Università degli studi di Milano-Bicocca

Data Science Lab for Smart Cities

Final Essay

Gentrification and Criminality

Does borough gentrification result in an increase or decrease in crime? London as an example.

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Abstract

Gentrification is the transformation of a city neighborhood from low value to high value. It is also viewed as a process of urban development in which a neighborhood or portion of a city develops rapidly in a short period of time, often as a result of urban-renewal programs. This process is often marked by inflated home prices and displacement of a neighborhood's previous residents.

This study's specific goal is to confirm the connection between gentrification and **crime**, attempting to provide an answer to the following question using a quantitative analysis: "*Does borough gentrification result in an increase or decrease in crime?*". To apply strategies to improve safety, it is crucial to research the numerous factors that might or might not influence crime. In fact, security is a fundamental need that all cultures share.

It was decided to carry out this analysis using data relating to **London**, as this city is already one of the most advanced smart cities among European cities and also gives free access to the public by putting its data in open source mode. Furthermore, the research of this phenomenon, as we know it, originated in this city.

Introduction

There has been discussion for some time about how the cities of the future will become smarter and also about "Smart Cities". The diffusion of technological tools, sensors and infrastructures that connect things to people and improve services and operations in a variety of sectors, is how smart cities are put into practice. An intelligent city is one in which people can live better, the environment is protected, mobility is efficient and sustainable, new economic and governance models are tested, people are given priority and actively involved in all activities. Consequently, technological progress is a key tool to achieve these results, rather than the ultimate goal of a smart city.

A city that develops into a smart city greatly increases the living standards of its citizens, making it more attractive for people to move to this city. This could stimulate an influx of wealthy residents, who also move to the poorest neighborhoods of the city, as these neighborhoods also experience a sharp increase in the quality of life. These wealthy new residents and the investors who follow this trend issue money to further improve the quality of their neighborhood, leading to an increase in the cost of living and driving out the poorer former residents. This process of affluent residents moving into a neighborhood, investing money in renovating it, increasing the quality of life and cost of living, and driving out poorer former residents, is called **gentrification**. Therefore, it is possible to think that there might be a link between gentrification and the development of cities that become smart.

Gentrification is the process of altering the character of a neighborhood through the entry of more affluent residents and establishments. In the fields of urban planning and politics, it is a frequent and controversial topic. While gentrification often increases the economic value of a neighborhood, the subsequent demographic shift can pose serious social problems in and of itself. A neighborhood's racial or ethnic makeup and median household income, for example, change frequently due to gentrification as housing and businesses become more expensive and previously inaccessible resources are expanded and improved.
Therefore, the phenomenon of gentrification is complex and has implications for both the social, economic and demographic landscape. Given this complexity, it was decided in this report to focus on the specific relationship with **crime**.

1 Gentrification

Gentrification is derived from the word "*gentry*," which historically referred to people of an elevated social status. In the United Kingdom, the term "*landed gentry*" originally described landowners who could live off of the rental income from their properties. British sociologist **Ruth Glass** was first to use the word "gentrification" in its current sense [1]. She used it in 1964 to describe the influx of middle-class people displacing lower-class worker residents in urban neighborhoods. Once this process of gentrification starts in a district it goes on rapidly, until all or most of the original working-class occupiers are displaced and the whole social character of the district is changed. In her sociologist's work, we find the following: *≪In such circumstances, any district in or near London, however dingy or unfashionable before, is likely to become expensive; and London may quite soon be a city which illustrates the principle of the survival of the fittest – the financial fittest, who can still afford to work and live there.≫*.

After living in London for more than 30 years, Glass began to notice the transformations that were taking place across the city, reflecting both the ambitious social changes that shaped the urban centers of post-war Britain and the emerging transition of the nation towards a post-industrial economy. Glass has observed a certain "*glimmer of affluence*" [1] which has begun to emerge in London neighborhoods and which he has sought to investigate more thoroughly. Glass noted the introduction of nobility, both upper and lower middle class, into traditionally working-class neighborhoods and their role in rebuilding areas in their image (stimulating the gentry process). For example, they bought large dilapidated Victorian houses that had been subdivided into apartments in previous decades and remodeled them once again into stately single-family homes. The shops and restaurants that populated the main streets of central and suburban London (now known as *Inner* and *Outer London* boroughs) had also begun a process of change. These neighborhood-level changes have put undue pressure on working-class families, forcing them to stay in the area under increasingly overcrowded conditions among their established kinship networks, or to move further outward into unfamiliar territory on the outskirts of the cities, where they were more isolated from their communities and extended families. More pertinently, Glass saw the invasive nature of these transformations that once they took over a neighborhood, the process would spread rapidly through other neighbors. These observations are the most noteworthy of his 1964 work.

So gentrification is the transformation of a city neighborhood from low value to high value. Gentrification is also viewed as a process of urban development in which a neighborhood or portion of a city develops rapidly in a short period of time, often as a result of urban-renewal programs. This process is often marked by inflated home prices and displacement of a neighborhood's previous residents.

Numerous cities around the world experience the phenomenon of gentrification, which can have a direct impact on housing market dynamics. In most major cities, some neighborhoods that were previously less than desirable have morphed into vibrant districts with plush condominiums and offices, new coffee shops and restaurants, expensive retail storefronts, and various entertainment choices.

Gentrification is a complex social issue with both benefits and drawbacks. Young families welcome the opportunity to buy reasonably priced homes in a safe community with sound infrastructure, and a wide choice of amenities and services. Local municipalities and governments also benefit from collecting higher taxes on rising property values and increased economic activity. However, the neighborhoods'

original inhabitants are often displaced from the very community, that they helped build, because of rising rents and a higher cost of living.

Historically, gentrification has become controversial because it has come with a significant component of discrimination against racial minorities, women and children, the poor, and older adults. Even as it may bring about a reversal in the decline of a city, displacement caused by gentrification can force prior residents into poorer and relatively unsafe areas, with limited access to affordable housing, healthy food choices, and social networks.

There are several approaches that attempt to explain the roots and the reasons behind the spread of the gentrification phenomen. **Palen & London** [2] compiled a list of five explanations:

1. demographic-ecological,
2. sociocultural,
3. political-economical,
4. community networks, and
5. social movements.

Furthermore, an oft-cited study of the Brookings Institution Center on Urban and Metropolitan Policy [3] highlights some of the factors that contribute to gentrification.

- Rapid job growth in both a city's downtown core and along its periphery can foster gentrification.
- Tight housing market dynamics play a critical role in causing gentrification and can vary from one location to the next.
- Preference for city amenities can play an important factor because certain demographic groups have traditionally preferred to live in urban neighborhoods because of attractions like cultural venues, a plethora of appealing restaurants and shops, vibrant street life, and population diversity. The presence of such features can help city planners to identify which neighborhoods would tend to gentrify.
- Increased traffic congestion can contribute because as metropolitan populations rise and infrastructure ages, the resultant increase in traffic congestion and commute times, along with the consequent decline in quality of life, can contribute to gentrification.
- Targeted public-sector policies play a role because many cities pursue revitalization policies—including tax incentives, public-housing plans, and local economic development tools—that offer incentives for middle- and high-income families to move into distressed communities, or for original residents to upgrade their homes.

However, focusing on the effects of this phenomenon is far more crucial. Gentrification is a complex process with a wide range of implications. There are a variety of opinions about this event in the literature, but in general it is thought to have both positive and detrimental effects on society in terms of economy, society and demographics changing of a city or an area.

Given the complexity, in this report it was decided to focus on the single relationship between gentrification and crime.

1.1 Gentrification and Criminality

Since gentrification is an urgent phenomenon, a large amount of literature has been devoted to it and, more specifically, to its relationship to crime. **McDonald** [4] provides somewhat of a literature review, albeit dated, of competing theories regarding the effects of gentrification. McDonald's defines gentrification as "*the apparent revitalization of private real estate markets in core cities*". An important distinction that must be made in such a definition is the existence of a population shift. However, it is necessary to specify that the simple improvement of the housing offer by long-term residents does not qualify as a gentrification phenomenon. There must be a movement of middle and upper class people in what used to be a mostly lower class neighborhood.

McDonald outlines some potential reasons why crime rates are decreasing due to gentrification and other potential reasons why they could be increasing. The reasons why they may fall are as follows:

1. affluent neighborhoods have, on average, less crime than poor neighborhoods;
2. revitalization at the hands of new residents can "pull in" instead of "expel" former residents;
3. new residents are more aware of the crime problem and establish initiatives to fight it, e.g. neighborhood watch;
4. affluent residents usually have greater political influence leading to more funding going to the police department, tougher stances on crime, etc.;
5. the displacement of poor residents can lead to the displacement of those responsible for committing the crimes.

Reason five is what gets at the heart of gentrification and is directly related to, if not the cause of, reason one. Reasons two, three, and four are periphery causes of the drop in crime, at least in the context of a model of gentrification.

On the other hand, McDonald also gives several reasons why gentrification might not lead to a decrease in crime:

- when individuals are displaced, they may only be displaced to adjacent blocks or neighborhoods which hardly prevents them from committing crime in their old neighborhood, especially with an influx of attractive targets;
- if gentrification is drawn out over a long period of time, there will be a very apparent income-gap between residents which suggests an increase in violent crime;
- gentrification in "cohesive ethnic neighborhoods" rather than "disorganized ghetto neighborhoods" may lead to the breakdown of natural order in the communities;
- gentrification can cause community conflicts which, on some occasions, results in criminal activity.

Most of these theorized effects occur at the onset of gentrification.

This study's specific goal is to confirm the connection between gentrification and crime, attempting to provide an answer to the following question using a quantitative analysis: "*Does borough gentrification*

result in an increase or decrease in crime?". This research question results from the established link between a neighborhood's crime rate and it. In fact, according to several studies, secure societies have particular social dynamics. The following are factors that are common among communities with the lowest rates of communal violence:

- economic stability, with low rates of unemployment, high standard of living, and poverty, as well as a narrow gap between the rich and the poor;
- neighborhood ties, such as high rates of house ownership, mixed-income areas, high levels of neighborly trust, and low vacancy rates;
- high voting rates, community influence over local laws and regulations, and a wealth of options for youth engagement outside of school are all examples of strong community engagement;
- high educational standards, low rates of suspension and absence;
- high rates of health insurance coverage and good health care;
- a good physical environment, including well-kept and lively public areas and a fair amount of vegetation.

Thus, it is clear that distinct risks of intercommunal violence result from diverse aspects of community design and the safest neighborhoods are those where everyone has access to what they require.

To apply strategies to improve safety, it is crucial to research the numerous factors that might or might not influence crime. In fact, security is a fundamental need that all cultures share, and US psychologist **Abraham Maslow** (best known for his theory on the hierarchy of needs [5]) views it as a crucial component of life's quality, as shown in **Figure 1**.

Figure 1: In 1954 the psychologist Abraham Maslow proposed a motivational model of human development based on a hierarchy of needs, arranged in a pyramid, according to which the satisfaction of the most basic needs is a necessary condition for those of a higher order to emerge. Basic needs, once satisfied, tend not to recur, while social and relational needs are reborn with new and more ambitious goals to achieve. At the base of the pyramid are the essential needs for survival, while going up to the top one encounters the more immaterial needs.

It was decided to run this analysis using London data, because of the fact that this city is already one of the most advanced smart cities and makes its data available to the public in an open source manner. Furthermore, the research of this phenomenon, as we know it, originated in this city.

2 London - United Kingdom

The largest city in England and the capital of the United Kingdom is **London**, which has a population of 8,799,800. Its huge territory places it behind Moscow and Istanbul as the third-largest city in Europe.

One of the most cosmopolitan and ethnically diverse cities in the world, London is home to many foreign-born or international residents, known as Londoners.

The London boroughs The administrative divisions of the area into which the British metropolis is divided are known as London's boroughs. They each have their own mayor and council. The Greater London County, which contains the 32 boroughs in their entirety, and the City of London County, which is not formally a borough because it is controlled by sui generis laws, make up the metropolitan region of London. Three of the 32 London boroughs — the Royal Borough of Kensington and Chelsea, the Royal Borough of Kingston upon Thames, and the Royal Borough of Greenwich — have the honorific designation of "royal borough", whereas Westminster is known as a city. Here is a list of every borough in London:

1. Barking and Dagenham;
2. Barnet;
3. Bexley;
4. Brent;
5. Bromley;
6. Camden;
7. Croydon;
8. Ealing;
9. Enfield;
10. Greenwich;
11. Hackney;
12. Hammersmith and Fulham;
13. Haringey;
14. Harrow;
15. Havering;
16. Hillingdon;
17. Hounslow;
18. Islington;

19. Kensington and Chelsea;
20. Kingston upon Thames;
21. Lambeth;
22. Lewisham;
23. Merton;
24. Newham;
25. Redbridge;
26. Richmond upon Thames;
27. Southwark;
28. Sutton;
29. Tower Hamlets;
30. Waltham Forest;
31. Wandsworth;
32. Westminster;
33. City of London, which is not classified as a London borough and is a separate county.

However, the so-called Output Areas (OA), which were initially developed following the 2,001 census, are the lowest level of geographic area for census results. Lower layer Super Output Areas (LSOAs), a geographical hierarchy made up of groups of OAs, typically four or five, are intended to improve the reporting of small area statistics in England and Wales. They have a typical resident population of between 1,000 and 3,000 persons and range in size from 400 to 1,200 houses. There are about 4,800 LSOAs in and around the London area.

2.1 London and Gentrification

Over the years, there have been a number of protests in the London boroughs as gentrification has grown.

In 2015, hundreds of protesters attacked a cereal cafe in east London, daubing the word “scum”

on the shop window (**Figure 2**) and setting fire to an effigy of a police officer. Riot police were called in to defend the Cereal Killer Cafe in Shoreditch after it was targeted by a large crowd of anti-gentrification activists carrying pigs' heads and torches. One protester who was at the demonstration said the Cereal Killer Cafe was targeted as a "symbol of gentrification".

Figure 2: Activists opposed to what they claim is the gentrification of parts of east London, threw paint and daubed the word "scum" on a business selling cereal.

Shoreditch, the place where this protest took place, is a district in the East End of London, close to the city centre. This district was once a run-down inner-city area, with ageing factories and warehouses that had ceased operations, prompting people to leave the vicinity. In their place, many Bangladeshi immigrants moved in, particularly around Brick Lane.
Shoreditch boasts a diverse cultural blend and is almost unrecognisable from three decades ago. The old industrial structures have transformed into residential flats and office spaces. Additionally, pubs and bars have been revamped and repurposed into restaurants and art galleries. The rapid influx of hi-tech companies has earned the area the moniker "Silicon Roundabout". But also in this place, an activist said: "*Many parents suffer the indignity of relying on food banks to feed their children while the new Shoreditch residents can make a successful business selling children's cereal for £5 a bowl*" [6].

In 2018, protesters brought sweeping brushes to City Hall and chanted about the working class being swept out of London because of gentrification - when housing is renovated or replaced, raising property values and displacing people on lower incomes.

These are only a few of the demonstrations that have occurred over time.

3 Dataset and Pre-Processing

Various datasets provided by the authorities or departments of the City of London were used to conduct this analysis. Due to the availability of the data, it was decided to verify the changes relating to the period relating to the years 2013 and 2019.

3.1 Crimes datasets

Firstly, two datasets provided by the UK Police [7] relating to crime in London were used, selecting the time period starting from January 2019 up to December 2019 (about 863,071) and starting from January 2013 up to December 2013 (about 3,380,154).

The 2019 crime dataset contains the following features:

`Crime ID`, `Month`, `Reported by`, `Falls within`, `Longitude`, `Latitude`, `Location`, `LSOA code`, `LSOA name`, `Crime type`, `Last outcome category`, `Context`, `Outcome type`, `Type`, `Date`, `Part of a policing operation`, `Policing operation`, `Gender`, `Age range`, `Self-defined ethnicity`, `Officer-defined ethnicity`, `Legislation`, `Object of search`, `Outcome`, `Outcome linked to object of search`, `Removal of more than just outer clothing`.

While the 2013 crime dataset contains the following features:

`Crime ID`, `Month`, `Reported by`, `Falls within`, `Longitude`, `Latitude`, `Location`, `LSOA code`, `LSOA name`, `Crime type`, `Last outcome category`, `Context`, `Outcome type`.

Since many of the extra features in the 2019 dataset had a very large amount of null data, and in order for data comparisons to be made, it was decided to keep only the most significant features present in both datasets. A brief description is also given below:

- `Reported by`: The force that provided the data about the crime.
- `Falls within`: At present, also the force that provided the data about the crime. This is currently being looked into and is likely to change in the near future.
- `Longitude` and `Latitude`: The anonymised coordinates of the crime.
- `Location`: The type of place of the crime (e.g. near supermarket).
- `LSOA code` and `LSOA name`: References to the Lower Layer Super Output Area that the anonymised point falls into, according to the LSOA boundaries provided by the Office for National Statistics.
- `Crime type`: Type of crime.
- `Last outcome category`: A reference to whichever of the outcomes associated with the crime occurred most recently. For example, this crime's "Last outcome category" would be "Formal action is not in the public interest".
- `Context`: A field provided for forces to provide additional human-readable data about individual crimes. Currently, for newly added CSVs, this is always empty.

Since the analyzes to be carried out in this work are spatial in nature, it was first decided to eliminate the null values relating to the Latitude and Longitude variables. Then the presence of other null values was verified for the remaining variables of both datasets and it was found that the 2019 dataset did not have null values while the one relating to 2013 had few null values for the "Crime type" and "Last outcome category". Therefore these records have been eliminated, in order to obtain two datasets with the same variables and no missing value.

Then the LSOAs relating only to the metropolis of London were selected and a variable was also added for each record of both dates to specify the borough to which they belong (this feature is necessary to make the graphs of the subsequent analyses).

As for the `Crime type` variable, the 2019 dataset has the following values:

- *Anti-social behaviour*: Includes personal, environmental and nuisance anti-social behaviour.

- *Bicycle theft*: Includes the taking without consent or theft of a pedal cycle.
- *Burglary*: Includes offences where a person enters a house or other building with the intention of stealing.
- *Criminal damage and arson*: Includes damage to buildings and vehicles and deliberate damage by fire.
- *Drugs*: Includes offences related to possession, supply and production.
- *Other crime*: Includes forgery, perjury and other miscellaneous crime.
- *Other theft*: Includes theft by an employee, blackmail and making off without payment.
- *Possession of weapons*: Includes possession of a weapon, such as a firearm or knife.
- *Public order*: Includes offences which cause fear, alarm or distress.
- *Robbery*: Includes offences where a person uses force or threat of force to steal.
- *Shoplifting*: Includes theft from shops or stalls.
- *Theft from the person*: Includes crimes that involve theft directly from the victim (including handbag, wallet, cash, mobile phones) but without the use or threat of physical force.
- *Vehicle crime*: Includes theft from or of a vehicle or interference with a vehicle.
- *Violence and sexual offences*: Includes offences against the person such as common assaults, Grievous Bodily Harm and sexual offences.

The 2013 dataset has the same values but additionally contains: "*Public disorder and weapons*" and "*Violent crime*". To ensure that both datasets have the same categories, it was decided to merge "*Public disorder and weapons*" into the more generic category "*Public order*" and instead "*Violent crime*", since the definition is ≪*Violent crime covers a variety of offenses – ranging from common assault to murder. It also encompasses the use of weapons such as firearms, knives and corrosive substances like acid.*≫ [8], it was decided to merge it into the "*Violence and sexual offences*" category.

3.2 Gentrification dataset

Since gentrification is a complex sociocultural phenomenon that includes several factors that occur in the area, there is no dataset that expresses the gentrification of London. Therefore, following the work done by Adam Almeida [9], the gentrification index for LSOA is based on the following formula:

$$G = \frac{1}{2}c - \frac{1}{4}e + \frac{1}{8}h - \frac{1}{8}d + 0.25$$

- G represents the **gentrification index**, making up a scale from 0.0 to 1.0 where the lower limit indicates an area of less gentrification and the upper limit indicates an area of severe gentrification;
- c represents the mean between the Residential Mobility Index in 2019 and 2013, this index provides an estimate of the "churn" of the residential population in the UK [10];

- e represents the proportion of non-white residents, this proportion is calculated by taking the sum of the non-white population (which includes the following categories of the dataset "Mixed White and Asian", "Mixed White and Black African", "Mixed White and Black Caribbean", "Mixed Other", "Asian Bangladeshi", "Asian Chinese", "Asian Indian", "Asian Pakistani", "Asian Other", "Black African", "Black Caribbean", "Black Other", "Other Arab", "Other Any other") over the total number of residents [11]

  $$e = \frac{n_{2019} - n_{2013}}{n_{2013}}$$

  where:

  - e represents the relative change in the proportion of non-white residents on an individual level,
  - n_{2019} represents the proportion of non-white residents in 2019,
  - n_{2013} represents the proportion of non-white residents in 2013.

- h represents the lower quartile house selling price compared to the borough average [12] [13]

  $$h = \frac{\frac{s_{2019}}{b_{2019}} - \frac{s_{2013}}{b_{2013}}}{\frac{s_{2013}}{b_{2013}}}$$

  where:

  - h represents relative change in median house sale price compared with the boroughwide average between December 2009 and December 2016,
  - s_{2019} represents the lower quartile house sale price in an LSOA in December 2016,
  - s_{2013} represents the lower quartile house sale price in an LSOA in December 2009,
  - b_{2019} represents the average of all median house sale prices in each LSOA across the borough in December 2016,
  - b_{2013} represents the average of all median house sale prices in each LSOA across the borough in December 2009.

- d represents relative change in multiple deprivation index score (IMD) that contains seven different domains of deprivation: income deprivation; employment deprivation; health deprivation and disability; education training and skills deprivation; barriers to housing and services; crime; and living environment deprivation [14] [15]

  $$d = \frac{i_{2019} - i_{2015}}{i_{2015}}$$

  where:

  - d represents the relative change in the IMD between 2019 and 2015,
  - i_{2019} represents the IMD score in an LSOA in 2019,
  - i_{2015} represents the IMD score in an LSOA in 2015.

  In this case the years considered are 2019 and 2015 as the multiple deprivation index is calculated every 4 or 5 years.

- finally a $b - value$ of 0.25 is added to standardize the gentrification score between 0.0 and 1.0.

The gentrification scores were categorized within the ranges shown in the following table:

Level	Gentrification score	Number of LSOAs
Minor	0.1 - 0.3	3259
Low	0.3 - 0.4	102
Moderate	0.4 - 0.5	10
High	0.5 - 0.6	3
Severe	0.6 - 0.8	2

3.3 Geospatial information of LSOA

To enable geographical representation of the data, this dataset has been enriched with spatial geometric information through the Ministry of Housing, Communities and Local Government [16]. The dataset contains the Spatial Projection is WGS84 and the Geography is at Lower Super Output Area (LSOA) Level.

3.4 Variation of crimes and gentrification by borough

To verify the correlation relating to the variation of crimes suffered in the London area between 2013 and 2019 and the gentrification index previously calculated for the same period, it was decided to create an additional dataset that contained all the crimes committed in 2019 and 2013 (with previously presented crime dataset features) and the following variables have been added:

- `year`, containing the value of the year in which the crime was committed;
- `tot_crime_2019` and `tot_crime_2013`, relating respectively to the total number of crimes committed for each borough in 2019 and 2013;
- `%variation_crime`, represents the variation of crimes committed in 2013 and 2019 using the following formula for calculation:

$$d = \frac{tot\_crime_{2019} - tot\_crime_{2013}}{tot\_crime_{2013}} * 100$$

- `%variation_crime_LSOA`, represents the variation of crimes committed in 2013 and 2019 for each LSOA using the previous formula;
- `G_index_median`, represents the median of the gentrification index values for each borough.

It is necessary to specify that we have chosen to use the median and not the average, to have an overall indicator of the gentrification index per borough, since the average is much more influenced by outliers.

3.5 Considerations and Limitations

The crime dataset, as anticipated, is directly collected by the London police. On its website, no specific restrictions are listed but it is a fact that not all crimes are reported every time, and this clearly demonstrates bias. This constraint, however, cannot be examined.

The crime dataset, as anticipated, is directly collected by the London police. On its website, no specific restrictions are listed. But it is a fact that not all crimes are reported every time, and this

clearly demonstrates bias. This constraint, however, cannot be examined.

As regards the dataset relating to the gentrification index, there are many limitations, this is because the construction of this index (which emerges from the equation present in the section 3.2) required the assignment of variable weights to the dependent variables used. The equation in question was chosen considering the work done by Adam Almeida [9]. This formula was derived after considering the academic literature on gentrification and, in particular, on how urban gentrification processes manifest themselves in London.

As previously mentioned, the gentrification index assumes values on a scale between 0.0 and 1.0. During the analysis, the presence of outliers was found for the chosen range, for which it was decided to bring the values above the upper limit to 1 and the negative values to 0. This choice was made for consistency with the adopted range. The reason for the presence of these outliers is probably due to a large variation in the individual components of the gentrification index. Surely the reason for the presence of these values should be investigated more thoroughly and any phenomena that have occurred in the area should be identified.

Population churn (c) is assigned the highest weight, representing 50 per cent of the total gentrification score. The 2019 work of Adam Elliott-Cooper et al., "Moving beyond Marcuse: Gentrification, displacement and the violence of unhoming" [17], argues that displacement is a core, defining feature of gentrification. However, displacement is notoriously difficult to measure empirically and therefore indirect markers, like population churn, are required to bypass this issue. An additional limitation of the population churn dataset is its accuracy in following households in multiple occupation (residential properties where multiple households share a common space). For the purposes of this analysis, a household "begins" when the first individual is identified in the home and "ends" when the last individual has left.

Relative change in the proportion of non-white residents (e) is the variable given the second-highest weighting, representing 25 per cent of the total gentrification score. As reflected in the literature, we determine that the process of urban displacement, particularly in the global north, is heavily experienced along racial lines and there exists a long history of factors fostering displacement (e.g. discrimination, overcrowding, demolition of social housing) occurring unequally on the basis of race, specifically in London and in Britain [18] [19] [20].

London is the region in the UK with the highest proportion of non-white residents (40.2%), who comprise a significant portion of the urban working class [21]. According to the Joseph Rowntree Foundation, 70% of those in Inner London experiencing income poverty are from non-white backgrounds and 50 per cent of those in Outer London [22]. Therefore, any marked decreases in the proportion of non-white residents in an area can be used as a proxy indicator of displacement of working-class residents and can be used to measure the process of gentrification across the city. Of additional note, major gaps exist in the literature on the effects of gentrification specifically on ethnic minorities in Britain when compared to the richer research that is undertaken in the US context.

The two indicators that are assigned the lowest weighting (12.5% each) are the relative change in the median house sale price, compared with the borough-wide average (h), and the relative change in IMD score (d). These variables represent class-based identifiers, as diminished home-buying potential

and deprivation are disproportionately experienced by people of lower socioeconomic status.

The vast majority of working-class people are employed in the rental sector, as the bottom 40% of incomes represent only 10% of all homeowners in England. For nearly everyone in the working class, the prospect of buying a home is remarkably low, making this variable a relatively weak indicator of class. However, the limitation of available data to the required level of granularity during the period in question made its inclusion necessary.
Unfortunately, however, the data provided by the Office for National Statistics relates only to the lower quartile of home sales by LSOA [12]. This data is then compared with UK House Price Index [13] but this does not allow us to consider several aspects, for example it does not include the sale of social housing through the right to purchase, which represents an important limitation for the study.
Housing tenure status, eviction data, right-to-buy sales and open-access data on council estate demolition at the LSOA level would have all supplemented the study and provided a more robust methodology.

Another limitation is the use of the English IMD scores for 2019 and 2015. The period of study (2019–13) is left without two year of data and leaves out neighbourhood changes that have occurred morerecently. The IMD scores were released only in 2019, 2015 and 2010 in England, making 2015 the best year for consideration due to less time spent. Furthermore, most indicators in the Indices of Deprivation 2015 relate to 2012–13 data, and indicators in the Indices of Deprivation 2019 mostly relate to 2016 data, presenting a slight delay in the time frame of analysis.

Data based on race and ethnicity and data based on class are weighted equally to reflect the shared impact of gentrification on London's multiracial working class. Yet these two categories are represented as discrete and independent in the formula, representing a constraint of the analysis. It has been noted that race and ethnicity have been central to the class composition of Britain since the inception of the British Empire, the impacts of which continue to be confirmed to the present day [23]. As a result, non-white people in Britain are disproportionately constituted within the working class and these two categories (race and class) do not exist as truly separate, introducing a challenge to the widely used variable independence rule within of the scientific field.

4 Analysis

4.1 Criminality

First of all, it is important to provide an overview of the crimes in the two years chosen. The following two figures show the amount of crime that occurred in London for each borough first for the year 2013 and then for the year 2019 (**Figure 3** and **Figure 4**).

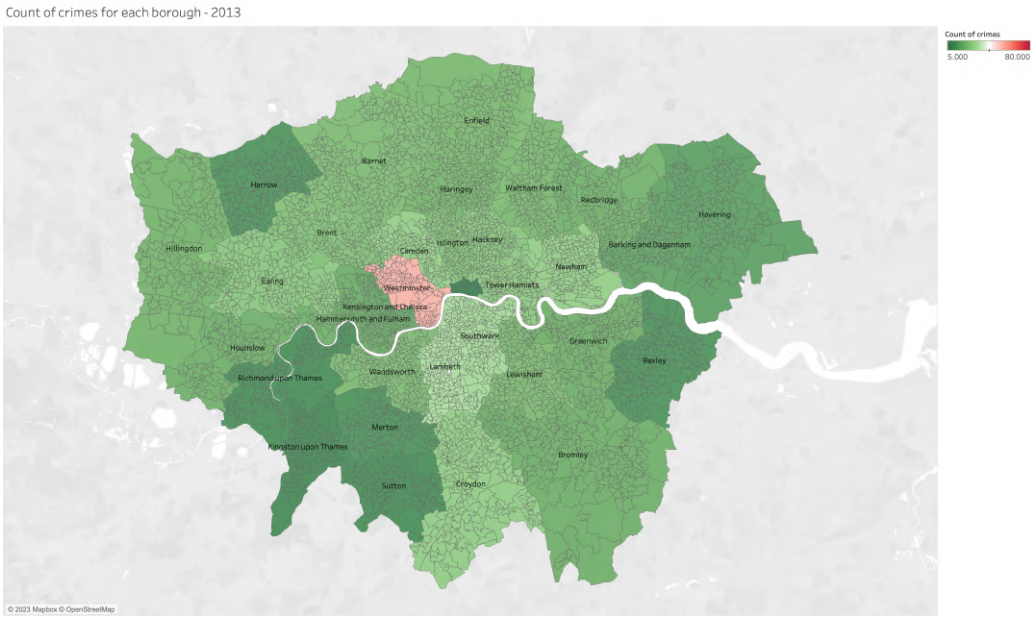

Figure 3: Map of the number of crimes that occurred for each borough in 2013.

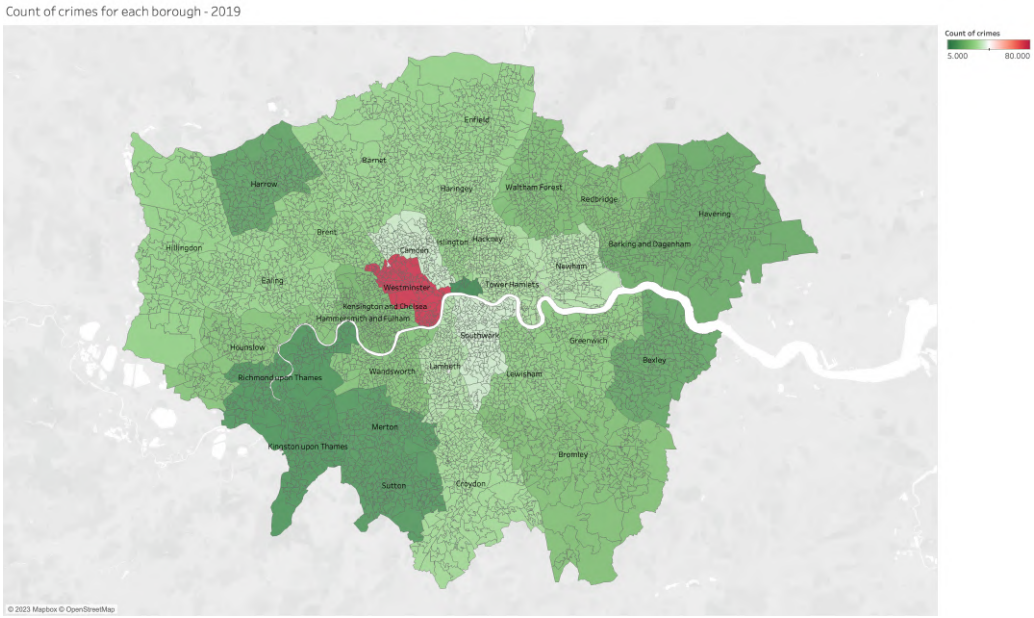

Figure 4: Map of the number of crimes that occurred for each borough in 2019.

From the images we can see how the greatest number of crimes are concentrated in the central areas of the city, more precisely in the borough of **Westminster**. This borough is often associated with the Houses of Parliament and Buckingham Palace, the London borough of Westminster is the epitome of London and its tourism. By comparing the two maps, it is clear that in general the number of crimes has increased throughout the country over the years.

In the figures **Figure 5** and **Figure 6** it is possible to see more clearly the ranking of the boroughs by number of crimes that occurred in the area by also analyzing which types of crimes are committed more frequently.
Observing the values on the abscissa axis of the histograms (**Figure 5** and **Figure 6**) it is evident,

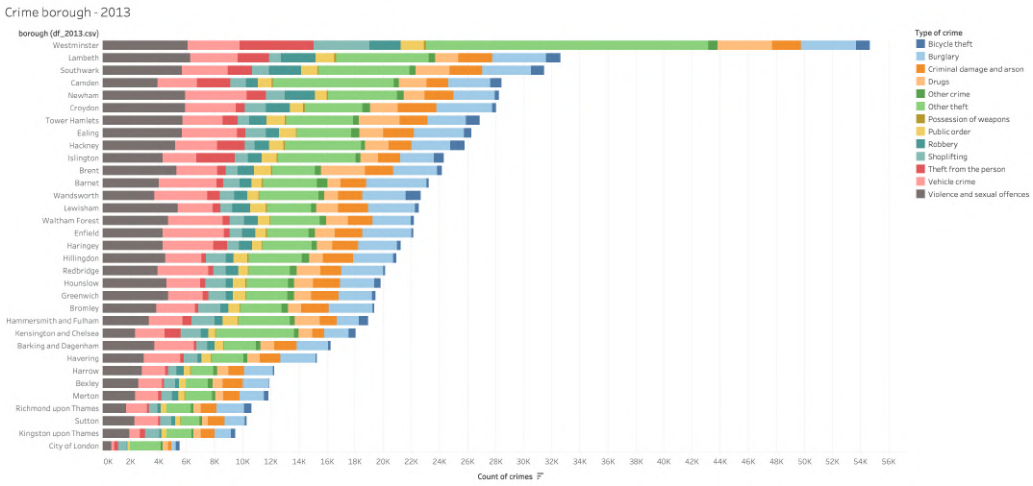

Figure 5: Ranking of boroughs by number of crimes committed in 2013 specifying the nature of the crimes that occurred.

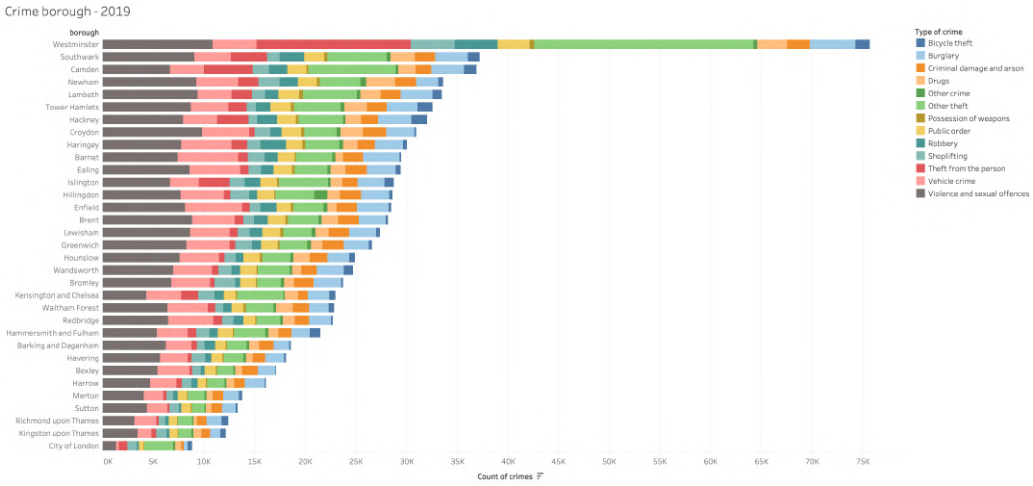

Figure 6: Ranking of boroughs by number of crimes committed in 2019 specifying the nature of the crimes that occurred.

in a clearer way, that the number of crimes has increased considerably over the years (about 160,000 crimes). Furthermore, it is possible to note that in the district with the highest number of crimes (Westminster) the most commonly committed crime is theft in general. There is also a significant increase in "thefts against the person" in 2019. This result is in line with expectations with respect to the characteristics of the borough.
The top five positions for both years are occupied by the following boroughs in slightly different positions: Westminster, Lambeth, Southwark, Camden, Newham. The same consideration can be made for the bottom positions of the ranking: City of London, Kingston upon Thames, Richmond upon Thames, Sutton, Merton.

It is important to specify that the **City of London** is not considered a borough and also has a local police force that is different from the rest of the territory: the City of London Police. This police department maintains a mounted police unit. Most likely having an additional control of the district through an additional local police, allows for better crime management, despite being a central district of the city.

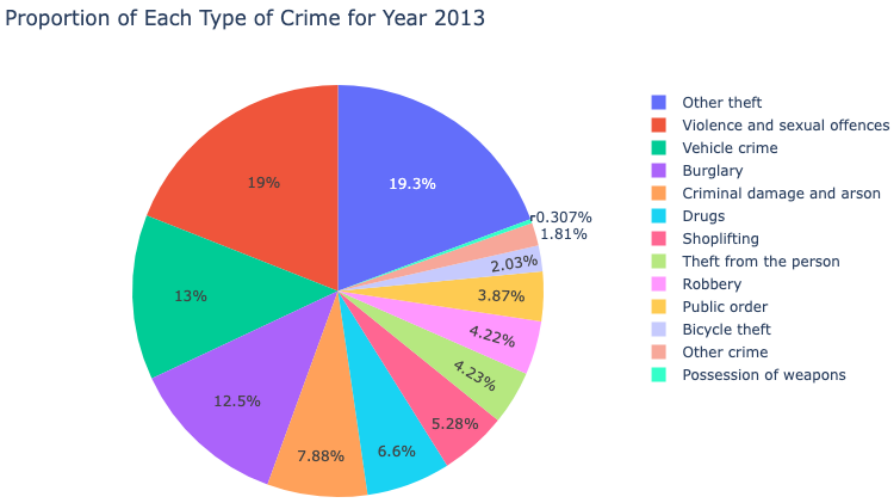

Figure 7: Pie chart of the percentages of types of crimes that occurred in London in 2013.

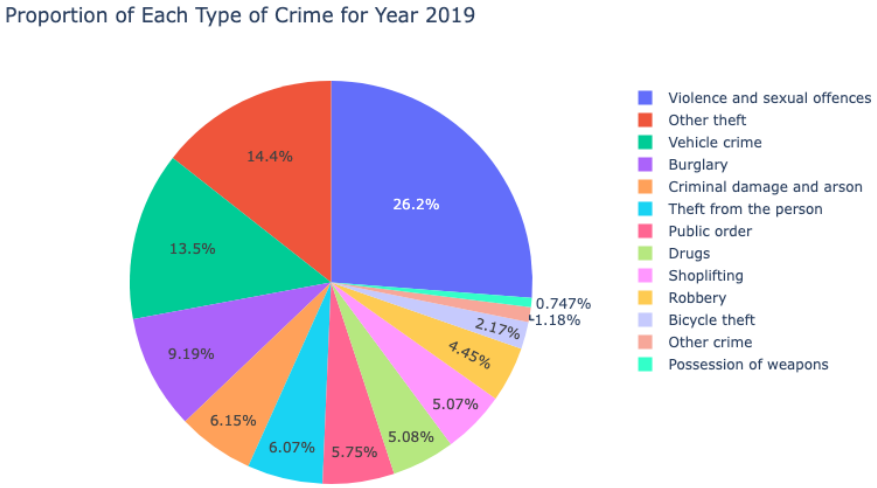

Figure 8: Pie chart of the percentages of types of crimes that occurred in London in 2019.

In the pictures **Figure 7** and **Figure 8** it is possible to have a general overview of what are the most common types of crime in London in the two years.

In first place in 2013 are thefts, with a percentage of 19.3%, followed by crimes related to violence and sexual offenses and finally by vehicle crime. In 2019 however, the first position is occupied with a percentage of 26.2% by crimes relating to violence and sexual offences, followed by other theft and then vehicle crime. It can therefore be observed that the type of crimes committed remains more or less unchanged between the two years, even if with different percentages and positions in the ranking.

More specifically, it is possible to observe an overview of the number of crimes committed for each LSOA in the area in the two years.

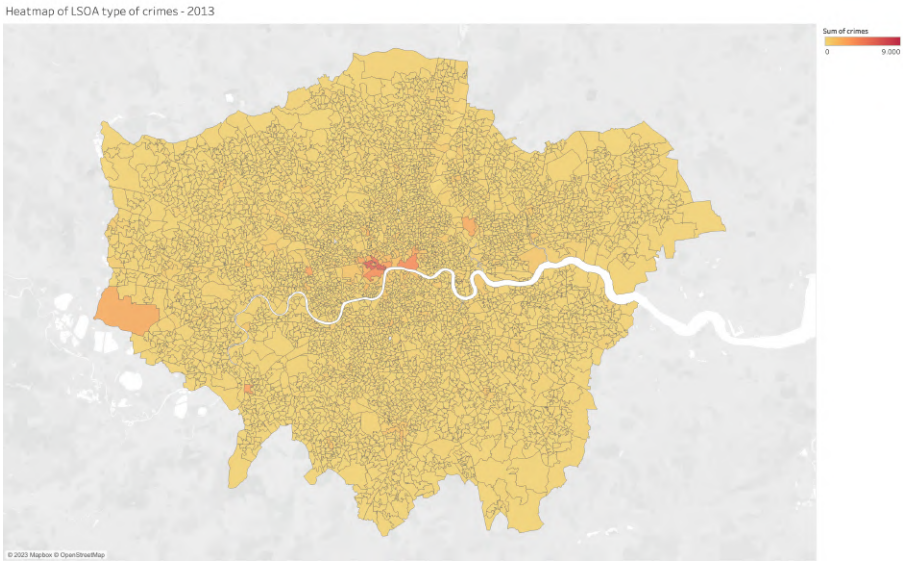

Figure 9: Heatmap relating to the number of crimes committed for each LSOA in 2013.

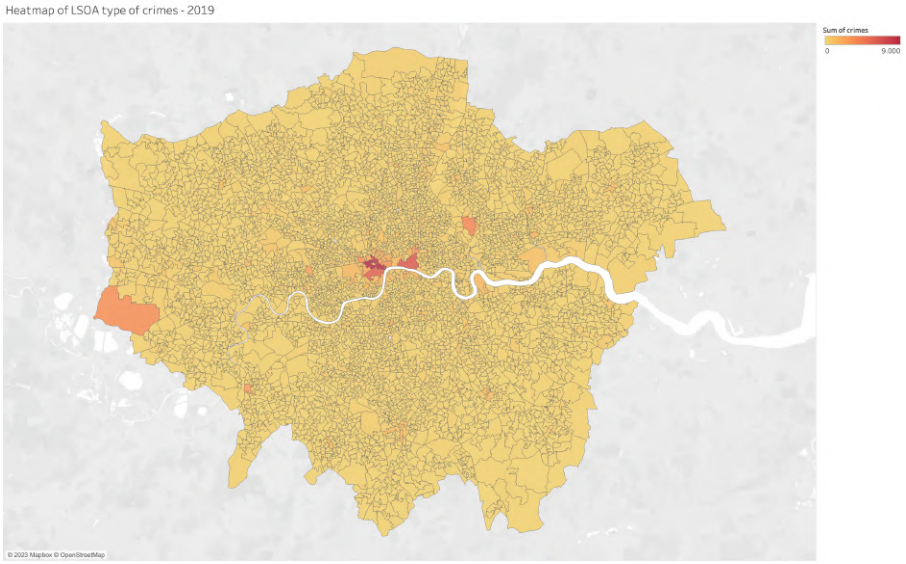

Figure 10: Heatmap relating to the number of crimes committed for each LSOA in 2019.

It can be seen that the coloring in the heatmaps of 2013 **Figure 9** and 2019 **Figure 10** is quite similar, in particular it is more accentuated in 2019 with a greater increase (confirming what has been said previously). The darkest coloring (corresponding to a higher number of crimes) is observed in the central areas, as expected. It is evident however, for both years, that **Hillingdon LSOA 031A** has a higher crime rate than the adjacent territories (about 2000 verified crimes in the year versus one or two hundred verified crimes in adjacent areas). The reason could lie behind the dimensions chosen for the analyses, i.e. this borough is the second largest in terms of size in London and therefore if the value were normalized for the population, the crime rate would be lower also because it is a very green area.

4.2 Gentrification

Having observed the crime situation in the two years in London, we can now observe the overview relating to the gentrification index in the area.

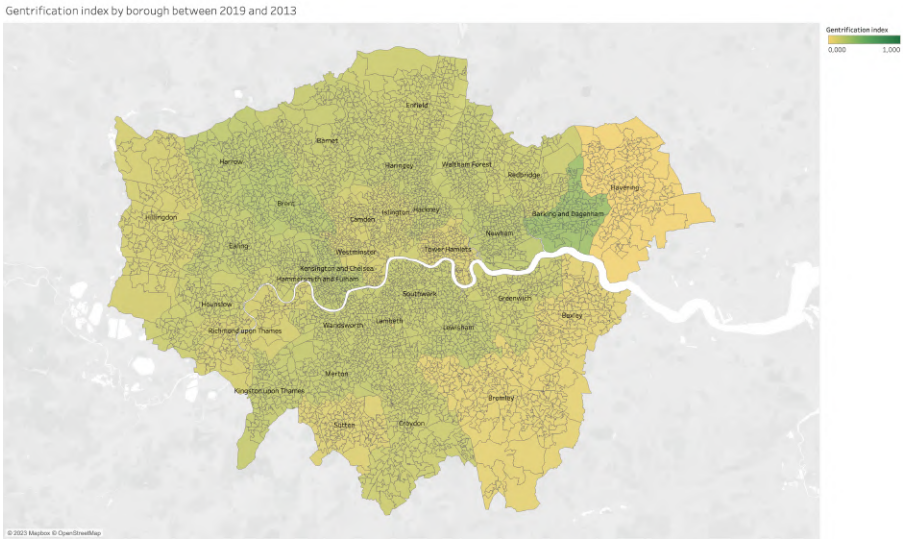

Figure 11: Heatmap relating to the median of gentrification index for each LSOA between 2019 and 2013.

borough	tot_crime_2019	tot_crime_2013	%variation_crime	G_index_median
Barking and Dagenham	18575	16234	14.420352	0.306134
Brent	28161	24167	16.526669	0.212317
Kensington and Chelsea	22982	18008	27.621057	0.193780
Harrow	16136	12234	31.894720	0.187297
Newham	33580	28257	18.837810	0.181394

Figure 12: Ranking of boroughs with the highest gentrification index value.

As can be seen from the heatmap (**Figure 11**), the coloring turns out to be quite uniform in fact the values that appear do not exceed 0.5. Furthermore, the borough that has undergone the most gentrification, also confirmed by the table in **Figure 12**, is **Barking and Dagenham**. This borough is one of the fastest growing London boroughs, the blend of green spaces with strong residential communities ensures that Barking & Dagenham is a tempting prospect for families and businesses alike.

The bottom 5 positions by median of gentrification index are occupied by: Tower Hamlets, Sutton, Bexley, Bromley and Havering. It is important to mention the borough of **Havering**, London's easternmost borough, as it appears to have the median gentrification index equal to exactly 0. This is because is one of the least dense areas of the capital thanks to its huge proportion of Metropolitan Green Belt land.

4.3 Gentrification and Criminality

The analysis continues by focusing on gentrification and crime. From the heatmap (**Figure 13**) it can be seen that the boroughs with the greatest variation in the number of crimes between 2019 and 2013 have a low median gentrification index value (around 0.1). This trend is confirmed by the graph (**Figure 14**) which also shows the negative correlation between the two phenomena: as gentrification increases, the variation in the number of crimes decreases. However, the value of the Pearson correlation coefficient does not appear to be very high (about -0.2).

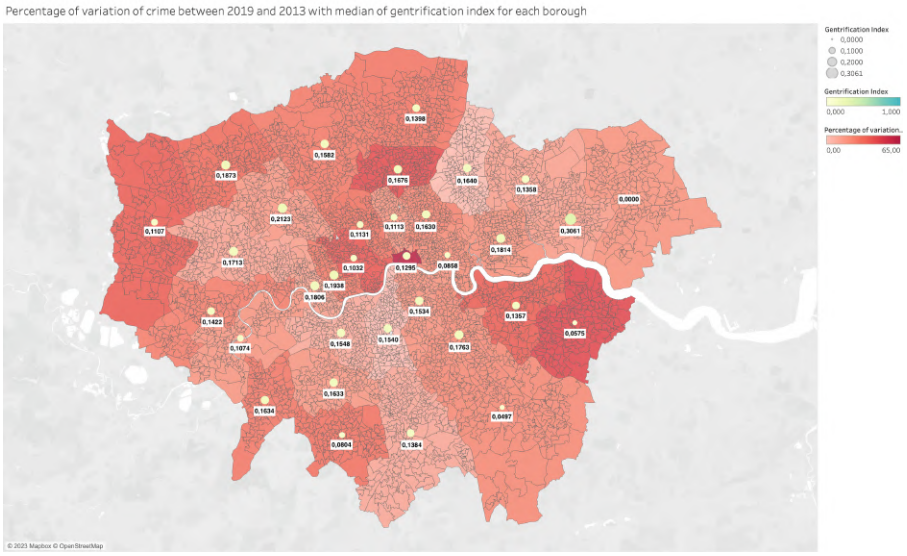

Figure 13: Heatmap of the variation in the number of crimes that occurred with the median gentrification index for each borough between 2013 and 2019.

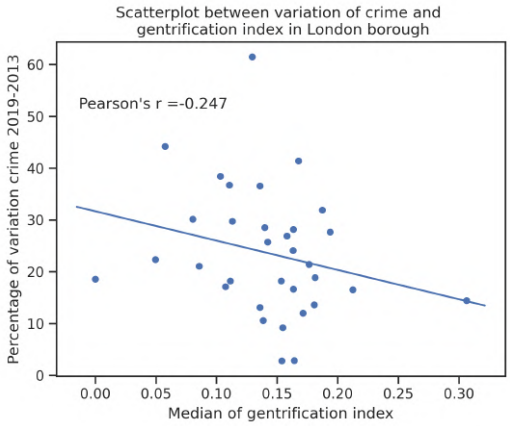

Figure 14: Scatterplot relating to the median of the gentrification index and the variation in the number of crimes between 2013 and 2019, highlighting the correlation line between the two variables.

It was decided to focus on the borough of **Kensington and Chelsea**, **Figure 15**, as it appears to be the neighborhood with the LSOAs with the highest gentrification index. It is also the third largest borough in the median gentrification index and it appears to be one of the first boroughs to have undergone the phenomenon of gentrification (the Notting Hill district inspired Ruth Glass to carry out her research).

It can be noted in detail that in the three LSOAs with the highest gentrification index value there is a slight decrease in the variation of crimes for two of these while in the remaining one there is a 38% increase in crime.

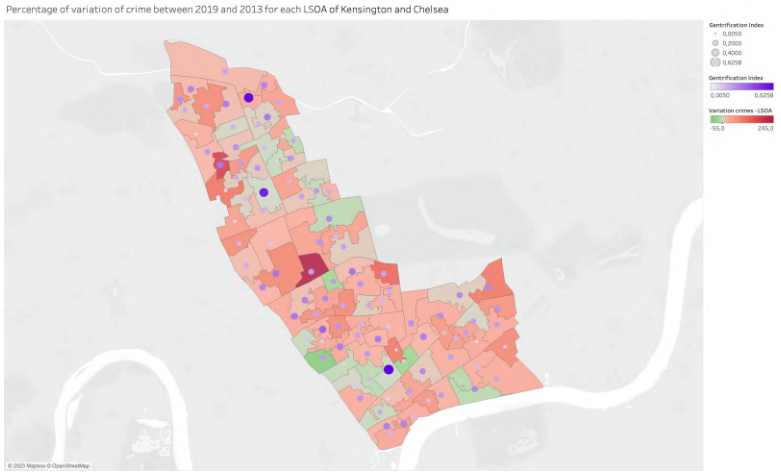

Figure 15: Heatmap of the variation in the number of crimes that occurred with the median gentrification index for Kensington and Chelsea between 2013 and 2019.

5 Conclusion and Future Developments

This work has focused on the effects of gentrification within the City of London and in particular its relationship to crime. Although in the literature there are cases of protests and violent demonstrations against this phenomenon, through the analyzes carried out it is possible to verify that in reality there is a slightly negative correlation between gentrification and the variation of crimes. This means that an increase in gentrification causes a slight decrease in the amount of crime in the area. Obviously, being a low correlation value (-0.2), a cause-effect relationship between the two phenomena cannot be confirmed.

It is necessary to point out that the analyzes presented contain limitations, already expressed in the section 3.5. A further bias, to be improved in the future, is present in the calculation of the variation of crime as the number of crimes is analyzed without considering the amount of relative resident population for each borough.

Therefore the analyzes could be improved both as regards the calculation of the indices considered, both for the choice of datasets (more accurate than those available for the following study) and for the more detailed analysis regarding the LSOAs with gentrification index values outliers with respect to the variables that compose it.

To conclude, gentrification is a complex phenomenon to analyze and which has many effects (both positive, such as the redevelopment of the district, and negative, such as the increase in the price of housing) on individual districts and on the entire city. As regards the relationship with crime, from the preliminary analyzes it can be hypothesized that gentrification therefore has a positive effect on the city. If this trend were confirmed with further more accurate analyses, cities could be invited to encourage this process.

References

[1] R. Glass, "Introduction: aspects of change,[w:] london: Aspects of change," *Center for Urban Studies, London: MacKibbon and Kee, xiii–xlii*, 1964.

[2] J. J. Palen and B. London, *Gentrification, displacement, and neighborhood revitalization.* State University of New York Press, 1984.

[3] M. Kennedy and P. Leonard, *Dealing with neighborhood change: A primer on gentrification and policy choices.* Brookings Institution Center on Urban and Metropolitan Policy Washington, DC, 2001.

[4] S. C. McDonald, "Does gentrification affect crime rates?" *Crime and Justice*, vol. 8, pp. 163–201, 1986.

[5] Piramide di Maslow. [Online]. Available: https://it.wikipedia.org/wiki/Piramide_di_Maslow

[6] Cereal Killer café targeted by vandals. [Online]. Available: https://www.standard.co.uk/news/london/cereal-killer-cafe-activist-defends-actions-of-protesters-a2957546.html

[7] UK Police. [Online]. Available: https://data.police.uk/data/

[8] The Crown Prosecution Service (CPS). [Online]. Available: https://www.cps.gov.uk/crime-info/violent-crime

[9] A. Almeida. Pushed to the Margins: A Quantitative Analysis of Gentrification in London in the 2010s. [Online]. Available: https://assets.website-files.com/61488f992b58e687f1108c7c/61d6fc536143d6219ea19fa4_Pushed-to-the-Margins-Gentrification-Report-min.pdf

[10] CDRC Residential Mobility Index LSOA 1997-2020. [Online]. Available: https://data.cdrc.ac.uk/dataset/cdrc-residential-mobility-index/resource/cdrc-residential-mobility-index-lsoa-1997-2020

[11] Census lsoa ethnicity language identity. [Online]. Available: https://data.london.gov.uk/dataset/2021-census-lsoa-ethnicity-language-identity

[12] Lower quartile house prices by lower layer super output area. [Online]. Available: https://www.ons.gov.uk/peoplepopulationandcommunity/housing/datasets/lowerquartilepricepaidbylowerlayersuperoutputareahpssadataset48/current

[13] UK House Price Index. [Online]. Available: https://data.london.gov.uk/dataset/uk-house-price-index

[14] Lower Super Output Area (LSOA) IMD2019 (WGS84). [Online]. Available: https://data-communities.opendata.arcgis.com/datasets/communities::lower-super-output-area-lsoa-imd2019-wgs84/explore?location=52.712664\%2C-2.327771\%2C7.00&showTable=true

[15] Indices of Multiple Deprivation (IMD) 2015. [Online]. Available: https://data-communities.opendata.arcgis.com/datasets/communities::indices-of-multiple-deprivation-imd-2015/explore

[16] Lower Super Output Area. [Online]. Available: https://data-communities.opendata.arcgis.com/datasets/6bced6c6f81448cf9692ed3f472b11ce

[17] Moving beyond Marcuse: Gentrification, displacement and the violence of un-homing. [Online]. Available: https://gala.gre.ac.uk/id/eprint/25400/7/25400\%20ELLIOTT-COOPER_Moving_Beyond_Marcuse_Gentrification_Displacement_Un-homing_\%28OA\%29_2019.pdf

[18] E. F. and K. O., "Ethnic Inequalities in London: Capital for All. London: Runnymede Trust," 2016.

[19] S. Lukes, N. De Noronha, and N. Finney, "Slippery discrimination: A review of the drivers of migrant and minority housing disadvantage," *Journal of Ethnic and Migration Studies 45(17)*, p. 3188–3206, 2018.

[20] R. A., "Racial banishment," *in Antipode Editorial Collective (eds) Keywords in Radical Geography: Antipode at 50*, 2019.

[21] G. K., "Forty Years of Struggle: A Window on Race and Housing, Disadvantage and Exclusion. Birmingham: Human City Institute," 2016.

[22] P. G. and K. P., "Poverty rates among ethnic groups in Great Britain," 2007.

[23] S. D. and M. L., ""we Are Ghosts" Race, Class and Institutional Prejudice. London: Runnymede Trust." 2019.