Master's thesis in Geography

Recent gentrification, socioeconomic shift and changing service accessibility of neighborhoods in the Helsinki Metropolitan Area

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Abstract: Gentrification has been widely studied since the 1960s for example in the United States and the United Kingdom, but the number of studies in Finland remains limited. Gentrification typically occurs when a previously disinvested neighborhood receives increased investment over a period of time, typically resulting in a change in the socioeconomic composition of the neighborhood's population. In Finland, the welfare state model has controlled gentrification, but recent studies suggest signs that it may be changing.

Previous studies have linked gentrification, displacement, and other socioeconomic changes to the development of public transport systems and other public investments. Improvements in the built infrastructure can improve accessibility to services but can also lead to increasing living costs and displacement of the low-income population.

In this master's thesis, I examine recent gentrification and the socioeconomic shift along with the changing service accessibility in the Helsinki Metropolitan Area from 2012 to 2023. A classical gentrification analysis utilizing socioeconomic variables is carried out across all neighborhoods in Helsinki, Espoo and Vantaa. The findings indicate that while many neighborhoods show potential for it, only a small percentage of them were gentrified during the study period. This suggests that the welfare state model and local policies continue to mitigate widespread gentrification. Furthermore, neighborhoods that experienced gentrification during the study period did not see improvement in service accessibility by public transport. However, neighborhoods that saw increased service accessibility also saw an increase in highly educated residents. The results indicate that further research is needed to better understand the relationship between gentrification, socioeconomic shift and service accessibility.

Työn nimi: Naapurustojen viimeaikainen keskiluokkaistuminen, sosioekonomiset muutokset ja muuttunut palveluiden saavutettavuus Pääkaupunkiseudulla

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Tiivistelmä: Keskiluokkaistumista on tutkittu laajasti 1960-luvulta lähtien esimerkiksi Yhdysvalloissa ja Isossa-Britanniassa, mutta Suomessa tutkimusten määrä on pysynyt vähäisenä. Keskiluokkaistuminen tapahtuu tyypillisesti silloin, kun aiemmin ali-investoituun naapurustoon tehdään paljon uusia investointeja tietyn ajanjakson sisällä. Tämä johtaa tyypillisesti naapuruston väestön sosioekonomisen koostumuksen muutokseen. Suomessa hyvinvointivaltiomalli on hillinnyt naapurustojen keskiluokkaistumista, mutta viimeaikaiset tutkimukset viittaavat siihen, että tilanne saattaa olla muuttumassa.

Aiemmat tutkimukset ovat yhdistäneet keskiluokkaistumisen, väestön syrjäyttämisen ja muut sosioekonomiset muutokset julkisen liikenteen järjestelmien parantamisen ja muiden julkisten investointien lisääntymisen kanssa. Rakennetun infrastruktuurin parannukset voivat parantaa palveluita ja niiden saavutettavuutta, mutta ne voivat myös johtaa elinkustannusten nousuun, ja sen seurauksena pienituloisen väestön syrjäytymiseen alueelta.

Tässä maisterintutkielmassa tarkastelen viimeaikaista naapurustojen keskiluokkaistumista ja sosioekonomista muutosta sekä palveluiden muuttunutta saavutettavuutta Pääkaupunkiseudulla vuodesta 2012 vuoteen 2023. Sosioekonomisia muuttujia hyödyntävä systemaattinen klassinen keskiluokkaistumisanalyysi on tehty Helsingin, Espoon ja Vantaan kaikille naapurustoille. Tulokset osoittavat, että vaikka monilla naapurustoilla on potentiaalia keskiluokkaistumiselle, vain pieni osa niistä on keskiluokkaistunut tutkimusjakson aikana. Tämä viittaa siihen, että hyvinvointivaltiomalli ja paikalliset poliittiset linjaukset lieventävät edelleen laajaa keskiluokkaistumista Pääkaupunkiseudulla. Keskiluokkaistuneissa naapurustoissa ei tapahtunut merkittävää palveluiden saavutettavuuden muutosta tutkimusjakson aikana. Kuitenkin yleisesti naapurustoissa, joissa palveluiden saavutettavuus parani, myös korkeasti koulutetun väestön osuus kasvoi. Tulokset osoittavat, että lisää tutkimustietoa tarvitaan, jotta voidaan paremmin ymmärtää gentrifikaation, sosioekonomisten muutosten ja palvelujen saavutettavuuden välistä suhdetta.

Contents

1. Introduction

According to the World Bank (2023), currently, around 56% of the global population resides in cities with an expected growing trend towards 70% by 2050. In the Western world, the level of urbanization is ahead of the world's average, as is also the case in Finland, with a continuing stable increase of inhabitants moving into urban areas and the degree of urbanization being 73,6 % of the population in 2022 (The Finnish Environment Institute, 2023). Since more and more people are moving into cities, it pressures the cities to change and grow to accommodate the incoming flow of people. In the Helsinki Metropolitan Area (HMA), the change is especially apparent in the inner-city areas where existing buildings and neighborhoods are being expanded, completely new neighborhoods are being built, some by reclaiming land from the sea, and industrial actors are being pushed towards the city's outskirts. At the same time, the public transport network has seen improvements and expansions in the recent decade, with even more expansions, like the Crown Bridges light rail (City of Helsinki, 2025) and Vantaa light rail (City of Vantaa, 2025) in the coming years.

Some could argue that the changes to the cities previously described are all good things for the city and its inhabitants, yet it is more complicated. Changes mentioned can lead to an interesting phenomenon, gentrification, which is quite a complex process that has been increasingly studied since the first use of the term by Ruth Glass in the '60s (Glass, 1964). The manifestation of gentrification is still rather like Glass's (1964) description, but within the city, the phenomenon has expanded from only affecting the inner-city neighborhoods of large cities (Hackworth & Smith, 2001) towards the neighborhoods on the outskirts (Drain, 2024; Pegler, Li, & Pojani, 2020) and becoming a more global phenomenon (N. Smith, 2006) affecting smaller and more rural cities in addition (Atkinson & Bridge, 2010).

However, gentrification remains a complex phenomenon that can manifest in various ways in different contexts, making it somewhat challenging to have a universal definition. One way to explain gentrification or better residential gentrification is that it is a phenomenon where usually underprivileged and/or disinvested neighborhoods experience a change over time to accommodate better the needs and the preferences of the gentry, the middle class, which can have an effect on the socioeconomic

composition of the population within the neighborhoods changing (Glass, 1964; Hammel & Wyly, 1996; Lees, Slater, & Wyly, 2008; Zuk, Bierbaum, Chapple, Gorska, & Loukaitou-Sideris, 2018). In previous studies, it is noted that areas facing gentrification tend to see the in-move of the more affluent middle-class to predominantly working-class neighborhoods, which can lead to the housing prices increasing, which then can lead to the out-move of the working-class population (Freeman, 2005; Zuk et al., 2018). The out-movement of the typically low-income (Hammel & Wyly, 1996) or working-class population is known as displacement. There is debate about whether gentrification causes displacement or not, and whether gentrification could happen without displacing the area's residents (Shaw & Hagemans, 2015).

Since gentrification has been identified as an important subject of research in the last 60 years, scholars have tried to measure it in multiple different ways to capture, at least some of the phenomenon, and better conceptualize the phenomenon in question. Since the scopes of the studies vary in geographical and temporal terms, the methodology must be adapted to suit the research context and available data. Many studies in the last 20 years have used the methodology created by Lance Freeman (2005) as a starting point (G. S. Smith, Breakstone, Dean, & Thorpe, 2020). Since the methodology is celebrating its 20th birthday and was created in the context of the United States (Freeman, 2005), it is not directly suitable for all geographical contexts, hence, other research exploring and comparing different methodologies and frameworks for measuring gentrification has been made (bunten, Preis, & Aron-Dine, 2024; Easton, Lees, Hubbard, & Tate, 2020; Finio, 2022; Hawkins, Ahmed, Roorda, & Habib, 2022; Lagendijk et al., 2014; Preis, Janakiraman, Bob, & Steil, 2021).

Economic factors, such as the change in land valuation (N. Smith, 1979, 1987), and policy factors, among others, have been identified as possible factors causing gentrification to occur. Some scholars have identified links between public transport-oriented development, also known as transit-oriented development (TOD), gentrification (Kahn, 2007) and new-build gentrification (Jyothi Chava, Newman, & Tiwari, 2019). With pressure to improve the public transit network and to create TOD policies, cities can trigger a process called transit-induced gentrification (Dawkins & Moeckel, 2016).

Gentrification research in the Helsinki region has remained relatively limited in comparison to the United States, United Kingdom, or even to the neighboring countries of Sweden and Denmark (Lilius, 2022), despite recent literature about gentrification existing (Drain, 2024; Karhula, 2015; Lilius & Hirvonen, 2023). Gentrification analyses made in the Helsinki Metropolitan Area have focused only on specific predefined neighborhoods. A systematic gentrification analysis of all neighborhoods of the Helsinki Metropolitan Area has not been published. Without a systematic analysis of gentrification, the phenomenon could potentially remain unnoticed in some neighborhoods and lead to more negative effects associated with gentrification in these areas.

Gentrification, together with public transport-oriented development, has been studied quite recently in the Helsinki Metropolitan Area, but the study was geographically limited to only covering areas close to the first expansion of the metro line (Meriläinen, Karhula, Kurvinen, Falkenbach, & Ala-Mantila, 2024). Meriläinen et al. (2024) note that their study of Helsinki Metropolitan Area can offer crucial new understanding about links of TOD and gentrification in the US-based research-dominated field since Finland's low levels of socioeconomic segregation and Nordic welfare state context.

In this master's thesis, I will be studying gentrification in the Helsinki Metropolitan Area through the socioeconomic changes of neighborhoods in relation to the service accessibility by public transportation, with the following research questions:

1) Which neighborhoods had the potential for gentrification and which had gentrified during the study period?
2) How has service accessibility changed during the study period?
3) What is the link between gentrification, socioeconomic change and service accessibility?

This study analyses the change over time at the neighborhood level using various data sets spanning roughly 10 years between 2012 and 2023. This study tries to utilize publicly available data as much as possible but also recognizes the limitations of entirely relying on open data sources. Therefore, some data had to be acquired separately from different institutions. This thesis aims to adapt and expand the

current methodologies of measuring gentrification to suit the context of Finland and to further the discussion of measuring gentrification in the Finnish cities and the context of the Nordic welfare state, while also trying to provide new contributions to gentrification research. This study also tries to connect service accessibility together with gentrification socioeconomic shift to potentially identify new links that could be utilized in future gentrification research.

In the next chapter titled ‘Background’, I will first go through the key historical shifts of gentrification research from the scope of this thesis. Then I will focus on the more recent gentrification research, different methodologies of measuring gentrification, and transit-oriented development with transit-induced gentrification. In the third chapter, I will be introducing the study area, data sets used and methodologies in detail with a description of the quantitative analysis process. After that, in the fourth chapter, I will analyze and interpret the results of the gentrification analyses. In the ‘Discussion’ chapter, I will analyze the results and the used methods with previous research and present the limitations of this study. Finally, in the concluding chapter, I will briefly summarize the content and the results of this thesis.

2. Background

2.1. Capturing the notion of gentrification

To capture the notion of gentrification one needs history and the different phases of said phenomenon. The term ‘gentrification’ was first used by a British sociologist named Ruth Glass in 1964 to describe the bundle of distinct ongoing urban processes in central London during that time. Scholars later argued that gentrification as a phenomenon is older than the word itself by some decades which is highlighted for example by Lees et al. (2008). Some of the urban processes Glass (1964) describes are for example the upgrading of housing units and division to smaller units, inflation of housing prices, displacement of working-class people and the changing social character of the affected neighborhood. These processes are nowadays better known as parts of so-called ‘classical gentrification’ (Lees et al., 2008).

In 1979 Neil Smith proposed the rent-gap theory which has been an influential theory used in analyzing gentrification and urban redevelopment. Smith (1979) argues that gentrification occurs when there is a significant difference between the current capitalized ground rent and the potential ground rent i.e. a rent gap. The current capitalized ground rent represents the rent of land in its current situation and the potential ground rent represents the potential rent that could be achieved if the land was put up to its highest monetary use. This rent gap incentivizes investment and redevelopment, especially in changing and expanding cities and especially previously undesirable central city neighborhoods where the land valuation changes over time. In these neighborhoods, aggressive redevelopment can lead to the displacement of lower-income residents (N. Smith, 1982, 1987).

Gentrification is not a phenomenon that manifests the same way through time and space. Scholars have identified different and distinct ‘waves’ of gentrification starting from the 1950s all the way to the present day (Aalbers, 2019; Hackworth & Smith, 2001; Lees et al., 2008). The different waves of gentrification are also tightly tied to local and global economic, political and other trends (Hackworth & Smith, 2001).

The first wave of gentrification according to Hackworth & Smith (2001) started as early as the 1950s and was seen mainly as an isolated and unsystematic process happening in small neighborhoods across the small neighborhoods in the USA and

Western Europe until 1973. However, during and after the recession in the early 1970s investors utilized the opportunity to purchase relatively inexpensive properties from the undervalued areas (Hackworth & Smith, 2001).

These processes set up the second wave of gentrification that started in the late 1970s (Hackworth & Smith, 2001). During the second wave, gentrification became more common and, in a way, systematic in smaller and non-global cities resulting in the displacement of the poorest residents (Hackworth & Smith, 2001). The recession of the early 1990s marked the end of the second wave due to diminishing flows of capital into gentrifying neighborhoods which prompted some to believe that gentrification would stop completely, or the reversal of the process would occur next (Hackworth & Smith, 2001).

However, after the recession, gentrification continued stronger than ever before, spreading into new neighborhoods yet untouched by the phenomenon and gradually expanding to the global phenomenon it is today (Hackworth & Smith, 2001). Starting from this third wave, large-scale capital and the involvement of the state became more influential in the process for the first time (Hackworth & Smith, 2001).

During the early 2000s, gentrification intensified so much that Lees (2008) dubbed it as the fourth wave. Fundamentally, the process remained like the third wave described by Hackworth & Smith (2001) but the influence of global flows of capital and gentrification encouraging politics that specifically benefit the wealthier population (Lees et al., 2008) in the eyes of Lees (2008) were enough to define it as its distinct phase, even though it is recognized by Lees et al. (2008) that this phase was only present in the context of the United States. Later, Aalbers (2019) argued that the fourth wave of gentrification, originally coined by Lees (2008) was merely an intensified extent of the third wave and not a ‘distinct’ wave itself.

Aalbers (2019) identified yet another transition period associated with the results of linked crises like the ‘dotcom’ bubble bursting (2001), the United States financial crisis (2007), the European debt crisis (2009) and the bursting of the Chinese stock market bubble (2015) that paved way for the fifth wave of gentrification. This fifth wave Aalbers describes in a rather abstract way as being the “urban materialization of finance-led capitalism” (Aalbers, 2019, p. 5) yet still being a continuation of the previous third and fourth waves. The fifth wave sees the state's increasing role in

gentrification supplemented by the capital of the financial sector and overall represents a broader trend in which urban development and global financial mechanisms are intertwined and impact how cities change and who benefits from that change. The effects of global capital grow stronger as properties are seen as a safe form of investment in wealthier circles, which can, in some instances outprice locals in the property markets (Aalbers, 2019). The share of profit-driven corporate landlords increases, which can cause the cost of housing to increase, and at the same time indicates a shift from individual property ownership towards corporations (Aalbers, 2019). The rise of platform capitalism in the form of platform-based companies like Airbnb that direct capital to specific neighborhoods in city centers that generally seem 'hip' is also seen as a distinct part of the fifth wave (Aalbers, 2019).

2.2. Recent developments in gentrification research

After dwelling on the history of gentrification, it is quite apparent that we cannot comprehend the gentrification happening today if we only consider the roots of gentrification research that are deeply rooted in the geographical contexts of the United States and the United Kingdom. Geographical contexts differ and that is the reason gentrification can be triggered and happen in differentiating ways around the globe. In recent times, the focus of gentrifying research has been shifting from US and UK-centric to a more global one focusing more on Europe, the Far East and the Global South (Atkinson & Bridge, 2010) as gentrification is now being recognized as a global process (Lees et al., 2008).

In the European context, gentrification has been studied in increasing numbers in continental Europe, mainly in the form of case studies. In Barcelona, gentrification is mainly driven by highly skilled international migration, tourism and the rise of the knowledge economy (de Jongh i Ferrer, Sanjuán, & Cano-Hila, 2024; Rodríguez & López-Gay, 2024). Tourism and the rise of platform capitalism have also been identified as a driving force of gentrification in Naples and Madrid a well (Pérez, Curto, Urquiaga, & Simon, 2024). In these studies, it is noted that the rise of platform capitalism (e.g. Airbnb) has successfully accelerated gentrification in central city areas of the large cities in Southern Europe which often leads to the

displacement of long-term residents from these areas. Studies also indicate a spatial overlap between high Airbnb densities and gentrification in central city areas (Hübscher & Borst, 2023; Wachsmuth & Weisler, 2018), even though there are also exceptions (Hübscher & Borst, 2023).

Another emerging concept in gentrification research is the so-called green gentrification, which refers to the process where urban green community spaces, such as parks, are created, which leads to rising housing costs (Anguelovski & Connolly, 2024; Gould & Lewis, 2016). In green gentrification, like in gentrification research in general, the rising inequality and displacement are considered important. There are numerous case studies of the effects of "greening" from North America, where the phenomenon has led to significant property value increases and displacement (Anguelovski et al., 2022; Gould & Lewis, 2016; Jo Black & Richards, 2020), and from Europe where there are cases where long-term residents are being displaced by green gentrification (Anguelovski et al., 2022; Goossens, Oosterlynck, & Bradt, 2020).

Big data has been recognized as a potential tool to help further gentrification research. Where traditional methods of measuring gentrification utilizing census-based approaches struggle, big data could potentially fill in since it allows the use of more varied and dynamic data sources. For example, Poorthuis, Shelton, & Zook (2022) and Chapple, Poorthuis, Zook, & Phillips (2022) have used geotagged social media data for tracking the mobilities and relational connections of residents and visitors of neighborhoods over time to gain a relational perspective on gentrification (Poorthuis et al., 2022). Big data, however, is not a new solution to all gentrification research that trumps all the previous methods of measuring, yet it provides additional and novel data sources that for example are not captured in censuses or any other conventionally collected sets of data. A potential limitation of utilizing big data sources in gentrification research is the constantly changing state of data availability, which can make long-term temporal comparison impossible or extremely difficult if some data becomes unavailable (Poorthuis et al., 2022). Nevertheless, the usage of big data in gentrification research will most likely increase in the coming years as more data becomes available and enough time has passed to draw comparisons with conventional data sets.

2.3. Public transport development, accessibility and the relation with gentrification

Public transport development, also transit-oriented development (TOD), refers to a design philosophy where the accessibility of services by improving the public transport network and reducing car dependency in cities (Berawi, Ibrahim, Gunawan, & Miraj, 2019). Typically, the idea connecting PT development with gentrification is that new transit investments will lead to other new development and increasing prices within the influence area leading to displacement of low-income residents, hence the term transit-induced gentrification (Dawkins & Moeckel, 2016). For example, in a US-based study Kahn (2007) found out that there is a connection between new walk-and-ride stations and greater gentrification. However, the results of many studies have inconsistent findings regarding the displacements of the low-income residents (Chapple & Zuk, 2019; Zuk et al., 2018). Since there still is the risk of displacement, policies and incentives need to be created to ensure that low-income residents can still enjoy the benefits of new PT development and better accessibility to services (J. Chava, Newman, & Tiwari, 2018; Dawkins & Moeckel, 2016). Qi (2024) found out new light rail development contributed more to gentrification and neighborhood upgrading when compared to development of rapid bus network.

Many studies regarding the relation of public transport development and gentrification focus especially on the network infrastructure improvements, but little attention has been given to subsequent change in service accessibility which is often the expectation when the network is being expanded. The focus of many studies is the areas closest to new PT development but often don't consider the consequences for accessibility of neighborhoods further away. Since there is general concern about the accessibility of services for low-income residents, a more refined approach to accessibility is required. For example, travel times by public transport would provide a more comparable metric for measuring the accessibility of services for all people of different socioeconomic backgrounds and a more refined way when compared to just the distance to services.

2.4. Gentrification research in Finland

Gentrification research in Finland is not as diverse as in other geographical contexts, yet academics have shown interest in studying the phenomenon, especially in the context of Helsinki and the Helsinki Metropolitan Area with only a few studies focusing on other major cities of Finland. The studies have focused on various aspects related to gentrification like the housing and welfare policies (Drain, 2024; Leino, Wallin, & Laine, 2025), the impact on communities (Lilius & Hirvonen, 2023) and transit-oriented development (Meriläinen et al., 2024).

Finland is a welfare state that has historically implemented policies that try to mitigate the negative effects associated with gentrification and especially residential displacement (Drain, 2024). The policies and systems in place related to subsidized housing, rent control, and social mixing make the study context of a Nordic welfare state drastically different when compared to for example the United States. However, Drain (2024) argues that the recent trends happening in Helsinki and Finland indicate that the current welfare state policies trying to mitigate gentrification are not enough to tackle global gentrification.

A recent study by (Lilius & Hirvonen, 2023) in a way agrees with the findings of Drain. They focused on how the housing estate neighborhoods developed originally in the 60s and the 70s have seen the growing interest of national and international real estate investors after the continuous socioeconomic decline after the 1990s (Lilius & Hirvonen, 2023). They argue that this new interest through urban renewal projects and infill development has led to displacement of the low-income residents. They conclude by highlighting that in the case of Helsinki population growth is seen as one of the main drivers together with changing policies for creating a rent gap and gentrification in these old suburban areas.

Meriläinen and others (2024) have studied transit-induced gentrification in the Helsinki Metropolitan Area with a more detailed focus on the recent metro extension. In this article, they try to figure out what type of socioeconomic changes occur in neighborhoods that see an increase in public transport-related investment and improved accessibility. In the study, they found out that socioeconomic change in these neighborhoods is indeed happening (Meriläinen et al., 2024).

2.5. Ways of measuring gentrification

For decades scholars have tried different ways of measuring gentrification through the means of both quantitative and qualitative analyses which have varied by time and geographical context. The first part of identifying gentrification is to define a criterion to identify the areas or neighborhoods that are seen as potential for gentrification to occur (Finio, 2022). The criterion typically follows the original definition of Ruth Glass and generally tries to seek out areas that have faced some kind of disinvestment and/or lower social class occupation (Finio, 2022; Galster & Peacock, 1986). After these areas have been identified, a change over a specified period is observed and then the realized change is compared against the criterion which classifies neighborhoods typically to gentrified and non-gentrifying (Galster & Peacock, 1986). This is the most common approach for measuring gentrification, but there is lot of variation in the criterion used (Finio, 2022) and this framework can be utilized as a basis for both quantitative and qualitative analyses.

The study period and the criterion for defining gentrification can differ drastically between studies. The study period typically is one decade which matches with the United States census cycles, but can be either shorter or longer, even decades long. The availability of applicable data is one of the key factors that ultimately determine the length of the study period, but it still needs to be long enough to allow enough change to occur (Finio, 2022; Zwiers, 2018). For example, Freeman (2005) uses 10-year period, Meriläinen et al. (2024) use a 12-year period and Anguelovski et al. (2022) use both 10 and 16-year periods.

Compared to variation in the study period, the variation in the criterion itself is diverse. As mentioned by Galster & Peacock the criteria for defining and measuring gentrification are typically tied to measuring disinvestment and/or socioeconomic change. Probably one of the most influential criteria for defining gentrification is of Freemans (2005) where a neighborhood is considered potential for gentrification if (1) located in the central city, (2) the median income is less than the median for the metropolitan area, (3) have a proportion of houses built in last 20 years less than the median of neighborhoods. Further, the neighborhoods are classified as gentrified if (4) the neighborhood's percentage of highly educated people increases more than the metropolitan area and (5) the neighborhood's real housing prices increase during the study period (Freeman, 2005). Other typical variables related to the population that

can be used in measuring gentrification are the share of poor households, share of renters, rental cost, household income, share of native language speakers to non-native, racial characteristics (typically only in US contexts), occupation (bunten et al., 2024; Finio, 2022; Lees et al., 2008; Meriläinen et al., 2024; Preis et al., 2021; G. S. Smith et al., 2020). Gentrification can also be analyzed only based on socioeconomic variables omitting variables regarding the housing market (Meriläinen et al., 2024; Yonto & Thill, 2020). Changes in these variables then are often compared to the city or metropolitan median values, and often the threshold for gentrification is either the specified metrics increase in the neighborhood more compared to the increase in metropolitan value, or the change of the specified metric of the neighborhood from below/above to above/below the metropolitan value depending on the variable. Another way to define potentially gentrifiable areas is not to compare the change in population statistics to the regional averages but to rank the neighborhoods and compare the change of the ranks over time (Hwang & Lin, 2016).

The previous paragraph summarized the so-called census-based measurements and how one could approach measuring gentrification. However, gentrification can also be studied by utilizing different kinds of proxies. These proxies can for example be the amount of coffee shops (Papachristos, Smith, Scherer, & Fugiero, 2011), dog parks (Grier & Perry, 2018), vintage clothing stores (Hubbard, 2016) and the density of Airbnb apartments (Hübscher & Borst, 2023). Changes in storefronts, buildings or greenery can also nowadays be analyzed through street view images and machine learning (Ilic, Sawada, & Zarzelli, 2019).

3. Material and methods

3.1. Study area

For this thesis I have chosen to study the forementioned phenomena in the context of the Helsinki Metropolitan Area, and specifically in the cities of Helsinki, Espoo and Vantaa. The Helsinki Metropolitan Area, however, also includes the city of Kauniainen, which had to be excluded from the study due to data availability. From this point onward, the Helsinki Metropolitan Area refers only to the cities of Helsinki, Espoo and Vantaa.

The three municipalities making the Helsinki Metropolitan Area consist of a total of 297 neighborhoods (Figure 1): 148 in Helsinki (*osa-alueet*), 88 in Espoo (*pienalueet*), 61 in Vantaa (*kaupunginosat*). This neighborhood level was chosen since it is the smallest regional division from which the socioeconomic data could be acquired from open databases.

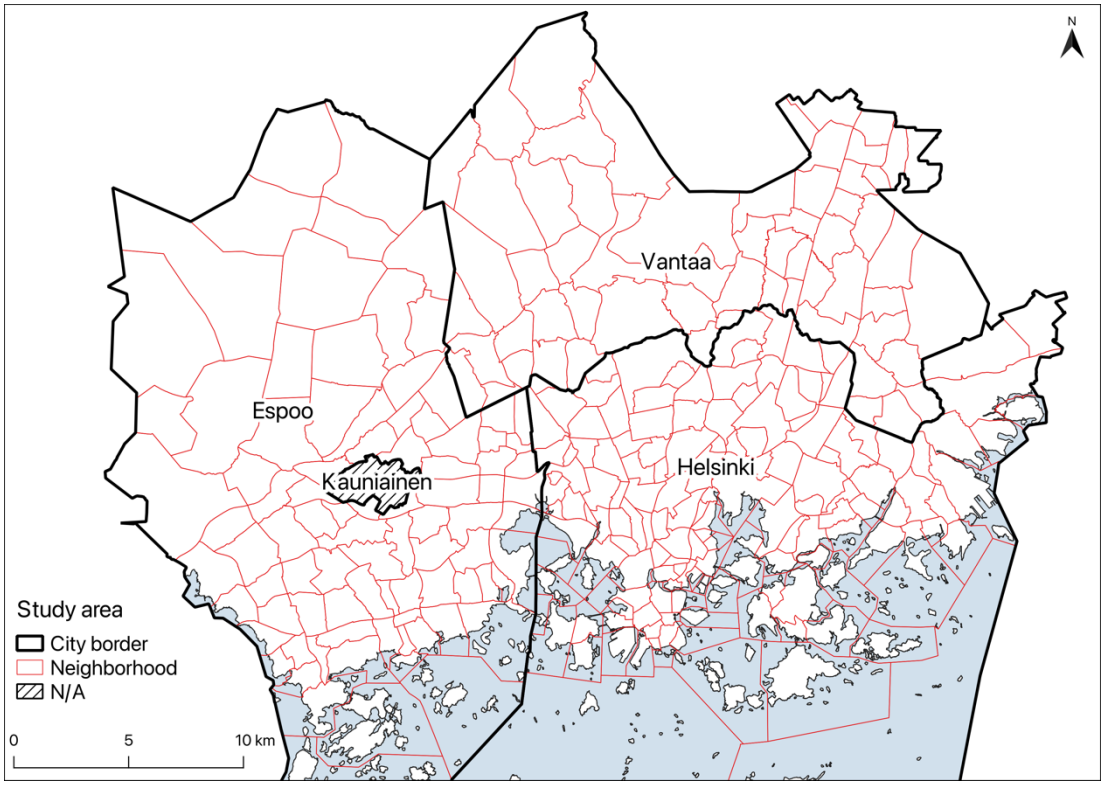

Figure 1. The study area covers the Helsinki Metropolitan Area excluding the city of Kauniainen. The study area consists of 297 neighborhoods (osa-alue).

3.2. Measuring gentrification

Based on existing literature on measuring gentrification, it will be analyzed only through socioeconomic variables which were chosen based on the data available. Gentrification is analyzed by comparing changes in household median income, the share of highly educated residents and the share of low-income households. The chosen variables align with previous research and are similar to the variables used in a study by Meriläinen et al. (2024) where they analyzed transit-induced gentrification within the Helsinki Metropolitan Area. The socioeconomic variables are first compared to citywide averages from which neighborhoods are classified either as potential for gentrification or not eligible for gentrification. Then, the potentially gentrifiable neighborhoods are classified into three classes (gentrified, ongoing gentrification and non-gentrifying) based on the realized change over time. The study for socioeconomic variables is 10 years between 2012 to 2022 which should allow enough time for change to occur and is in line with previous gentrification research.

As mentioned, there are two ways to analyze the realized change in socioeconomic variables. I have chosen to utilize the less-used method where variables need to cross over to the other side of the regional median value for gentrification to occur. This choice is due to my understanding of what gentrification should measure. I'll argue that if an area is to be considered as gentrified, it needs to change enough to 'cross over' to the 'better' side of the regional averages, whereas Freeman-based methodologies typically accept gentrification to occur if the rate of change surpasses the change of regional averages. I'll further argue this through the following example. If a bottom 10 % neighborhood turns into a bottom 20 % neighborhood, Freeman-based classification in often cases would classify the area as gentrified even though the neighborhood would still not be classified as a 'middle-class'. The used criterion and classification are presented below (Figure 2).

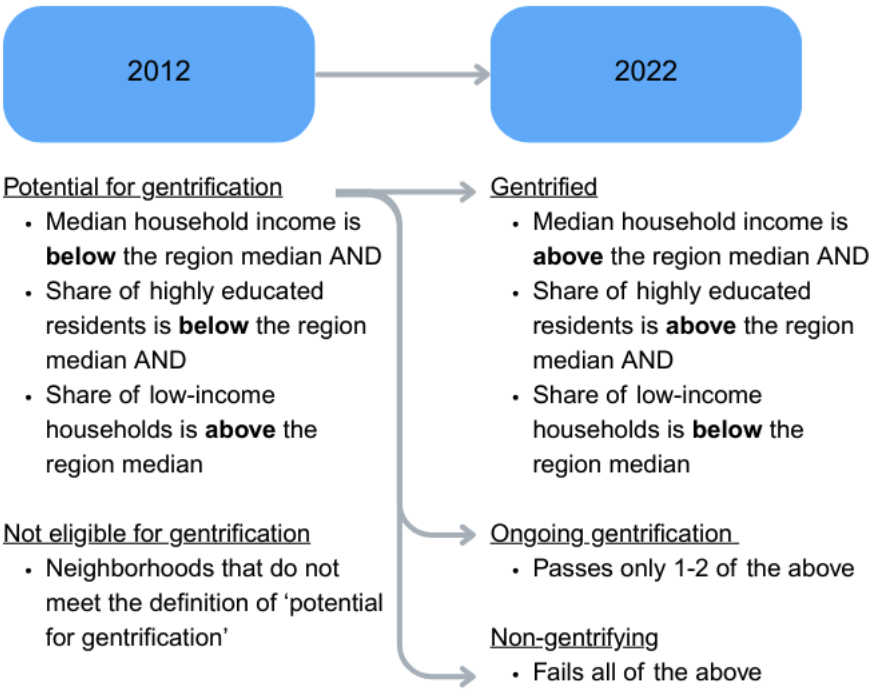

Figure 2. Criterion and classification for analyzing gentrification.

3.3. Data and pre-processing

3.3.1. Socioeconomic variables

For measuring gentrification and socioeconomic change in neighborhoods, three variables were chosen: median household income (€), the share of highly educated residents (%) and the share of low-income households (%). Socioeconomic variables were obtained from the *Aluesarjat* database (2024), which distributes the official registry data of Statistics Finland aggregated to city and neighborhood level within the Helsinki Metropolitan Area (Helsinki, Espoo & Vantaa). Data sets used for this study are from the years 2012 and 2022 and represent the situation of the last day of the mentioned year (31.12.). The neighborhood level socioeconomic variables are always compared to the values of the city where the neighborhood belongs to i.e. median household income of a neighborhood in Helsinki is compared to the city-wide median of Helsinki.

Median household income

Median household income represents the median nationally taxable income of households (*valtionveronalainen tulo*) in euros of the given year. The monetary values of 2012 were adjusted for inflation and are represented in 2022 value. Median income data is classified if there are under 100 households within the neighborhood.

The highest median income in 2012 of the three cities is in Espoo (60 197 €), second highest in Vantaa (51 009 €) and lowest in Helsinki (44 460 €) (Table 1). When comparing the change from 2012 to 2022, only Helsinki saw an increase in median income (+ 936 €) whereas in Espoo and Vantaa median income dropped 3 216 € and 4 403 € respectively.

Share of highly educated residents

The share of highly educated residents represents the share of the population that holds any higher education degree or higher. The share of highly educated residents is calculated by dividing the number of highly educated residents by the total population. The number of highly educated residents is classified if the number is below an unspecified threshold and therefore the share of highly educated residents cannot be calculated for neighborhoods containing classified values.

The share of highly educated residents in 2012 was highest in Espoo, then Helsinki and lastly Vantaa (Table 1). The share of these residents has remained similar in Espoo (+ 0,7pp) whereas in Helsinki the share has increased over 8pp and in Vantaa increased 2,5pp.

Share of low-income households

The share of low-income households represents the share of all households where the household's disposable monetary income per consumption unit (the so-called equivalent income) is less than 60 % of the median disposable monetary income of all households. The share of low-income households is calculated by dividing the number of low-income households with the number of all households. The number of low-income households is classified if the number is below an unspecified threshold and therefore the share of low-income households cannot be calculated for

neighborhoods containing classified values.

The share of low-income households in 2012 ranged from 10,7 % to 15,1 % of all households (*Table 1*). In Helsinki, only a small change in the share of low-income households occurred (+ 0,1pp) but in Espoo and Vantaa, the share increased by 1,9pp and 2,7pp respectively.

Table 1. Change in socioeconomic variables in Helsinki, Espoo and Vantaa in 2012 and 2022.

		Median household income	Share of highly educated residents	Share of low-income households
2012	Helsinki	44 460 €	37,0 %	15,1 %
	Espoo	60 197 €	46,4 %	10,7 %
	Vantaa	51 009 €	29,0 %	10,8 %
2022	Helsinki	45 396 € (+ 936 €)	45,3 % (+ 8,3)	15,2 % (+ 0,1)
	Espoo	56 981 € (- 3 216 €)	47,1 % (+ 0,7)	12,6 % (+ 1,9)
	Vantaa	46 606 € (- 4 403 €)	31,5 % (+ 2,5)	13,5 % (+ 2,7)

3.3.2. Travel time matrix

Travel time matrix (TTM) contains travel time information in minutes for routes between all 250 m x 250 m YKR grid cell centroids (*n=13231*), which makes the data compatible with multiple different data sources utilizing the standardized grid. TTM has been calculated for 2013, 2015, 2018 and 2023 (Fink, Willberg, & Toivonen, 2023; Tenkanen & Toivonen, 2019). TTM has travel times calculated for walking, cycling, public transport and private motorcars in each iteration.

TTM has been calculated with two distinctively different methodologies. 2013-2018 data sets have been calculated with an older methodology (Tenkanen & Toivonen, 2019) whereas the 2018-2023 data sets have been calculated with a more refined and accurate methodology (Fink et al., 2023). The 2018 data set is the only one that has been calculated with both methodologies. In all data sets the travel times are rounded to the nearest minute.

In this study, only the public transport travel times are utilized. Public transport travel times have been calculated for midday traffic (12 pm-1 pm) in all iterations. Starting from 2015, the travel times have been additionally calculated for morning rush hour traffic (8 am-9 am) and beginning in 2018 (only new methodology) for nighttime traffic (2 am-3 am) to better highlight the dynamic nature of the public

transport network. In the table below (*Table 2*) I have highlighted the key differences between the two methodologies used to calculate travel times for public transport.

Table 2. Key differences between the older (Tenkanen & Toivonen, 2019) and the newer methodologies (Fink et al., 2023) used to calculate public transport travel times.

	Tenkanen & Toivonen (2019)	Fink et al. (2023)
Calculation tool	MetropAccess-Reititin	r5py with localization modifications
Calculation method	Fastest of 10 departure times within the hour using so-called Golomb ruler	The median of all departures within the hour
Walking speed	4.2 km/h	4.7 km/h (average) or 3.43 km/h (slow)

3.3.3. Central area classification

Central areas are defined utilizing a framework (Rehunen et al., 2014) originally created for a research project of the Finnish Environment Institute to identify center and retail areas. The original framework was applied by the Helsinki-Uusimaa regional council *(Uudenmaan liitto)* to create a more nuanced framework better suited for the region (Jutila, 2018). The classification is available for standardized the 250 m x 250 m YKR grid. The geoprocessing model classifies grid cells into classes 1-8 based on the diversity of services within the cell and nearby cells, the population within the cell and jobs within the cell. Classes 1-2 are not considered central areas since the diversity of services is too low. Classes 3-4 include jobs from 3 of 5 fields, and classes 6-7 include jobs from 4 of 5 fields. Classes 7-8 include jobs from all fields and offer the most diverse services. Classified grid cells are then merged to form central areas. A more detailed description of the classification process is available in the methodology overview publication (Jutila, 2018).

The data set (Helsinki-Uusimaa Regional Council, 2024) that was provided by the regional council and that is used in this study was at the time of receiving the most recent iteration of the classification. The classification was done January 1st, 2024, and utilizes the population data from 2022 and the employment data from 2021

therefore the data essentially represents the center areas in 2022.

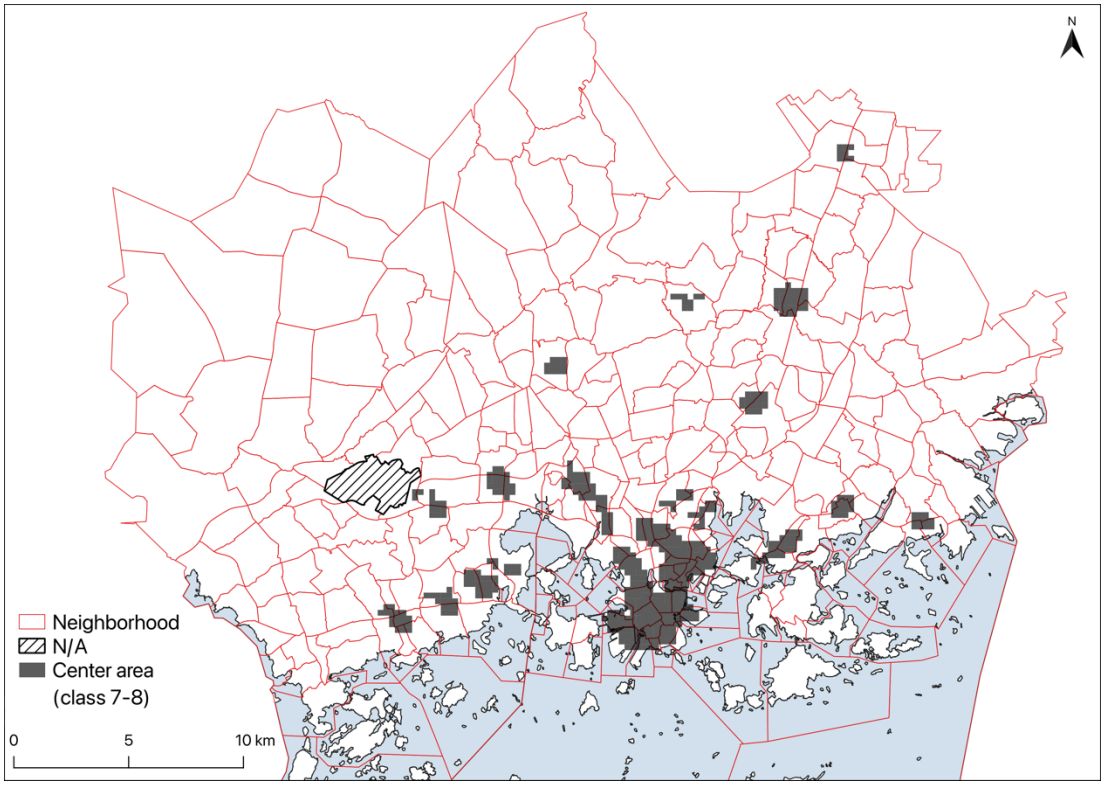

Figure 3. Center areas with the most diverse services (class 7-8) in 2022 according to Jutila (2018).

3.3.4. Other data sets

Population from 2012 and 2022 for the 250 m x 250 m grid cell for the YKR grid cell division was obtained from the Finnish Environment Institute which is derived from the official population registry of Finland (Väestön keskusrekisteri, 2022). The population data is utilized for the population weighing of travel times.

3.4. Analysis process

The data processing will be carried out utilizing Python version 3.11.10 with libraries such as Pandas and GeoPandas. Statistical analyses will be conducted with Stata/MP version 18.0. QGIS version 3.34.1 is used to create map visualizations.

3.4.1. Identifying neighborhood's potential for gentrification and gentrified neighborhoods

Neighborhoods in the HMA are classified according to the criterion presented in section 2.5 as *potential for gentrification* and as *not eligible for gentrification* based on the socioeconomic values in 2012. Neighborhoods that contain classified or missing values will be excluded from the gentrification analysis. Then the areas that were classified as potential for gentrification will be classified into three classes (*gentrified*, *ongoing gentrification* and *non-gentrifying*) according to the realized change in the socioeconomic variables between 2012 and 2022. The set of criteria used in the classification of neighborhoods is presented in Figure 2.

3.4.2. Calculating public transport travel time changes to center areas

Since HMA consists of multiple cities (Helsinki, Espoo, Vantaa), a more refined classification of center areas was deemed necessary instead of using the location of CBDs or Helsinki city center for example since not all people consider utilizing the services of any given center. Based on the location and the amount of center areas in the data set, only the centers in classes 7-8 were considered due to the highest diversity of services present. Center areas act as a proxy for service clusters in this study.

Since we do not have information on which central areas and their services are the most frequently utilized by residents of each neighborhood, it is assumed that residents utilize the services of the nearest center. The closest center is measured by travel time in minutes with public transport in midday traffic. This approach is chosen since it is the only way to measure the change in travel times between 2013 and 2023 by utilizing the TTM available. Public transport travel times are utilized since not everyone has access to a private motorcar, and it overall better reflects the travel method of many living in the urban areas.

To compare public transport (PT) travel times between 2013 and 2023, the data from columns *pt_m_t* and *pt_m_avg* will be used respectively. These columns were chosen for the analysis since they are the only available columns that contain similar and comparable data. These columns represent the public transport travel times in midday traffic and consider the so-called door-to-door approach which excludes the

waiting time at home at the beginning of the journey (Fink, Willberg, Klein, Heikinheimo, & Toivonen, 2024).

First, each cell is assigned a travel time in minutes to the cell that is classified as a class 7-8 center area which is reached the fastest using public transport. Due to the rather significant methodological switch after 2018 the TTM data needs to be adjusted to take into consideration the mentioned switch. The adjustment is done utilizing the TTM from 2018 where the same data is calculated with both methodologies.

Second, the travel times of 2018_{old} and 2018_{new} in columns *pt_m_t* and *pt_m_avg* respectively are compared in each grid cell *(n=13231)* to calculate a systematic adjustment layer which can be applied to 2013 data resulting in 2013_{adj} to make the 2013 data comparable with 2023 data. By utilizing the systematic adjustment for each cell, it assumes that the change caused by the methodological shift in 2018 applies directly to 2013 data.

$$2013_{adj} = 2013 + (2018_{new} - 2018_{old})$$

Third, the adjusted 2013 (2013_{adj}) and 2023 data is aggregated to neighborhood level making direct comparison possible with socioeconomic variables. The travel time to the nearest center for each neighborhood is assigned utilizing a population-weighed median approach, i.e. the aggregated value of a given neighborhood represents the time it takes for 50 % of the area's population to reach the closest center. Official population data for 2012 and 2022 in 250 m x 250 m YKR grid format are used respectively to calculate population-weighted values. The resulting weighted aggregated values are Agg2023 and $Agg2013_{adj}$.

Fourth, after the population weighted travel times for each neighborhood are calculated for 2013 ($Agg2013_{adj}$) and 2023 change in travel times between Agg2013 and 2023 are calculated.

$$population\ weighted\ PT\ travel\ time\ change = Agg2023 - Agg2013_{adj}$$

Fourth, the travel times are aggregated to the neighborhood level making direct comparison possible with socioeconomic variables.

3.4.3. Statistical analysis

After gentrification has been identified and the travel times to the nearest center areas calculated it is possible to analyze the statistical relation between the socioeconomic variables and public transport travel times. The covariation is measured between all utilized variable pairs.

For this part of the study, the percentage point change is calculated for the socioeconomic variables. Median income values are transformed using a logarithmic scale to better reflect the characteristics of income.

Since the covariation of all variable pairs is not linear and some data sets contain outlier values, the covariation of said variables will be analyzed by calculating the Spearman's rank correlation coefficient, which is more suited for analyzing data with these characteristics compared to the Pearson correlation coefficient (de Winter, Gosling, & Potter, 2016). Through this bivariate analysis it is possible to find out whether any of the used socioeconomic variables correlate with the accessibility of neighborhoods.

4. Results

4.1. Gentrification pressured neighborhoods

Based on the definition of gentrification presented in the previous section (Figure 2) the neighborhoods potential for gentrification in 2012 was identified. From all neighborhoods in Helsinki, Espoo and Vantaa *(n=297)* around 20 % *(n=61)* were deemed potential for gentrification, and around 60 % *(n=176)* were deemed not eligible for gentrification. The remaining 20 % of neighborhoods *(n=59)* were excluded from the analysis due to one or more missing values in used socioeconomic variables. The excluded neighborhoods are areas that have very little or no population due to industry, nature areas such as forests and parks or bodies of water which to an extent makes them irrelevant when analyzing gentrification in existing neighborhoods. It is also noteworthy that newly built neighborhoods such as Sompasaari and Länsi-Pasila in Helsinki are also excluded since they were not in residential use the same way they were in 2022.

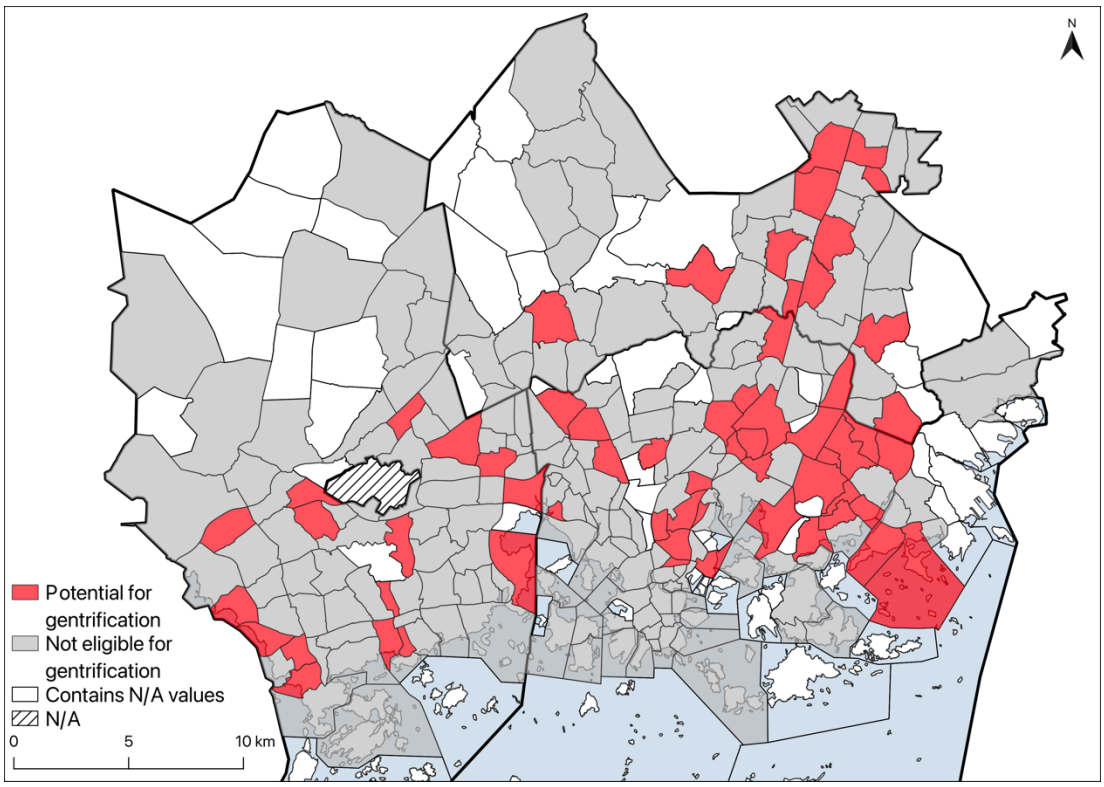

Figure 4. Neighborhoods with potential for gentrification in the Helsinki Metropolitan Area in 2012.

The neighborhoods with potential for gentrification are situated mainly outside of identified center areas yet some of these neighborhoods are partially or fully within the center areas (Figure 5). Around half *(n=29)* of the neighborhoods potential for gentrification overlap with the public transport (metro and railroad) network and around two thirds *(n=41)* when considering neighborhoods within 500 meters of the rail network.

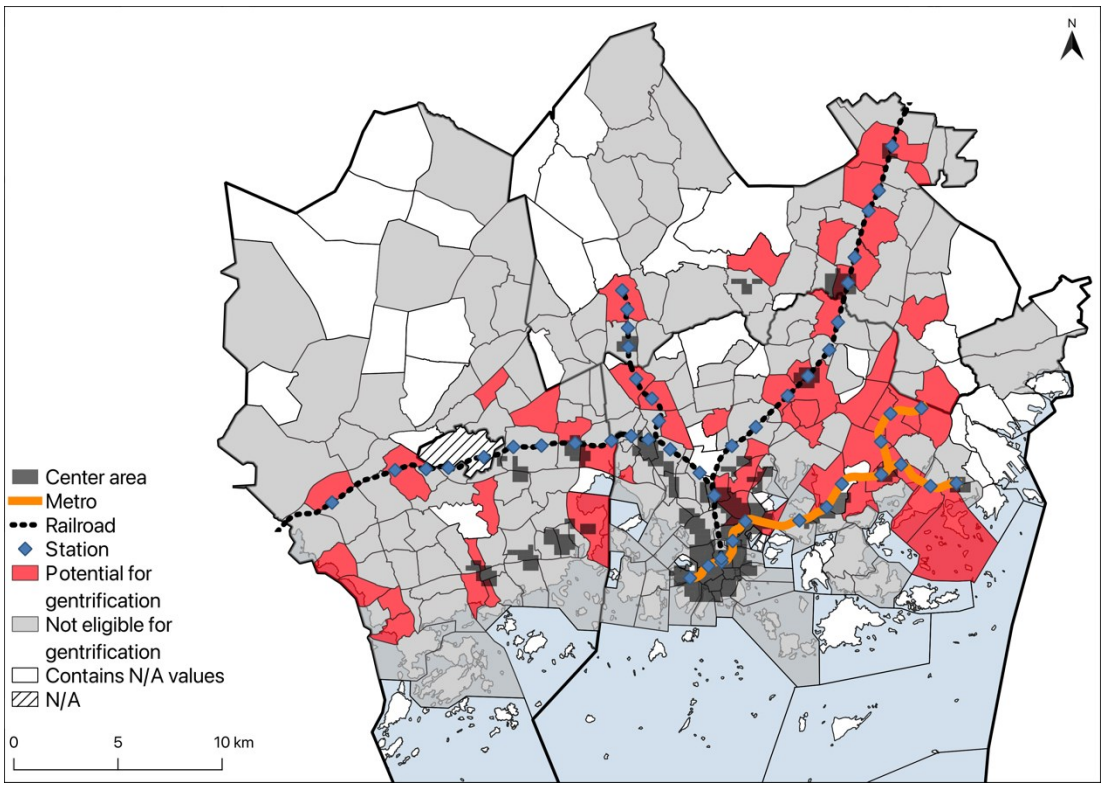

Figure 5. Neighborhoods potential for gentrification in the Helsinki Metropolitan Area in 2012 with center areas, metro line and railroad presented as in 2012.

4.2. Gentrification between 2012–2022

After the successful identification of gentrification-pressured neighborhoods, it is possible to identify the neighborhoods that have undergone gentrification according to the classification (Figure 2) i.e. have gentrified and neighborhoods that have ongoing gentrification. Rest of the areas that were classified as potential for gentrification are classified as non-gentrifying according to the classification criteria.

In total only five (n=5) neighborhoods from the neighborhood's potential for

gentrification were identified and only one (n=1) neighborhood was classified as ‘gentrified’. In the remaining four (n=4) neighborhoods gentrification is ongoing. That is only 8 % of the neighborhoods that were identified as potential for gentrification. The only gentrified neighborhood is Kalasatama, Helsinki. Neighborhoods that have ongoing gentrification are: Vallila, Helsinki; Toukola, Helsinki; Länsi-Herttoniemi, Helsinki and Kuitinmäki, Espoo. No gentrified neighborhoods or neighborhoods with ongoing gentrification were identified from Vantaa. The rest of the neighborhoods potential for gentrification (n=56) were deemed non-gentrifying, representing that the area did not gentrify during the study period.

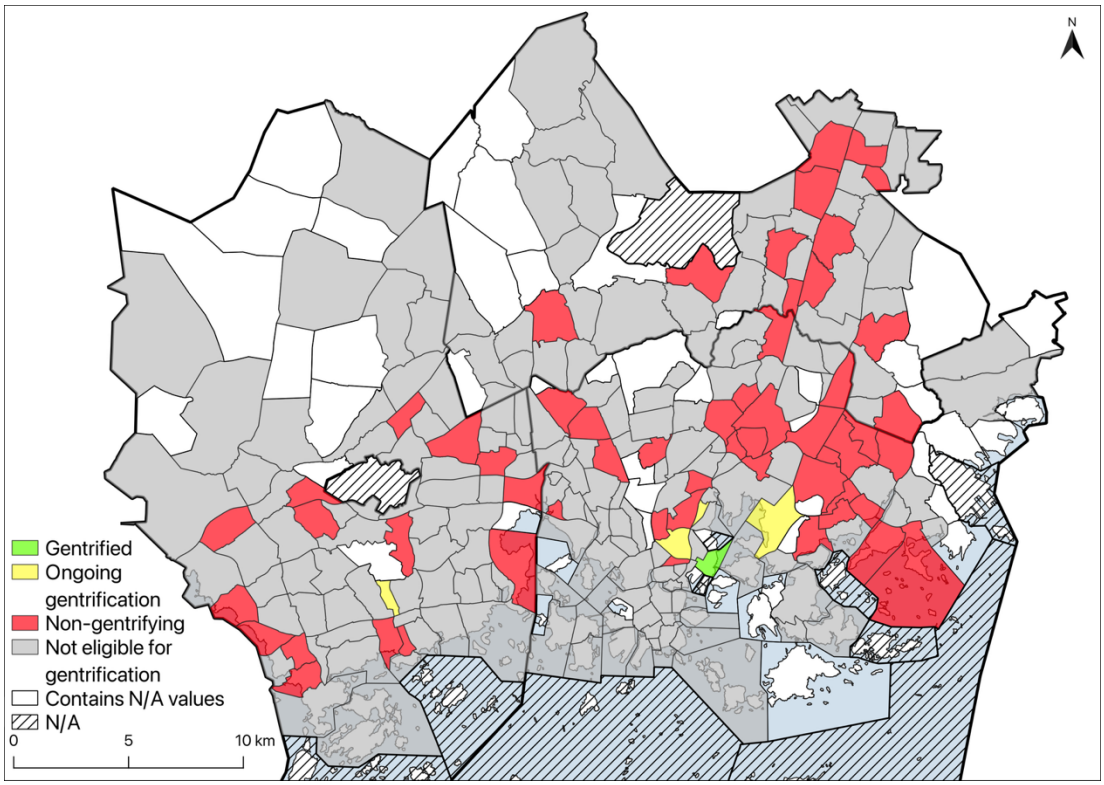

Figure 6. Gentrified (green), ongoing gentrification (yellow) and non-gentrifying (red) neighborhoods between 2012 and 2022.

Out of gentrified neighborhoods, Kalasatama was the only one that fulfilled the condition to be classed as gentrified i.e. the median income of households and the share of highly educated residents rose above the citywide values and the share of low-income households dropped below the citywide average. In the other four neighborhoods, only one of the three criteria was met, which was in all cases the

condition where the share of highly educated residents rose from above the median. There were no other potentially gentrifiable neighborhoods than Kalasatama where the criteria for the change of median income or low-income households were met.

4.3. Travel times to nearest center areas

Travel times by public transport tend to increase as the distance to the center increases, which is generally true in the Helsinki Metropolitan Area. Around 30 % of neighborhoods (n=89) reach the nearest center area by public transport in less than 10 minutes and around 70 % (n=207) in less than 20 minutes in 2013.

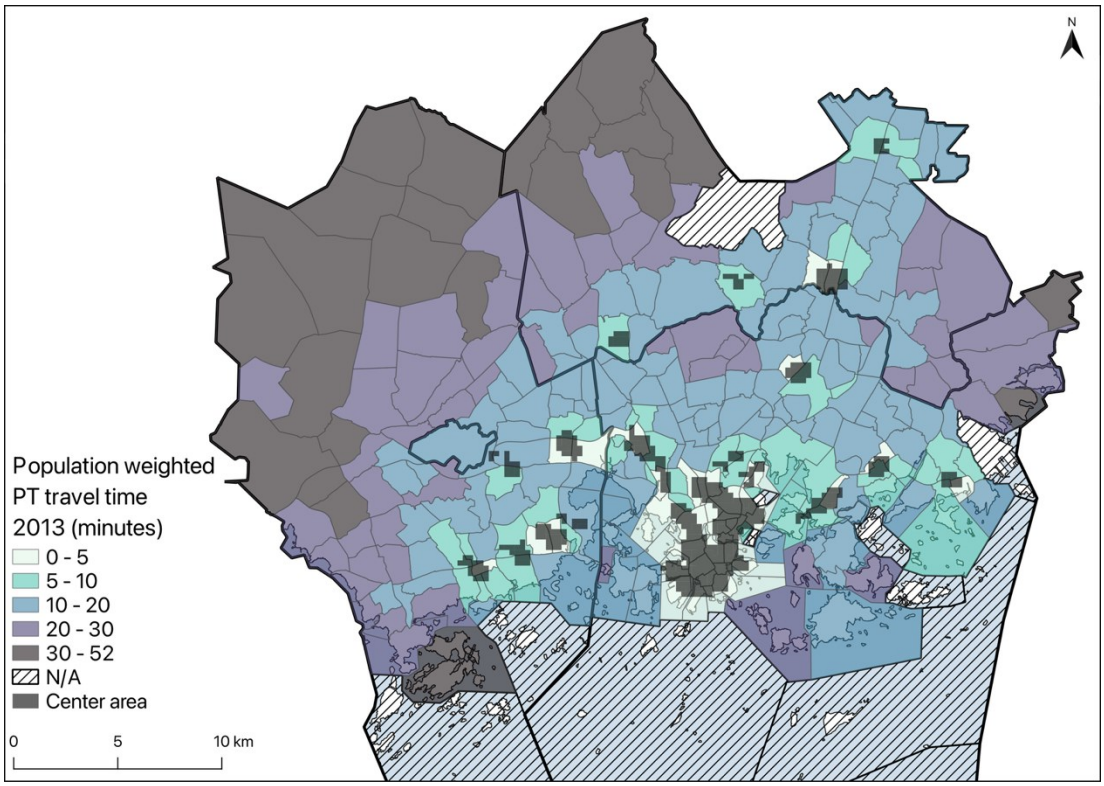

Figure 7. Population weighted travel times to the nearest center in 2013.

Population-weighted public transport travel times to the nearest center reveal that around three-fourths (n=221) of all neighborhoods have rather insignificant changes in travel times (± 2 minutes) when analyzing the change between 2013 and 2023. The areas where the change is considered insignificant appear relatively close to the established center areas. Apart from a few exceptions, the areas with a more significant change in travel times appear further away from the established center

areas where some areas have seen a reduction greater than 2 minutes in travel times (n= 17) and some have seen reductions in travel times of more than 2 minutes (n=49). The areas with significant decreases in travel times appear closer to new public transport developments such as the western metro expansion and the ring rail line.

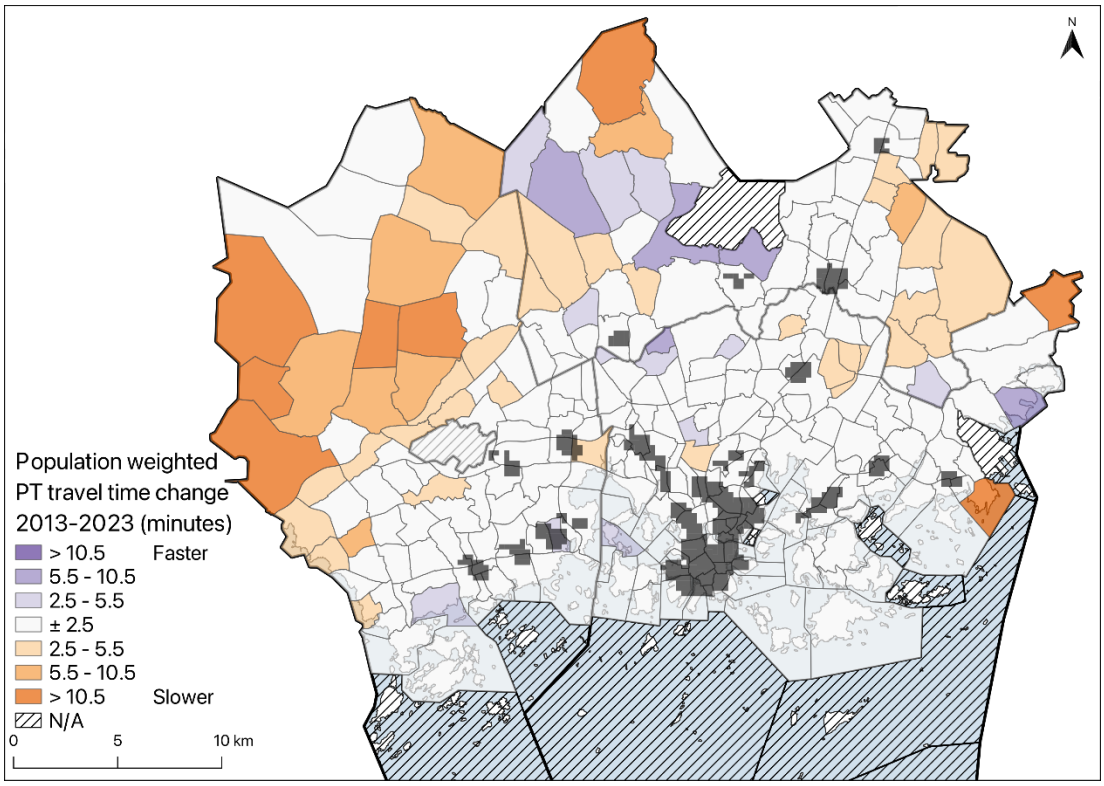

Figure 8. The change in population-weighted public transport travel time to the nearest centers between 2013 and 2023.

4.4. Covariation of socioeconomic variables and travel time

4.4.1. Gentrified neighborhoods and neighborhoods with ongoing gentrification

There were in total 5 neighborhoods that were either partially (ongoing gentrification) or completely gentrified. In all five neighborhoods, the socioeconomic metrics remained at similar levels or saw an increase even though Kalasatama was the only neighborhood where the change was enough to count for gentrification in all the variables (Table *3*). All five neighborhoods saw a great increase especially in the share of highly educated residents compared to the regional averages.

Population-weighted travel time to the nearest center area in three of the

neighborhoods (Kalasatama, Vallila, Toukola) in 2013 was 0 minutes, which means that at least half the population of that neighborhood is living within the identified center area. The travel time change compared to 2023 was also 0 minutes in the same neighborhoods. In Länsi-Herttoniemi the median weighted travel time to the nearest center in 2013 was 9 minutes and increased by two minutes to 11 minutes in 2023. In Kuitinmäki, the median weighted travel time in 2013 was 8 minutes and remained the same in 2023.

In 80 % (n=4) of the gentrified neighborhoods, the travel time change was 0 minutes during study period, and in 60 % (n=3) the travel time was and remained at 0 minutes during the study period. Only in 20 % (n=1) the travel time increased if the area was classified as gentrified or partially gentrified. There were no gentrified or partially gentrified neighborhoods that saw a decrease in public transport travel times to the nearest center.

Table 3. Change in socioeconomic variables in gentrified neighborhoods and neighborhoods with ongoing gentrification in 2012 and 2022.

		Median household income	Share of highly educated residents	Share of low-income households
2012	Kalasatama	34 159 €	29,7 %	32,9 %
	Vallila	35 785 €	35,3 %	22,1 %
	Toukola	38 777 €	35,5 %	15,2 %
	Länsi-Herttoniemi	35 899 €	31,3 %	18,4 %
	Kuitinmäki	48 267 €	41,4 %	13,8 %
2022	Kalasatama	57 675 € (+ 23 516 €)	52,3 % (+ 22,6)	10,8 % (- 22,1)
	Vallila	40 770€ (+ 4 985 €)	50,6 % (+ 15,3)	19,9 % (- 2,2)
	Toukola	39 938 € (+ 1 161 €)	48,0 % (+ 12,5)	15,4 % (+ 0,2)
	Länsi-Herttoniemi	38 317 € (+ 2 418 €)	46,2 % (+ 14,9)	18,1 % (- 0,3)
	Kuitinmäki	48 250 € (- 17 €)	48,9 % (+ 7,5)	12,9 % (- 0,9)

4.4.2. All neighborhoods

When analyzing the bivariate relations for all neighborhoods in the study area for 2012, 2022 and the change between 2012–2022 in socioeconomic variables we can see that the results are parallel with each other (Table 4). There is a very strong negative correlation between median household income and the share of low-income households, a fairly strong positive correlation between income and highly educated residents and a moderate negative correlation between low-income households and

highly educated residents. The similarities in results continue further when analyzing the relations of change that have happened in the socioeconomic variables during the study period. As the median income increases, so do the proportion of highly educated residents whereas the median income and the share of highly educated residents both decrease when the share of low-income residents increases.

After adding the travel times to the center areas into the mix, results start to show some variations. In 2012/2013 there is a moderate positive correlation between median income and travel times, which means that the median income increases when moving further (in time) from the centers. A similar moderate negative correlation is present between travel time and the share of low-income households, which means that centers are more accessible for people living in neighborhoods with a larger share of low-income households. The correlation between highly educated residents and travel time is very weak and negative meaning that neighborhoods with better accessibility have a slightly larger share of highly educated population compared to less accessible neighborhoods.

Change in travel time to the nearest center area correlates very weakly with all the socioeconomic variables used. There is a very weak positive correlation between the change in median income and travel time and a very weak negative correlation between the change in highly educated residents and travel time. There is no correlation between the change in the share of low-income households and the change in travel time. The results mean that the median income increased slightly in areas that saw a decrease in center accessibility whereas the share of highly educated residents increased in areas that saw improvement in center accessibility.

Table 4. Spearman´s correlation coefficients for all neighborhoods.

	2012 / 2013				2022 / 2023				Change (2012-2022/ 2013-2023)			
	Median household income (log)	Share of highly educated residents	Share of low-income households	PT travel time to nearest center	Median household income (log)	Share of highly educated residents	Share of low-income households	PT travel time to nearest center	Median household income (log)	Share of highly educated residents	Share of low-income households	PT travel time to nearest center
Median household income (log)	1.0000				1.0000				1.0000			
Share of highly educated residents	0.6544	1.0000			0.5907	1.0000			0.5887	1.0000		
Share of low-income households	-0.8893	-0.4847	1.0000		-0.8268	-0.4594	1.0000		-0.7075	-0.5159	1.0000	
PT travel time to nearest center	0.4364	-0.0681	-0.4635	1.0000	0.3978	-0.1905	-0.4349	1.0000	0.0445	-0.1036	0.0004	1.0000

5. Discussion

This study set out to systematically analyze recent gentrification and socioeconomic change of neighborhoods and their relation to the accessibility of services and center areas in the Helsinki Metropolitan Area. Despite limitations and the lack of standardized methodology for measuring gentrification in this geographical context, the study successfully identified gentrification in the study area. Further, the study also identified covariation between socioeconomic variables and accessibility within the study period.

5.1. Gentrification in the Helsinki Metropolitan Area

As the results show, the analysis revealed in total 61 neighborhoods out of the potential 237 neighborhoods were considered potential for gentrification at the beginning of the study period. From these, only one gentrified and four others have ongoing gentrification whereas the rest of the neighborhoods did not meet the criteria for gentrification.

Freeman (2005) defines that for gentrification to occur, the neighborhood needs to be in the central city area. Out of the 61 neighborhoods with potential for gentrification 29 of them are at least partly within the known center areas. However, only a few of these areas in the context of the Helsinki Metropolitan Area would be considered as central city areas i.e. located in the center of Helsinki which is the center of the metropolitan area. Only studying gentrification in Helsinki central would mean that there would only be a few neighborhoods with potential for gentrification in the whole metropolitan area. This is why it was appropriate in the context of the study area to consider the whole metropolitan area since gentrification has spread from inner-city neighborhoods towards the edges, and even to rural areas (Brown-Saracino, 2017).

The analysis revealed five neighborhoods that were considered gentrified or partially gentrified. In previous research Drain (2024) has studied gentrification in six different neighborhoods as a case study during a much longer period, and interestingly Toukola was also one of which was identified as gentrifying in this study. Kallio neighborhood, which is typically thought of when discussing gentrification in the Helsinki region, was not found even as potential for gentrification, which is in line with the critique and findings by Karhula (2015).

Lilius and Hirvonen (2022) analyzed the changes in two housing estate neighborhoods of Myyrmäki and Myllypuro (postal code areas). This study found that Myyrmäki was considered not gentrifiable due to the higher-than-average level of higher-educated residents whereas Myllypuro was considered potentially gentrifiable but did not gentrify during the study period.

Based on the analysis about gentrification in the Helsinki Metropolitan Area and when comparing results with other studies in different geographical contexts it can be said that gentrification in Finland is rather small. This means that the welfare state model built to reduce socioeconomic inequality is working like Drain (2024) also mentions. However, Drain (2024) and Lilius & Hirvonen (2023) also point out that the direction the welfare system and policies are headed can potentially make gentrification more significant phenomena in the context of Finland, yet the extent of the phenomenon would still be far away from contexts like the United States.

Limitations

The data availability for studying gentrification is one of the biggest limitations when considering the study at hand. The openly available data limits the research to the neighborhood *(osa-alue)* level. The size of the areas is considerably larger when compared to for example the Census Tracts in the United States which are typically used there. Since the neighborhoods are relatively large, it generalizes the area quite a bit, which can cover more subtle changes happening only in one part of the neighborhood. In Finland, there is very detailed data available in the 250-meter YKR grid or even as microdata that was utilized by Meriläinen et al. (2024). However, this data is costly and can be difficult to acquire but could lead to more accurate results when studying gentrification.

One of the greater limitations of this chosen spatial resolution was that there is currently no data available for the rent or housing prices, which would have provided key details about the changing of neighborhoods and potentially could have helped to identify rent gaps. Some statistics related to housing are available by postal code areas, but the areas are larger compared to the used neighborhood level and they combine multiple different types of neighborhoods in some cases which would have resulted in more inaccuracies with the analysis. The postal code level data, however, could be utilized in smaller cities or by accepting the inaccuracies associated with it.

Yet the most important choice that affects the results of the analysis is how one defines gentrification. There have been numerous different approaches for measuring it but not one comprehensive methodology that could be applied in every possible scenario. To quote Loretta Lees (1998, p. 2258) "… different methodological frameworks result in different outcomes of gentrification." which to this day holds. For example, Preis et al. (2021) have found that using different methodologies can result in very different results.

5.2. Changing accessibility of services

Travel times to known central areas remained quite similar near center areas whereas there were more changes further away from these areas. In most of the neighborhoods, the difference in travel time can be considered insignificant. Many of the areas around the edges of the study area are less densely populated when compared to the neighborhoods closer to the centers.

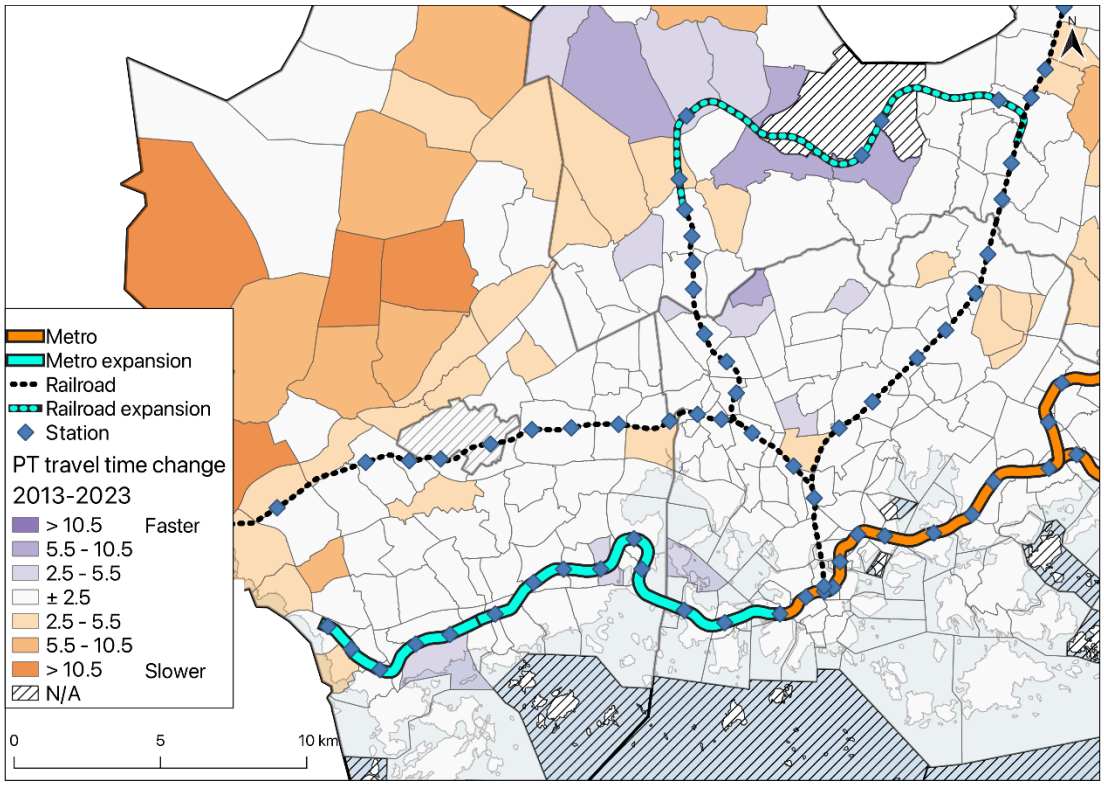

Figure 9. Public transport network expansions opened between 2012 and 2023 and changed travel times to the nearest center areas.

Figure 9 shows that public transport travel times changed significantly in some neighborhoods that are along the rail network expansion. Most of the neighborhoods in Vantaa in proximity of railroad expansion saw increased accessibility to central areas and therefore to services. Only a few areas along the metro expansion saw an increase in service accessibility. Some areas saw a significant decrease in service accessibility along both expansions.

Limitations

There were many challenges and compromises to get the data from 2013 and 2023 to a comparable form. The two quite different methodologies used to calculate the travel times presented a challenge to make them comparable with each other. After analyzing the 2018 data calculated with both methodologies the old methodology overestimates travel times in areas that are furthest away from the center areas i.e. the edges of the study area. When making the 2013 data comparable with 2023, it is assumed that the relationship between methodologies has remained the same as in 2018, which must be noted when critically analyzing the results of the analysis.

The 2013 data was only available for midday travel times, which means that it does not represent the 'peak capacity' of the public transport network. Due to this limitation the comparison was made in midday travel times. There are also other differences in the methodologies like the different walking speeds that make the comparison more difficult. For better and more accurate results the analysis should be made utilizing data calculated with the same methodology and in a time of day that represents the peak capacity of the public transport network.

The number of services in any given location changes over time. In this study, only the center area data representing 2022 was used, which leaves uncertainty in the analysis. This study assumes that the services and center areas have remained similar during the study period, which might not have been the case since services are constantly concentrated on bigger centers which could lead to certain center areas being classified differently between years. The analysis also assumes that the people living in the Helsinki Metropolitan Area only utilize the services within the metropolitan area which can be untrue, especially in areas closer to the edges of the study area.

5.3. The relation of socioeconomic composition and accessibility

The results of this study indicate that there is only a slight correlation between the change in socioeconomic variables and travel time changes. This result is consistent with the recent study of Meriläinen et al. (2024) from the same study area.

Part of the Kuitinmäki area was studied by Meriläinen et al. (2024) as part of their study area. In their study, Meriläinen and others conclude that the share of highly educated residents increased near new public transport stations compared to the treatment areas. The result is also true in this study where there was a 7,5 pp increase in the share of highly educated residents in the Kuitinmäki region whereas the median household income and share of low-income residents remained similar during the study period. Yet, Kuitinmäki was the only one experiencing gentrification and other neighborhoods didn't see such drastic changes.

The results mean that at least only the change in travel time does not automatically indicate a significant change in the socioeconomic composition of any given neighborhood in a relatively short 10-year period. The new public transport improvements didn't affect travel times significantly close to the new stations and there is no gentrification happening in nearby neighborhoods apart from Kuitinmäki. This result is in line with the findings of Qi (2024) that find that new rail can influence transit-induced gentrification, but it can take longer to happen. Kahn (2007) found out that there are connections between gentrification and new 'walk and ride' stations. Since the new rail expansions are still relatively new, gentrification could potentially be analyzed in the future. The analysis shows that multiple neighborhoods near the new rail network extensions were identified as potentially gentrifiable but did not gentrify (Figure 10).

Based on the results and previous studies, special interest should be given to neighborhoods that have seen considerable increases in center accessibility to catch potential gentrification and mitigate the negative aspects of the phenomenon. Yet, it is noteworthy that in the five neighborhoods that were at least partially gentrified did not see significant changes in center accessibility, which means that improved service accessibility did not result in gentrification.

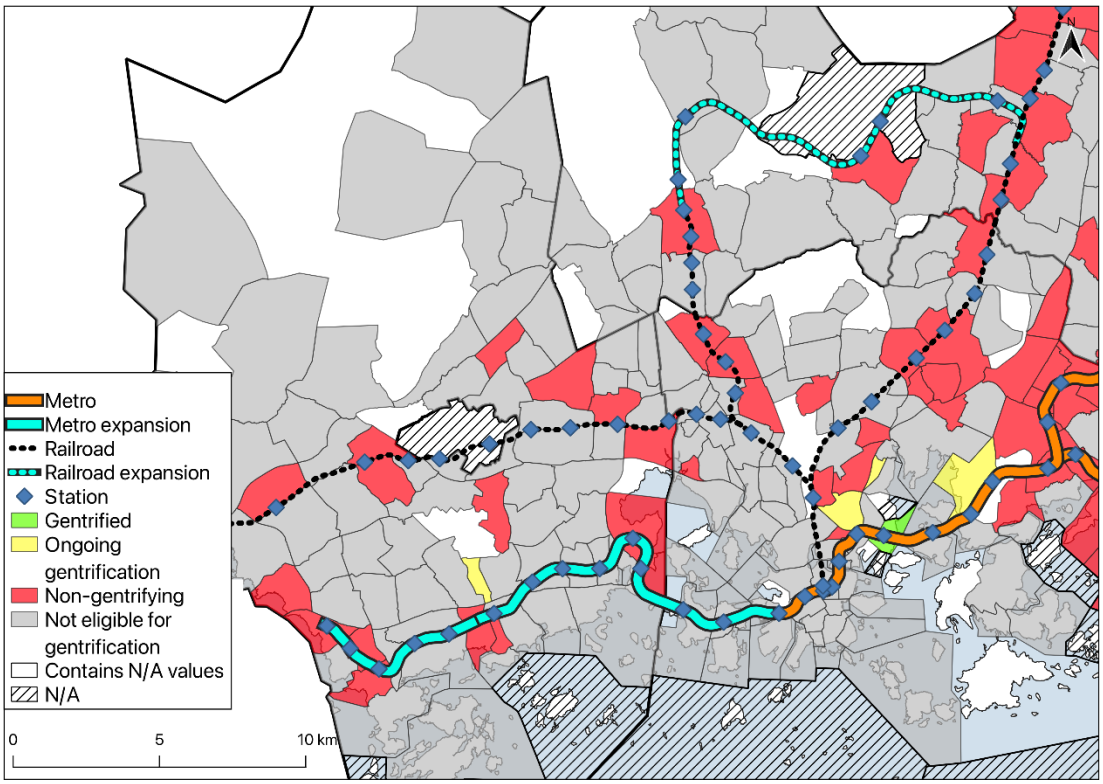

Figure 10. Public transport network expansions opened between 2012 and 2023 and gentrification analysis results.

Limitations

Even though there is a correlation between the socioeconomic variables and travel times to nearest centers, it is only covariation of different variables and does not tell anything about the causation. Since the Spearman correlation coefficients between socioeconomic variables and travel times are relatively low, it indicates that there are other third variables i.e. confounders that could impact the results. Meriläinen et al. (2024) have taken into account many confounders such as the type of housing units, population density and other population metrics in their regression analysis.

5.4. Future research directions

In this study, I utilized quite a traditional framework for measuring gentrification using registry data and only at the end combined it with travel time data. The original idea for this study was to study the relationship between the mentioned registry data and mobile phone big data that would reveal the daily mobility patterns of residents

of each neighborhood and try to figure out if there are patterns that could predict gentrification in the area. The plan was however scrapped due to data availability from the beginning of the study period, but the idea could be executed further down the line when more data becomes available. The relationship between gentrification and mobility people has been studied before utilizing social media data (Poorthuis et al., 2022) and for example taxi trip records (Gardiner & Dong, 2021).

As mentioned back in Chapter 2, new big data approaches can provide a new set of tools that can be used for analyzing gentrification in combination with already available census data. When combining big data with conventional data sets it can be possible to gain more profound knowledge about the processes driving gentrification and socioeconomic change and help better understand the relationship of different aspects. With enough data and the advancement in artificial intelligence, it may be possible to in some extent predict gentrification in the future. If predicting reliably gentrification becomes a reality it would mean that policies mitigating the adverse effects associated with gentrification could be directed to at-risk neighborhoods promptly. Mobile phone big data could also potentially be used to study displacement related to accessibility changes which cannot be studied utilizing only the national registry data.

Future studies in the Helsinki Metropolitan Area could dive deeper into socioeconomic changes that happened in other neighborhoods that did not gentrify that were not analyzed in this study as it focused mainly on areas that did gentrify and on the whole study area in general. Even the same data made for this study could be analyzed further. It would also be interesting to recreate this study in five or ten years to compare the results and analyze the impact of new public transport expansions further down the line since it appears that the 10-year study period might be too short to see gentrification in the context of Finland.

6. Conclusion

In conclusion, this study found that there were over 60 neighborhoods that had the potential for gentrification, from which five faced gentrification during the study period. Nevertheless, the study recognizes that there is potential for gentrification in the Helsinki Metropolitan Area. This study argues that gentrification is a phenomenon that should be studied more in Finland, especially in the larger cities.

This study further argues that new methods regarding the accessibility of services and daily mobilities of people can provide meaningful additions to studying gentrification and the socioeconomic change of neighborhoods. The findings indicate that there is some covariation between socioeconomic shift and service accessibility even though the gentrified neighborhoods did not see significant changes in service accessibility. This study provides only one possible approach for measuring gentrification and combining it with accessibility research, but further research is needed to determine the most suitable method for studying gentrification with service accessibility.

The advancements in technology, especially regarding big data applications, can and most likely will provide more ways to integrate previously unavailable data with traditional variables used for measuring gentrification. A diverse set of variables and data could be utilized to find links between variables, that could then, in theory, be used as indicators to potentially predict gentrification. Predicting gentrification will probably never be viable in this ever-changing world, but even a little hint of the phenomenon could be used to make timely changes in policies to tackle gentrification. These new tools could also be used to study gentrification related displacement, which is difficult to study with traditional data sets.

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