-2.15%	-1.7%	-3860	1.86%	12%	14450	-2.07%	-8%	-7700
	PERI_LOW_B	0.11%	20%	2265	-2.43%	9.5%	18070	1.22%	22%	20000	-1.84%	3%	2360
	PERI_VERYLOW	0.23%	32%	1020	-1.12%	16.8%	9505	1.62%	29%	8630	-3.64%	3%	1080
Metropolitan totals		-	-	***8120***	-	-	***29040***	-	-	***67400***	-	-	***-25865***
Metropolitan baselines		***0.1%***	***11.1%***	-	***-1.7%***	***3.7%***	-	***2.62%***	***15.7%***	-	***-2.67%***	***-7.9%***	-

Table 14 Residential dynamics associated with different socioeconomic groups across the 11 accessibility-based clusters of Greater Montreal Area between 2006 and 2016. Note that red cells indicate values that are above the metropolitan baselines; whereas blue cells indicate values that are below the metropolitan baseline.

6.2.4 The Greater Vancouver Area

Before we proceed to analyze the residential dynamics in the Greater Vancouver Area, it is important to emphasize that the accessibility-based geography of Greater Vancouver (see Figure 5) exhibits more scattered and patchwork-like patterns. These patterns suggest that the urban form of the Greater Vancouver Area is relatively more polycentric than the other two city regions, which is consistent with the conclusion in Shearmur & Coffey (2002) and Shearmur et al., (2007).

Accordingly, essential services and amenities are more geographically dispersed in Greater Vancouver as opposed to being heavily concentrated in the urban centre. In fact, the map depicts numerous local centres within the suburban and peripheral municipalities in Greater Vancouver that are distinguishably more accessible than their surroundings (e.g., "SUB MEDIUM B"). We expect this spatial complexity in the suburban and peripheral regions to heavily inform the residential dynamics of different socioeconomic groups in the Greater Vancouver Area.

On Table 15, the proportion of knowledge workers relative to the sociodemographic structure of Greater Vancouver's population experienced a slight decline over this decade even though their numbers increased by a large amount. The proportion of creative workers increased marginally in parallel with an increase in their population. Both the population size and proportion of sales & service workers expanded. Finally, although the proportion of blue-collar workers relative to the sociodemographic structure declined, the size of their population grew larger, which is unique among the three city regions.

Within Downtown Vancouver, "DT_HIGH_B" recorded a sizeable improvement in the resident proportion of creative and knowledge workers in parallel with an equally sizeable decline in the proportion of blue-collar and sales & service workers, although the number of lower-income workers living in this cluster increased. In the remaining downtown clusters, the resident proportions associated with the four occupational groups fluctuated less significantly. There was a slight increase in the resident proportion of lower-income workers in "DT_VERYHIGH". Whereas the resident proportion of both elite professionals and lower-income workers in "DT_HIGH_A" both declined by a small amount.

In the central region, the proportion of elite professionals relative to the sociodemographic structure of "CENTRAL_HIGH" rose noticeably. In the meantime, the proportion of lower-income workers declined by a significant amount. However, the region had a net gain in the number of lower-income workers residing in "CENTRAL_HIGH".

In the suburban region, the changes in the sociodemographic structure of component clusters were modest in terms of values. For instance, the resident proportion of creative workers improved only by a marginal amount. "SUB_MEDIUM_A" had a noticeable decline in relation to the resident proportion of knowledge workers, but the value is insignificant when compared to the metropolitan baseline. Changes in the resident proportion of sales & service workers and

changes in the resident proportion of blue-collar workers in the two suburban clusters essentially neutralized each other. There was a net increase in the local population of lower-income workers in both suburban clusters.

The majority of component clusters in the peripheral region of Greater Vancouver documented an elevated decline in the resident proportion of knowledge workers relative to the metropolitan baseline. The only exception is "PERI_VERYLOW_B" where the resident proportion of knowledge workers rose by a modest amount. Changes in creative workers and lower-income workers' proportions within the peripheral clusters were inappreciable.

Based on these observations, we conclude that only parts of Downtown Vancouver, specifically "DT_HIGH_B", experienced an improvement in local socioeconomic character between 2006 and 2016 due to an influx of knowledge workers. This improvement was not correlated with a displacement of lower-income residents. In fact, the number of lower-income workers residing in "DT_HIGH_B" increased over this decade. In comparison, the socioeconomic character of the remaining parts of Downtown Vancouver, including "DT_VERYHIGH" and "DT_HIGH_A", remained relatively stable. The socioeconomic character of the central cluster in Greater Vancouver became wealthier over the decade due to an influx of both creative and knowledge workers. In spite of this, the central cluster reported a net growth in the population of lower-income workers. The suburban region of Greater Vancouver largely upheld its socioeconomic character over the decade. In a similar manner, the peripheral region of Greater Vancouver has largely upheld its socioeconomic character.

		Creative			Knowledge-based			Sales & Services			Blue Collar		
Subregion	Cluster	Δ proportion	Δ population (%)	Δ population	Δ proportion	Δ population (%)	Δ population	Δ proportion	Δ population (%)	Δ population	Δ proportion	Δ population (%)	Δ population
Downtown core	DT_VERYHIGH	0.65%	35%	665	-3.13%	17%	2165	2.44%	38%	2115	-0.82%	5%	70
	DT_HIGH_A	1.01%	34%	1440	-2.05%	15%	3835	-0.21%	19%	1800	-0.67%	6%	190
	DT_HIGH_B	0.91%	94%	910	6.72%	103%	4910	-5.40%	40%	1145	-6.44%	-21%	-265
Central region	CENTRAL_HIGH	1.65%	41%	1735	1.54%	21%	4315	-0.58%	14%	1985	-4.31%	-17%	-1395
Suburban region	SUB_MEDIUM_A	0.50%	29%	1740	-2.40%	6%	4060	3.04%	25%	12005	-2.63%	-3%	-910
	SUB_MEDIUM_B	0.30%	25%	435	-0.78%	17%	2120	2.38%	31%	2140	-2.45%	-1%	-30
Peripheral region	PERI_MEDIUM_A	0.59%	26%	1610	-2.81%	2%	1500	2.05%	18%	7240	-1.01%	3%	790
	PERI_MEDIUM_B	0.31%	20%	910	-2.76%	1%	670	2.29%	18%	7355	-0.97%	3%	1000
	PERI_LOW	0.31%	28%	2055	-3.19%	8%	7470	1.50%	24%	13820	-0.53%	14%	6715
	PERI_VERYLOW_A	0.21%	31%	1845	-2.22%	17%	13170	1.65%	32%	12980	-1.42%	14%	4485
	PERI_VERYLOW_B	-0.08%	5%	90	0.25%	8%	1675	0.26%	9%	930	-2.43%	-3%	-390
Metropolitan totals		-	-	***13435***	-	-	***45890***	-	-	***63515***	-	-	***10260***
Metropolitan baselines		***0.5%***	***30.0%***	-	***-2.1%***	***9.9%***	-	***1.6%***	***23.0%***	-	***-1.6%***	***5.1%***	-

Table 15 Residential dynamics associated with different socioeconomic groups across the 11 accessibility-based clusters of Greater Vancouver Area between 2006 and 2016. Note that red cells indicate values that are above the metropolitan baselines; whereas blue cells indicate values that are below the metropolitan baseline.

6.2.5: Chapter conclusion

Across the three metropolitan regions, a positive change in socioeconomic character, or gentrification, took place primarily in the downtown core or the centre region of each metropolis due to a disproportionate influx of higher-paid professionals, especially knowledge workers. According to the conceptual definition in Ley (2003) and Hackworth & Smith (2001), the nature of sociodemographic change in these highly accessible subregions resembles the characterization of gentrification in its second phase. Conversely, the less accessible subregions have largely maintained the original socioeconomic character; however, the proportion of lower-income workers in the local sociodemographic structure increased slightly in a few cases. No association between accessibility and sociodemographic change existed on the local level.

However, we identify an interesting phenomenon on the local level. Within Downtown Vancouver and the central region of Greater Montreal, the socioeconomic character of highly accessible clusters has remained relatively unchanged, whereas the socioeconomic character of less accessible clusters became upgraded. This suggests the most accessible parts of these metropolitan regions may have already been highly gentrified before 2006 and inner-city gentrification has spread to neighbouring less accessible areas.

Closely related to change in socioeconomic character or gentrification is the issue of displacement of lower-income residents. As opposed to focusing on the working class, whose numbers inevitably declined due to de-industrialization, our analyses combine blue-collar workers and sales & service workers into what we refer to as lower-income workers. Accordingly, our results show that only in a few isolated local cases was there a decline in the population of lower-income workers in parallel with an influx of elite professionals.

6.3 Population and employment dynamics in relation to the geography of 15-Minute City

6.3.1 Introduction

As noted in the literature review, there has been a growing movement among urbanists in the academic and professional realms to prioritize accessibility, particularly by active modes of transportation, in the centre of urban planning and design in order to promote sustainability and improve the quality of urban life. Among many similar concepts, the 15-Minute City rose to prominence during the COVID-19 pandemic as a promising model to help cities build back better and increase resilience against future crises. It set out an appealing vision in which residents are able to access the most essential urban services and amenities within 15-minute walking or biking distance from their homes.

According to its pioneer theorists, wide adoption of the 15-Minute City model in managing urban growth and urban renewal solves many devastating problems created by car dependency, particularly environmental and ecological degradation that underpins the impending climate crisis. Although the 15-Minute City has gained considerable political clout, there is still a great deal of research work needed to clarify its definition, intent, and application. This present research has a unique opportunity to contribute to the expanding literature on the 15-Minute City as our resulting accessibility-based cluster geographies encompass the six main considerations of urban social functions in the original conceptualization of the 15-Minute City (Moreno et al., 2021). In other words, the accessibility-based cluster geographies depict which parts of each metropolitan region function as the 15-Minute City where residents are likely to be able to reach essential urban services and amenities within a 15-minute walk.

In addition to the mapping of the 15-Minute City in each metropolitan region, this final part of our analysis investigates the patterns of intra-metropolitan population and employment dynamics between 2006 and 2016 in relation to the geography of the 15-Minute City. Specifically, we examine the overall population dynamics, the overall employment dynamics, and two sectoral employment dynamics through both a relative measure and an absolute measure. Accordingly, Tables 16 - 18 feature the results of a total of four relative and four absolute measures in the context of each metropolitan region.

In the case of relative measures, we employ a bivariate gradient scheme to colour-code the cluster-level values in contrast to the corresponding metropolitan baseline in order to visually convey their significance. Cells that are coloured in red depict a relatively inflated value or a stronger performance compared to the metropolitan baseline. Oppositely, the cells that are coloured in blue indicate a relatively low-lying value or a weaker performance compared to the metropolitan baseline.

For the outcomes of absolute measures, the tables present both individual cluster-level values and totalled values associated with different subregions as well as the entire metropolitan region. Additionally, the ratios of subregional totals relative to the metropolitan totals are also featured in the tables.

Note that our interpretation of these ratios depends on the assumption that if population and employment growths within each metropolitan region were evenly distributed across different subregions, population and employment gains within each subregion should make up one-quarter of total gains on the metropolitan level. Any ratio that is significantly less than one-quarter conveys that the absolute population or employment growth in the given subregion is relatively modest. Whereas any ratio that is significantly above one-quarter conveys that the absolute population or employment growth in the given subregion is relatively large. Finally, any negative ratio conveys that the population or employment dynamics in the given subregion are opposite of the metropolitan dynamics.

Structurally, this part of our analysis is composed of three geographically focused subsections. In each subsection, we first introduce the overall regional statistics, which function as the baseline values against which the significance of local level statistics is evaluated, particularly in the case of relative measures. After that, we explain the local, cluster-level performance and the overall subregional performance relative to the measures, followed by our interpretations of emergent patterns. Finally, in a concluding section, we discuss the similarities and distinctions in terms of the patterns of intra-metropolitan growth across the three metropolitan regions and how these patterns inform policymaking in relation to the 15-Minute City.

6.3.2 The Greater Toronto Area

On Table 16, Greater Toronto's population increased by 13.8% or 360845 people between 2006 and 2016. In the meantime, total employment in the metropolitan region increased by 11.2% or 281350 jobs. In relation to specific economic sectors, creative employment in Greater Toronto rose by 7.1 % or 9885 jobs. Knowledge-based employment rose more substantially by 25.4% or by 129085 jobs during this period.

In Downtown Toronto, "DT_HIGH" and "DT_VERYHIGH_A" had exceptionally high population growth rates. However, overall Downtown Toronto accounted for a modest portion of total population growth in the wider metropolitan region. In regard to employment, "DT_HIGH" had an inflated growth rate in relation to all jobs as well as jobs in the creative and knowledge-based sectors. However, in absolute terms, "DT_VERYHIGH_A" created a larger number of new jobs. Overall, the number of new jobs, including new knowledge jobs, in Downtown Toronto made up a significant ratio (around one-third) of total employment growth in the wider metropolitan region. In comparison, creative employment growth in Downtown Toronto was modest.

In the central region, both overall population and employment growth rates in central clusters fell short of the metropolitan baselines. The absolute population and job growths (overall and sector-wise) did not compose a significant proportion of the metropolitan totals. Notably, "CENTRAL_HIGH" had a highly inflated growth rate in relation to creative employment, but the absolute number of new creative jobs in this cluster was not significant.

Similarly, the four suburban clusters underperformed on the relative measures in most incidences. However, if we look at absolute numbers, the population growth in "SUB_MEDIUM_A" and "SUB_LOW_A" was at least doubled the amount as that in clusters belonging to the urban core or the central region. The number of new jobs and specifically knowledge-based jobs in these two clusters were also of large quantity. Overall, the suburban region accounted for a significant portion of totalled population and employment growths, apart from creative employment, in Greater Toronto. The suburban region had a net loss of creative employment.

In the peripheral region, "PERI_VERYLOW_A", reported remarkably strong performance across the board. As a matter of fact, almost 40 percent of population growth in the entire Greater Toronto Area converged on "PERI_VERYLOW_A", so did one-third of new jobs and a whopping 90 percent of new creative jobs in all of Greater Toronto Area. Overall, the peripheral region accounted for a substantial portion of population and employment growths (overall and sectoral) in Greater Toronto.

These results show that in the Greater Toronto Area, highly inflated population and employment (overall and sectoral) growth rates were generally associated with highly accessible subregions with characteristics of the 15-Minute City, being the downtown core and the central region. However, the peripheral region also reported significant population and employment growth rates.

Absolute population growths within the Greater Toronto Area had completely opposite spatial patterns from growth rates. The peripheral region with extremely low 15-Minute City potential received the largest inflow of new residents in the entire metropolitan region, followed by a slightly more accessible suburban region. In other words, the majority of population growth occurred outside areas with characteristics of the 15-Minute City, which has negative implications for urban sustainability, especially from the environmental standpoint. These implications are discussed in further detail in the chapter conclusion.

In relation to overall employment growth, the number of all new jobs created during this decade was more evenly distributed across the Greater Toronto Area. However, the suburban and peripheral regions together accounted for a larger share of employment growth than the urban centre. In terms of sectoral employment growth, among the four subregions, Downtown Toronto had the largest growth of knowledge-based jobs.

On the contrary, a dominant share of new creative jobs was created in the peripheral region. It appears that knowledge-based firms assign special value and prestige to office locations in Downtown Toronto, driving large employment growth here. Whereas creative businesses were disproportionately growing in the metropolitan outskirts.

These findings are not utterly surprising because the suburban and peripheral regions encompass the largest land mass, providing ample amount of land to accommodate new residents and new businesses. But they appear to challenge the popular perception of the urban centre being the dominant growth pole of the respective metropolitan region.

Finally, we fail to discern any reliable association on the local level between accessibility and population growth, nor between accessibility and employment growth in both relative and absolute terms.

Subregion	Cluster	Δ TOTAL_POP	Δ TOTAL_POP (%)	Δ TOTOAL_JOBS	Δ TOTAL_JOBS(%)	Δ CR_JOBS	Δ CR_JOBS (%)	Δ KB_JOBS	Δ KB_JOBS (%)
Downtown core (Downtown Toronto)	DT_VERYHIGH_A	20075	54.0%	58380	18.0%	-900	-3.8%	34340	22.3%
	DT_VERYHIGH_B	5620	9.6%	5150	10.9%	980	12.5%	1540	22.2%
	DT_HIGH	26600	94.1%	25065	36.5%	1455	13.6%	12850	73.9%
Subregional totals (% of metropolitan totals)		*52295 (14.5%)*	-	*88595 (31.5%)*	-	*1535 (15.5%)*	-	*48730 (37.8%)*	-
Central region	CENTRAL_HIGH	16265	9.4%	9285	10.4%	1890	34.0%	2435	12.3%
	CENTRAL_MEDIUM	15230	11.8%	9275	10.7%	-145	-1.5%	5110	25.7%
Subregional totals (% of metropolitan totals)		*31495 (8.7%)*	-	*18560 (6.6%)*	-	*1745 (17.7%)*	-	*7545 (5.8%)*	-
Suburban region	SUB_MEDIUM_A	63845	14.6%	27520	8.6%	-2965	-16.0%	14515	23.8%
	SUB_MEDIUM_B	2520	0.8%	2095	1.4%	-105	-1.7%	3280	15.9%
	SUB_LOW_A	48455	8.8%	29190	9.2%	1430	10.8%	12280	22.9%
	SUB_LOW_B	17010	5.4%	11505	6.5%	-695	-8.3%	4220	14.0%
Subregional totals (% of metropolitan totals)		*131830 (36.5%)*	-	*70310 (25.0%)*	-	*-2335 (-23.6%)*		*34295 (26.6%)*	-
Peripheral region	PERI_VERYLOW_A	141505	29.3%	81420	10.7%	8370	27.9%	34435	30.9%
	PERI_VERYLOW_B	3720	4.7%	22465	13.7%	570	11.1%	4080	31.9%
Subregional totals (% of metropolitan totals)		*145225 (40.2%)*	-	*103885 (36.9%)*	-	*8940 (90.4%)*	-	*38515 (29.8%)*	-
Metropolitan totals		*360845*	-	*281350*	-	*9885*	-	*129085*	-
Metropolitan baselines		-	*13.8%*	-	*11.2%*	-	*7.1%*	-	*25.4%*

Table 16 Population and employment dynamics within the Greater Toronto Area in relation to the accessibility geography (or the geography of the 15-Minute City) between 2006 and 2016. Note that red cells indicate values that are above the metropolitan baselines; whereas blue cells indicate values that are below the metropolitan baseline.

6.3.3 The Greater Montreal Area

On Table 17, Greater Montreal's population increased by 8.1% or 135210 people between 2006 and 2016. In the meantime, total employment in the metropolitan region increased by 6.9% or 119445 jobs. Creative employment in Greater Montreal rose by 5.1% or 4985 jobs. Knowledge-based employment rose more substantially by 13.4% or by 35945 jobs.

In Downtown Montreal, the population growth rates in both composing clusters were above the metropolitan baseline. However, the number of new residents in Downtown Montreal only made up a small portion of total population growth in the wider metropolitan region. For employment, Downtown Montreal reported a net job loss over this decade. Looking at the two specific sectors, on one hand, creative employment declined by a large amount in both downtown clusters. On the other hand, knowledge-based employment grew by a substantial amount in "DT_HIGH", which compensated for the slight decline in the other. Overall, the number of new knowledge-based jobs represented a significant fraction of totalled increase in the wider metropolitan region.

The central region had a moderate population growth in each of its component clusters. In terms of absolute population growth, the central region accounted for only a small fraction of the total population growth in the wider metropolitan region. Across the three employment measures, the central region recorded inflated growth rates as well as large absolute growths. Overall, the number of new jobs in the central region composed a disproportionate ratio of total employment growth in the wider metropolitan region. The central region also had a disproportionate ratio of new knowledge-based employment. Noteworthily, creative employment particularly burgeoned in the central region.

In the suburban region, the population growth rates in its component clusters were significantly below the metropolitan baseline. Moreover, there was a population decline in some areas. Overall, the net population increase in the suburban region made up a modest fraction of the metropolitan totals. Furthermore, the number of new jobs created in the suburban region during this decade also made up a modest fraction of the total new jobs in the entire metropolitan region.

In the peripheral region, one particular cluster, i.e., "PERI_LOW_B", recorded outstandingly large population growth in absolute number, which alone accounted for nearly one-half of all population growth in Greater Montreal. Shockingly, the peripheral region of Greater Montreal absorbed 80 percent of population growth in the entire metropolitan region. Similarly, the peripheral region accounted for a dominant share of all new jobs, including many creative and knowledge jobs, created in Greater Montreal.

In the Greater Montreal Area, population and employment growth rates were not found to correlate with accessibility levels on any scale of analysis. In fact, both highly accessible subregions with characteristics of the 15-Minute City and the inaccessible, peripheral subregion reported elevated population and employment growth rates.

In terms of absolute numbers, the peripheral region of Greater Montreal absorbed over 80% of total population growth in the wider metropolitan region, which marks a significantly higher percentage than what we observe in the Greater Toronto Area. Over 60% of all new jobs in Greater Montreal were created in the peripheral region. In other words, an even larger share of population and employment growth in the Greater Montreal Area occurred in car-dependent areas with few 15-minute characteristics, which is far from being favourable from the urban sustainability standpoint.

In addition, there were some interesting particularities in the urban centre of Montreal that are worth highlighting. Firstly, highly inflated population growth rates were associated with the downtown core, whereas highly inflated employment growth rates were associated with the central region. This divergent pattern appears to be caused by factors other than accessibility. Moreover, as Downtown Montreal became more residential, new economic activities started to percolate into the nearby central areas as well as the peripheral outskirts. Although Downtown Montreal experienced a slight decline in its overall employment size, its locational advantages remained highly attractive to knowledge-based firms.

Subregion	Cluster	Δ TOTAL_POP	Δ TOTAL_POP (%)	Δ TOTOAL_JOBS	Δ TOTAL_JOBS(%)	Δ CR_JOBS	Δ CR_JOBS (%)	Δ KB_JOBS	Δ KB_JOBS (%)
	DT_VERYHIGH	1955	25.8%	-1420	-4.1%	-1020	-19.5%	-565	-19.3%
Downtown core	DT_HIGH	6810	22.3%	75	0.0%	-3900	-15.5%	9240	9.3%
Subregional totals (% of metropolitan totals)		*8765 (6.5%)*	-	*-1345 (-1.1%)*	-	*-4920 (-98.7%)*	-	*8675 (24.1%)*	-
	CENTRAL_VERYHIGH	1775	5.3%	10375	21.2%	2385	38.0%	3350	55.8%
	CENTRAL_HIGH	3155	5.1%	2810	5.3%	950	26.5%	2215	32.8%
Central Region	CENTRAL_MEDIUM	9005	11.3%	20535	22.3%	2125	21.7%	4865	32.4%
Subregional totals (% of metropolitan totals)		*13935 (10.3%)*	-	*33720 (28.2%)*	-	*5460 (109.5%)*	-	*10430 (29.0%)*	-
	SUB_HIGH	2530	3.4%	-1145	-2.1%	-325	-12.2%	100	1.3%
	SUB_MEDIUM_A	3460	2.4%	4185	2.7%	-70	-1.1%	2630	14.9%
Suburban region	SUB_MEDIUM_B	-3405	-1.6%	10385	7.7%	70	1.7%	2215	16.1%
Subregional totals (% of metropolitan totals)		*2585 (1.9%)*	-	*13425 (11.2%)*	-	*-325 (-6.5%)*	-	*4945 (13.8)*	-
	PERI_LOW_A	18205	3.9%	105440	35.8%	6780	60.1%	11420	30.4%
	PERI_LOW_B	63700	16.0%	-56145	-12.4%	-1700	-11.2%	-3090	-6.3%
Peripheral Region	PERI_VERYLOW	28020	20.7%	24350	16.2%	-310	-3.9%	3565	31.0%
Subregional totals (% of metropolitan totals)		*109925 (81.3%)*	-	*73645 (61.7%)*	-	*4770 (95.7%)*	-	*11895 (33.1%)*	-
Metropolitan totals		*135210*	-	*119445*	-	*4985*	-	*35945*	-
Metropolitan baselines		-	*8.1%*	-	*6.9%*	-	*5.1%*	-	*13.4%*

Table 17 Population and employment dynamics within the Greater Montreal Area in relation to the accessibility geography (or the geography of the 15-Minute City) between 2006 and 2016. Note that red cells indicate values that are above the metropolitan baselines; whereas blue cells indicate values that are below the metropolitan baseline.

6.3.4 The Greater Vancouver Area

On Table 18, Greater Vancouver's population expanded by 15.6% or 172100 people between 2006 and 2016. In the meantime, total employment in Greater Vancouver increased by 13.7% or 133855 jobs. Creative employment rose by 17.5% or 9675 jobs. Knowledge-based employment rose more substantially by 20.2% or 35515 jobs.

In Downtown Vancouver, the population growth rates in its component clusters were above the metropolitan baseline. However, the number of new residents in Downtown Vancouver accounted for a small portion of total population growth in the wider metropolitan region. In relation to jobs, all three component clusters recorded a moderate growth rate in both overall and knowledge-based employment. Whereas creative employment in each downtown cluster grew at an inflated rate. In absolute number, the ratio of new knowledge-based jobs and the ratio of new creative jobs in Downtown Vancouver relative to metropolitan totals were disproportionately large. This ratio was modest concerning the overall employment.

The central region of Greater Vancouver recorded an inflated population and employment growth rates across the board. However, the absolute number of population and employment increases (overall and sectoral) in the central region only constituted a small fraction of the metropolitan totals.

The suburban region had a moderate population growth rate in each of its component clusters. The number of new residents in the suburban region only amounted to a small portion of the total population growth in the entire metropolitan region. In relation to employment, the suburban clusters had a relatively poor performance across the board. Across the three employment measures, the absolute growth in the suburban region made up a small fraction of the metropolitan totals.

In the peripheral region, population growth rates in the more accessible peripheral clusters, i.e., "PERI_MEDIUM_A" and "PERI_MEDIUM_B", were lower than the metropolitan baseline. Whereas the population growth rates in two less accessible clusters, i.e., "PERI_LOW" and "PERI_VERYLOW_A" were above the metropolitan baseline. Moreover, the absolute population growths in the latter were of a substantially larger number. Overall, the peripheral region of Greater Vancouver absorbed the majority of population growth in the entire metropolitan region. Similarly, for employment, the absolute job growths according to the overall and sectoral measures were larger in "PERI_LOW" and "PERI_VERYLOW_A" than in the more accessible two. Overall, the number of new jobs in the peripheral region made up a dominant share of employment growth in the entire Greater Vancouver Area.

From these results, we can conclude that population and employment growth in Greater Vancouver unfolded in an overall similar fashion as the other two metropolitan regions although it had some particularities. Inflated population and employment growth rates were generally correlated with the downtown core and central region, which exhibit characteristics of the 15-Minute City. However, in absolute numbers, the peripheral region, especially the least accessible outskirts, made up a dominant ratio (over 60%) of total population growth in the entire metropolitan region. A dominant share of new jobs was also created in the peripheral region. In other words, much like the two other city regions, population and employment growth in Greater Vancouver is concentrated in car-dependent areas with few characteristics of the 15-Minute City. Interestingly, over 50% of new knowledge-based employment in Greater Vancouver was created in the peripheral region, which can be attributed to rapidly growing town centres like Metrotown that provide high-end office space in new mixed-use towers highly attractive to knowledge-based firms. On the contrary, new creative jobs were highly concentrated in the downtown core.

6.3.5 Chapter conclusion and further remarks

Across the three metropolitan regions, inflated population and employment growth rates were generally associated with downtown and central locations exhibiting the characteristics of 15-Minute City, although peripheral locations with low 15-Minute city potential also reported elevated growth rates. However, in absolute number, peripheral locations comprised a dominant fraction of both total population and total employment growths in the respective metropolitan region. Conversely, Downtown and central locations comprised only a modest proportion of the metropolitan population and employment gains. For specific sectors, the downtown core and central region comprised a significant share of new knowledge-based jobs in each metropolitan region, suggesting that knowledge-based firms are relatively more attracted to locations with 15-Minute City characteristics than other firms. In the Greater Vancouver Area, the urban centre also comprised a dominant share of new creative jobs.

From the above, it appears that in the context of the three Canadian metropolitan regions, although locations exhibiting 15-Minute City characteristics were growing at a faster pace, they did not receive as many new residents or businesses as peri-metropolitan locations. One reason may be that these locations have limited land for new housing and office space. Or another reason may be that the majority of people and firms are not very attracted to the 15-Minute City environment. No matter what the reasons are, the three Canadian metropolitan regions grew in a fashion that perpetuated automobile dependency among the population, which contradicts the principles of sustainable urban growth. Across the three metropolitan regions, a massive growing population lived in car-dependent peripheral outskirts where it is extremely challenging if not impossible for residents to meet their most essential needs within a 15-minute walking distance. Similarly, a large volume of jobs was created in these remote peripheral areas that are primarily accessible by cars.

Subregion	Cluster	Δ TOTAL_POP	Δ TOTAL_POP (%)	Δ TOTOAL_JOBS	Δ TOTAL_JOBS(%)	Δ CR_JOBS	Δ CR_JOBS (%)	Δ KB_JOBS	Δ KB_JOBS (%)
Downtown core (Downtown Vancouver)	DT_VERYHIGH	5980	24.8%	5915	11.2%	885	29.7%	2250	11.8%
	DT_HIGH_A	9755	19.9%	8020	11.8%	2650	57.7%	1115	6.9%
	DT_HIGH_B	8285	75.7%	15665	19.1%	1490	17.8%	9210	33.5%
Subregional totals		*24020 (14.0%)*	-	*29600 (22.1%)*	-	*5025 (51.9%)*	-	*12575 (35.4%)*	-
Central region	CENTRAL_HIGH	8840	16.2%	7220	20.0%	795	44.2%	1385	31.6%
Subregional totals		*8840 (5.1%)*	-	*7220 (5.4%)*	-	*795 (8.2%)*	-	*1385 (3.9%)*	-
Suburban region	SUB_MEDIUM_A	21990	13.3%	8345	8.6%	185	3.2%	2375	14.8%
	SUB_MEDIUM_B	5550	19.0%	3275	8.5%	-435	-15.9%	1135	16.8%
Subregional totals		*27540 (16.0%)*	-	*11620 (8.7%)*	-	*-250 (-2.6%)*	-	*3510 (9.9%)*	-
Peripheral region	PERI_MEDIUM_A	14815	9.5%	10625	8.4%	605	9.8%	1480	5.9%
	PERI_MEDIUM_B	13155	8.4%	10070	17.2%	715	39.0%	2080	22.0%
	PERI_LOW	39315	16.6%	17125	12.6%	1640	20.3%	4455	20.9%
	PERI_VERYLOW_A	40670	23.7%	41135	23.1%	1245	14.5%	8135	39.0%
	PERI_VERYLOW_B	3745	7.6%	6460	6.2%	-100	-2.3%	1895	20.4%
Subregional totals		*111700 (64.9%)*	-	*85415 (63.8%)*	-	*4105 (42.4%)*	-	*18045 (50.8%)*	-
Metropolitan totals		*172100*	-	*133855*	-	*9675*	-	*35515*	-
Metropolitan baselines		-	*15.6%*	-	*13.7%*	-	*17.5%*	-	*20.2%*

Table 18 Population and employment dynamics within the Greater Vancouver Area in relation to the accessibility geography (or the geography of the 15-Minute City) between 2006 and 2016. Note that red cells indicate values that are above the metropolitan baselines; whereas blue cells indicate values that are below the metropolitan baseline.

7. Conclusions

7.1. Research inspiration and design

Just a little over a decade ago, an official UN-Habitat report (UN-Habitat, 2010) announced that more than half of the world's population lived in urban areas, which is a monumental landmark in history of human civilization. In the same report, the percentage of the urban population was predicted to grow at an exponential rate and reach an incredible 68% by the second half of the 21st century.

Subsequent to this ambitious forecast, new data (UN-Habitat, 2020) shows that over one-third of the world's population and 60% of the world's urban population now live in larger metropolitan areas. They are understood as regional urban agglomerations composed of a dominant city, smaller satellite cities and towns, as well as the surrounding suburban and peripheral areas that are economically and demographically integrated into the regional agglomeration. The data predicts that the majority of new urban dwellers in the next decades will live in metropolitan areas around the world. By the year 2035, over 50% of the world's population will live in metropolitan areas.

Canada is a highly urbanized country with three dominant urban agglomerations or metropolitan areas, namely the Greater Toronto Area, the Greater Montreal Area, and the Greater Vancouver Area, which are the focus of this present research. In an immigration-dependent country like Canada, population growth, particularly urban population growth, depends on skilled immigrants from other parts of the world. According to the 2016 Census information, between 2011 and 2016, these three metropolitan areas together absorbed over half of all landed immigrant populations (Statistics Canada, 2017).

While these statistics about metropolitan population growth are fascinating and cheerful, they have multifaceted implications on urban systems that are incredibly challenging for professional planners and policymakers to grasp and wrap their heads around. The present research based in the Canadian context tackles a few of these challenges in connection with important concepts and theories proposed in contemporary economic geography literature, especially theories about the determinants of locational choice, gentrification and displacement, and urban sustainability. It is important to recognize that these challenges transcend disciplinary boundaries and involve an enormous amount of complexity and unresolved controversies in the relevant literature.

The literature review section provides a non-exhaustive summary of what previous studies have identified, theorized, and contested in relation to these planning-related challenges. However, we cannot examine and synthesize every conjecture or research finding set out in all existing studies. Instead, we dedicate our attention to the prevailing themes that are most pertinent to our research interests. Hence, it is possible that the narratives that emerged from

our three-part literature review have significant blind spots, which may have been looked at by less prominent studies.

Methodologically, this present research adopts a high-level, aggregate approach in analyzing the spatial patterns of population and employment locations in relation to accessibility in each metropolitan region, particularly focusing on the following relationships: 1) the association between accessibility and residential sorting of talented workers; 2) the association between accessibility and gentrification; 3) the association between accessibility and population and employment growths.

Additionally, because the variables implemented in the construction of the metropolitan accessibility geography resemble closely the criteria identified for the 15-Minute City, this present has a unique opportunity to contribute to the growing knowledge base about the 15-Minute City design.

7.2 Research outcomes and policy implications

7.2.1 Intra-metropolitan locations of the creative class and disadvantaged workers

To unpack further, the first challenge examined in this paper pertains to understanding the intra-metropolitan locations of the creative class and disadvantaged workers, which indirectly reveals their locational preferences. This challenge involves two policy implications.

The first policy implication deals with the conception of effective strategies and programs to attract talented workers who are understood to be the backbone of the post-industrial, knowledge-based economy. There already exists a large body of research that examines what locational factors gravitate population to one locality as opposed to others. This literature can be broadly divided into two opposing camps: the class theory and the creative class theory, which have drastically different policy recommendations.

On the one hand, the more recent creative class thesis (e.g., Clark et al. 2002; Florida, 2002; Florida, 2005; Lee et al., 2004) posits that localities that rank high relative to soft, lifestyle-oriented amenities, including openness, tolerance, diversity, and cosmopolitan entertainment are more successful at attracting the “creative class” or elite professionals working in creative and knowledge-based industries. According to this logic, effective urban strategies to attract creative talents should intervene in relatively intangible domains that directly impact the social and cultural environment, as well as physical facilities associated with arts and culture. Besides the various types of soft, social programs mentioned in Peck (2005), implementing assistance programs for new immigrants, funds for festivals, inclusionary and mixed-use zoning policy, and incentives for entrepreneurs may also help attract members of the creative class.

On the other hand, the classical theory emphasizes the importance of utility-oriented amenities, lifecycle, and budget in determining the local choice of everyone, including members of the creative class. Classical utility-oriented amenities (e.g., Karsten, 2007; Kim et al. 2005; Roback 1982) include transportation, childcare and schooling, parks and recreational facilities, dwelling size, and housing affordability. Therefore, according to the classical theory, effective strategies to attract populations, including members of the creative class, can include increasing the quantity and quality of essential amenities, diversifying housing options, as well as making housing more affordable.

Moreover, two trending urban design concepts, "Complete Communities" and "15-Minute City", have been modelled with a strong focus on providing residents with convenient access to basic urban services and amenities within a comfortable walking or biking distance. This present research has a unique opportunity to investigate if members of the creative class are attracted to places that exhibit characteristics of the 15-Minute City.

Overall, the outcomes of our analysis in *Section 6.1* indicate that in the year 2016, a larger population of the creative class resided in distant, inaccessible parts of each metropolitan region as opposed to highly accessible locations in the urban centre that qualify as the 15-Minute City design. This suggests that the 15-Minute City design did not appeal to the majority of creative and knowledge workers in Canada. In other words, factors that are unique to suburban and peripheral residences, such as bigger living spaces and private gardens, took priority over accessibility and lifestyle considerations in the residential decision-making of many creative and knowledge workers.

The outcomes of our analysis in *Section 6.2* indicate that between 2006 and 2016, the three urban centres had a smaller absolute population growth associated with both creative and knowledge workers than peri-metropolitan locations. This suggests that members of the creative class in the three top-tier Canadian metropolitan regions were indeed more attracted to peri-metropolitan locations although they appear being more concentrated in the urban centre.

In relation to policymaking, these research outcomes suggest that place-making policies and programs focusing on improvements of soft, bohemian amenities may be effective at increasing the competitive edge of a metropolitan region in the global grab for creative talents against other metropolitan regions. It appears not to be the case for competitions within metropolitan regions. Similarly, local planning programs following the 15-Minute City or Complete Communities design might not prove to be an effective tool to attract elite professionals from other parts of the metropolitan regions. However, our results show that creative talents within a metropolitan region tend to form larger concentrations in neighbourhoods that are rich in soft, bohemian amenities, resulting in creative havens or creative milieus like the Mile-End in Montreal.

The second policy implication relates to tackling intra-metropolitan residential segregation between the elite and disadvantaged socioeconomic groups, and more importantly the inequity in accessibility outcomes resulting from such spatial divisions. Our research methodology enables us to investigate if the residences of elite professionals and disadvantaged workers in the three Canadian metropolitan regions are divided between areas that adhere to the 15-Minute City model and those that do not. This knowledge is particularly valuable because it concerns the income-based parity in accessibility to essential urban services and amenities that directly affect people's quality of life and wellbeing.

Our results in *Section 6.1* show that in all three metropolitan regions, members of the creative class made up a greater share of the local population in highly accessible urban locations than is the case region-wide. Conversely, disadvantaged workers, particularly blue-collar workers, made up a greater share of the local population in inaccessible peri-metropolitan locations than is the case region-wide. This contrast depicts a divided residential geography across the three metropolitan regions where elite professionals disproportionately occupied central areas that have a high concentration of essential urban services and amenities within a 2 km distance, which are conveniently accessible on foot and by bicycle. Whereas disadvantaged worker groups disproportionately occupied the remaining peri-metropolitan areas that have a very low concentration of essential urban services and amenities within a 2km distance, which means they are more likely to be dependent on cars to perform basic social functions.

7.2.2 Gentrification and displacement

The second challenge addressed in this research involves deciphering the characteristics and mechanisms associated with sociodemographic change across metropolitan regions. The urban centres are the particular focus.

Relevant studies (e.g., Edlund et al., 2015; Ehrenhalt, 2013; Smith et al., 2020) have noted the pervasiveness of gentrification within city centres of large metropolises marked by a steady increase in residential occupation by members of the creative class.

Empirically, the second part of our analysis (*see Section 6.1.2)* demonstrates that the socioeconomic character of the three urban centres (i.e., the downtown core plus the central region) became wealthier between 2006 and 2016 due to an influx of elite professionals with high salaries, particularly knowledge workers. In the Greater Toronto and Greater Montreal Area, we identify a substitution effect in relation to the proportions of knowledge workers and creative workers in local populations within the downtown core. Conversely, the suburban and peripheral clusters in the Greater Montreal and Greater Vancouver Area have largely upheld their socioeconomic character during this decade. In the Greater Toronto Area, the suburban clusters experienced a slight increase in the proportion of disadvantaged workers with lower incomes, resulting in a soft decline in their socioeconomic character.

We stress that although an influx of knowledge workers into the three urban cores concurred with a decline in the blue-collar population in the composing clusters, the combined population of blue-collar and sales & service workers increased in almost all cases, except for the "CENTRAL_HIGH" cluster in Montreal. This means if we consider employment migration from working-class industries to sales & service industries due to structural economic change and place both on the lower end of the income spectrum, the gentrification of the three Canadian urban centres was not correlated with a displacement of residents with lower salaries.

Thus, like Hamnett (2003), we argue that many gentrification writers in popular media speak of the displacement of working-class residents in gentrifying neighbourhoods; however, they fail to consider that working-class occupations have been disappearing in western cities. It is natural to identify a decline in the number of residents who occupy blue-collar jobs across census years, not because of displacement but because of de-industrialization which leads to the disappearances of blue-collar jobs. In this research, our approach to mitigate this bias from looking at census population data across years is to examine the combined population statistics of blue-collar workers and sales & service workers. Our assumption is that many blue-collar workers who had become jobless transferred into booming service economy sectors with lower barriers to entry. We emphasize that we are not arguing displacement never occurs to financially vulnerable communities, but we advocate for a more objective and less biased approach to examine gentrification and neighbourhood changes.

As for anti-displacement policies, there already exist many tools at the disposal of planners and politicians. At the very least, just cause eviction ordinances protect low-income residents from being arbitrarily evicted from their current affordable residence. This instrument works more effectively alongside rent control ordinances, which eliminates the likelihood of landlords evicting low-income tenants to obtain higher rents. Moreover, rent control prevents bidding war between potential tenants, thus, preserving the affordability of existing housing stock. The third instrument, condo conversion control restricts the conditions upon which a multi-unit rental building may be divided into individual for-sale condominium units, hence, preserving the availability of more affordable housing tenure and quantity of affordable rental housing units.

Another more progressive instrument is inclusionary zoning ordinances, which requires mandatory provisions of social and affordable housing units in new developments, therefore, expanding the number of affordable units that are accessible to lower-income residents. There are also additional planning tools to encourage voluntary participation in inclusionary zoning schemes, such as density bonuses. Besides enacting these policies through legislation, the existence of effective monitoring bodies including quasi-legal tribunals and citizen-led boards as well as monitoring mechanisms ensures conformance to these policies and correction of deviations. For more information relating to general displacement prevention policies and successful case studies, the Council of Europe (2020), U.S. Department of Housing and Urban Development (2018) and Great Communities (2007) are excellent references.

7.2.3 Urban growth and urban sustainability

The third and final challenge involves grappling with the geography of population and employment growths within metropolitan regions in relation to promoting smart and sustainable urban growth. It is important to note that cities account for the majority of GHG emissions worldwide, and urban transportation is one of the largest sources of emissions. The geography of population and employment growth has a direct effect on urban transportation and hence GHG emissions because a significant portion of urban trips comprises commute trips conducted from one's home to the workplace and other essential destinations, like shops and leisure. In addition to the environmental component, there is also an equity component associated with these essential commutes in terms of mobility modes and access.

The COVID-19 pandemic brings this issue to the spotlight as governments implemented various mobility-restrictive measures to contain the virus outbreak. Lower-income workers disproportionately bore the negative impacts because they are typically more reliant on transit services to access essential urban amenities and services. In the context of post-COVID recovery and building urban resilience against the climate crisis, the 15-Minute City emerged as a promising design model for future urban growth whereby all residents can fulfill their basic daily needs within a 15-minute walking or biking distance, thus, eliminating the need for the automobile in these trips. Thanks to our research design, we have a unique opportunity to contribute to the growing knowledge base about the 15-Minute City.

Our findings in *Section 6.1.3* depict that although highly accessible locations in the urban centre had the fastest population and employment growth rates, the majority of new residents and jobs were concentrated in suburban and peri-metropolitan locations that have few resemblances of to the 15-Minute city characteristics. Across the three metropolitan regions, a massive growing population lived in car-dependent peripheral outskirts where it is extremely challenging if not impossible for residents to meet their most essential needs within a 15-minute walking distance. Similarly, a large volume of jobs was created in these remote peripheral areas that are primarily accessible by cars. In other words, the three Canadian metropolitan regions grew in an unsustainable fashion that perpetuates car dependency, adding more vehicle miles travelled and GHG pollution each year.

Alternatively, our findings also suggest that the car-oriented lifestyle remained acceptable if not preferable for a large growing population. In other words, the 15-Minute City or the Complete Communities concept may encounter less enthusiasm and support among populations outside the urban centre than one may expect. Thus, we recommend that city planners and policymakers in each of the metropolitan regions prepare themselves to encounter questions, concerns, and possibly anger in relation to implementing plans and policy changes pursuant to the 15-Minute City and Complete Communities model, especially outside the urban core. That said, it is also possible that many people desire to live in 15-Minute City neighbourhoods, but the quantity of their supply is very limited, resulting in unaffordable housing prices. It may be worth it for future research to conduct population surveys regarding the interest in the 15-Minute City in peripheral communities.

On a positive note, our findings provide a rationale and justification for intensifying mixed-use developments in populous peripheral locations and upzoning amenity-dense areas to increase their capacity to accommodate new residents, which comes with their own set of challenges and problems, which are outside the scope of this research.

7.3 Research limitations and future research areas

The primary consideration in the methodological development of this present research is to understand and map the linkages between accessibility and the locations of populations (population growth) and employment (employment growth) within the three Canadian metropolitan areas. Like any quantitative study, our research design is influenced by the nature of the research data. In the context of this research, we rely on accessibility data on the census dissemination block (DB) level and labour force survey data at place of residence and place of work on the census tract (CT) level. We begin the discussion of the limitations of this research arising from the accessibility data.

To remind our readers, we implemented the accessibility dataset obtained from Statistics Canada's Proximity Measures Database portal in constructing the accessibility-based geographies, which is the foundation of our subsequent analysis. This dataset includes ten indices relating to essential destinations/amenities desired by the population. It does not contain indices relating to amenities and infrastructure desired by businesses and industries like major transportation facilities – highways, seaports, and airports. Therefore, our analyses of the locations of employment growth in relation to our customized accessibility geography in *Section 6.3* is naturally subject to critique.

In this regard, a future research area includes developing accessibility measures associated with known attractors for firms and businesses and replicating the rest of our methodology to analyze the linkages between accessibility to these business attractors and employment growth. Alternatively, it would be interesting to combine proximity measures for amenities desired by the population and those desired by businesses in a more comprehensive dataset and use this dataset to construct the geography of highly attractive localities for both populations and businesses.

Data-related limitations arising from the labour force survey data influenced our choice of analytical approach. As mentioned earlier, we have many missing entries (i.e., 0 response count) associated with 2-digit NACIS and NOC variables on the CT level in less populated suburban and peripheral locations. Regression analysis does not work in the context of this research because the spatial distribution of employment and population subcategories is such that many of these subcategories are absent from certain parts of the city, although regression models have methodical advantages.

Instead, we must adopt an aggregate-level analysis approach. We eventually settled on the method of hierarchical clustering to assemble individual CTs into larger geographic units based on similarities in relation to their accessibility indices. We then aggregated the population and employment data from individual component CTs to these larger units and tabulated tables from which we draw subsequent observations about, for instance, where certain types of people and jobs are located across these geographic units.

Unlike regression models where one can assess the strength of each correlation using correlation coefficients, the associations discerned from our tables are rather incidental. However, neither regression nor aggregate analysis methods convey the direction of causality. Similar clustering methods have been applied in other geospatial studies in various subdisciplines related to geography (e.g., Carvalho, et al., 2009; Darand et al. 2014; Isserman, 1997; Shearmur, 2012; Wang et al., 2020).

Moreover, as convincingly argued by Shearmur (2012), metropolitan areas are dynamic systems with messy internal processes and workings, which make them difficult to be analyzed in a clean and unambiguous way using regression models. In fact, analyses adopting higher levels of agglomeration mitigate the effects of haphazard and unpredictable smaller-scale processes or events and produce more exact and useful findings about metro areas.

We also acknowledge that minor decisions in the development of our research design, including our choices related to the clustering function (i.e., cluster quantity and agglomeration method) and choices related to gentrification and growth performance indicators, submit our subsequent analyses to critiques. However, our choices are backed by extensive conceptual and methodical justifications (see section 4).

In our opinion, future research interested in the same queries as ours can narrow the geographic focus to the urban centres of metropolitan regions where the CT-level labour force entries are largely complete. Subsequently, it is possible to apply regression models to investigate and quantify the correlation between accessibility variable(s) and population and employment variables on the neighbourhood (CT) level. Such investigations will further contribute to our knowledge about the impact of accessibility on shaping the urban residential and employment geography as well as the distribution of population and employment growths. Future research may also wish to experiment with a multivariate regression model incorporating individual accessibility variables, employment variables, and population variables to determine the relative strength of correlations.

Finally, we acknowledge the limitations of our analyses in relation to the series of tables on which we purposefully exclude a fifth occupational class consisting of public and community service workers. In this regard, we follow the tradition in the literature. Similar studies based in the American and European contexts (e.g., Ley, 2003; Florida, 2002; Markusen, 2006; Florida & Adler 2018) also largely ignored this group and narrowed the focus of their analyses to contrast elite professional groups composed of creative and knowledge workers with working-class groups composed of sales & service and blue-collar workers.

The main reason for disregarding this group relates to the conceptual and practical difficulties of distinguishing the socioeconomic status of this group because it composes a mixed bag of occupations that have varying levels of income. Not only is there a division between the public and community service sectors in relation to income, but income-based stratification also exists within each sector. It can be interesting for future research to deconstruct this occupational class into smaller subgroups that share a similar socioeconomic standing and analyze their residential distributions and dynamics across metropolitan regions. Particular attention should be placed on community service occupations that are lower-paid and more precarious, such as social workers and project coordinators. These workers are equally prone to be displaced by gentrification and suffer from poor accessibility outcomes as sales & service and blue-collar workers, but they are largely ignored in relevant research.

8. Bibliography

Abdelfattah, L., Deponte, D., & Fossa, G. (2022). The 15-minute city: Interpreting the model to bring out urban resiliencies. *New Scenarios for Safe Mobility in Urban AreasProceedings of the XXV International Conference Living and Walking in Cities (LWC 2021), September 9-10, 2021, Brescia, Italy*, *60*, 330–337. https://doi.org/10.1016/j.trpro.2021.12.043

Alasia, A., Newstead, N., Kuchar, J., & Radulescu, M. (2021). Measuring proximity to services and amenities: An experimental set of indicators for neighbourhoods and localities. *Statistics Canada*. Retrieved from: https://www150.statcan.gc.ca/n1/pub/18-001-x/18-001-x2020001-eng.htm. Accessed on May 12th 2022.

Alfken, C., Broekel, T., & Sternberg, R. (2015). Factors Explaining the Spatial Agglomeration of the Creative Class: Empirical Evidence for German Artists. *European Planning Studies*, *23*(12), 2438–2463. https://doi.org/10.1080/09654313.2014.979767

Alonso, W.A., 1964. Location and land use: toward a general theory of land rent, Harvard University Press, Cambridge.

Anderson, P., Levinson, D., & Parthasarathi, P. (2013). Accessibility futures. *Transactions in GIS*, *17*(5), 683-705.

Arauzo-Carod, J. M., & Viladecans-Marsal, E. (2009). Industrial location at the intra-metropolitan level: The role of agglomeration economies. *Regional Studies*, *43*(4), 545-558.

Asheim, B., & Hansen, H. K. (2009). Knowledge bases, talents, and contexts: On the usefulness of the creative class approach in Sweden. *Economic geography*, *85*(4), 425-442.

Atkinson, R., & Easthope, H. (2009). The consequences of the creative class: The pursuit of creativity strategies in Australia's cities. *International Journal of Urban and Regional Research*, *33*(1), 64-79.

Azmi, D. I., & Karim, H. A. (2012). Implications of walkability towards promoting sustainable urban neighbourhood. *Procedia-Social and Behavioral Sciences*, *50*, 204-213.

Barley, S. R. (1986). Technology as an occasion for structuring: Evidence from observations of CT scanners and the social order of radiology departments. Administrative Science Quarterly, 31,78–108. doi:10.2307/2392767

Bauder, H., & Sharpe, B. (2002). Residential segregation of visible minorities in Canada's gateway cities. *Canadian Geographer/Le Géographe canadien*, *46*(3), 204-222.

Bell, W. (1968). The city, the suburbs, and a theory of social choice. In Greer, S., McElrath, D., Minar, D. W., & Orleans, P. (Eds.), The new urbanization: Twenty studies in the transformation of the human community in the new nations and the old (pp. 132–168). New York: St Martin's Press.

Benassi, F., Crisci, M., & Rimoldi, S. M. (2022). LOCATION QUOTIENT AS A LOCAL INDEX OF RESIDENTIAL SEGREGATION. THEORETICAL AND APPLIED ASPECTS1. *Rivista Italiana di Economia Demografia e Statistica*, *76*(1), 23-34.

Berry, C. R., & Glaeser, E. L. (2005). The divergence of human capital levels across cities. *Papers in regional science*, *84*(3), 407-444.

Billingham, C. M., & Kimelberg, S. M. (2013). Middle-Class Parents, Urban Schooling, and the Shift From Consumption to Production of Urban Space. *Sociological Forum*, *28*(1), 85–108. https://doi.org/10.1111/socf.12004

Boisjoly, G., & El-Geneidy, A. M. (2017). How to get there? A critical assessment of accessibility objectives and indicators in metropolitan transportation plans. *Transport Policy*, *55*, 38–50. https://doi.org/10.1016/j.tranpol.2016.12.011
Bontje, M. A., & Crok, S. (2006). Amsterdam, creative knowledge city? The debate on the economic future of Amsterdam and its region. *Creativity and diversity: key challenges to the 21st century city*, 144-161.

Bontje, M. and Musterd, S. (2005) What kind of place do the creative knowledge workers live in? in Franke, S. and Verhagen, E. (eds.) Creativity and the City; How the Creative Economy is Changing the City. Rotterdam: Nai Publishers.

Boterman, W., Karsten, L., & Musterd, S. (2010). Gentrifiers settling down? Patterns and trends of residential location of middle-class families in Amsterdam. Housing Studies, 25(5), 693–714.

Bourne, L. S. (1981). The geography of housing. London: Edward Arnold.
Branding the creative city. In S. Haddock Vicari (Ed.), Brand-building: The creative city – A critical look at current concepts and practices (pp. 17–37). Firenze: Firenze University Press.)

Brown, J.E., & Mczyski, M. (2009). Complexcities: locational choices of creative knowledge workers. *Built Environment, 35*, 238-252.

Butler, T., & Robson, G. (2003). Negotiating Their Way In: The Middle Classes, Gentrification and the Deployment of Capital in a Globalising Metropolis. Urban Studies, 40(9), 1791–1809. https://doi.org/10.1080/0042098032000106609

Capasso Da Silva, D., King, D. A., & Lemar, S. (2019). Accessibility in practice: 20-minute city as a sustainability planning goal. *Sustainability*, *12*(1), 129.

Carpenter, J., & Lees, L. (1995). Gentrification in New York, London and Paris: an international comparison. *International Journal of Urban and regional research*, *19*, 286-286.

Carvalho, A. X. Y., Albuquerque, P. H. M., de Almeida Junior, G. R., & Guimaraes, R. D. (2009). Spatial hierarchical clustering. *Revista Brasileira de Biometria*, *27*(3), 411-442.

Cervero, R., Rood, T., & Appleyard, B. (1999). Tracking accessibility: employment and housing opportunities in the San Francisco Bay Area. *Environment and Planning A*, *31*(7), 1259-1278.

Clark, W. A. V., & Huang, Y. (2003). The life course and residential mobility in British housing markets. Environment and Planning A, 35, 323–339.

Clark, W. A. V., Deurloo, M. C., & Dielemann, F. M. (1984). Housing consumption and residential mobility. Annals of the Association of American Geographers, 74(1), 29–43. Clark, W. A. V., &

Cole, D. B. (1987). Artists and urban redevelopment. The Geographical Review 77, pp. 391–407.

Cooke P (2002) Knowledge economics: clusters, learning and cooperative advantage. Routledge, London

Council of Europe (2020). Managing Gentrification: Policy brief. Retrieved from: https://rm.coe.int/managing-gentrification-icc-policy-brief-may-2020/16809e9af5

Couture, V., & Handbury, J. (2017). *Urban revival in America, 2000 to 2010* (No. w24084). National Bureau of Economic Research. creative city development strategy in Milwaukee. Cities, 25, 230–242.

Cristaldi, F. (2002). Multiethnic Rome: toward residential segregation?. *GeoJournal*, *58*(2), 81-90.
Cucchiara, M. B., & Horvat, E. M. (2009). Perils and Promises: Middle-Class Parental Involvement in Urban Schools. American Educational Research Journal, 46(4), 974–1004. https://doi.org/10.3102/0002831209345791
Darand, M., & Mansouri Daneshvar, M. R. (2014). Regionalization of precipitation regimes in Iran using principal component analysis and hierarchical clustering analysis. *Environmental Processes*, *1*(4), 517-532.

Davidson, M., & Lees, L. (2005). New-Build 'Gentrification' and London's Riverside Renaissance. *Environment and Planning A: Economy and Space*, *37*(7), 1165–1190. https://doi.org/10.1068/a3739

Duranton, G., & Guerra, E. (2016). Developing a common narrative on urban accessibility: An urban planning perspective.

Edlund, L., Machado, C., & Sviatschi, M. (2022). Gentrification and the Rising Returns to Skill. *Economica*, *89*(354), 258–292. https://doi.org/10.1111/ecca.12398

Ehrenhalt, A. (2012). *The great inversion and the future of the american city* (1st ed.).

El-Geneidy, A. M., & Levinson, D. M. (2006). Access to destinations: Development of accessibility measures.

Erikson, R., & Goldthorpe, J. H. (1992). The constant flux: A study of class mobility in industrial societies. New York, NY: Oxford University Press.

Federal Reserve Bank of Cleveland. (2013). Economic trends: November 2013. Retrieved from https://www.clevelandfed.org/en/Newsroom%20and%20Events/Publications/Economic%20Trends/2013%20Economic%20Trends

Florida, R. (2002). The rise of the creative class. New York: Basis Books.

Florida, R. (2005). Cities and the creative class. New York: Routledge.

Florida, R. (2017). *The new urban crisis: How our cities are increasing inequality, deepening segregation, and failing the middle class—And what we can do about it*. New York, NY: Basic Books.

Florida, R., & Adler, P. (2018). The patchwork metropolis: The morphology of the divided postindustrial city. *Journal of Urban Affairs*, *40*(5), 609–624. https://doi.org/10.1080/07352166.2017.1360743

Florida, R., Mellander, C., & Stolarick, K. (2008). Inside the black box of regional development—human capital, the creative class and tolerance. *Journal of economic geography*, *8*(5), 615-649.

Florida, R., Mellander, C., & Stolarick, K. (2016). Human capital in cities and suburbs. *The Annals of Regional Science*, *57*(1), 91–123. https://doi.org/10.1007/s00168-016-0763-8

Fox-Rogers, L., Murphy, E., & Grist, B. (2011). Legislative change in Ireland: A Marxist political economy critique of planning law. Town Planning Review, 82(6), 639–668.

Frenkel, A. (2012). Intra-metropolitan competition for attracting high-technology firms. *Regional Studies*, *46*(6), 723-740.

Frenkel, A., Bendit, E., & Kaplan, S. (2013). Residential location choice of knowledge-workers: The role of amenities, workplace and lifestyle. *Cities*, *35*, 33–41. https://doi.org/10.1016/j.cities.2013.06.005

Geurs, K. T., & Van Wee, B. (2004). Accessibility evaluation of land-use and transport strategies: review and research directions. *Journal of Transport geography*, *12*(2), 127-140.

Gilderbloom, J. I., Riggs, W. W., & Meares, W. L. (2015). Does walkability matter? An examination of walkability's impact on housing values, foreclosures and crime. *Cities*, *42*, 13-24.

Glaeser, E. L. (Ed.). (2010). *Agglomeration economics*. University of Chicago Press.

Glaeser, E.L. (2004) Review of Richard Florida's *The rise of the creative class*. Retrived from: https://scholar.harvard.edu/files/glaeser/files/book_review_of_richard_floridas_the_rise_of_the_creative_class.pdf. Accessed on May 7th 2022

Great Communities (2007) Preventing displacement policy fact sheet. http://www.greatcommunities.org/wp-content/uploads/pdf/2007%2011%20Preventing%20Displacement%20Policy%20Fact%20Sheet.pdf

Guillain, R., Le Gallo, J., & Boiteux-Orain, C. (2006). Changes in spatial and sectoral patterns of employment in Ile-de-France, 1978-97. *Urban studies*, *43*(11), 2075-2098.

Hackworth, J. and Smith, N. (2001). The changing state of gentrification. Tijdschrift voor Economische en Sociale Geograifi 92(4), pp. 467–477

Hall, T. and Robertson, I. (2001). Public art and urban regeneration: advocacy, claims and critical debates. Landscape Research 26(1), pp. 5–26.

Hamnett, C., 2003. Gentrification and the middle-class remaking of inner London, 19612001. Urban Stud. 40, 2401–2426. https://doi.org/10.1080/ 0042098032000136138.

Handy, S. L., & Niemeier, D. A. (1997). Measuring accessibility: an exploration of issues and alternatives. *Environment and planning A*, *29*(7), 1175-1194.

Hartgen, D. T., Fields, M. G., & Moore, A. T. (2009). *Gridlock and growth: the effect of traffic congestion on regional economic performance* (No. 371). Los Angeles, CA: Reason Foundation.

Howell, O. (2005). The "creative class" and the gentrifying city: Skateboarding in Philadelphia's Love Park. *Journal of architectural education*, *59*(2), 32-42.

Hulchanski, J. D. (2010). The three cities within Toronto : Income polarization among Toronto's neighbourhoods, 1970–2005. Toronto, ON, Canada: Cities Centre Press. Retrieved from http://www.urbancentre.utoronto.ca/pdfs/ curp/tnrn/Three-Cities-Within-Toronto-2010-Final.pdf

Hur, M., & Morrow-Jones, H. (2008). Factors that influence residents' satisfaction with neighborhoods. Environment and Behaviour, 40, 619–635.

Isserman, A. M. (1977). The Location Quotient Approach to Estimating Regional Economic Impacts. *Journal of the American Institute of Planners*, *43*(1), 33–41. https://doi.org/10.1080/01944367708977758
Jacobs J (1969) The economies of cities. Random House, New York

Jiao, J., Wang, J., Jin, F., & Du, C. (2016). Understanding relationship between accessibility and economic growth: a case study from China (1990–2010). *Chinese Geographical Science*, *26*(6), 803-816.

Karsten, L. (2007). Housing as a way of life: Towards an understanding of middleclass families' preference for an urban residential location. Housing Studies, 22, 83–98.

Kim, J. H., Pagliara, F., & Preston, J. (2005). The intention to move and residential location choice behaviour. *Urban studies*, *42*(9), 1621-1636.

Kim, T. K., Horner, M. W., & Marans, R. W. (2005). Life cycle and environmental factors in selecting residential and job locations. *Housing studies*, *20*(3), 457-473.

Kiuru, J., & Inkinen, T. (2017). Predicting innovative growth and demand with proximate human capital: A case study of the Helsinki metropolitan area. *Cities*, *64*, 9-17.

Kolenda R, Liu CY (2012) Are central cities more creative? The intrametropolitan geography of creative industries. J Urban Aff 34(5):487–512

Kolko, J. (2016) Urban Revival? Not For Most Americans. Retrieved from: http://jedkolko.com/2016/03/30/urban-revival-not-for-most-americans/. Accessed on May 7th 2022
Kotkin, J. and F. Siegel (2004) Too much froth. Blueprint 6, 16–8.

Krugman P (1990) Increasing returns and economic geography. NBER 3275. http://www.nber.org/papers/w3275

Lawton, P., Murphy, E., & Redmond, D. (2010). Examining the role of 'creative class' ideas in urban and economic policy formation: The case of Dublin, Ireland. International Journal of Knowledge-Based Development, 1(4), 267–286.

Lawton, P., Murphy, E., & Redmond, D. (2013). Residential preferences of the 'creative class'? *Cities*, *31*, 47–56. https://doi.org/10.1016/j.cities.2012.04.002

Lees, L. (2000). A reappraisal of gentrification: Towards a "geography of gentrification." Progress in Human Geography, 24, 389–408. doi:10.1191/030913200701540483

Ley, D. (1986). Alternative explanations for inner-city gentrification: a Canadian assessment. *Annals of the association of american geographers*, *76*(4), 521-535.

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

Ley, D. (2003). Artists, Aestheticisation and the Field of Gentrification. *Urban Studies*, *40*(12), 2527–2544. https://doi.org/10.1080/0042098032000136192

Ley, D., & Lynch, N. (2012). Divisions and disparities in lotus-land: Socio-spatial income polarization in greater Vancouver, 1970–2005. Toronto, ON, Canada: Cities Centre, University of Toronto. Retrieved from http://neighbourhoodchange.ca/documents/2012/10/divisions-and-disparities-in-lotus-land-socio-spatial-income-polarizationin-greater-vancouver-1970-2005-by-david-ley-nicholas-lynch.pdf

Litman, T. (2003). Measuring transportation. *Traffic, mobility and accessibility. ITE Journal*, *73*(10), 28-32.

Luborsky, M. R., Lysack, C. L., & Van Nuil, J. (2011). Refashioning One's Place in Time: Stories of Household Downsizing in Later Life. *Journal of aging studies*, *25*(3), 243–252. https://doi.org/10.1016/j.jaging.2011.03.009

Lucas R (1988) On the mechanics of economic development. J Monet Econ 22:3–42

Malanga, S. (2004) The curse of the creative class. City Journal Winter, 36–45.

Malecki EJ (1991) Technology and economic development: the dynamics of local, and national change. Longman, Harlow

Maré, D. C., & Coleman, A. (2011). *Estimating the determinants of population location in Auckland*. 71.

Markusen, A. (2006). Urban development and the politics of a creative class: Evidence from a study of artists. Environment and Planning A, 38, 1921–1940.

Mathews, V. (2010). Aestheticizing Space: Art, Gentrification and the City: Art, gentrification, and city. *Geography Compass*, *4*(6), 660–675. https://doi.org/10.1111/j.1749-8198.2010.00331.x

McCann, E., & Ward, K. (2010). Relationality/territoriality: Toward a conceptualization of cities in the world. Geoforum, 41, 175–184.

McGranahan, D., & Wojan, T. (2007). Recasting the creative class to examine growth processes in rural and urban counties. Regional Studies, 41, 197–216.

Melo, P. C., Graham, D. J., Levinson, D., & Aarabi, S. (2017). Agglomeration, accessibility and productivity: Evidence for large metropolitan areas in the US. *Urban Studies*, *54*(1), 179-195.

Meloche, J.-P. (2020). Family residential choices in Montreal metropolitan area: A community-based analysis. *Canadian Journal of Urban Research*, 17.

Mieszkowski, P., & Mills, E. S. (1993). The Causes of Metropolitan Suburbanization. *Journal of Economic Perspectives*, *7*(3), 135–147. https://doi.org/10.1257/jep.7.3.135

Miller, M. M., Gibson, L. J., & Wright, N. G. (1991). Location quotient: A basic tool for economic development analysis. *Economic development review*, *9*(2), 65.

Moreno, C., Allam, Z., Chabaud, D., Gall, C., & Pratlong, F. (2021). Introducing the "15-Minute City": Sustainability, resilience and place identity in future post-pandemic cities. *Smart Cities*, *4*(1), 93-111.

Musterd, S. (2006). Segregation, urban space and the resurgent city. Urban Studies, 43, 1325–1340.

Muth RF (1961) The spatial structure of the housing market. Pap Reg Sci 7(1):207–220

Niedomysl, T., & Hansen, H. K. (2010). What matters more for the decision to move: Jobs versus amenities. Environment and Planning A, 42, 1636–1649.

O'Callaghan, C. (2010). Let's audit bohemia: A review of Richard Florida's 'creative class' thesis and its impact on urban policy. Geography Compass, 4(11), 1606–1617.

Ozbay, K., Ozmen-Ertekin, D., & Berechman, J. (2003). Empirical analysis of relationship between accessibility and economic development. *Journal of Urban Planning and Development*, *129*(2), 97-119.

Páez, A., Scott, D. M., & Morency, C. (2012). Measuring accessibility: positive and normative implementations of various accessibility indicators. *Journal of Transport Geography*, *25*, 141-153.

Peck, J. (2005). Struggling with the creative class. International Journal of Urban and Regional Research, 29, 740–770.

Peck, J., & Theodore, N. (2010). Mobilizing policy: Models, methods and mutations. Geoforum, 41, 169–174.

Pereira, R.H.M., Banister, D., Schwanen, T., Wessel, N., 2018. Distributional effects of transport policies on inequalities in access to opportunities. In: Presented at the Transportation Research Board 97th Annual MeetingTransportation Research Board.

Porter, M. E. (2012). The economic performance of regions. *Regional competitiveness*, 137-166.

Prashker, J., Shiftan, Y., & Hershkovitch-Sarusi, P. (2008). Residential choice location, gender and the commute trip to work in Tel Aviv. Journal of Transport Geography, 16, 332–341.
Rauch J (1993) Productivity gains from geographic concentration of human capital: evidence from the cities. J Urban Econ 34:380–400

Rauterkus, S. Y., & Miller, N. (2011). Residential land values and walkability. *Journal of Sustainable Real Estate*, *3*(1), 23-43.

Roback, Jennifer (1982), "Wages, Rents, and the Quality of Life," Journal of Political Economy, 90:6, pp. 1257–78.

Rokicki, B., & Stępniak, M. (2018). Major transport infrastructure investment and regional economic development–An accessibility-based approach. *Journal of Transport Geography*, *72*, 36-49.

Rossi, P. H. (1955). Why families move. Glencoe, Illinois: The Free Press.

Scott, A. J. (2006). Creative cities: Conceptual issues and policy questions. Journal of Urban Affairs, 28, 1–17.
Shearmur, R. (2007). The new knowledge aristocracy: the creative class, mobility and urban growth. *Work Organisation, Labour and Globalisation*, *1*(1), 31-47.

Shearmur, R. (2012). The geography of intrametropolitan KIBS innovation: Distinguishing agglomeration economies from innovation dynamics. *Urban Studies*, *49*(11), 2331-2356.

Shearmur, R., & Coffey, W. J. (2002). A tale of four cities: Intrametropolitan employment distribution in Toronto, Montreal, Vancouver, and Ottawa–Hull, 1981–1996. Environment and Planning A, 34,575–598. doi:10.1068/a33214

Shearmur, R., Coffey, W., Dubé, C., & Barbonne, R. (2007). Intrametropolitan employment structure: Polycentricity, scatteration, dispersal and chaos in Toronto, Montreal and Vancouver, 1996–2001. Urban Studies, 44, 1713–1738. doi:10.1080/ 00420980701426640

Shen, Q. (1998). Location characteristics of inner-city neighborhoods and employment accessibility of low-wage workers. *Environment and Planning B: Planning and Design*, *25*(3), 345–365. https://doi.org/10.1068/b250345

Simon C (1998)/ Human capital and metropolitan employment growth. J Urban Econ 43:223–243

Simon C, Nardinelli C (1996) The talk of the town: human capital, information and the growth of English cities, 1861–1961. Explor Econ Hist 33(3):384–413

Smith, A. (1776). 1776. The Wealth of Nations. *Oxford University Press, Oxford*.

Smith, D. A., Shen, Y., Barros, J., Zhong, C., Batty, M., & Giannotti, M. (2020). A compact city for the wealthy? Employment accessibility inequalities between occupational classes in the London metropolitan region 2011. *Journal of Transport Geography*, *86*, 102767. https://doi.org/10.1016/j.jtrangeo.2020.102767

Sohn, D. W., Moudon, A. V., & Lee, J. (2012). The economic value of walkable neighborhoods. *Urban Design International*, *17*(2), 115-128.

Spencer, G. M. (2015). Knowledge neighbourhoods: Urban form and evolutionary economic geography. *Regional Studies*, *49*(5), 883-898.

Statistics Canada (2016) Geographic distribution of immigrants and recent immigrants and their proportion within the population of census metropolitan areas, Canada, 2016 [Data visualization tool]. https://www150.statcan.gc.ca/n1/daily-quotidien/171025/t001b-eng.htm
Statistics Canada. (2017). *Geographic distribution of immigrants and recent immigrants and their proportion within the population of census metropolitan areas, Canada, 2016*
Storper, M., & Scott, A. (2009). Rethinking human capital, creativity and urban growth. Journal of Economic Geography, 9, 147–167.

U.S. Department of Housing and Urban Development (2018). Displacement of Lower-Income Families in Urban Areas Report. Retrieved from: https://www.huduser.gov/portal/sites/default/files/pdf/displacementreport.pdf

UN-Habitat. (2020). Global State of Metropolis 2020–Population Data Booklet.

Saraiva, M., & Pereira, M. (2016). Active accessibility: A review of operational measures of walking and cycling accessibility. *Journal of transport and land use*, *9*(1), 209-235.

Wachs, M., & Kumagai, T. G. (1973). Physical accessibility as a social indicator. *Socio-Economic Planning Sciences*, *7*(5), 437–456. https://doi.org/10.1016/0038-0121(73)90041-4

Wang, S., Liu, H., Pu, H., & Yang, H. (2020). Spatial disparity and hierarchical cluster analysis of final energy consumption in China. *Energy*, *197*, 117195. https://doi.org/10.1016/j.energy.2020.117195

Watson, T. (2009). Inequality and the measurement of residential segregation by income in American neighborhoods. *Review of Income and Wealth*, *55*(3), 820-844.

Wojan, T. R., Lambert, D. M., & McGranahan, D. A. (2007). Emoting with their feet: Bohemian attraction to creative milieu. *Journal of economic geography*, *7*(6), 711-736.

Wyly, E. K., & Hammel, D. J. (2004). Mapping neo-liberal American urbanism. In *Gentrification in a global context* (pp. 28-49). Routledge.

Baum, S., Yigitcanlar, T., Horton, S., Velibeyoglu, K., & Gleeson, B. (2007). The role of community and lifestyle in the making of a knowledge city. *Griffith University, Brisbane*.

Yigitcanlar, T. (2010). Knowledge-based development of cities: a myth or reality?. *International Journal of Knowledge-Based Development*, *1*(3), 153-157.

Zimmerman, J. (2008). From brew town to cool town: Neoliberalism and the
Zukin, S. (1982). Loft living: culture and capital in urban change. New York: Johns Hopkins University Press