Retail related developments in medium-sized Dutch inner-city shopping areas at the beginning of the 21st century

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Master's thesis

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Preface

In front of you lies the master thesis 'Retail related developments in medium-sized Dutch inner-city shopping areas at the beginning of the 21st century'. This thesis has been written to meet the graduation requirements of the master's track Urban Systems and Real Estate of the Master in Architecture, Building and Planning at Eindhoven University of Technology. Since September 2022, I have been researching and writing this thesis.

During the final part of my Architecture and Construction Engineering bachelor study at Avans University of Applied science I noticed that my interest lies in analysing and shaping the complete urban environment rather than one single building. With this in mind, I started this study at the TU/e three years ago alongside a part-time job in real estate development of housing. To push my limits and step outside my comfort zone, I chose to delve deeper into retail by choosing a method that required skills that I did not yet have. For example, I have worked with the open-source geographic information system QGIS. furthermore, I gained more experience in writing a literature study and analysing data with computer programs I already was familiar with, like SPSS and Microsoft Excel. This thesis has therefore taught me valuable lessons, both professionally and personally.

In the first place, I want to thank my main supervisor Ir. Aloys Borgers for his excellent guidance and support during the writing of this thesis. His unvarnished feedback helped me take my thesis to the next level. I would also like to thank Dr.ing. Peter van der Waerden and Prof.dr. Theo Arentze for their contribution during the process. Furthermore, I would like to thank the company Locatus for providing the necessary data.

Finally, I would like to thank my family and friends for their unconditional support during the writing of this thesis.

I wish you a pleasant reading,

Iris Smith

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Summary

This thesis aims to study the impact of macro-occurrences on retail-related changes in inner-city shopping areas of medium-sized cities in the Netherlands. Although these cities are facing the most challenges from the beginning of the 21th century since they serve primarily only local consumers and hardly can take advantage of tourism, research on this topic is lacking. The research focuses on developments in both the retail facility mix and the spatial pattern of retail facilities. From the findings, recommendations can be made for retailers, retail facility owners, as well as the municipality with decision and policy making. The main research question in this research is:

What retail-related developments have taken place in inner-city shopping areas in medium-sized cities in the Netherlands at the beginning of the 21st century, and how have macro-occurrences influenced these developments?

This question is divided into three sub-questions. The first examines the recent but also the historic macro-occurrences and academic perspectives that affected both the retail facility mix and the spatial pattern. The second sub-question investigates the developments in the retail facility mix in the beginning of the 21st century and the macro-occurrences possibly influencing these developments. The last sub-question analyses the developments in the spatial pattern of retail facilities during the same period and the macro-occurrences that may have influenced these developments.

To be able to answer the main research question, a mixed-method approach is used in this study. Qualitative and quantitative methods are combined. First, a literature review is conducted to gather existing knowledge on the impact of macro-occurrences on the composition and the spatial distribution of retail facilities, covering historical and academic perspectives. Subsequently, quantitative research has been conducted on the development in the retail facility mix and the change in the spatial pattern of retail facilities in seven selected medium-sized cities in the Netherlands (100,000 to 250,000 inhabitants). For the analyses, a dataset of Locatus has been used, containing retail facility information from 2004 to 2022, including details about e.g. the type, retail floor area, and geographical coordinates of each outlet in the downtown shopping areas. Utilizing these data and the findings from the literature, the retail facilities have been divided into functions and types. Furthermore, as for the function store, there is looked at two extra attributes: if the store is affiliated to a certain retail-chain or not, and if the store can be classified as (fashion) department store or not. To determine the developments in the retail facility mix over the years, data about the number of retail facilities per function, type, and attribute has been compared. As for the analyses of the change in spatial pattern, first, a tool in QGIS has been used to calculate the mean nearest neighbour distance over the years and for the different kinds of retail facilities. Subsequently, the data about the changes in both the mix and spatial pattern have been analysed separately by going through the following tests and analyses per function, type, and attribute:

1. Friedman test: to test if there is a significant difference in the patterns over the years
2. Trendline analyses: to analyse if there is a trend visible in the change in the patterns over the years
3. Spearman rank-order test: to test if there are significant correlations between the differences in pattern over the years between two different functions, types, or attributes

The results of all these tests and analyses are described, supported by graphs and city maps. This included looking at parallel developments at the macro level, such as the emergence of e-commerce and the occurrence of the financial crisis.

The results lead to the following conclusions. Firstly, the number of stores in inner-city shopping areas of Dutch medium-sized cities started decreasing around 2010, which confluences with a combination of the delayed effects of the emergence of e-commerce and the financial crisis. In contrast, only the number of stores that sell daily goods such as food and personal care products is increasing. The number of experience facilities is increasing throughout the years since 2004, which may be linked to the emergence of the experience economy around 2000. This is mainly reflected in the increase in takeout/delivery and fast-food restaurants. The increase in experience facilities has experienced delays, during the same time periods as the occurrences of both the financial crisis and the COVID-19 pandemic. Furthermore, a shift from department stores to fashion department stores has taken place. Looking at the results of the trendline analyses, it seems plausible that this development is caused by a combination of the emergence of e-commerce, the financial crisis and the emergence of (inter)national retail-chain stores. The retail-chain stores are also replacing the independent stores, especially when looking at the RFA of these stores. The decrease in retail-chain stores after 2013 also confluences with macro-

occurrences such as the delayed effects of the emergence of e-commerce and the financial crisis, and the pandemic.

From the results of the analyses on both the retail facility mix and the spatial pattern, it can be concluded that the change in the spatial pattern of retail facilities can be explained by the developments in the retail facility mix. Evidence is found that the decrease in the number of retail facilities leads to an increase in the mean nearest neighbour distance and thus a more scattered spatial pattern. This can be explained by the idea that when a retail facility closes, it leaves a gap between remaining retail facilities. Furthermore, while the number of experience and hospitality facilities increases, the mean nearest neighbour distance between these facilities decreases. This means that new experience or hospitality facilities settle near existing experience or hospitality facilities. Although it is expected that that an increase in the average retail floor area (RFA) also leads to larger distances between retail facilities, no evidence is found for this assertion.

From this research, it can be concluded that developments in the retail facility mix often confluence with ongoing or sudden macro-occurrences. Constant, linear trends may be influenced by ongoing macro-occurrences such as the emergence of e-commerce and the emergence of the experience economy. However, some developments are characterised by shifts, accelerations, and delays, which often confluences with sudden macro-occurrences such as the financial crisis, and the COVID-19 pandemic. These developments in the retail facility mix (especially in the number) often result in a change in the spatial pattern of retail facilities. An increase in the number, leads to a more agglomerated spatial pattern and vice versa.

Since medium-sized cities are seen as important player in a country's economic structure (Leeuwen & Rietveld, 2011), it is important keep the inner-city attractive for consumers. Retail is an important component for this inner-city attractiveness (Karlsson & Nilsson, 2017), also, the developments in the retail landscape affect the consumer experience the most (Birkin, et al., 2002). Therefore, it is recommended for retailers, retail facility owners, and municipalities to monitor these developments and to have an idea how macro-occurrences may trigger these developments. Based on this research, some recommendations can be made to create and keep the inner-city of medium-sized cities attractive. The first is that municipalities should encourage the transformation of vacant facilities in the core of inner-cities into another (temporary) retail-related function, to support diversity in the city-centre. Furthermore, retail facility owners are recommended to transform or sell their retail facilities outside the main core of the inner-city. In addition, it is recommended to invest in properties near fashion department stores and hospitality facilities. Retailers are recommended to negotiate for flexible renting contracts, which makes it easier to relocate when the current location becomes unpopular.

As for the managerial implications for both businesses in retail and policy makers that operate in the retail industry, the retail industry needs to adapt retail strategies due to the shift in shopping preferences. Diversification, interactive displays, impressive environments, and events attract customers beyond consumption (Sit et al., 2003). By creating robust supply chains and online services, retail facilities will become more resistant to macro-occurrences such as financial crises or pandemics. The ideal shopping area is compact, which is in contrast with the current more scattered pattern of retail facilities. Therefore, retail facility locations should be aligned with the developments in shopping behaviour. Customer preferences must be prioritized for a complete and satisfying shopping experience.

This study addresses the underexposure in recent research of the changes in inner-city shopping areas in medium-sized cities in the Netherlands. Even though medium-sized cities are most prone to changes (Locatus, 2023), these cities have been overlooked in recent studies. By giving an historic overview of the emergence and development of retail in cities in Europe, in combination with the analyses of macro-occurrences since the start of the 20th century and their impact on the retail facility mix and the spatial pattern of retail facilities, this research offers comprehensive insights. The outcome of this study may help retailers, retail facility owners, as well as the municipality with decision and policy making. The complete overview of macro-occurrences and their impact on retail in the inner-city helps to assess how the future retail pattern and retail composition of a medium-sized city might change when it is subjected to macro-occurrences. The methods used in this thesis diverge from the existing techniques used in ongoing research. These techniques include the use of the mean nearest neighbour analysis tool in QGIS to measure the development in spatial patterns. The results of this research align with ongoing research concerning shopping areas in large Dutch cities, making it plausible that the conclusions and recommendations of studies regarding large cities are also applicable to medium-sized cities. In addition, this thesis offers a detailed understanding of the composition of downtown shopping areas. This research bridges a gap in the literature by shedding light on the transformative processes in Dutch medium-sized cities' inner-city shopping areas.

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Glossary

Term	*Definition*
Retail facilities	All brick-and-mortar facilities that provide goods and services to the end-user. These facilities include both large and small stores, but also hospitality facilities such as restaurants or services like banks and brokerages. In this research, retail facilities are divided into functions, types, and attributes.
Retail Facility Mix	The total number and composition of all retail facilities.
Spatial pattern	The spatial distribution of retail facilities.
Medium-sized cities	Cities with between 100,000 and 250,000 inhabitants.
Macro-occurrences	Major incidents or inventions that occur (suddenly) at the country, continent or world level and may affect the composition and spatial pattern of retail facilities.
Retail-related trends	Long-term developments in retail, driven or not by macro-occurrences.
Functions	All retail facilities are grouped into four functions: store, experience, service, and vacant.
Types	The retail facilities with functions store and experience are sub-divided into types. Stores are sub-divided into: daily stores, fashion & luxury stores, leisure time stores, in/around house stores, and other stores. Experience facilities are sub-divided into: hospitality facilities, and culture & recreation facilities.
Attributes	As for the function store, two extra attributes are added: if stores are affiliated with a retail-chain or not, and if the store can be classified as (fashion) department store.
Retail facilities (#)	Total number of retail facilities in an area (per function, type, or attribute)
Retail facilities (%)	Total share of retail facilities in an area per function/type/attribute compared to the total number of facilities (with a certain function)
RFA	Retail floor area in square meters, the covered space accessible and visible to the consumer (including space behind the counter and display window, excluding warehouses and staff areas)
Average RFA	Average RFA per retail facility per function/type/attribute
RFA (%):	RFA share per function/type/attribute compared to the total RFA overall retail facilities per function

1. Introduction

People's shopping needs are constantly changing by macro-occurrences. For instance, at the beginning of the last century, digital technologies were non-existent. Now, people, things, and places are always connected (SWECO, 2022; Melillo, 2020). As a result, the number of internet sales has been increasing during the years (Dolega, et al., 2021). This causes people to spend less money in traditional brick-and-mortar stores (Dolega, et al., 2021; Verhoef, et al., 2015; Rose, et al., 2012; Weltevreden & Rietbergen, 2009). The development of cities and their shopping centres also depends on demographic factors such as population growth (Cilliers, et al., 2021) or economic factors (Property Council, 2022). An example of an economic factor is the financial crisis between 2008 and 2014 which had an impact on people's spending patterns (Gfk, 2015) and indirectly on purchases in inner-city shopping areas (Harasta, 2020; Tangpong et al. 2009). The most recent global event that has impacted shopping behaviour is the COVID-19 pandemic. Due to measures to contain the virus, consumer confidence dropped to a negative rate (Cushman & Wakefield, 2021). Furthermore, the new ways of working and moving drastically changed the use of cities and their shopping centres (Soroui, 2021; Pojani & Alidoust, 2021; Cilliers, et al., 2021; Cilliers, 2018).

The change in shopping needs by macro-occurrences subsequently impacts retail-related changes in inner-city shopping areas, such as the spatial distribution of stores. Stores close, stores move, new stores pop up, store types change e.g., from fashion to vacancy, and stores lose their original function and transform for example into residential functions. A well-known phenomenon in changing the retail landscape at the micro-level is the Retail Apocalypse in the United States which refers to the closing of more than thousands of physical retail stores since 2015 (Helm, et al., 2020; Bhattari, 2019; Meyersohn, 2019). According to Harasta (2020), in 2018, the largest number of retail bankruptcies in history was counted. However, already at the beginning of the 2000s, retailers faced dwindling sales, bankruptcies, and mass closures, from which some were unable to recover (Harasta, 2020). This trend is most visible in the United States, but other countries are also struggling with the Retail Apocalypse like Spain or the United Kingdom (Jeffery, 2019; Morcuende & Lloberas, 2022). While several sources attribute the changes in the retail market to a Retail Apocalypse, some sources question whether this apocalypse exists (Kline, 2018; Mathews, 2018). One reasonable explanation that stores are closing is that the retail landscape is evolving by external developments and retailers that are not evolving are becoming obsolete (Danziger, 2017; Morgan, 2018). However, there was still a net growth of more than 2,000 stores in the US in 2018.

The retail landscape is also changing in the Netherlands. Retail expert Paul Moers predicted in the article of Leeuwen (2018) that shops would close, also in the Netherlands, but not on such a large scale as in the US. When looking at the national figures from Statistics Netherlands (2022) about the number of physical store locations per year, it can be concluded that there was a peak in the number of physical locations in 2010 with 97.1 thousand locations. This number slowly decreased until 1 January 2021, when there were still 83.1 thousand physical stores (see Figure 1). This is a difference of more than 13 thousand shops (14%). Based on figures from Statistics Netherlands (2022) and Locatus (Wit, 2022), it can be concluded that Dutch consumers' shopping behaviour has changed permanently. This has an impact on the creation of today's retail landscape and how it will continue to evolve in the future.

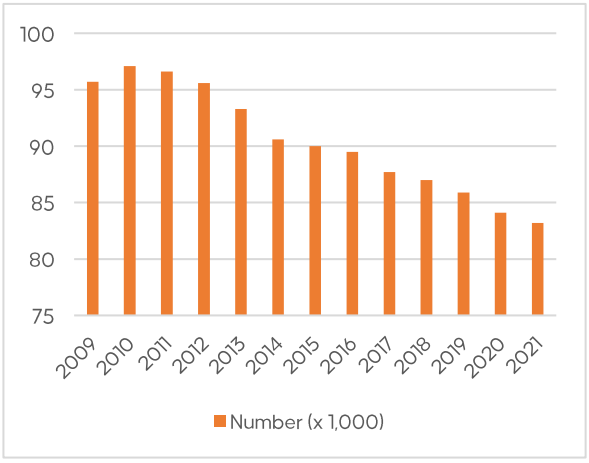

Figure 1: Number of physical retail locations in the Netherlands

1.1 Problem definition

So, people's shopping needs are constantly changing by macro-occurrences such as the emergence of e-commerce or the financial crisis. These changing needs lead to retail related developments, such as the opening and closure, or the relocation of stores. However, the analyses of these developments are lacking for medium-sized cities in the Netherlands, although these medium sized cities face the most challenging changes in their retail structure, like increasing store vacancies (Locatus, 2023). Also in other countries in Europe, store vacancy has increased most in the mid- and small-sized cities (e.g. Hallsworth & Coca-Stefaniak, 2018; Grimmeau & Wayens, 2016; Madry, 2016). Whereas consumers are more likely to return to the inner-city shopping area of large cities

(Delage, et al., 2020), medium-sized cities primarily only serve the local population and hardly can take advantage of tourism (Chatterjee, et al., 2020; Clols, 2021). It is therefore expected that changes in the composition and the spatial pattern of retail facilities will mainly be seen in medium-sized cities. However, many studies were conducted for big cities in North America only, and not for (medium-sized) cities in Western Europe or for the Netherlands in particular (Grewal et al., 2017; Dawson, et al., 2008; Kent, et al., 2003). Furthermore, changes within the inner-city shopping area affect the consumer experience the most (Birkin, et al., 2002). Some studies look at changes in retailing from a geographical point of view, focussing on changes in trade areas, at the city or regional level, these are too coarse to understand changes within the inner-city shopping areas (Birkin, et al., 2002; Brown, 1994). For this reason, this study will dive into the retail-related developments and it's causes in inner-city shopping areas of medium-sized cities in the Netherlands.

Previously conducted research on the spatial dynamics of retail in inner-cities is written from a marketing or economical perspective (e.g. Grewal, et al., 2017; Evans, 2011). Older studies from this same perspective describe organizational retail change as a cyclical event (Brown, 1987, Brown, 1993). However, recent research from a spatial planning perspective shows that the spatial pattern of retail is influenced by (sudden) recent macro-occurrences, such as the invention of internet (e.g. Dolega, et al., 2021), and the COVID-19 pandemic (e.g. Cilliers, et al., 2021) which may affect this cyclical thought. Current studies on spatial dynamics take into account only retail decline and only one macro-occurrence and its effect on the retail landscape (Kickert, et al., 2020; Delage, et al., 2020). Other changes in the retail landscape (like the emergence of the experience economy (Pine and Gilmore, 1999) are neglected. Although, a confluence of macro-occurrences may lead to a combination of developments in the retail landscape. A complete overview of the macro-occurrences and the effects on the retail structure is lacking, even though this overview can be enlightening. Therefore, this study will include multiple macro-occurrences and their influence on retail-related developments.

Also, historic issues such as the rise of department stores, and chain stores are not discussed in current research (Stobart, 2010; Miellet, et al., 2001), while studying the history of the emergence and development of the retail landscape may help to identify ongoing trends and patterns. Understanding the history can help by better understanding the current and future changes in the retail pattern (Halmy, et al., 2015). So, in order to better understand the change in the retail structure nowadays, it is necessary to look at the historical developments in the retail landscape and the causes of these developments. Therefore, in this research a link will be made between both historical and current macro occurrences and the effects on the retail landscape in inner-city shopping areas.

High-fidelity data about retail facilities from 2004 to 2022 in the Netherlands is made available for this research. With this dataset, it is possible to conduct quantitative research on the recent changes in retail in inner-city shopping areas and to link this with findings from literature. By means of a literature study on the current trends, in combination with the quantitative research on this data, an overview of the confluence of different macro-occurrences and the retail-related developments in the inner-city shopping area can be made.

1.2 Purpose and research questions

The purpose of this study is to shed light on the impact of macro-occurrences on retail-related changes in inner-city shopping areas of medium-sized cities in the Netherlands (between 100,000 and 250,000 inhabitants). This includes the closures of retail facilities, changes in retail facility function, and changes in the spatial distribution of retail facilities during recent years. The outcome of this study may help retailers, retail facility owners, as well as the municipality with decision and policy making, since the retail-related development in inner-cities often depend on their decisions. Furthermore, the results of this study give an insight in the developments that have taken place to come at the current status of the retail landscape in inner-cities. Also, the conclusions may help to assess how the future retail pattern and retail composition of a medium-sized city might change when it is subjected to macro-occurrences. To achieve this purpose, this study aims to answer the following main research question:

What retail-related developments have taken place in inner-city shopping areas in medium-sized cities in the Netherlands at the beginning of the 21st century, and how have macro-occurrences influenced these developments?

Macro-occurrences refer to major incidents or inventions that occur (suddenly) at country, continent or world level and affect the composition and spatial pattern of retail facilities. To answer this main research question, it is broken down into three sub-questions. The answers to these sub-questions together form the answer to the main question.

a. *What (recent) macro-occurrences and retail-related academic perspectives follow from literature and how did they affect both the retail facility mix and the spatial distribution of retail facilities in cities in western Europe?*
b. *Can a development in the retail facility mix in inner-city shopping areas in Dutch medium-sized cities be observed at the beginning of the 21st century and what macro-occurrence may influenced these changes?*
c. *Can a development in the spatial pattern of retail facilities in inner-city shopping areas in Dutch medium-sized cities be observed at the beginning of the 21st century and what macro-occurrences may influenced these changes?*

In these sub-questions, the term retail facilities refers to all brick-and-mortar facilities that provide goods and services to the end-user. These facilities include both large and small stores, but also hospitality facilities such as restaurants and services like banks and brokerages. The retail facility mix can be defined as the composition of retail facilities. With spatial pattern, the spatial distribution of diverse retail facilities is meant.

1.3 Research approach

To be able to answer the main research question and related sub-questions, a mixed-method design will be used. A qualitative research method will be combined with quantitative research methods. First, a literature review will be conducted. This review will provide an overview of the existing knowledge on the influence of macro-occurrences on the composition and the spatial distribution of retail facilities. It includes the emergence and development of inner-city shopping areas in western Europe from the year 500 till now, influenced by macro-occurrences to put current trends and developments into perspective. Furthermore, the academic perspectives in the field of retailing will be analysed. From this literature review, also several current trends regarding the developments concerning retail facilities will follow. With these results, an answer will be given to sub-question a.

Subsequently, two different quantitative analyses will be conducted to measure developments in the composition and spatial pattern of retail facilities in inner-city shopping areas in medium-sized cities in the Netherlands from the beginning of the 21st century. First, analyses will be conducted on data to compare the number of different kinds of retail facilities over the years by using Microsoft Excel and SPSS. This will be done to determine the developments in the retail facility mix over the years. With the results of these analyses, an answer to sub-question b will be given. Furthermore, the outcomes of the mean nearest neighbour distance analysis tool in QGIS will be analysed to observe developments in the spatial pattern of retail facilities. Using the results of this analysis, an answer will be given to sub-question c.

Finally, the conclusions of the literature review, the analyses of the changes in the retail facility mix and the spatial pattern of retail facilities will be brought together to see if a confluence can be observed between macro-occurrences, the developments in the retail facility mix and in the spatial pattern of retail facilities.

1.4 Academic and societal relevance

By looking at recent developments in inner-city shopping areas in the Netherlands, this study adds to the current literature on spatial retail dynamics in medium-sized cities in the Netherlands and thus in western Europe. By focusing on the relation between macro occurrences on the one hand and developments throughout the years in the spatial distribution and the composition of retail facilities on the other hand, the results of this research will give an insight into how macro developments may affect the retail landscape in medium-sized inner-city shopping areas. The relation between more than one macro-occurrence and the changes on micro-level in European medium-sized inner-city shopping areas is new in the literature.

Furthermore, a complete overview of the emergence and development (including causes) of the retail landscape in West Europe will be added to the current body of literature. This research will therefore provide a clear and complete picture of the urban dynamics in inner-city shopping areas in medium-sized cities in the Netherlands. The results will provide insights into the historic and current trends in retail, but also into the effect on the composition and spatial pattern of retail facilities at the beginning of the 21st century. The outcomes of this thesis will help to better understand the current composition and spatial pattern of retail facilities in medium-sized cities.

For this purpose, high-fidelity data of retail facilities in different cities and in yearly periods will be compared with each other, this is new in the academic field since this kind of data previously lacked (Kickert, et al., 2020). By means of quantitative research, the impact of several macro-occurrences and the development of retail in

inner-cities will be analysed. This may reveal developments in the retail pattern which can lead to interesting insights into the factors that drive these developments. The methods used in this study may be seen as an example for future studies with high-fidelity data, since there are more and more companies that provide high-fidelity data nowadays.

This research aims at identifying which kind of retail facilities are most prone to developments in the local retail structure. In addition, these developments are linked to current trends and macro-occurrences. By gaining insight into these current trends and macro-occurrences and the associated changes in the retail landscape, property owners can actively anticipate making their properties suitable for other, more long-lasting use. In addition, it helps with decision-making in portfolio management of retail real estate owners. The same insights can be used as input by municipal, or provincial governments to create future-proof policies and visions for inner-city shopping areas in medium-sized cities.

Due to changes in shopping needs induced by macro developments, the retail environment of inner-cities is developing. However, these developments affect the consumer experience the most. Inner-city shopping areas suffer due to intensified competition from other shopping areas and retail is the most important attribute for inner-city attractiveness (Karlsson & Nilsson, 2017). To keep shopping areas attractive and viable, policymakers, retailers, real estate owners, and real estate investors must respond to these developments. In addition to the fact that this research provides insight into why inner-city shopping areas are as they are, the results also provide insights for the future. Thus, the results may be used as input for future research on the prediction how the inner-city shopping areas of medium-sized cities will change when subjected to macro-occurrences.

1.5 Structure

This study is structured as follows. First, a literature review is conducted on the origins and development of retail structure from the Middle Ages in cities in Europe to put the recent changes in the composition and spatial pattern of retail facilities into perspective. This review can be found on the next page in chapter 2. Furthermore, in Chapter 2, additional relevant developments on the spatial distribution of stores and cities described in the literature are outlined. The results of this study lead to an answer to sub-question a. After the literature review, the methodology to perform analyses on the developments in the retail facility mix and the spatial pattern of retail facilities is described in Chapter 3. In Chapter 4, the results of both analyses are presented. These results are used to answer sub-questions b. and c respectively. The results of the literature review, in combination with the results of analyses on the developments in the retail facility mix and the spatial pattern together will be used to answer the main question in Chapter 5. In the same chapter, the recommendations also will be described. Furthermore, in chapter 5 the relation with ongoing research, critical reflection, suggestions for future research, and managerial implications are given.

2. Literature review

This chapter describes the spatial dynamics of retail in inner-cities. It starts with a review of the emergence of inner-city shopping areas in European cities and their development through the years. Through this literature review, an answer will be sought to sub-question a: *"What (recent) macro-occurrences and retail-related academic perspectives follow from literature and how did they affect both the retail facility mix and the spatial distribution of retail facilities in cities in western Europe?"*. In this context, also an analysis will be conducted to examine the macro-occurrences that (may) have influenced the emergence and development of shopping areas. In addition, academic perspectives in the field of retail are described, such as theories regarding the structure of cities and the location of shopping facilities in cities, as well as theories regarding consumer behaviour. In the concluding section, sub-question a. will be answered by giving a historic overview of the developments. Also, the current retail trends that are happening in western European cities that follow from certain macro-occurrences will be discussed.

2.1 Retail history

To put short-term changes into perspective, it is important to understand the emergence of long-term macro developments in inner-city shopping areas in cities. This review describes the development of inner-city retail structures in western European cities, starting in the Middle Ages to the present.

2.1.1 Middle Ages (500-1350)

When looking at the development of European cities, most cities arose around 1300 alongside the rivers and canals that were connected to the sea (Rutte, 2005). The fertile agricultural land next to the rivers played into the creation and flourishing of cities. Cities grew organically as more people settled here for economic reasons (Cappon & Engen, 2002). Cities were flourishing the most when they were concentrated together. These cities together could form a solid economic system (Boone, 2013). Where previously land lords and bishops ruled, authority increasingly shifted to citizens, merchants, and boatmen. They became increasingly powerful (Blockmans, 2010). The emerge of a city and its growth is thus mainly due to trade. This trade took place on market squares. On these squares, farmers and households from the countryside sold their agricultural products, like firewood, vegetables, meat, and handicrafts to the urban population. In addition, household items were offered for sale. Guilds, like craftsmen, artisans, and shopkeepers, presented their wares (Cruz, 2023). The markets usually took place once or twice a week at the central square, or in bigger cities on more interconnected squares. When there were several market squares in a city, each market square sold a different type of product. For example, there were market squares that sold only cloth or only fish (Toftgaard, 2016). Accessibility of the retail activities at the marketplace was a crucial factor in the location of retail activities, convenience was important (Lesger & Furnée, 2014). At this time, the covered market squares in Europe, the market halls, also became a well-known phenomenon (Coleman, 2006) These squares and halls were often considered the most important place in the city, the church and town hall were often located near (Gawryluk, et al., 2019; Narolewska, 1998). For centuries, these places remained the most important retail location (Lesger & Furnée, 2014).

2.1.2 Early Modern Europe (1350-1650)

The further development of cities is subject to external factors. This could be seen in the mid-14th century when many people died of the plague. Cities were especially affected by the Plague, where people lived densely combined with poor hygiene. Due to relocation movements and death from the disease, the population of cities in Europe declined during this time (Brand, 2011). The Eighty Years' War is another factor that affected the development and spread of cities in Europe. After Spain took over Antwerp in 1585 and the southern part of the Netherlands, people fled to the cities in the Northern part. These cities formed a tight economic system, with Amsterdam as the most important city (Lesger, 1993). Due to the economic growth of maritime trade (the Golden Age), the Northern part of the Netherlands attracted even more immigrants from German countries (Vries, 1984).

International trade by sea became increasingly important, but only took place from business to business (B2B). During the early modern period, the transition from agrarian medieval society to modern capitalism took place (Bouman, 1938). As money was invented in Europe in the sixteenth century, subsistence production and exchange of products became increasingly uncommon. Bouman (1938) stated that the free formation of prices and the pursuit of profit caused the bourgeois accumulation of wealth to reach great proportions. The demand

for luxury products in the early modern period that followed capitalism started in northern Italy but quickly spread throughout the rest of Europe (Bruno, 2021; Barnard, 2020).

According to Lesger and Furnée (2014), it can be concluded that cities in Europe grew and new districts around these cities developed. Shopkeepers and other retailers not only were located at the traditional marketplaces but also at major intersections and main streets of these new districts. This led to a change in the spatial distribution of stores. Around 1460 the first planned retail area in a city emerged the Great Bazaar of Istanbul (Coleman, 2006). Durable (luxury) goods could be found in the city centre and daily necessities were further provided in smaller towns and districts around the city (Lesger & Furnée, 2014). The development of this retail structure continued during the Retail Revolution.

2.1.3 Retail- and Industrial Revolution (1650-1850)

The 'Retail Revolution' between 1650 and 1800 is viewed as a vital component of the economic growth in early modern Europe (Blondé & Damme, 2010; Stobart & Hann, 2004). During this time, alongside the established merchants, the number of stores, stalls, hawkers, and peddlers rose enormously. These smaller stores focussed on specific products, such as food, textiles, and/or hardware (Ogilvie, 2010). This is because the middle class spent generously on luxury goods and the masses bought cheap fashion and utensils (Brewer & Porter, 1993; McKendrick, 1974). This revolution ran partly parallel to the Industrial Revolution, which began around 1750.

During the industrial revolution, new raw materials were found, and equipment like steam engines, and infrastructures like canals and railroads were (re)invented (Hohenberg & Lees, 1995). The new inventions brought major changes in the demography of Europe, like a huge increase in the scale of cities (especially in regions where raw materials were mined) and the shift of the economic heart of Europe from the Northern part of the Netherlands to the Midlands in England (Mil & Rutte, 2021). The major renewal of infrastructure connected new industrial cities with existing cities. Both flows of goods and passengers between (inland) cities emerged (Lees & Lees, 2013). During this period, also the time allocation of women and children shifted from leisure and household chores to income-earning work. The variety and quantity of products in the markets increased and the composition of the market's customers changed at the same time due to the change in demographics (Toftgaard, 2016).

New forms of market consumption and market labour reinforced each other. Demand for new goods increased. The retail and industrial revolution led to factory industrialization, agricultural revolution, and proto-industrialization, the start of modern economic growth (Vries, 1994; Brewer & Porter, 1993). Although the retail ratio (the number of retailers per 1,000 inhabitants) in the Dutch Republic rose until 1740, it stagnated until 1800. After the abolition of the guilds which relaxed professional demarcation, the retail ratio increased again. This is due to the lowering in transaction costs of bringing new market wares to poorer customers (Heuvel & Ogilvie, 2013). This trend can also be seen in other European countries, such as Portugal (Cruz, 2023). Subsequently, in the eighteenth and nineteenth centuries, increasingly planned (covered) shopping areas such as shopping arcades and passages emerged in Europe (Geist 1989; Mackeith, 1986).

2.1.4 Telecommunication and Department Stores (1850-1950)

The retail industry in Europe experiences significant growth and innovation in the decades around 1900. These innovations include the invention of telecommunications like the telegraph in 1844 and telephone in 1876 (Warf, 2006). Mail-order retailing emerged during this time in the United States and later in western Europe. It was an answer to the urbanized market which mostly affluent consumers took advantage of (Coopey, et al., 1999). These innovations allowed people, regardless of gender, age, or socioeconomic status, to contact retail establishments located far from where they lived. Through indirect contact by mail/telephone/telegraph, customers could access an extensive range of goods from all over the world (Nilsson, 2022). Where previously only companies traded with other companies internationally, international trade between companies and consumers was now emerging. According to Coopey, et al. (2011) and Schwarz et al. (2004) mail-order retailing led to increased competition among retailers and the development of innovative marketing techniques. Many retailers began to invest in mail-order channels, alongside their physical stores to reach a wider audience and generate additional revenue streams. Coopey, et al. (2011) concluded that during 1900-1960, the share of mail orders in the total retail sales grew, but this was at the expense of the traditional brick-and-mortar-stores, at least in Great Britain.

Another innovation that took place during this time, is the emergence of the department store. Around 1850, department stores and market halls had their first entrance into the urban landscape of major cities in the United States and Europe. The micro-level retail industry has faced major changes since the emergence of department stores. The spread and influence of the department store is well known. In the first half of the 20th century, the

traditional department store became a dominant player in the retail scene (Whitaker, 2011; Johnson & Sung, 2009; Pasdermadjian, 1954). The department stores were often located in the centre of cities and contributed to the modern town centre (Haput, 2012). Department stores were often characterized as stores with an organization into separate departments, coupled with central operating functions, including accounts for marketing (Fuijoka & Stobart, 2018; Gareth, 1992). Further, they had excellent service, attractive displays, home delivery (mail-order retailing), entertainment events and a large variety and depth of up-to-date merchandise and fashion (Fuijoka & Stobart, 2018; Haupt, 2012; Johnson & Sung, 2009). The traditional department stores dominantly sold luxury goods until the late 1920s. With the wide range of merchandise and amusement, department stores were also often visited as a form of entertainment. Convenience shopping took place in smaller stores that provided goods and primary necessities in local neighbourhoods (Heyrman, 2017; Haupt, 2014). Haupt (2014) also argues in his article that department stores primarily served the wealthy. The working class was served by the co-operative movement, which emerged in the nineteenth century. These co-operatives began selling enormous quantities of cheap goods. This took advantage of the working-class.

Large stores, such as department stores and co-operatives, were a completely new concept in the landscape of cities. However, this new element did not eliminate other established formats. Literature states that open-air markets continued although the market halls were open for the public. Also, traditional stores and boutiques did not disappear when the department stores arose. The small stores targeted other market segments than the bigger stores. Both old and new developments in retailing are still co-existing nowadays (Lesger & Furnée, 2014; Haupt, 2012).

Furthermore, the invention of the automobile around the 1920s had an enormous impact on the retail structure in cities. The increase in automobile traffic led to dramatic changes in the accessibility to retail in metropolitan regions. In her article, Handy (1993) describes the link between the evolution of transportation and retail hierarchies. As people had the opportunity to visit retailers in a wider range, people moved out of the city centre. This development has pushed retail activities outside the boundaries of the residential areas. This makes using the car more attractive than active transportation modes. At the same time, the inner-city shopping areas became more a place to stay and for amusement than for convenience shopping (Handy, 1993).

2.1.5 Automobile and Shopping Malls (1950-2000)

World War II had an impact on how retail developed. Convenience became increasingly important at this time. During this time, one-price stores also emerged, such as Prisunic in France. These stores were a major competitor to the traditional department stores. The low prices were attractive to consumers. This was a contrast to the luxury products and high-end fashion offered by department stores (Haupt, 2012).

Before World War II, shopping facilities developed spontaneously in the central parts of inner-cities and along main streets connecting the inner-city with surrounding neighbourhoods. When housing was in high demand after World War II, new residential districts were planned and built on a large scale with good facilities and shopping centres. The rules of the classification of shopping centres and business configurations by Berry (1963), based on the hierarchical system of Christaller (1933), were followed. Christaller distinguished between the following levels in settlements from low to high: convenience centres, neighbourhood centres, community centres, regional centres, and the metropolitan central business district. The shopping centres in the lower levels of the hierarchy were built around supermarket locations. Supermarkets were the driving force behind the development of these retail locations. Compared to most other countries, this structure is well reflected in the Netherlands (Borchert, 1998).

After 1950, automobiles were taking on an increasingly vital role in the streetscape. Already before 1960, scientists concluded that American consumers were shopping less and less on foot (Nelson, 1958). While even only 1 in 10 consumers owned a car, consumers refrained from walking when faced with long shopping trips (Gruen & Smith, 1960). The automobile became increasingly dominant on the streets. Experts at this time suggested that a planned shopping centre should not exceed 200 meters in length and that the maximum distance between parking spaces and stores should not exceed 100 meters (Hasty, 1983; Beddington, 1982; Jones, 1969).

The emergence of the shopping mall in Europe is also linked to the post-World War II period. It is a kind of amalgamation of the market hall from the Middle Ages and the shopping arcades/passages during the retail and industrial revolution. However, the idea of an enclosed area with stores and accompanying parking lots originated in the 1920s in the United States. The developments were intended to attract people from other regions and cities to a particular place, and not to serve the local population. Thus, this revolved more around experience shopping than convenience shopping. However, the first mall was not built until after 1950 in Edina in the United

States: The Southdale Center (Warnaby & Medway, 2018; Malcolm, 2004). According to Dychtwald (1997), Oates, et al. (1996), and Kaufman (1995), the popularity of malls in Europe was particularly due to the ageing population and the relatively high number of physically disabled consumers at this time . Minimizing the walking distance between stores became increasingly important to increase convenience for consumers (Gehrt, et al., 1996). This is how malls were created. Stores were situated vertically from each other. In this way, the walking distance between parking and stores, and between different stores was reduced. The trend of large out-of-town shopping malls was increasingly implemented in several European countries such as France and Germany (Nijkamp, et al., 2003). This caused consumers to visit the shopping malls outside the city for their shopping, rather than the historic inner-city shopping area. Subsequently, traditional downtown retailers must close their stores because of disappointing visitor numbers (RetaiLink, 2019). However, the Netherlands has always discouraged such developments through policy (Nijkamp, et al., 2003). In contrast, several indoor shopping malls have been built in inner-city shopping areas in cities in the Netherlands, such as the Heuvel Galerie in Eindhoven or Hoog Catharijne in Utrecht.

There was an emergence and expansion of supermarkets, but also a decline in the number of small stores after World War II. Small independent food stores faced enormous competition with supermarkets (Jacques, 2018). The forerunner of the supermarket, the self-service grocery shop, was developed in the late 1940s by the Co-op (Shaw & Alexander, 2008). Between 1950 and 1965, the number of self-service stores increased sharply in Europe. This was also seen in England, for example (Bailey, et al., 2010). Bailey et al. (2010) also indicate in their article that between 1965 and 1975 a rapid development of the supermarket followed. Supermarkets at that time were in places that were easily accessible by car. Often this was in neighbourhood centres, main streets, and housing areas (Uttke, 2011). Here, too, convenience was paramount. According to Uttke (2011), local food markets like supermarkets are anchors for centrality in urban centres.

The chain store also had a rise in the years between 1950 and 2000. Several chain stores experienced increases in market share in the United Kingdom (Brown & Mergoupis, 2010). At the same time, there was also an increase in the number of specialist stores (Olczak, 2015). An example of a chain-store is Zara. At the end of the year 2000, Zara had a total of 1,080 stores spread across several countries (Williams, 2002). The emergence of these chain stores came at the same time as the founding of the European Union in 1957. This creation created free trade between member states in the EU. This allowed companies from one EU country to offer goods and services in another EU country without being based there (European Union, Sd; European Political Strategy Centre, 2017).

Another major change that took place between 1950 and 2000 was the rise of mass tourism. Earlier, only the upper classes could travel for pleasure and residential change. However, in the twentieth century, the number of middle-class people who could travel grew rapidly. More people, goods, services, and money moved between different places and countries. This brought a huge boost in the economic development of many countries (Greenwood, 1976; Peters, 1969). Shopping is one of the most important activities for a tourist (Albayrak et al., 2016; Lloyd et al., 2011; Yu & Littrell, 2003). Toward the year 2000, increasingly global cities focused on tourism as a source of income (Hoffman et al., 2003; Judd & Fainstein, 1999). Urban redevelopment plans were created to accommodate additional stores to welcome more tourists (Martinotti, 1996). Convenience shopping was replaced by leisure shopping with the rise of commercial, inter-national fashion chains combined with luxury fashion (Rabbiosi, 2015).

At the end of the 20th century, internet-based e-commerce was flourishing (Tian, et al., 1999). Companies started to establish themselves in the virtual world, next to their bricks-and-mortar stores. Mail-order retailers were also an important part of the rise of e-commerce. Thus, more mail-order retailers started using the Internet to sell their products. Where before international competition was small, even with mail-order retailing, the rise of e-commerce caused a change (Aoyama & Schwarz, 2004). Products and services became available through the internet. This included for example cameras, books, and tickets for sport matches. However, Barbonis and Laspita (2005) concluded that the e-commerce adaptation of consumers was low around 2,000. According to Aoyama and Schwarz (2004), consumers are primarily passive recipients of technological change. Although, today's world proves that consumers have embraced e-commerce (Dolega, et al., 2021).

Whereas the car previously dominated the streetscape of inner-city shopping centres, this was changing in increased cities toward the year 2000. The development of superstores, hypermarkets and various other types of out-of-town stores changed the traditional retail system. Consumers took their cars to large out-of-town stores for their necessary products (Heitkamp, 2000; Peiffer-Smadja & Torre, 2018). The demand for retail in the inner-city shopping centre changed (Shaw, 1978). This made it less and less necessary to reach the city centre by car.

As early as 1970, studies and experiments on the pedestrianization of inner-city shopping centres were conducted. These studies were conducted mainly in cities of England: Newcastle, Lees, and London (Morris, 1971; Wyborn, 1973; Turner & Giannopoulos, 1974). After experiments, increased plans were made to make inner-city shopping centres in Europe car-free. An example of this plan is the Ideplan 77 for Copenhagen's city centre (Kerndal-Hansen, 1983). This increased the comfort of walking consumers. Leisure shopping won out even more over the convenience of being able to get close to stores by car. This shows that not only macro-occurrences affect the spatial dynamics of retail facilities in inner-cities, but also meso-developments in the form of policies do have an influence on them.

These developments also affected the retail hierarchy in the Netherlands. The lowest levels in the hierarchy became less important, and the popularity of the highest level increased. However, the lifting of the ban on large-scale retailing in the periphery combined with the discouragement of cars in inner-city shopping areas also reduced this popularity (Borchert, 1998). However, the city centre remained the most important retail concentration in urban areas. This is true in the Netherlands, but also in most Western European countries (Guy, 1994). Despite the dynamics in retail, the spatial pattern of shopping centres as described by Berry (1963) is still clearly visible.

2.1.6 E-Commerce and Vacancy (2000-2020)

Since 2000, the number of purchases and sales via the Internet has been increasing (Dolega, et al., 2021). At the same time, the first smartphone was also launched, allowing people to be even more and faster in touch with businesses and each other. In the United States and the United Kingdom, 20%of all purchases in 2018 took place online (Leeuwen M. v., 2018). There were also a lot of online sales in the Netherlands that year. 64% of Dutch people aged twelve or older said they bought something online in 2018. In 2022, this was already 74%. Recent figures show that mainly clothing/shoes, meals, and cosmetics/perfume are bought online. The least are printed books, electronics/devices, and personal care products (Statistics Netherlands, 2023).

The rise of online stores is causing a decrease in spending in brick-and-mortar stores (Rose, et al.; 2012). To prevent this, more offline stores are also opening online stores but there are also online stores opening offline stores. Combining online with offline shopping is also called a multi-channel strategy. Recently, there has been a shift from multi- to omnichannel shopping: the integration of social media and other mobile channels into offline and online retail. This includes the use of (instant) personalized mobile advertising and the online search for products but offline buying them, or vice versa (Verhoef, et al., 2015). Rijksoverheid (Sd) states that between 2001 and 2007, the central bank in the United States continually lowered interest rates incrementally. This allowed both individuals and businesses to borrow money cheaply and easily. For example, banks issued variable-rate mortgage loans to individuals who could not afford them. As long as these interest rates remained low, individuals were able to pay these loans. However, in 2007 variable interest rates rose and many homeowners were not able to pay their mortgage anymore and were forced to sell their homes. Because many homes were suddenly offered on the housing market, their value decreased. As a result, homeowners were unable to repay their mortgages and banks suffered huge losses. Governments had to intervene to guarantee the flow of money between banks and individuals and businesses.

According to Tangpong et al. (2009), the economic downturn resulted in many brick-and-mortar stores that closed and several retail chains' going out of business. One reason for this is that cities are traditionally locations for recreational shopping and making non-daily purchases. These activities are conjuncture-sensitive activities (Expertgroep Future Retail City Center, 2016). However, already at the beginning of the 2000s, retailers faced dwindling sales, bankruptcies, and mass closures, from which some were unable to recover (Harasta, 2020). The financial crisis accelerated this tendency. This trend is also called the Retail Apocalypse and is most visible in the United States (Helm, et al., 2020; Bhattari, 2019; Meyersohn, 2019). But other countries are also struggling with the Retail Apocalypse like Spain or the United Kingdom (Morcuende & Lloberas, 2022; Jeffery, 2019). While several sources attribute the changes in the retail market to a Retail Apocalypse, some sources question whether this apocalypse exists (Kline, 2018; Mathews, 2018). One reasonable explanation that stores are closing is that the retail landscape is evolving and retailers that are not evolving are becoming obsolete (Morgan, 2018; Danziger, 2017).

Although this crisis occurred mainly in the United States, it also affected the Netherlands. Because the Netherlands is an exporting country with an open economy, the credit crisis had a major impact on the Dutch economy. Due to lower demand for products, there was also more unemployment which influenced people's spending patterns (Rijksoverheid, sd). Falling demand for products and goods affected the Dutch retail market. For example, store sales declined. There was a sharp drop in retailers' sales in 2009 (Statistics Netherlands (CBS), 2023).

This also reduced the demand for retail properties. As a result, there was a sharp drop in retail rents during the recession. Nevertheless, retail vacancy rates continued to rise. Some retail locations at the time became unprofitable for retail at any level of rent. This was also due to declining willingness to buy and consumer confidence which hit a low point in early 2013 (GfK, 2015). Combined with the abundance of depts resulting from leveraged buyouts before the financial crisis and the subsequent runaway growth in retail space caused the start of the growing vacancy rates in inner cities (Townsend et al., 2017; Thompson, 2017). However, the vacancy rate in inner cities is due not only to the financial crisis but also to the shift from offline shopping to online shopping (Statistics Netherlands, 2023). Ossokina, et al. (2016) wrote in their CPB Policy brief on post-crisis retail vacancy rates in the Netherlands that retail vacancy rates are mostly concentrated at the edges of shopping areas. They also concluded that stores like to cluster and benefit from each other's visitors together and that vacant stores harm neighbours (Ossokina, et al., 2016).

During these years, the Experience Economy also became an established term in the retail world. The term was first introduced by Pine and Gilmore (1999) in their book as the sale of memorable experiences to consumers. It is an economy in which many products and services are sold with a focus on the positive effects these can have on consumers' lives. It takes a combination of goods and services to enable an experience. Consumers enter intuitive relationships with brands and retailers with who they feel connected. For example, consumers pay not only for a coffee but also for the cosy ambience and the skilled and friendly staff (Pine & Gilmore, 1999). The rise of the Experience Economy is also affecting inner-city shopping areas. Whereas earlier consumers were looking for functionality in inner-city shopping areas in terms of store offerings, they are now looking for experience. The quality of the complete inner-city experience is becoming increasingly important and affects the engagement, satisfaction, and loyalty of local residents. A consequence of this is an increase in the evening and night-time economy (especially the hospitality sector), where consumer experience is central (Coca-Stefaniak & Carroll, 2014).

This trend can also be supported by figures. For example, in 2018, there was still a net growth of more than 2,000 stores in the US. But this growth occurred mainly in the food sector. Nevertheless, the number of department stores, stores with speciality soft goods, and drugstores decreased (Holman & Buzek, 2018). This trend can also be recognized in the Netherlands. Locatus has been tracking the ratio of retail vs non-retail in the Netherlands since 2014. This shows that for a long time, the decrease in the number of retail stores was offset by an increase in the number of stores in non-retail. Since 2020, however, the decrease in retail has been greater than the increase in non-retail (Locatus, 2023). The increase in the number of stores in 2021 was due to the increase in the number of stores in the food sector, especially bread, pastry, and confectionery stores, supermarkets, and liquor stores (3.4%). The number of stores with non-food products remained the same (Statistics Netherlands, 2022). This is also consistent with the research of Holman and Buzek (2018), who indicated a renewed interest in small stores with unique products and personalized service.

The change in the retail landscape is also related to demographic changes. In large cities, the vacancy rate does not rise as much as in medium or small cities. For example, the Netherlands is facing an ageing population with a decrease in the share of young people. In 2022, the average Dutchman was 42.4 years old, compared with 33.2 in 1975 (Statistics Netherlands, 2023). Figures from 2013 show that the ratio of people aged sixty-five or older varies by region. The provinces of Zeeland, Limburg, and Drenthe (the shrinkage regions) tend to have the highest rate of ageing, while the provinces of Flevoland, North and South Holland, and Utrecht have a lower grey pressure than the Netherlands as a whole (Compendium voor de Leefomgeving, 2013). These developments are not only related to the ageing of the population in the shrinkage regions but also to the moving of the younger generation out of these regions (CBS Open data StatLine, 2011). Older people also have a different shopping behaviour than younger people. This combined with the shrinkage in the number of inhabitants and households, the demand for stores in the local retail market is changing and becoming smaller. This is seen in the increasing vacancy rates in small and medium-sized cities (Compendium voor de Leefomgeving, 2015).

Where department stores were previously immensely popular, these are currently no longer in favour of most consumers (Burayidi & Yoo, 2021; de Jong, 2014). These stores were previously designated as ‘anchor’ stores, stores that increase, through their names’ reputation, the traffic of shoppers at or near their location (Konishi & Sandfor, 2003). In the last decades, beside the traditional department stores, other types of anchors arose in the Netherlands. Large international fashion retailers such as H&M, Zara, and Primark successfully entered the Dutch market and expanded in scale. This is also reflected in the total retail floor area in the Netherlands. While the total retail floor area of international retailers has been increasing since 2005, the total retail floor area of Dutch retailers has been declining since 2011. This growth in international retailers is especially seen in large

cities such as Amsterdam, the Hague, Rotterdam, and Utrecht. However, Dutch retailers still possess more retail floor area than international retailers (Boesveldt, 2017).

Not only large department stores are struggling, but also shopping malls are no longer popular (Burayidi & Yoo, 2021). Online shopping is having a major impact on the future of shopping malls, but the malls were already struggling before the rise of e-shopping. These difficulties, at least in the US, come from overbuilding shopping malls and the proliferation of shopping malls near each other. Many indoor shopping malls in the Netherlands face vacancy. However, the difference between malls is large, some are almost decaying while others are still lively (Wesseling, 2022). Stores for daily groceries and entertainment proved to be a success for shopping malls. Although, this is also true for planned shopping centres in neighbourhoods and districts, for example (Sit, et al. 2003).

Another major occurrence in the past 20 years, is the SARS-CoV-2 virus. This virus causes the well-known COVID-19 disease. Through coughing and sneezing, the virus can be transmitted from person to person. The virus was first discovered in China in December 2019, and the virus has gone around the world since (RIVM, 2022). In early 2020, the virus first appeared in the Netherlands. Several measures were used to contain the virus, including mandating the wearing of mouth masks, as well as lockdowns and store closures. These measures impacted the retail market. As a result, consumer confidence dropped to a negative rate during the COVID-19 crisis (Cushman & Wakefield, 2021). During the COVID-19 period, RetailSonar observed several trends in shopping areas in both the Netherlands and Belgium. They found that customers visited stores less often, but when they did, they spent more. In addition, customers were buying locally much more often (RetailSonar, 2020). Whereas in large city centres such as Amsterdam or Rotterdam, sales decreased by 21%, in smaller towns sales increased by 12.5% (Haar & Quix, 2020). One explanation is that during the pandemic, people preferred the safe environment of the local shopping area more. Another explanation is that tourists were not able to visit cities and their centres. RetailSonar (2020) concluded that strong traffic builders near a store, such as hospitality, commuting and tourism, play a major role in a store's success. They also revealed that customers are looking less for experience and more for convenience during the COVID-19 period. All measures caused people to increasingly make their purchases online (RetailSonar, 2020).

Since measurements began in 2006, the number of international overnight guests in the Netherlands has been increasing every year. However, there are two exceptions where a dip can be seen in the number of overnight guests: during the financial crisis and the COVID-19 crisis (NBTC, 2021). During the COVID-19 pandemic, it was apparent that tourism has a major impact on store performance. As discussed, sales decreased in large cities but increased in smaller cities (Haar & Quix, 2020). The purchase and rental prices of stores were continuously increased after the expiration of rental contracts. The collapse of retail activities related to tourism during COVID-19 significantly accelerated this process (Clols, 2021; Chatterjee, et al., 2020). Clols (2021) conducted a study on the impact of declining tourism due to restrictions during the COVID-19 pandemic in Barcelona. He found that the number of vacant stores increased dramatically in the tourist shopping streets in the city centre. In the luxury shopping street with international brands, only a few stores closed their doors. This means that some streets served only the tourist market and when this market disappears, the retail pattern changes.

2.2 Retail-related academic perspectives

In the past hundred years, there have been academics developing theories related to (the location of) retail developments in urban areas. In addition, research into consumers' shopping motivations revealed relevant insights. This section tries to link these academic perspectives to the historic developments discussed above.

2.2.1 Urban land use models

Over the years, urban land-use models have been developed to explain the growth and composition of land-use in cities, including the location of retail in the city. Around 1930, (socio-)economists Burgess and Hoyt produced respectively the Concentric Zone Theory (1925) and the Sector Model (1939). Both models assume that cities develop in concentric circles, with the Central Business District (CBD) at the centre and residential housing radiating outwards. The model assumes that cities are monocentric in which (retail) trade only took place in the CBD (Hoyt, 1939; Park & Burgess, 1925).

In a counter-response to these simple monocentric models, these models were followed up by more organic models including the Multiple Nuclei Model (Harris & Ullman, 1945) and the Urban Realms Model (Vance, 1972). In these models, cities consist of multiple urban areas/developments with each their centre of activity and

growth. Both models assume that retail locations are in multiple places in the city and give a more realistic representation of urban areas, unlike the previously mentioned monocentric city models.

2.2.2 Law of Retail Gravitation and Central Place Theory

Theories that explain the size and distribution of retail locations are the Law of Retail Gravitation and the Central Place Theory. According to the Law of Retail Gravitation (Reilly, 1931), groups of customers are drawn to certain retail locations because of factors such as distance to and size of shopping areas, market population, and location of competing shopping areas. His theory assumes that the greater the distance between the consumer and the shopping area, the less likely consumers are going to travel to that location. However, these consumers are willing to travel a longer distance for larger shopping centres (Francica, 2021; Wagner, 1974; Reilly 1931; Reilly, 1929).

Christaller's Central Place Theory (1933) explains the economic relationships between retail centres based on the size and geographical distribution of these centres and influenced the retail structure in several west European countries. The Central Place Theory can be visualized in a pattern of hexagons that form when setting up the catchment areas of the different levels of retail centres (Janssen, 2011; Christaller, 1933). This theory also considers the maximum distance a consumer is willing to travel for a particular type of retail centre. As described before in the review of retail history, the Central Place Theory was used for retail planning in the Netherlands after World War II. The retail structure in the Netherlands can be defined as fine-woven, intricate, and hierarchically differentiated (Jansen, 2011).

2.2.3 Retail Agglomeration and Minimum Differentiation

Retail agglomeration can be defined as a group of retail stores in proximity, which compete and cooperate simultaneously (Sanyal & Ghosh, 2017). By clustering stores, complementary goods are sold more frequently by the stores in these clusters. It also allows market share to be captured and customers can compare goods (Brown, 1989; Hotelling, 1929). In addition, research concludes that when a retailer establishes itself close to compatible peers and anchor stores, it is less likely for them to fail in the long run (Kickert & Hofe, 2018).

One of the first theories explaining retail agglomeration is Hotelling's Principle of Minimum Differentiation (1929). This principle explains the retail agglomeration of similar stores in shopping areas. The theory is about the fact that many products (such as glasses) have more similarities than differences while differentiation is crucial for success. He focused on why similar companies settle in the same neighbourhoods of a city. Hotelling found that consumers prefer the closer store of two options when purchasing fixed-priced goods with identical features. This forces both firms to settle in the middle of the market, because a firm that chooses to settle on one side of the middle would leave most of the market to its competitor (Mutyala, 2011; Hotelling, 1929).

2.2.4 Shopping motives

Although the early theories regarding shopping assumed that consumers consider shopping as a utilitarian activity (something that must be done), already in the 1970s, Tauber hypothesized that motives for shopping are not only related to buying a product but to other needs as well (Tauber, 1972). This initiated a lot of research regarding shopping motives, supporting that shopping can be a hedonic activity as well. The utilitarian shopping motive is about the efficiency of the shopping process. These are mainly goal-oriented customers whose goal is to complete a shopping task (Babin et al. 1994). Hedonic shopping motivations are associated with amusement, pleasure, and enjoyment (Babin et al. 1994). Consumers seek the pleasure of shopping rather than the utility of the purchase and derive satisfaction from the shopping experience (Mikalef et al. 2013). AbedRabbo et al., (2022) found that interactions with entertainment facilities (cinemas, pubs, and bowling) cafes, and restaurants or special events organized in the city centre complemented the utilitarian purpose of shopping in the centre and had a strong influence on consumers' intention to stay and spend money in the centre. This fits with the emergence of the experience economy (Pine and Gilmore, 1999).

This shift from utilitarian to hedonic shopping is also related to changes in consumer preferences. As Statistics Netherlands data show, increasingly fewer consumers value owning products. From this follows the trend of sharing, borrowing, or renting versus buying products. Whereas before it was only about digital products such as Spotify or Netflix. Now all types of products are shared such as homes via AirBnB or scooters via Felyx (ShareNL, 2015). The increasing complexity and unpredictability of consumer behaviour cause the retail landscape is becoming increasingly complex. The role that traditional brick-and-mortar-retail has is changing by the competition form online retailers and the growing presence of leisure activities and services (Dolega, et al., 2021). The shift from buying to borrowing is also related to the shift from utilitarian to hedonic shopping.

The emergence of online shopping also initiated a lot of research on shopping motives and the changing retail environment. For example, Dolega et al. (2021) concluded that due to the shift to internet shopping in recent years, the trend of experience shopping is continued. Inner-city areas become comparison and leisure destinations (Dolega, et al., 2021). This increase in online shopping has a major impact on the closure of brick-and-mortar stores (Rose, et al., 2012). Weltevreden and van Rietbergen indicated in 2009 that city centres are most likely to face the substitution of in-store shopping for e-shopping, even though online shopping also creates additional demand (Weltevreden & Rietbergen, 2009). However, it will not cause all physical stores to disappear (Burayidi & Yoo, 2021). Several studies on the psychological and sociological consequences of the shift to online shopping prove also that online retail and delivery services can only partially replace the historical meaning of shopping (Mosteller et al., 2014; Wang et al., 2011). This is also evident from studies conducted during the Covid-19 crisis and its associated lockdowns, in which people were restricted in travel and individual freedom (Pieh et al., 2021; Rossi et al., 2020).

2.2.5 Anchor Stores

From 1950, there was increasing research into the 'ideal' shopping centre and anchor stores were discussed for the first time. Konishi & Sandford (2003) in their research define the anchor store as: *"a store that increases, through its name's reputation, the traffic of shoppers at or near its location. Consumers, attracted by the anchor's name, are likely to visit the location, and thus nearby stores' sales and profits are increased by the presence of the anchor."* Examples of anchor stores are department stores (especially in the past), and in the present day, supermarkets and (inter)national chain stores. The anchor store was valued by mall developers for their ability to attract shoppers as well as non-anchor tenants to malls (Gould, et al., 2005; Brueckner, 1993; Benjamin, et al., 1992). Therefore, these stores were often found in most shopping malls (Zhou & Clapp, 2015; Konishi & Sandfort, 2003). When a new planned shopping mall opens, it needed the commitment of one or more anchor stores. The opening of an anchor store changes the economics of clusters of independent stores (Kramer, 2008). For example, Swamynathan, et al. (2013) suggest in their research that anchor stores are an important driver for mall patronage. There are also benefits for other stores collocating with anchor stores in shopping centres, such as increased traffic and complementary sales (Konishi & Sandfort, 2003; Damian, et al., 2010). The study by Kickert and Vom Hofe (2018) shows that other retailers still benefit from locating near anchor stores, measured in long-term failures. about shopper circulation in a planned shopping centre, the role of anchor stores is discussed. They concluded that most consumers in a shopping area are confined to a relatively small part of the shopping centre. Here the intersections of the main streets are the busiest places. This is often where the key tenants (anchors) are located. These anchors also provide circulation in the shopping area. Furthermore, a strong connection can be seen between similar stores in the vicinity. Although the articles discussed above are primarily about anchor stores in planned shopping centres, it is evident that similar mechanisms apply in inner-city shopping areas.

2.2.6 Tenant mix

The tenant mix consists of two components (Kirkup & Rafiq, 1994). The first includes the proportion or number of space or units of different retail/service types. This is also called the Retail Mix (number, size, and types of stores). This retail mix determines whether consumers are attracted to the centre. Arentze (1999) concluded that consumers are especially happy with choice opportunities and diversity in shopping areas. Research by Sit et al. (2003) concluded that consumers appreciate food and entertainment in shopping centres. However, these elements were lacking during the time of research. Recent literature does indicate that today a shift toward these facilities in shopping centres is underway (Locatus, 2023; Dolega, et al., 2021). The second component of tenant mix concerns the relative placement of tenants in the centre. This component stimulates shopper circulation in the shopping centre and encourages impulse shopping (Kirkup & Rafiq, 1994). Especially the location of anchor stores is important to stimulate circulation. In addition. Brown (1993) concluded that consumers often visit the same types of stores in proximity, matching the expected effects of agglomeration.

2.3 Conclusion

To answer the first sub-question (a): *"What (recent) macro-occurrences and retail-related academic perspectives follow from literature and how did they affect both the retail facility mix and the spatial distribution of retail facilities in cities in western Europe?"*, a literature review of retail history and -academic perspectives has been conducted in this chapter. This concluding section will first provide an overview of the most important findings of the literature review on the developments in inner-city shopping areas and the field of academic research

through the years. Furthermore, it will outline the current trends and their implications for brick-and-mortar retail facilities during the period 2004 - 2022.

2.3.1 Historic overview

The inner-city shopping areas of cities have undergone considerable changes since the emergence of market squares in historic inner cities around 1300. Retail originated in places where merchants, farmers and guilds crossed paths and could exchange their goods. This happened in the market squares, the most important places in the city. Shopping at that time was done based on convenience and took place in easily accessible places.

Due to economic growth in the mid-14th century, cities became increasingly crowded places where many people lived in small areas with poor hygiene. War and disease changed demographics in cities. The rise of sea trade between companies, the introduction of money and the rise of capitalism widened income gaps in society, and the demand for luxury goods increased. As cities expanded on the outer edges, new places for trade emerged. Where previously trade had only taken place on traditional market squares, small stores were now opened on intersections of main streets. Here also a distinction arose in the sale of durable (luxury) goods in the city centre and the daily necessities that were also sold in the smaller districts. During the early modern period, the first planned retail area, the Great Bazaar of Istanbul was opened.

During the retail- and industrial revolution between 1650 and 1850, the number of merchants that sold specific goods rose enormously. Due to the new infrastructure that the industrial revolution entailed, flows of goods and passengers between cities emerged. However, health and safety were neglected during this time.

As a reaction to the industrial revolution, concerns about health and safety in cities grew. The emergence of new communication technologies around 1850, gave customers access to a wide range of goods from around the world via mail/phone/telegraph. International trade emerged between companies and consumers. The growth of mail-order retail came at the expense of traditional brick-and-mortar stores. Around the same time, the first department store opened, after which it became a dominant player as an anchor store in shopping areas.

Affluent consumers bought their luxury items here as a form of entertainment. While women used to shop for entertainment, this changed to a utilitarian shopping motive as they had no free time because they had to work in factories. These anchor stores attracted consumers and non-anchor tenants because they provide increased traffic and complementary sales for stores that were located nearby. Partly because of this, smaller stores could continue to exist alongside the new, large retail formats. But they also served a different consumer and offered, unlike the anchors, convenience products. After the emergence of these anchor stores, more thought was given to land use in cities, including their retail locations. The mono-concentric theories of Burgess (1925) and Hoyt (1939) are examples of this. Later, more organic, and realistic models that describe a city containing multiple centres for (retail) trade were developed by Harris and Ullman (1945), and Vance (1972). Theories to describe retail agglomeration were also described during that time, like Hotelling's (1929) principle of minimum differentiation.

The law of retail gravitation (1931) and the central place theory of Christaller (1933) explain the patterns of retail centres considering the size of the centre and the maximum distance a consumer is willing to travel for a particular type of centre. The last model was used in post-World War II reconstruction in the Netherlands. During this time, new residential districts with new shopping facilities were built on the outskirts of cities to meet the housing shortage. During this time, convenience prevailed over entertainment. Large, cheap, one-price stores emerged as a contrast to the traditional department stores that sold mostly luxury goods. However, research from the 1970s hypothesized that shopping is related to more than only buying a product. Furthermore, the automobile became more dominant in the streetscape of city centres. Planned shopping malls with parking facilities arose in city centres (in the Netherlands) as well as in the periphery (in other countries in Europe). The same was true for supermarkets, which often stimulated retail developments in residential areas. Although this was criticised by academics and urban planners at the end of the 20th century, after which inner-city shopping areas were made more suitable for pedestrians. The rise of the planned shopping centre-initiated research into the ideal shopping centre, including the tenant mix. It could be concluded that consumers often visit the same type of stores in proximity and consumers welcome diversity in the shopping area. Furthermore, the formation of the European Union allowed free trade between countries, which initiated the increase of the number if (inter)national chain-stores. The rise of e-commerce at the end of the 20th century, combined with the competition from supermarkets (outside the inner-city) and (inter)national chain stores, caused a decline in the number of small stores in inner-city shopping areas.

This trend continued after the year 2000 and was reinforced by the economic downturn just after the turn of the century. Convenient shopping was growingly taking place online, also due to restrictions imposed by COVID-19. In combination with the emergence of the experience economy, inner-city shopping areas are becoming increasingly a place for leisure. Where previously trade flourished on historic market squares, this has now become primarily a meeting place with hospitality facilities. This can also be seen in the shift from non-food-related stores to (smaller) food-stores and hospitality in inner-city shopping areas. Due to an ageing population and the outflow of the younger population from some parts of the country, shrinkage regions emerge. The demand for stores in these shrinkage regions is different from the demand in growth regions. With the younger generation of consumers, leasing and sharing appears to be a new trend. Department stores and shopping malls are no longer in favour and a shift in anchor stores towards the (inter)national retail chain fashion department stores can be observed.

Based on this literature review, it can be interpreted that new ways for trade had an immense impact on the shopping behaviour of consumers and thus on the development of the retail landscape in Europe. For example the emergence of sea trade, the industrial revolution, and the development of new communication technologies. Furthermore, some current trends and their impact appear to be consistent with past trends. For example, the emergence of e-commerce seems to match the emergence of mail-order-retail about 200 years ago, which probably also cause the closure of many stores. Furthermore, it seems that when consumers are doing well economically, they are more likely to shop for experience. For instance, during the beginning of the 14th century, wealthy people were looking for experience in buying luxury items, which may led to a rise in the number of stores selling luxury goods in the inner city. Around 1850, after the industrial revolution, department stores emerged. These stores sold luxury goods and were visited by consumers with an experience motive. Nowadays, people in the Netherlands are relatively wealthier than e.g. 50 years ago after the World War II period (Sonsbeek, et al., 2023). And right now, an experience economy seems to be emerging again. Not in stores that provide luxury goods, but in hospitality and other experience facilities.

A schematic overview of the emergence of retail in cities in West-Europe, including legend can be found in Figure 2 on the next page.

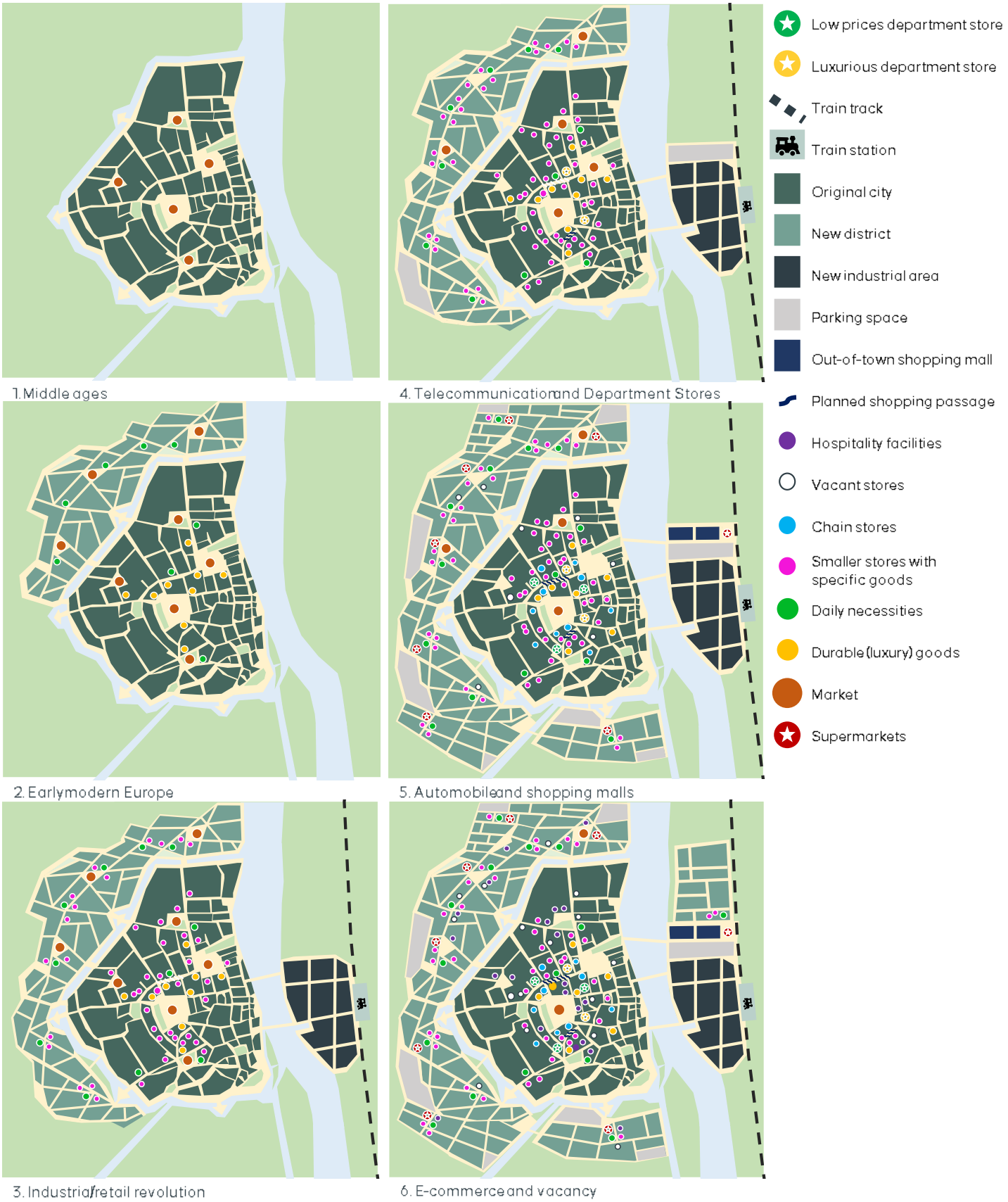

Figure 2: Schematic overview of the emergence of retail in cities in West-Europe

2.3.2 Current trends

The historic literature review provides a clear overview of all the macro-occurrences and academic perspectives that have taken place in history, and how inner-city shopping in general in western Europe areas responded to them. However, the main question that will be answered through this study focuses particularly on the developments of inner-city shopping areas from the 21st century onwards. To answer the main research question, the current trends in particular are important.

Looking at these current trends, it can be concluded that the number of stores has been decreasing in inner-city shopping centres due to the rise of mail-order and later online retailing. However, the financial crisis between 2008 and 2014 and the COVID-19 pandemic between 2019 and 2022 accelerated this decrease. Furthermore, since the emergence of the European Union, the (inter)national competition between stores increased. In addition, there is a shift in anchor stores: from department stores to (inter)national fashion department stores. Shopping malls are also no longer popular. Utilitarian and hedonic shopping motives alternate over the centuries. Since the turn of the last century, there has been increasing talk of the experience economy. Now, convenience shopping is increasingly done online, and inner-city shopping areas are becoming a place for leisure where people seek entertainment. This is also reflected in the streetscape, where an increase is taking place in the number of hospitality and cultural/recreational facilities.

Briefly, four major retail trends in western European cities follow from certain macro-occurrences going on for the past 20 years. These are presented in Figure 3 below.

1. Decrease in the number of stores Due to the emergence of e-commerce and sharing economy (around 2000). The decrease accelerated during the financial crisis (2008-2014) and the COVID-19 pandemic (2019-2022).	**3. Change in anchor stores** From the traditional department store (e.g., V&D or Bijenkorf) to fashion department stores (e.g., H&M or Zara) due emergence of retail-chain stores
2. Increased competition between (inter)national chain stores Since the emergence of the European Union (around 1960).	**4. Emergence of the experience economy** Since the emergence of e-commerce (around 2000); seen in the increase in number of experience facilities in the city centre.

Figure 3: Overview four major retail trends in Western Europe

However, the literature that has been studied is mainly about planned shopping centres in large cities in Europe. Research on these trends for inner-city shopping areas in the Netherlands is lacking. Also, research is lacking on the effects of these recent changes on the spatial pattern of retail facilities in inner-city shopping areas. Therefore, this study there will focus on the effects of these trends on both the retail facility mix and the spatial pattern of retail facilities in inner-city shopping areas of medium-sized cities.

3. Methodology

To be able to answer sub-questions b and c about the development in the retail facility mix and spatial pattern of retail facilities respectively, quantitative desk research will be conducted. This research will consist of analyses of the changes in the retail facility mix as well as in the spatial pattern of retail facilities. Since data has been made available for this study, the method used in this study is data-driven. The analyses will be used to test whether the current trends that follow from the literature review (see sub-section 2.3.2) also apply to retail in medium-sized cities in the Netherlands. Furthermore, it will be analysed how the developments in the retail facility mix may influence the developments in the spatial pattern of retail facilities. In addition, it will be analysed whether any developments in the composition and spatial pattern of retail facilities can be seen that do not follow from the literature.

This chapter will explain the methodology used for these analyses. First, the cities that will be subject to the analyses will be presented in section 3.1. In section 3.2, the collection and characteristics of the data will be described. In section 3.3, the division of the retail facilities will be described. The method for analysing the changes in the retail facility mix over the years will be presented in section 3.4. Subsequently, the way the change in the spatial pattern of retail facilities will be analysed is presented in section 3.5. The method to test confluences between changes in the retail facility mix and the spatial pattern of retail facilities will be described in section 3.6. This chapter finishes with the concluding section 3.7.

3.1 Selected cities

First, it is determined which medium-sized cities in the Netherlands are most suitable for this analysis. In this thesis, medium-sized cities are defined as cities with 100,000 to 250,000 inhabitants. To be able to correctly compare the retail developments in these cities, cities are selected that currently have approximately the same number of inhabitants. For this, the most recent (January 2022) population size is analysed. The information is obtained from Statistics Netherlands. The cities of Amersfoort, Apeldoorn, Arnhem, Breda, 's Hertogenbosch, Enschede, Haarlem, and Nijmegen seem to be the best match given the number of inhabitants (all between 155 thousand and 185 thousand inhabitants).

Since tourism has a major impact on inner-city shopping areas (Chatterjee, et al., 2020; Clols, 2021), there is also looked at the number of overnight stays in lodging facilities per municipality in 2019. This is done to check the influence of tourism on the selected cities. All cities are similar in terms of numbers (under 500 thousand overnight stays), except for Apeldoorn with 1.828 million overnight stays (Statistics Netherlands, 2021). For this reason, Apeldoorn is excluded from the final selection. The final selection consists of 1. Amersfoort, 2. Arnhem, 3. Breda, 4. 's Hertogenbosch, 5. Enschede, 6. Haarlem, and 7. Nijmegen. The locations of these cities are shown in Figure 4.

Figure 4: Location indication

3.2 Data collection and characteristics

To perform both the analyses on the developments in the retail facility mix and the spatial pattern, a dataset with high-fidelity geographical data about retail facilities in inner-city shopping areas over the years 2004 to 2022 is made available by Locatus for this study. Locatus is the market leader in retail information in the Benelux. More than 20 years ago they started building a database containing information about stores, shopping areas and passers-by counts in shopping areas. The dataset made available by Locatus includes variables for all retail facilities (IDs) in each selected city and each of the years from 2004 to 2022: the type, sub-type, category, retail floor area, and location (X- and Y-coordinates). The variables, including examples of the corresponding data, in the dataset are presented in Table 1. As for the type, sub-type and category per ID, Locatus' designations will be used.

Table 1: Structure of the total dataset for analyses (example)

City	Year	ID	Retail chain	Type	Sub-type	Category	RFA	X_Local	Y_Local
Arnhem	2019	182908	Zara	Fashion & luxury	Clothing & fashion	Fashion department store	862	6.893641	52.217051
…	…	…	…	…	…	…	…	…	…

The variables in Table 1 can be explained as follows:

City: Name of the city in which the retail facility is located

Year: Year of observation

ID: Unique number assigned to a retail facility

Retail chain: Name of retail chain to which a retail facility is affiliated, or 'Independent' if store is not affiliated with a retail chain

Type: Highest level of the Locatus designation (divided into sub-types and then into categories)

Sub-type: Collective name for categories with the same characteristics regarding the goods that are being sold (divided into categories)

Category: Characterisation of an activity of a retail facility

RFA Retail floor area in square meters, the covered space accessible and visible to the consumer (including space behind the counter and display window, excluding warehouses and staff areas)

X_Local: X-coordinate of the geographic centre of the retail facility, according to the national system (in the Netherlands RD (National Triangle))

Y_Local: Y-coordinate of the geographic centre of a retail facility, according to the national system (in the Netherlands RD (National Triangle))

Locatus distinguishes ten different Types. All retail facilities are assigned to only one of these ten types. For all types, at least five retail facilities are observed per city and year, except for the type Transportation and fuel. For this reason, all retail facilities assigned to this type are excluded from this study.

3.3 Division of retail facilities

Based on the types, sub-types, and categories as assigned by Locatus (see Section 3.2), a new division is made in retail facilities (see Table 2). With these new division, a dataset is created based on the original dataset of Locatus. This is done to match the findings from the qualitative research with the findings from the quantitative research. In addition, this is done to be able to perform analyses to determine changes in the retail facility mix and the spatial pattern. The way this new division is created is described in this section.

Firstly, the nine different types are grouped into four functions: store, experience, service, and vacant. As can be seen in Table 2, only the functions store and experience consist of more than one type. These types correspond to the types assigned by Locatus (see Section 3.2). Furthermore, only for the retail facilities with the function store, there is looked at two extra attributes: if the store is affiliated to a certain retail-chain or is independent, and if the store can be classified as (fashion) department store or not. These have been determined based on the current trends that follow from the literature review (see Sub-Section 2.3.2).

The retail-chain attribute has the value 'Yes' or 'No'. This value is determined using the values of the 'Retail Chain' variable of Locatus. Stores that have the value 'No' are independent. All other stores (affiliated with a retail-chain) do get the value 'Yes'.

As for (fashion) department stores, there will be a distinction made between department stores, fashion department stores or stores other than (fashion) department stores. the latter is given the name 'No Value' in the dataset. Locatus has designated certain retail facilities as fashion department store or department store. These designations are taken over and are used in this study. With department stores, all retail facilities with the type of fashion & luxury and the Locatus sub-type department store are meant (e.g., De Bijenkorf, Hema, V&D). Fashion department stores include all retail facilities with the type fashion & luxury, the Locatus sub-type clothing &

fashion, and the category fashion department store (e.g., C&A, De KOOPman, H&M). Table 2 gives a schematic overview of the functions, types, and attributes.

Table 2: Division of the retail facility mix

Function	Retail chain	Type	Department store
Store	Yes or no	Daily	
		Fashion & luxury	Department store, fashion department store, or no value
		Leisure time	
		In/around house	
		Other store	
Experience		Hospitality	
		Culture & recreation	
Service		Services	
Vacant		Vacancy	

To get an idea of the distribution of the retail facility mix of all retail facilities per function, type, and attribute, Figures 5 to 9 have been created. These figures show the share of the total number of retail facilities or the total retail floor area for all years and all seven cities together. Figure 5, shows the share of the total number of retail facilities per function compared to the total number of all retail facilities. Since only the functions Store and Experience are divided into multiple types, the share of these types compared to the total number of retail facilities of that particular function are given in Figure 6 and Figure 7. So for example the total number of in/around house stores compared to the total number of all stores. The share of (fashion) department stores compared to the total number of stores is <1%. Therefore, the share of (fashion) department stores is displayed as the total RFA of the (fashion) department stores relative to the total RFA of all stores (see Figure 8). The percentage of stores that are linked to a certain retail chain or not compared to the total number of stores is shown in Figure 9 .

From Figures 5 to 9, it can be concluded that some functions, types, and attributes are in the majority, while others are in the minority. However, all distinctions have a share of at least 5% (in number or RFA). In this study, this is assessed as significant. So, it is acceptable to continue with this set of distinctions. The results of the analyses of the changes in both the retail facility mix and the spatial pattern of retail facilities will be shown per function, type, and attribute in Chapter 4.

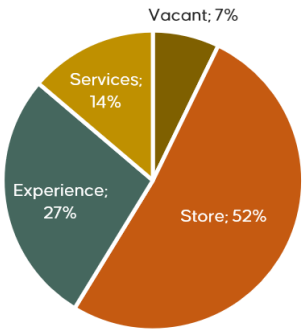

Figure 5: Distribution of the total number of retail facilities into the number of retail facilities per function (N = 116,362 retail facilities)

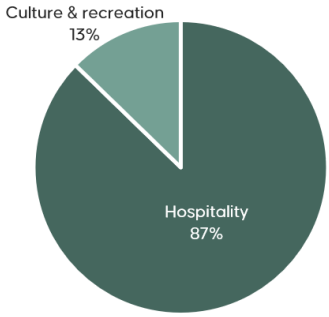

Figure 6: Distribution of the total number of experience facilities into the number of facilities per type (N = 31,996 experience facilities)

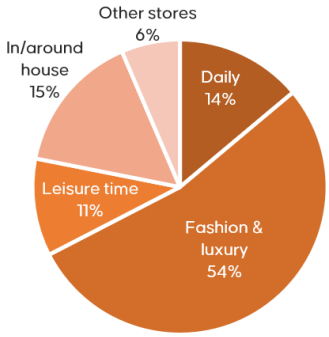

Figure 7: Distribution of the total number of stores into the number of stores per type (N = 59,983 stores)

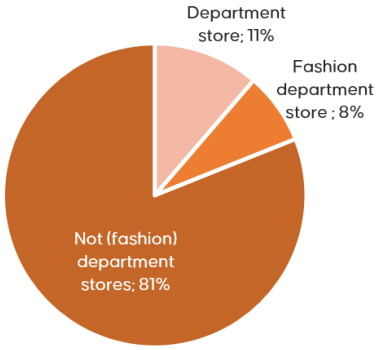

Figure 8: Distribution of the total RFA of stores into the RFA of (fashion) department stores and other stores (N = 11,482,896m^2)

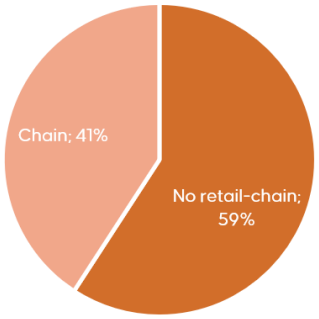

Figure 9: Distribution of the total number of stores into the number of chain and no-chain stores (N = 59,983 stores)

3.4 Changes in the retail facility mix

To answer sub-question b: *"Can a development in the retail facility mix in inner-city shopping areas in Dutch medium-sized cities be observed at the beginning of the 21st century and what macro-occurrence may influenced these changes?"*, analyses will be conducted to determine developments in the retail facility mix. The results of these analyses will be linked with the recent trends that follow from the literature review (Sub-Section 2.3.2). In this way, it is possible to see what may influenced the changes in the retail facility mix. The analyses will be conducted using Microsoft Excel and the statistical program SPSS. To evaluate the trends, several units of measurement will be considered (see below). These include information about the number of retail facilities and the RFA of retail facilities. Since the retail floor area of only stores and vacant facilities is known since 2004, the RFA will only be analysed for the functions store and vacant. Therefore, the units of measurement for the functions, types, and attributes include:

Retail facilities (#):	Total number of retail facilities per function, type, or attribute (e.g. the total number of stores)
Retail facilities (%):	Total share of retail facilities per function/type/attribute compared to the total number of facilities with a certain function (e.g. the share of the number of hospitality facilities compared to the total number of experience facilities)

In addition, only for the functions vacant and store there will be also looked at:

Average RFA: Average RFA per retail facility per function/type/attribute (e.g. the average RFA of all fashion & luxury stores)

RFA (%): RFA share per function/type/attribute compared to the total RFA of all functions, types, or attributes (e.g. the share of RFA of all fashion & luxury stores compared to the RFA of all stores.

The analyses will be performed in three steps per function, type, and attribute for all seven medium-sized cities together from 2004 to 2022. First (step 1), it will be assessed whether (the share of) the number or RFA of retail facilities differs over the years or not. If the difference over the years is significant, the data will be analysed using trendlines to see what kind of developments in the number or RFA took place from 2004 to 2022 (step 2). Finally (step 3), the correlations between the developments over the years will be evaluated to see if certain developments confluence with each other. The elaboration of these three steps will follow in the next three sub-sections.

3.4.1 Differences over time

The first step is to determine if (the share of) the number or RFA per function, type, and attribute significantly differs over time from 2004 to 2022. Based on this analysis, a division can be made between the units of measurements that do significantly differ over the years, and that do not differ over the years. It is expected that the units of measurements that do not significantly differ over the years are not influenced by macro-occurrences. For this test, (the share of) the total number or RFA of a certain function, type, or attribute, per city and per year will be compared with each other. This input will be analysed by means of the non-parametric Friedman test, a non-parametric alternative of the ANOVA Repeated Measurements test. The ANOVA test is not usable since the data does not meet the assumption of a normal distribution and the sample size is small (only seven cities). The Friedman test is more commonly used in the medicine field to test differences in effects over time (Riffenburgh, 2006).

The Friedman test will be performed using Microsoft Excel, an example of the elaboration of the test for the years 2004 to 2010 is given in Table 3. Firstly, the input data will be prepared. Per function, type, or attribute, (the share of) the total number or RFA per city and per year will be calculated. Subsequently, per city, this data will be ranked over the years. The rankings over all cities will be added together, and then squared (mentioned as T and T^2). Then, the Friedman F_r Statistic, which is distributed as chi-square, will be calculated with Formula 1 (Riffenburgh, 2006). In this test, k indicates the number of years and n the number of cities.

$$F_r = \frac{12}{nk(k+1)}(T_1^2 + T_2^2 + \cdots + T_k^2) - 3n(k+1) \quad \textbf{(1)}$$

Then, the critical value will be obtained from the Tables of Probability Distributions (Riffenburgh, 2006) (χ^2 right tail) for $k-1$ df. The P-value will be calculated by Microsoft Excel. If the critical value is smaller than the Friedman F_r Statistic and the p-value is smaller than 0.05, it can be concluded that (the share of) the total number or RFA of a certain function, type, or attribute significantly differs over the years.

Table 3: Example Friedman test

	2004		2005		2006		2007		2008		2009		2010	
City	*Number*	*Rank*	*Number*	*Rank*	*Number*	*Rank*	*Number*	*Rank*	*Number*	*Rank*	*Number*	*Rank*	*Number*	*Rank*
Amersfoort	650	7.0	637	6.0	632	3.5	634	5.0	624	2.0	622	1.0	632	3.5
Arnhem	897	6.0	858	1.0	869	3.0	861	2.0	895	4.0	896	5.0	901	7.0
Breda	1014	6.0	1005	5.0	1000	2.5	993	1.0	1019	7.0	1000	2.5	1003	4.0
Den Bosch	1052	7.0	1008	4.0	999	2.0	989	1.0	1004	3.0	1009	5.0	1013	6.0
Enschede	577	1.0	640	6.0	643	7.0	626	4.0	624	3.0	623	2.0	628	5.0
Haarlem	1154	7.0	1118	4.0	1142	6.0	1125	5.0	1117	2.5	1117	2.5	1110	1.0
Nijmegen	977	7.0	943	1.0	973	6.0	945	2.0	963	3.0	970	4.0	972	5.0
T		41.0		27.0		30.0		20.0		24.5		22.0		31.5
T^2		1681.0		729.0		900.0		400.0		600.3		484.0		992.3

The results were substituted in Equation 1 to obtain:

$$F_r = \frac{12}{nk(k+1)}(T_1^2 + T_2^2 + \cdots + T_k^2) - 3n(k+1)$$
$$= \frac{12}{7 \times 7 \times 8}(8786.5) - 3 \times 7 \times 8 = 9.14$$

Looking at the critical value of the Friedman F_r Statistic (9.14), in Table III of the Tables of Probability Distributions (Riffenburgh, 2006) for α = 0.05 and with $k - 1 = 6\ df$, it is 12.59. Since the critical value is larger than the Friedman F_r Statistics it can be concluded that the total number of retail facilities does not differ over the years 2004 to 2010. The P-value, calculated with Microsoft Excel, is 0.17.

If (the share of) the number or RFA of retail facilities with a certain function, type or attribute does significantly differ over the years, these developments will be analysed using trendlines, explained in sub-section 3.3.2. In case there is no significant difference in a certain unit of measurement of a function, type or attribute, this unit of measurement will be excluded from the next analyses and tests.

3.4.2 Trendlines

Since the Friedman test only tests if (the share of) the number or RFA of retail facilities significantly differs over the years, it is interesting to find out how this (share of) number or RFA develops over time. In this way, it is possible to see if certain developments confluence with macro-occurrences that followed from the literature review. For this purpose, several steps will be executed using trendlines in Microsoft Excel. Only the units of measurement of a certain function, type that significantly differ over the years will be included in these trendline analyses.

As first step, a scatter diagram will be created per unit of measurement for every function, type or attribute for which differences over the years have been proven through the Friedman tests. These diagrams will include information about the quantity of one unit of measurement per function, type, or attribute on the Y-axis. On the X-axis of the diagrams, the years (2004 to 2022) will be presented. Per year, one data-point will be presented, representing the unit of measurement (e.g. the number of stores) of all seven cities together.

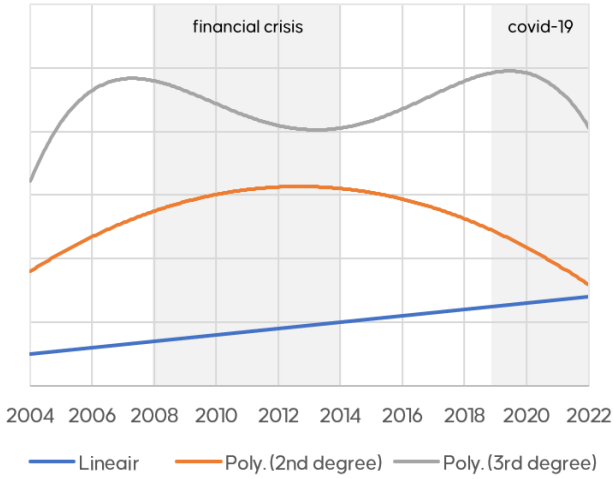

Figure 10: Example linear and polynomial trendlines

Subsequently, the most suitable trendline will be added to these diagrams by assessing the determination coefficient. The shape of the trendline indicates the course of the trendline. From the literature review, the assumptions can be made that (the share of) the number or RFA of retail facilities per function/type/attribute constantly decreased or increased from 2004 to 2022. However, two sudden macro-occurrences happened between 2004 and 2022: the financial crisis and the COVID-19 pandemic. These occurrences may influence an ongoing trend. For this purpose, in this study two different lines are distinguished: linear and polynomial. Microsoft Excel offers more types of trendlines. However, testing these trendlines has shown that the determination coefficient of these other trendlines does not strongly deviates from the linear or polynomial trendline. A visual representation of the used linear and polynomial lines can be found in Figure 10. The linear trendline implies a linear trend in e.g., the number of retail facilities. It can be a trend with an increasing slope, or a decreasing slope. The polynomial trendlines, on the other hand, show complex trends. This trendline is a curve that can bend and contains multiple terms of different powers. It can imply for example a U-shaped curve or an S-shaped curve. The grade of the equation defines the number of peaks and/or dips. These imply how much the data fluctuates over the years. Since it is expected that the constant trends can be influenced by two sudden macro-occurrences a requirement is set for the polynomial trendlines. This requirement entails that only polynomials up to and including the third degree will be included in this study.

As told above, trendlines will be assessed by the determination coefficient of the trendline. So, subsequently, the determination coefficient (R^2 value) will be added to the diagrams. The R^2 values will automatically be calculated by Microsoft Excel while fitting the trendlines. With this R^2 value, the degree of correspondence between

the trendline and the actual data points will be assessed. It indicates the percentage of variance in the dependent variable (e.g., the number of retail facilities) that can be explained by the trendline (Gouda, et al., 2019). In this study, the determination coefficient indicates how well the data points follow a certain trendline over the years and thus show a clear development. In this study, the interpretation of both the determination coefficient as well as the correlation coefficient are derived from the 'rule of thumb' of Prion & Haerling (2014). The R^2 value can be interpreted as:

0.00 – 0.04:	Negligible correspondence
0.04 – 0.16:	Weak correspondence
0.16 – 0.36:	Moderate correspondence
0.36 – 0.64:	Strong correspondence
0.64 – 1.00:	Very strong correspondence

In this study, there will be looked for a strong correspondence between the trendline and the datapoints over the years in order to reduce the risk of deciding there is a clear development while in fact there is no trend. This means that the R^2 value for a linear or polynomial up and including the third-degree trendlines should be 0.64 or higher. Trendlines with an R^2 value below 0.64 will be excluded from the results.

The last part is the description of the trendlines and explaining the developments in trendlines. This will be done per function, type, and attribute. A relationship is sought between the macro-occurrences as described in the literature review and the trends that are visible in the data. Furthermore, to better understand certain trends, additional information about the trends will be provided based on findings from the dataset. For example, to see what function, type or attribute replaces a department store when it closes. This is done by analysing the data by means of dummy coding in combination with pivot tables in Microsoft Excel. Dummy coding is a technique to convert categorical data into numerical values. Pivot tables allow to summarise, analyse, and reorganize these numerical values and other large amounts of data based on various criteria. In this way, it will be examined what kind of trends can be identified from the data about the number or RFA of retail facilities per function, type, or attribute between 2004 and 2022.

3.4.3 Confluences in developments

From the literature review, it can be concluded that several developments in the retail facility mix confluence with each other. For example, the number of fashion department stores increases at the same time as the number of department stores is decreasing. To evaluate if these confluences also occur in medium-sized cities in the Netherlands, the Spearman rank-order correlation test will be executed. It is chosen to conduct this non-parametric test since the data is not normally distributed and the sample size is small. In this study, the test measures the confluence of two developments with one certain unit of measurement. The outcome will be presented as the Spearman correlation coefficient (denoted by r_s).

The input for this test are the units of measurement per function, type or attribute for all seven cities together from 2004 to 2022 (N = 19). So for example, the number of stores for all seven cities together for the years 2004 to 2022. The developments in the different units of measurements will be compared with each other to test if there are confluences. To keep the results manageable, only the same units of measurement are compared with each other. For example, the development in the total number of stores will be compared with the development in the total number of daily stores. Furthermore, only the units of measurement that are included in the trendline analyses are included, so if the Friedman test proves a significant difference over the years and the trendline shows an R^2 value of more than 0.64. The results of Spearman's rank-order correlation test will be presented in a matrix. This matrix includes the correlation coefficient r_s, and the significance value. The results will be interpreted according to the 'rule of thumb' of Prion & Haerling (2014) for interpreting Spearman correlation coefficient results:

0.00 – 0.20:	*Negligible* confluence between two developments
0.21 – 0.40:	*Weak* confluence between two developments
0.41 – 0.60:	*Moderate* confluence between two developments
0.61 – 0.80:	*Strong* confluence between two developments
0.81 – 1.00:	*Very strong* confluence between two developments

As for the Spearman correlation coefficient, the null hypothesis is that there is no confluence. When the results of the Spearman correlation tests show a statistical significance of P-value < 0.05, the null hypothesis can be rejected. This means that there is a confluence between the two variables.

In this study, only the significant and relevant very strong correlations will be described and exceptionally if relevant also significant and strong correlations. With the results of this part of the analysis on the development in the retail facility mix, it can be concluded if developments of a certain function/type/attribute confluence with the developments of another function/type/attribute. Furthermore, it can also be concluded in what way the developments correlate with each other: positive or negative.

3.5 Changes in the spatial pattern of retail facilities

By means of analysing the developments in the spatial pattern of retail facilities, an answer will be given to sub-question c: *"Can a development in the spatial pattern of retail facilities in inner-city shopping areas in Dutch medium-sized cities be observed at the beginning of the 21st century and what macro-occurrences may influenced these changes?"*. This is done by conducting spatial analyses. These analyses will help to observe how the spatial distribution of the different functions, types or attributes develops over the years. Furthermore, it will be analysed if the developments confluence with the happening of macro-occurrences.

In Sub-Section 3.5.1 it is described how the spatial pattern will be analysed. Subsequently, in Sub-Section 3.5.2, information about generating the data about the spatial pattern over the years using the geographical information system computer program QGIS is given. Also the implementation of the data processing is given in this sub-section. Subsequently, the output data will be analysed using the same techniques as for the analyses of the changes in the retail facility mix. These techniques are shortly discussed in sub-section 3.5.3. In addition to these techniques, also a visual inspection of maps including the locations of retail facilities throughout the years will be conducted.

3.5.1 Analysing spatial pattern

Based on findings in the literature, the changes in the spatial pattern of retail facilities can be measured by observing the agglomeration of retail facilities. This agglomeration can be measured in several ways. According to Heinritz, et al. (2003), a retail agglomeration can be defined as a gathering of three or more retailers within a certain distance. Measuring the number of certain retail facilities in a certain radius is a common method to analyse agglomerations (e.g., Kickert, et al., 2020, Ripley, 1976 or Howard, et al., 2016). Kickert, et al (2020) for example use the radius of fifty meters because this distance allows for measurements of retail facilities across the street, within viewing distance. However, the radius is self-determined and is not scientifically based. Also, some inner-city shopping areas are larger than others or have an obstacle (e.g., canals) running through the inner-city which influences this measurement. To avoid this, the distance between outlets must be respected.

Some studies also include the retail floor area of retail facilities in measuring retail agglomeration. However, in this study, the developments in the RFA of retail facilities are already included in the analyses of the development in retail facility mix. The results of these analyses will be tested for correlations with the results of the analyses in the developments in spatial pattern (see section 3.5). Therefore it is chosen to exclude the RFA from the spatial pattern analyses.

Research on shopping centre rents implies that the distance of stores in particular to other stores of the same type, can be identified as one of the most important determinants for choosing a location (Hirsch, et al., 2016). According to the research of Hirsch (2016), retail clustering can be detected by analysing mean distances between stores. This includes the comparison of the mean distance between stores of the same type with the mean distance between stores of another type. This helps to see if stores of the same type are located closer to each other than those of other types. This Nearest neighbour analysis method is also used often in ecological studies (Rifaie, et al., 2015; Stoyan and Penttinen 2000; Perry et al. 2006). This test suffers from the inability to characterise patterns at distances beyond the nearest neighbour since the test only includes the distance to the nearest neighbour and not the distance to the second, third, etc. nearest neighbour. Although, the test is capable of accurately describing patterns at shorter distances (Perry, et al., 2006).

This technique matches the purpose of this study since it is important to see how the spatial pattern and thus the agglomeration of retail facilities develops over time. The technique is scientifically based, excludes the RFA of retail facilities, and considers the distance between retail facilities. Therefore, it is chosen to determine the change in spatial pattern over the years utilizing the nearest neighbour analysis method. An increase in the mean nearest neighbour distance over time implies that the spatial pattern is becoming more scattered, while a decrease in the mean nearest neighbour distance implies that the spatial pattern is becoming more agglomerated.

The mean nearest neighbour distance between every retail facility and their nearest another retail facility (of the same function or type, or attribute) in a certain dataset ($\overline{D}$) will be calculated using Formula 2 (Rifaie, et al., 2015):

$$\overline{D} = \frac{\sum_{i=1}^{n} d_i}{n} \quad \textbf{(2)}$$

In this formula, d_i equals the distance between retail facility i and its nearest neighbouring retail facility (of the same function or type, or attribute), and n corresponds to the total number of retail facilities in the dataset.

For this method, a dataset containing geographical datapoints should be imported in QGIS. Using the 'Nearest neighbour analysis' tool in this program, the mean nearest neighbour distance can be calculated. This mean nearest neighbour distance represents the mean distance between all data points and its nearest neighbouring datapoint. This mean distance helps to understand patterns and the spread of datapoints. Datapoints can be clustered, evenly spread, or scattered. By comparing the mean nearest neighbour distance of a certain function, type, or attribute over the years, it can be seen whether the retail facilities cluster more (mean distance decreases), or spread (mean distance increases) over the years, and thus if and how the spatial pattern develops over time.

Although the results of the tool may show that the spatial pattern changes over the years, the outcome does not say anything about the locations of retail facilities. An example of this effect is shown in Figure 11. In this figure, it can be seen that the nearest neighbour distance of retail facility 1 does not differ in the two different situations. However, the nearest neighbour distance of retail facility 4 in year 4 does differ from the nearest neighbour distance in years. In this research, it is important to see if the spatial pattern changes over the years, and with the nearest neighbour analysis tool this is possible. In combination with the visual analysis of maps including the datapoints over the years, it is still possible to see specific changes in the spatial pattern of retail facilities over the years.

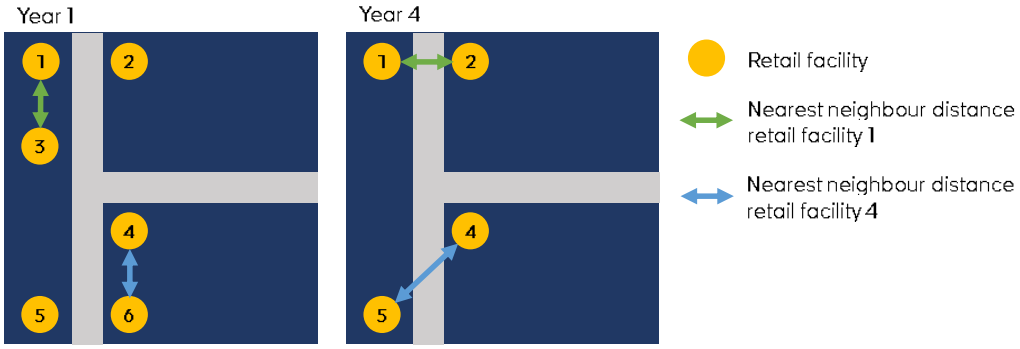

Figure 11: Example of the how the nearest neighbour analysis works

3.5.2 Implementation

As for this study, the retail facilities are grouped per function, type, and/or attribute. To determine the mean nearest neighbour distance per function, type, and attribute, and per city and year, the total dataset will be separated into smaller datasets using Microsoft Excel. Each dataset represents data per certain city, per certain year, and per certain function, type, or attribute. For example, a smaller dataset contains all geographical points of stores in Breda, in 2004. These smaller datasets will be converted to CSV files to insert the geographical data into QGIS. Subsequently, for every dataset a Nearest neighbour analysis will be performed. The Nearest neighbour analysis will only be performed in cases where a dataset contains more than one retail facility. As for the mean nearest distance between neighbouring stores, the bird's eye view distance between the geographic centres of retail facilities will be considered. As processing, transporting, and analysing geographical data is time-consuming, it is determined for this study that the analyses will be conducted every three years. This means that the analyses will be conducted for the following years: 2004, 2007, 2010, 2013, 2016, 2019, and 2022. The results of these tests will be presented in a table, including per function, type, or attribute, the city, the year, and the mean nearest neighbour distance.

3.5.3 Analysis of the results

Using the results of the Nearest neighbour analyses, the development in the spatial pattern of retail facilities will be analysed. For these analyses, the same techniques as for analyses of the developments in the retail facility

mix will be used (see section 3.3). This firstly includes conducting the Friedman test to analyse significant differences in the mean nearest neighbour distances over the years. Hereafter, trendline analyses will be used to see what the developments in mean distance over time entail. During this step, also maps including the geographical datapoints of retail facilities will be compared. The last part entails the analyses of the confluences of the developments in the spatial pattern by means of a correlation.

Differences over time

For the first step, the differences over time in the observed mean nearest neighbour distance for the seven cities together will be assessed. Since the data is not normally distributed and the sample size is small, again the non-parametric Friedman test will be used. With this test, the significant difference between the mean distance over the years will be evaluated. Further elaboration of this approach can be found in sub-section 3.3.1. If the difference over the years is not significant, the certain function, type, or attribute will be excluded from the trendline and correlation analyses.

Trendlines

To analyse what the significant differences entail and to see how the mean nearest neighbour distance of a certain function, type, and attribute develops over the years, trendline analyses will be performed. Here too, the same approach is used for the analyses of the developments in the retail facility mix (see sub-section 3.3.2). First, diagrams are created presenting the average mean nearest neighbour distance across all seven cities combined over the years. Then, the most suitable trendline will be fitted to these diagrams based on the determination coefficient (the R^2 value). As for the retail facility mix, the trendline must be very strongly corresponding with the datapoints ($R^2 > 0.64$). If not, the trendline will not be described in the results and will also be excluded from the correlation analyses.

In addition to the trendline analyses, visual inspections will be performed on maps containing the locations of retail facilities per function, type, and attribute. This will only be done for the functions, types, and attributes that are included in the trendline analyses. Per function, type, and attribute, three maps representing three different years of one certain city will be presented containing the locations of retail facilities. For this purpose, a selection will be made for one city and the three years per function, type, and attribute. This selection is based on the developments in the mean nearest neighbour distance from 2004 to 2022 per city. The city will be selected if the development in the mean nearest neighbour distance best matches the trendline. Depending on the development of the mean nearest neighbour distance, the three most interesting years will be selected. The aim of this visual analysis is to provide a more detailed picture of the changes in the spatial pattern. Since only one city is inspected at a time to save time, these analyses only give an impression of these detailed changes and therefore cannot simply be copied for all medium-sized cities. Therefore, the results of these analyses will be excluded in the conclusions.

Confluences in developments

The final part of the spatial pattern analyses is the analysis of confluences. With the Spearman rank-order correlation test, the coincidence between the developments of the mean distances of different functions, types, and attributes over the years will be assessed. Both the execution and the interpretation of the results will be done in the same way as for the retail facility mix. This means that only the significant and relevant very strong correlations will be described, and exceptionally if relevant also significant and strong correlations. The elaboration of this test can be found in sub-section 3.3.3. The results of this test will be described per function, type, and attribute.

3.6 Confluences between developments in retail facility mix and spatial pattern

To test confluences between developments in the retail facility mix and the spatial pattern of retail facilities, Spearman rank-order correlation tests will be conducted. The mean nearest neighbour distance will be compared to the units of measurements of the change in retail facility mix. For this, only the developments in the units of measurement with $R^2 > 0.64$ are included. The purpose of this test is to find out if the developments in the retail facility mix may confluence with the developments in the spatial pattern of retail facilities.

By examining whether the development in mean nearest neighbour distance confluences with the development in (the share of) the total number or RFA of retail facilities, it can be concluded if these developments confluence with each other. For instance, the increase in the average RFA may confluence with the increase in the mean nearest neighbour distance. In addition, the decrease in the number of retail facilities can be related to the increase in the mean nearest neighbour distance between them. For the results of these tests, only the correlations

between the mean nearest neighbour distance and the different units of measurement will be analysed per function, type, or attribute.

3.7 Conclusion

The developments in the retail facility mix and the spatial pattern of retail facilities over time will be determined by going through several steps.

First, the most suitable cities for the analyses are determined. Based on the number of inhabitants and the impact of tourism, seven medium-sized cities in the Netherlands are selected to perform the analyses: Amersfoort, Arnhem, Breda, 's Hertogenbosch, Enschede, Haarlem, and Nijmegen.

To perform the analyses, a dataset from Locatus will be used containing information about all retail facilities in the selected cities from 2004 up until 2022. The information includes per retail facility the city, year, unique ID number, retail-chain, type, sub-type, category, retail floor area (RFA), and X- and Y-coordinates.

Based on the current trends that are derived from the literature review, the retail facilities are divided into functions, types, and attributes. Each retail facility is allocated to one of the four functions: vacant, store, experience, or service. Retail facilities with the function store or experience, are then assigned to several types, specifying what kind of store or experience facility the retail facility contains. For example, a store can be assigned as a daily store. The attributes define if stores are linked to a retail-chain or not and if stores are designated as (fashion) department stores.

As for the developments in the retail facility mix, data will be analysed using Microsoft Excel and SPSS. Since the received dataset can be directly used in these programs, data preparation is not necessary. From the dataset, several units of measurement per function, type and attribute will be derived and analysed. These units of measurement include:

- Total number of retail facilities per function, type, or attribute (e.g. the total number of stores)
- Total share of retail facilities per function/type/attribute com-pared to the total number of facilities with a certain function (e.g. the share of the number of hospitality facilities compared to the total number of experience facilities).

In addition, only for the functions vacant and store there will be also looked at:

- Average RFA per retail facility per function/type/attribute (e.g. the average RFA of all fashion & luxury stores)
- RFA share per function/type/attribute compared to the total RFA of all functions, types, or attributes (e.g. the share of RFA of all fashion & luxury stores compared to the RFA of all stores.

The developments in the spatial pattern of retail facilities will be analysed using the Nearest neighbour analysis tool in the computer program QGIS. This tool calculates the mean distance between all retail facilities and the nearest neighbouring retail facility per function/type/attribute. This calculation will be executed every three years: 2004, 2007, 2010, 2013, 2016, 2019, and 2022. By analysing the mean distances over the years and corresponding maps, it can be analysed if and how the pattern changes over the years.

The data about the change in retail facility mix and the spatial pattern will subsequently be analysed, both in the same way. A schematic overview of these steps can be seen in Figure 12.

Subsequently, the trendlines of the developments in retail facility mix as well as in spatial pattern will be compared using the Pearson rank-order correlation test. Employing this test, it will be analysed whether a development in the retail facility mix confluences with a development in spatial pattern.

The results of all tests will be presented in the next chapter, separated into developments in the retail facility mix and developments in the spatial pattern of retail facilities.

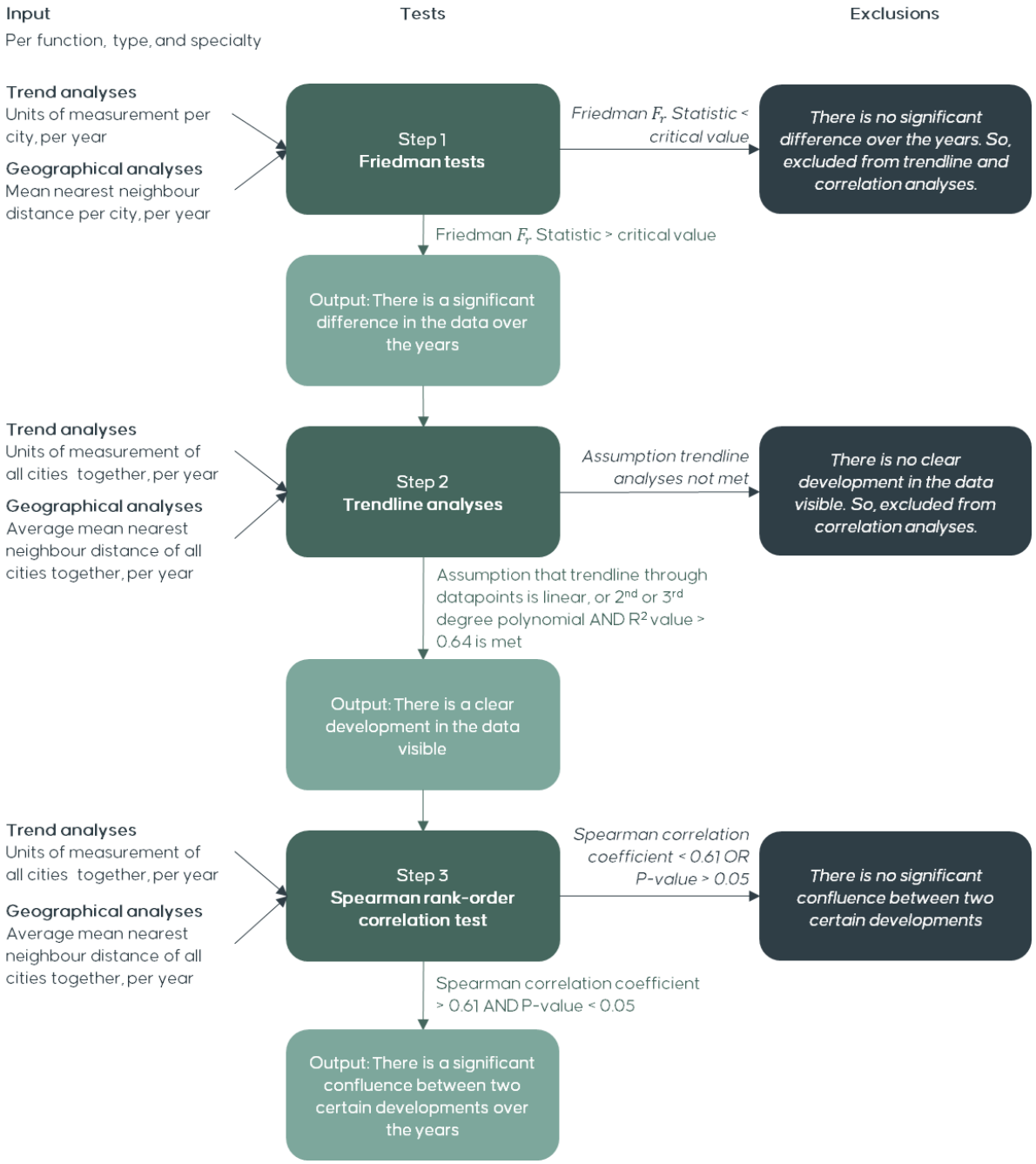

Figure 12: Schematic overview of the data analyses

4. Results

In this chapter, the results of analyses of the changes in the retail facility mix and the changes in the spatial pattern of retail facilities will be presented. In the first section (4.1), the developments in the retail facility mix will be described. The developments in the spatial pattern will be described in section 4.2. Results from both the retail facility mix and the spatial pattern will be presented step by step: difference over time, trendlines, and confluences. At the end of both the first two sub-sections, a conclusion will be presented. In section 4.3, the confluence between the developments in the retail facility mix and the spatial pattern of this retail facility mix will be presented. This chapter finishes with a concluding section under 4.4, in which the conclusions of both the developments in the retail facility mix and spatial pattern will be combined.

4.1 Developments in retail facility mix

In this section, the results of the analyses on the developments in the retail facility mix will be presented. The results will be divided into the results of the Friedman tests (difference over time), the trendline analyses, and the correlations tests to see if developments confluence. Herewith, it will also be examined what influenced the found changes. This section ends with a concluding sub-section in which the developments in the retail facility mix and will be presented, including the possible causes.

4.1.1 Difference over time

To evaluate if there are any differences in (the share of) the number or RFA of retail facilities over time in medium-sized cities in the Netherlands, the Friedman test has been conducted. These Friedman tests have been conducted for all functions, types, and attributes separately. The results of these tests are summarized in Table 4. The results are shown for all units of measurement, defined in sub-section 3.3.

Table 4: Summary results Friedman tests – change in retail facility mix

	Retail facilities (#)		Retail facilities (%)		Average RFA		RFA (%)	
	Fr	P	Fr	P	Fr	P	Fr	P
Function								
Total	85.54	0.00			39.41	0.00		
Store	110.24	0.00	115.34	0.00	55.70	0.00	-	-
Experience	102.56	0.00	111.42	0.00				
Service	42.30	0.00	33.42	0.01				
Vacant	53.43	0.00	62.28	0.00	29.80	0.04	53.33	0.00
Type - store								
Daily	64.89	0.00	110.09	0.00	44.59	0.00	105.45	0.00
Fashion & luxury	102.22	0.00	57.92	0.00	51.18	0.00	59.48	0.00
Leisure time	109.58	0.00	84.10	0.00	66.44	0.00	18.60	0.42
In/around house	119.56	0.00	111.98	0.00	64.92	0.00	98.39	0.00
Other stores	35.79	0.01	31.80	0.02	44.72	0.00	55.68	0.00
Type - experience								
Hospitality	103.12	0.00	58.74	0.00				
Culture & recreation	27.00	0.08	-	-				
Attributes								
Department store	61.55	0.00	53.63	0.00	75.37	0.00	77.82	0.00
Fashion department store	21.05	0.28	39.29	0.00	54.02	0.00	-	-
Retail-chain store	97.74	0.00	78.50	0.00	37.37	0.00	66.25	0.00
Independent store	116.57	0.00	-	-	33.54	0.01	-	-

With k = 19 (years) and n =7 (cities)
Critical value for α = 0.05 and with k-1=18 dfis 28.87 (Riffenburgh, 2006)

If Fr > critical value = H0 rejected, there is a change over the years
If Fr < critical value = H0 accepted, there is no change over the years

The results of the Friedman tests are interpreted by comparing the critical value with the calculated Friedman F_r Statistic. The critical value for α = 0.05 and with $k = 19\ years$ and thus $k - 1 = 18\ df$ is 28.87 (Riffenburgh, 2006). For the vast majority, the Friedman F_r Statistic is larger than the critical value with p < 0.05. This means that the null hypothesis can be rejected and the number or RFA of retail facilities significantly differs over the years for most units of measurement of the functions, types, and attributes. However, there are three exceptions in red in Table 4.

Based on these results, the share of RFA of the type leisure time compared to the total RFA over all stores, the total number of retail facilities with the type culture & recreation and the total number of retail facilities with the attribute fashion department stores will be excluded in the trendline analyses.

4.1.2 Trendlines

Through trendline analyses, it is determined how (the share of) the number or RFA of retail facilities develops throughout the years. The analyses of trendlines consist of three steps including the creation of scatter diagrams, adding the most suitable trendline (linear, 2nd-degree polynomial or 3rd-degree polynomial), and adding the determination coefficient (R^2). A summary of the results of these steps per unit of measurement and function/type/attribute can be found in Table 5.

Table 5: Summary results trendline analyses – change in retail facility mix

	Retail facilities (#)		Retail facilities (%)		Average RFA		RFA (%)	
	TL	R2	TL	R2	TL	R2	TL	R2
Function								
Total	Lin	0.85	-	-	Lin	0.66	-	-
Store	Lin	0.89	Lin	0.87	Pol (3rd)	0.59	Pol (3rd)	0.48
Experience	Lin	0.90	Lin	0.90	-	-	-	-
Service	Pol (2nd)	0.69	Pol (3rd)	0.75	-	-	-	-
Vacant	Pol (3rd)	0.59	Pol (3rd)	0.68	Pol (3rd)	0.10	Pol (3rd)	0.48
Type - store								
Daily	Lin	0.84	Lin	0.89	Lin	0.87	Lin	0.94
Fashion & luxury	Lin	0.72	Pol (2nd)	0.63	Pol (3rd)	0.39	Pol (3rd)	0.58
Leisure time	Lin	0.97	Lin	0.95	Lin	0.75	x	x
In/around house	Lin	0.97	Lin	0.94	Pol (2nd)	0.71	Lin	0.88
Other stores	Pol (3rd)	0.65	Pol (3rd)	0.56	Lin	0.73	Lin	0.69
Type - experience								
Hospitality	Lin	0.86	Pol (3rd)	0.86	-	-	-	-
Culture & recreation	x	x	Pol (2nd)	0.67	-	-	-	-
Attributes								
Department store	Pol (2nd)	0.76	Pol (3rd)	0.61	Pol (2nd)	0.77	Pol (2nd)	0.81
Fashion department store	x	x	Lin	0.70	Lin	0.71	Lin	0.81
Retail-chain store	Pol (2nd)	0.87	Lin	0.68	Pol (3rd)	0.18	Pol (2nd)	0.90
Independent store	Lin	0.99	Pol (2nd)	0.92	Pol (3rd)	0.59	Pol (2nd)	0.91

TL = type of trendline
R2 = determination coefficient

If R2 > 0.64 = strong correspondence
If R2 < 0.64 = no correspondence

Lin = linear trendline
Pol (2nd) = polynomial trendline, 2nd degree
Pol (3rd) = polynomial trendline, 3rd degree

From these results, it can be concluded that some units of measurements of certain functions, types, or attributes are excluded in the descriptions of the trendlines. These trendlines have an R-squared value lower than 0.64, which means that the trendline does not correspond strongly to the datapoints. The datapoints fluctuate too strong over the years and clear development can be detected. The trendlines excluded from the description of the results are shown in red in Table 5. The results of the trendline analyses will be presented per function, type, or attribute in Figures 13 to 51.

All retail facilities together

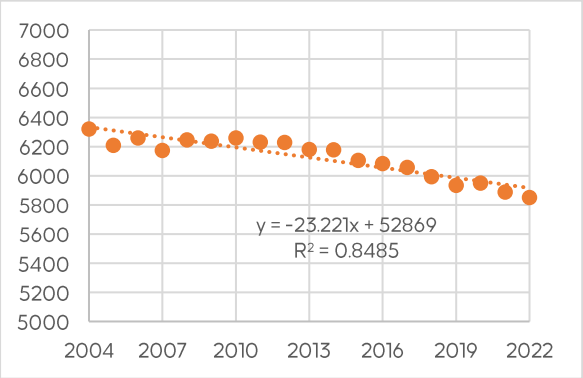

Figure 13: Trendline - number of all retail facilities together

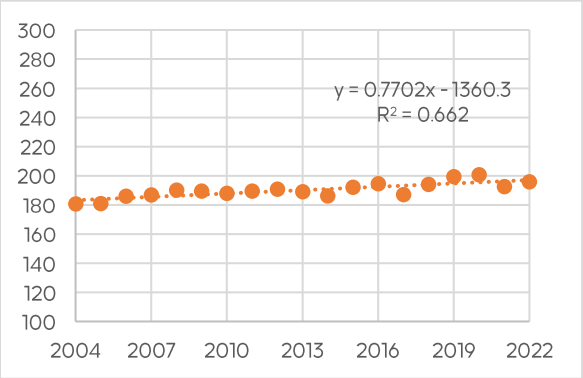

Figure 14: Trendline - average RFA of all stores and vacant facilities

When looking at the diagram of the total number of all retail facilities together over the years in Figure 13, a decreasing linear trendline can be seen. However, deviating from this trendline is a fluctuation between 2004 and 2008. After 2010, the number of retail facilities started to decrease. The start of this decrease may be linked to the delayed effects of the emergence of e-commerce and the financial crisis that started around 2008. Furthermore, a stagnation can be seen between 2019 and 2020. However, based on the findings from literature it can be expected that the number of retail facilities would decrease, this is contrary to this stagnation. However, when looking at the diagrams of the different functions (see Figures 15, 17, 19 and 21), this stagnation can be explained by an accelerated decrease in the number of stores, while the number of experience and service facilities increased. Also the percentage of vacant facilities increased during this time. since these developments confluence with the timespan of the COVID-19 pandemic, these developments may be linked to the effects of the pandemic.

Looking at the average RFA of retail facilities, it only includes the RFA of stores and vacant facilities since the RFA of service and experience facilities is unknown for most years. This average RFA is linearly increasing (see Figure 14). However, no conclusion can be drawn from this diagram since it is not clear if the increase is due to an increase in the average RFA of stores or of vacant facilities. This is since the development in the RFA of both the stores and vacant facilities are fluctuating too much over the years (see Table 5). Also in literature, no clear development in the in- or decrease in average RFA of retail facilities is found.

Stores

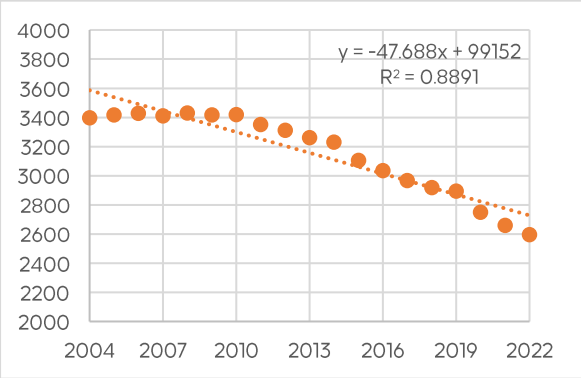

Figure 15: Trendline - number of retail facilities with the function store

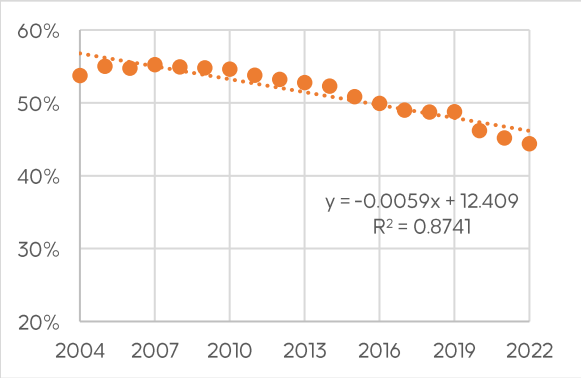

Figure 16: Trendline - number of retail stores relative to the total number of all retail facilities

In Figure 15 and Figure 16, the trendline diagrams about the (share of the) number of retail facilities with the function store are given. Both trendlines follow a decreasing linear trend and the decrease in the number as well as the share started in 2010. This same trend can be seen in the total number of all retail facilities. Sources claim that stores have been closing since the year 2000, referred to as the retail apocalypse (e.g. Harasta, 2020). However, this is not visible in the figures for Dutch medium-sized cities. However, the start of the decrease in 2010 may be linked to the delayed effects of both the emergence of e-commerce since 2000 and the start of the financial crisis in 2008. In total, there are two accelerations in the described decrease: between 2014 and 2015, and between 2019 and 2020. The first one confluences with the end of the financial crisis in 2014, and the second one with the start of the start of the COVID-19 pandemic in 2019.

Since (the share of) the RFA of stores is fluctuating too much over the years, no conclusion can be drawn from the developments in the RFA.

Experience facilities

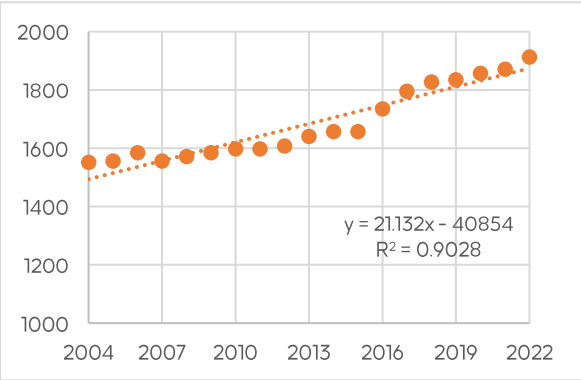

Figure 17: Trendline - number of experience facilities

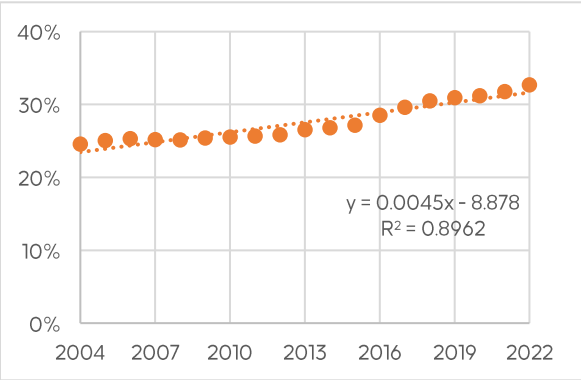

Figure 18: Trendline - number of experience facilities relative to the total number of retail facilities

In line with the findings from the literature (Coca-Stefaniak & Carroll, 2014), (the share of) the number of experience facilities is increasing through the years. This can be seen in Figure 17 and Figure 18. Both diagrams show an increasing linear trendline. However, the increase in the total number of experience facilities experienced an acceleration of the increase between 2015 and 2017, which may be linked to the end of the financial crisis in 2014.

When looking at the share of the number of experience facilities relative to the total number of retail facilities, it can be seen that the share is increasing linearly, while the trendline of the share of the number of stores is decreasing over the years (see Figure 16). This is in line with the findings from the literature showing convenience shopping is moving from an offline to an online environment (Mikalef et al. 2013), and the experience economy is emerging (Coca-Stefaniak & Carroll, 2014).

Service facilities

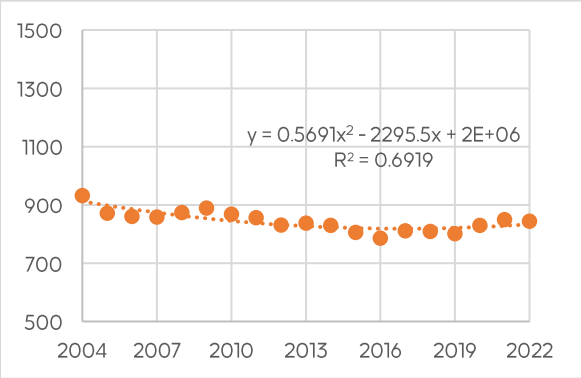

Figure 19: Trendline - number of service facilities

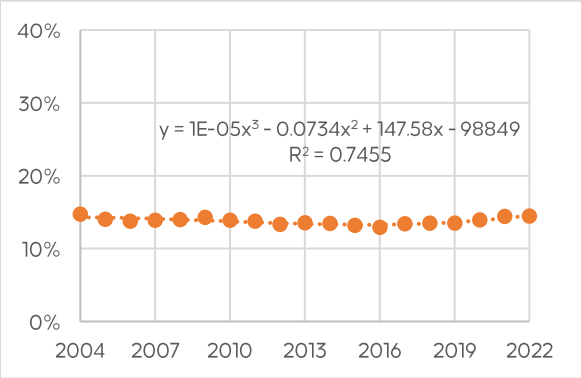

Figure 20: Trendline - number of service facilities relative to the total number of all retail facilities

The (share of the) number of service facilities is fluctuating over the years. Anyway, the datapoints can be represented in both cases with a third-degree polynomial trendline (see Figure 19 and Figure 20). These trendlines show both a declining line between 2004 and 2016 after which the trendlines increased again. However, both the number as well as the share of service facilities is fluctuating over the years. In addition, no relationship is found in literature between macro-occurrences and the developments in the number of service facilities. Therefore, no hard conclusion can be drawn from the development in the number of service facilities.

Looking at the dataset, the total number of service facilities over all years together mainly consist of hairdressers (26%), employment agencies (15%), real estate agencies (9%), and beauty salons (7%). However, the decrease in the number of service facilities during the financial crisis is mainly due to the decrease in the number of employment agencies and real estate agencies (2008-2014). During the COVID-19 pandemic (2019-2022), the increase in the number of service facilities was mainly due to the increase in the number of hairdressers and nail studios. These findings contribute to the idea that people are coming to cities increasingly for experience instead of convenience.

Vacant facilities

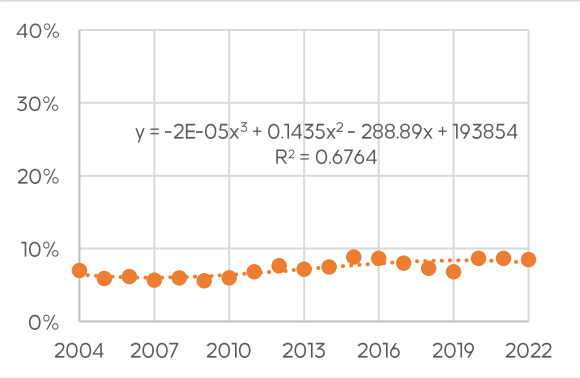

Figure 21: Trendline - number of vacant facilities relative to the total number of retail facilities

No feasible trendline for the number of vacant facilities could be determined, however, the trendline of the share of vacant facilities relative to the total number of retail facilities shows an R-squared value above 0.64. However, the trendline of this measurement is a 3rd-degree polynomial. This implies a fluctuating trend over the years. When looking at the diagram in Figure 21, it can be seen that the share increases between 2009 and 2012, which might be linked to the financial crisis. Accelerated increases can be seen between 2014 and 2015, and between 2019 and 2020. The first acceleration confluences with the end of the financial crisis in 2014, while the second acceleration confluences with the start of the COVID-19 pandemic in 2019. The share decreased between 2016 and 2019, which confluences with the end of the financial crisis and the start of the COVID-19 pandemic.

When looking at the dataset to see what functions are most likely to transform to a vacant facility and vice versa. From this analysis it can be concluded that mostly the function store transforms to vacant facilities. Also, the acceleration between 2014 and 2015, and between 2019 and 2020 can be explained by an increased number of stores that transformed into vacant facilities. However, most of the vacant facilities that transform into another function, transform back to store again. However, since 2010, increasingly more vacant facilities transform into a hospitality function which is in line with findings from literature about the emergence of the experience economy (Pine and Gilmore, 1999). Furthermore, vacant retail facilities remain vacant on average for 2.4 years, which explains the fluctuation in (the share of) the number or RFA of vacant facilities. Since the number of all retail facilities together is decreasing, and the share of vacant facilities remains the same over the years, it seems likely that retail facilities either will be merged with another retail facility (which corresponds to the increasing average RFA of stores and vacant facilities together in Figure 14), or will be transformed into another function than a retail facility such as housing.

Daily stores

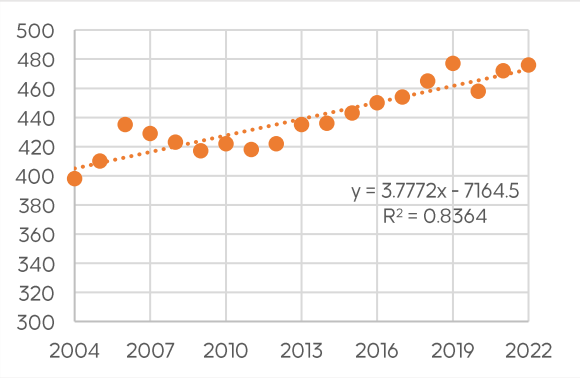

Figure 22: Trendline - number of daily stores

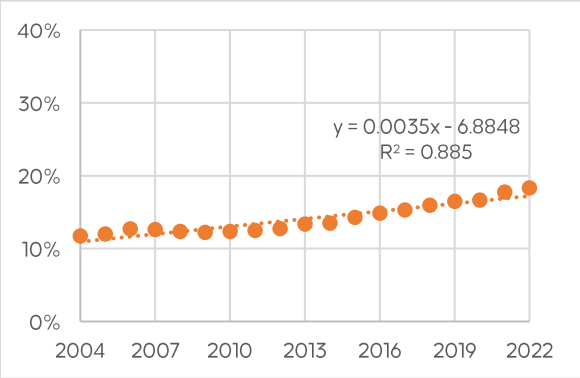

Figure 23: Trendline - number of daily stores relative to the total number of stores

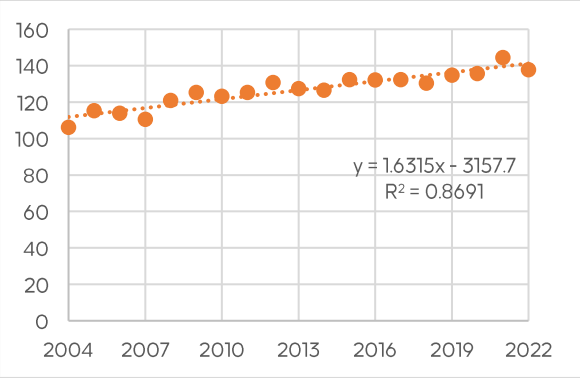

Figure 24: Trendline - average RFA of daily stores

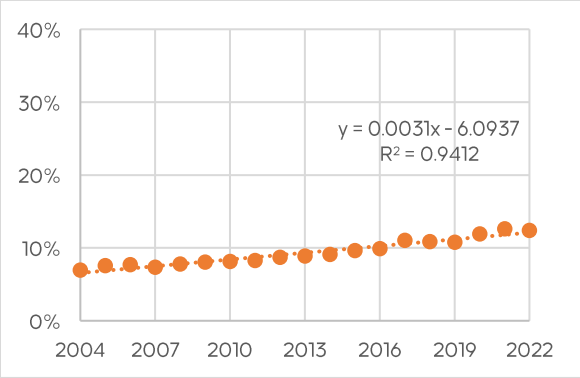

Figure 25: Trendline - RFA of daily stores relative to the total RFA of all stores

When looking at the diagrams of the (share of the) number as well as RFA of daily stores, a positive linear trend-line can be seen in all figures (see Figures 20 to 23). The biggest increase can be seen in the number of supermarkets (17%), the number of perfumery stores (11%), and delicatessen stores (11%). This may be linked to the trend that non-food stores are being replaced by food-stores. However, the increase in the number of perfumery stores is in contrast with findings from the literature, which states that perfume is one of the mostly online bought products. However, there are some deviations from the trendlines, which can be partly explained by the effects of macro-occurrences. For example, the number of daily stores is relatively much increasing between 2017 and 2019, until the COVID-19 pandemic started in 2019. Between 2019 and 2020, the number of daily stores dropped.

The average RFA of daily stores fluctuates over the years. According to the findings in the data, this can be linked to the opening and closing of supermarkets and drugstores. These type of stores have by far the largest average RFA of all daily stores. Respectively supermarkets and drug stores have an RFA of 695m^2 and 245m^2 relative to the average of 90m^2 of all daily stores together. As stated before, the number of all stores is decreasing over the years. However, this is contradictory to the increased share of both the number and RFA of daily stores. This implies that the composition of the type of stores is changing over the years.

Fashion & luxury stores

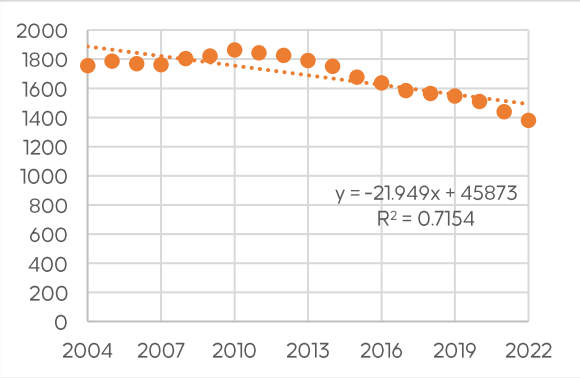

Figure 26: Trendline - number of fashion & luxury stores

As for Fashion & luxury stores, only a trend can be detected in the total number of fashion & luxury stores (see Figure 26). This diagram shows a decreasing linear trendline. However, there are some fluctuations. After a stagnation between 2004 and 2007, the number of fashion & luxury stores increases until 2010. The stagnation is due to an increase in the number of retail-chain stores that is cancelled out by a decrease in the number of independent stores (see Figure 46 and 49). Between 2008 and 2010, the number of retail-chain stores was still increasing while the decrease in the number of independent stores stagnated (Figures 46 and 49). After 2010, the number of fashion & luxury stores decreased. From the literature it is expected that the number of (fashion & luxury) stores would decrease due to the financial crisis that started in 2008 (e.g. Tangpong et al., 2009). In addition, the emergence of e-commerce also played a role in the decrease. For example, the start of the decrease coincides with the launch of the online fashion retailer Zalando in the Netherlands (Vogel, 2020). Therefore, it is plausible that the start of the decrease may be linked to the delayed effects of both these macro-occurrences. Furthermore, after a stagnation in the decrease between 2018 and 2019, the number of fashion & luxury stores decreased again since 2019. This decrease confluences with the start of the COVID-19 pandemic in 2019.

Looking at the dataset, it can be concluded that most of the decrease in the number of fashion & luxury stores between 2010 and 2022 is due to a decrease in womenswear stores (22%), shoe stores (19%), and men's and women's wear stores (15%). This is also in line with the finding that clothes and shoes are one of the most online bought products (Statistics Netherlands, 2023).

Leisure time stores

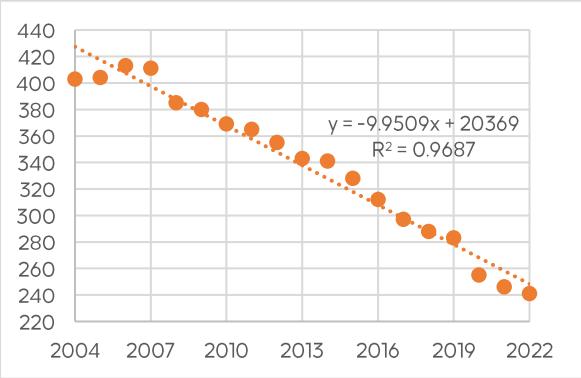

Figure 27: Trendline - number of leisure time stores

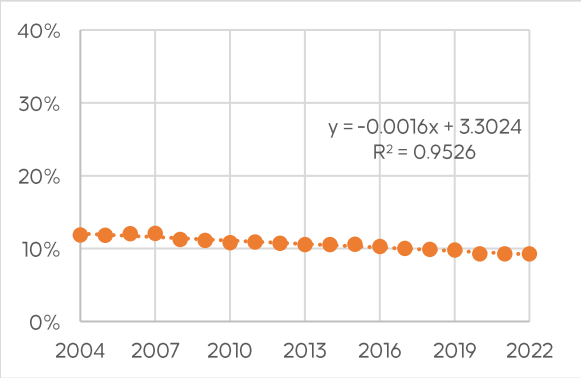

Figure 28: Trendline - number of leisure time stores relative to the total number of stores

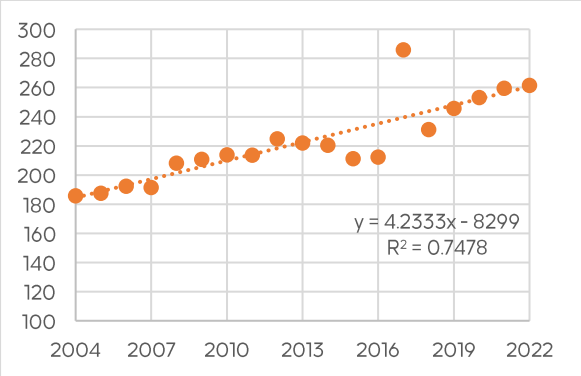

Figure 29: Trendline - average RFA of leisure time stores

In Figures 27 to 29 the trendlines about the (share of the) number and the RFA of leisure time stores are given. From the first two trendlines, it can be seen that (the share of) the number of leisure time stores is linearly decreasing over the years, although the decrease in the share is limited. This is also in line with the decrease in the number of all stores together over the years. The actual decrease in the number started between 2007 and 2008, which can be linked to the financial crisis. However, this would be a quick respond since the financial crisis started in 2008. Furthermore, an acceleration in the decrease of the number of leisure time stores can be seen between 2019 and 2020, which may be linked to the COVID-19 pandemic. From the literature, it is found that books, electronics, and devices are the least online bought products (Statistics Netherlands, 2023). This implies an increase or at least a stagnation in the number of leisure time stores. However, this is in contrast with the findings from the trendline analyses.

The average RFA of leisure time stores is linearly increasing over the years. This indicates an increase in the scale of this type of store over the years. According to the data, the increase can be explained by the increase in the average RFA of large sports stores like Decathlon, which accounts for 57% of the total increase in average RFA. Despite the increase in the average RFA, no change can be seen in the share of RFA over the years. This is probably because the increase in average RFA is cancelled out against the decrease in the number of leisure time stores, leaving the share of RFA unchanged. Furthermore, one outlier can be seen in the development of the average RFA in 2017. This is due to the opening and closing of two Topshelf Megastores in the former V&D buildings in the inner-cities of Nijmegen and Arnhem with an RFA of more than 10,000m^2.

In/around house stores

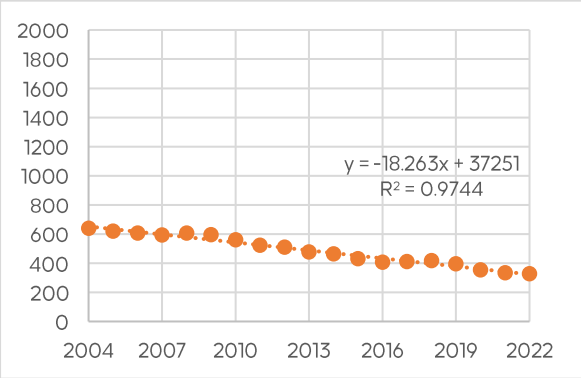

Figure 30: Trendline – number of in/around house stores

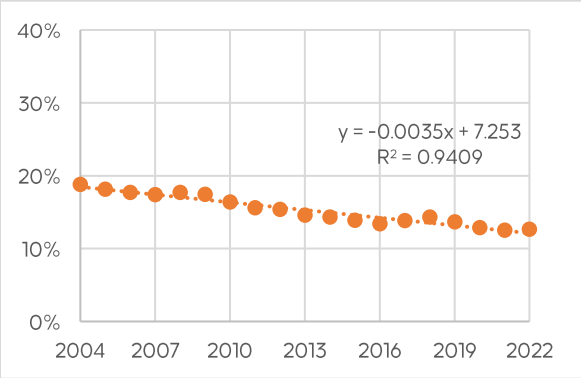

Figure 31: Trendline – number of in/around house stores relative to the total number of all stores

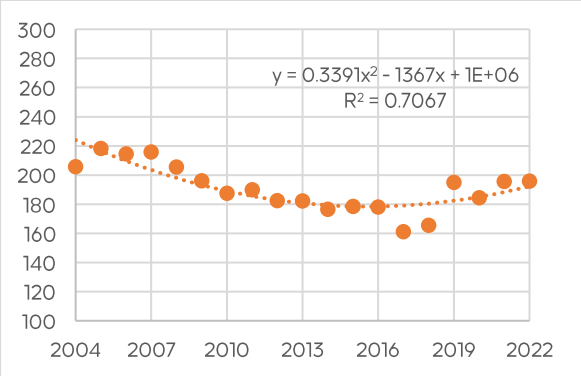

Figure 32: Trendline – average RFA of in/around house

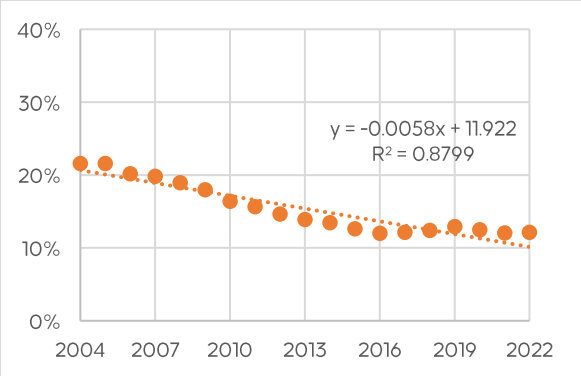

Figure 33: Trendline – RFA of in/around house stores relative to the total RFA of all stores

The (share of the) number of in/around house stores follows a decreasing linear trend (see Figure 30 and Figure 31). This is in line with the change in the number of the total number of all stores together. No specific findings from literature can be linked to this development.

The trendline of the average RFA is a 2nd-degree polynomial (Figure 32), but the datapoints fluctuate over the years. The trendline decreases until around 2016 and increases afterwards. This means that since 2016 in/around house stores have experienced a scale-up. This increase in scale has occurred particularly in small DIY stores (24%), bicycle stores (15%), and kitchen- and bathroom stores (13%). The share of RFA of the in/around house stores relative to the total RFA of all stores together follows in contrast a decreasing linear trendline, as can be seen in Figure 33. So, although the RFA of in/around house stores fluctuates over the years, it did not much influence the share of RFA.

Other stores

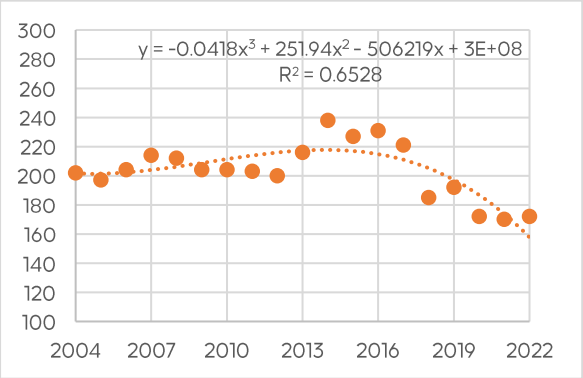

Figure 34: Trendline – number of other stores

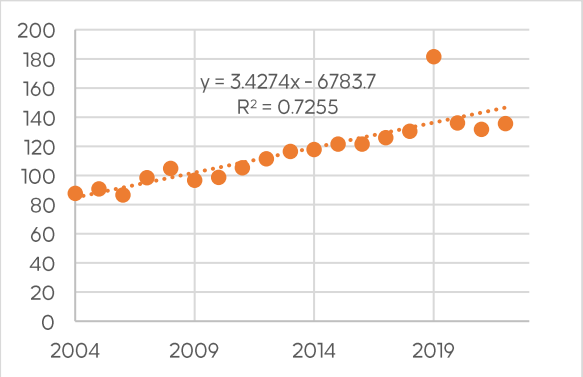

Figure 35: Trendline – average RFA of other stores

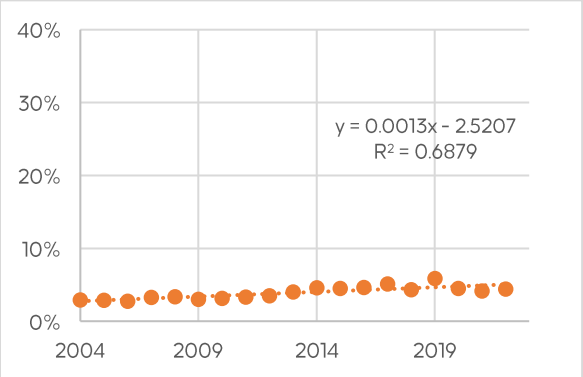

Figure 36: Trendline – RFA of other stores relative to the total RFA of all stores

The diagram of the number of other stores is shown in Figure 34. The trendline in this diagram shows that the number of other stores increases between 2004 and 2015, and decreases afterwards. However, the number of other stores fluctuates strongly over the years. therefore, it is hard to conclude if some developments in the number confluence with macro-occurrences.

The diagrams of (the share of) the average RFA of other stores (Figure 35 and Figure 36) both show an increasing trendline. This indicates a scale-up of other stores over the years. This increase in scale has taken place particularly in batch goods such as the So Low (41%), and party goods stores (23%). Furthermore, there is one outlier in the development of the average RFA of other stores in 2019. This is due to the opening and closing of the Johny van Doorn centre in the former V&D and Topshelf building in Arnhem. In this centre, it was possible for entrepreneurs to rent space for a variety of uses such as workshops (Helden, 2018).

Hospitality facilities

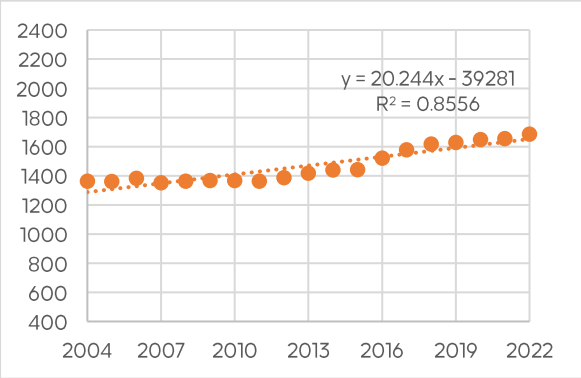

Figure 37: Trendline - number of hospitality facilities

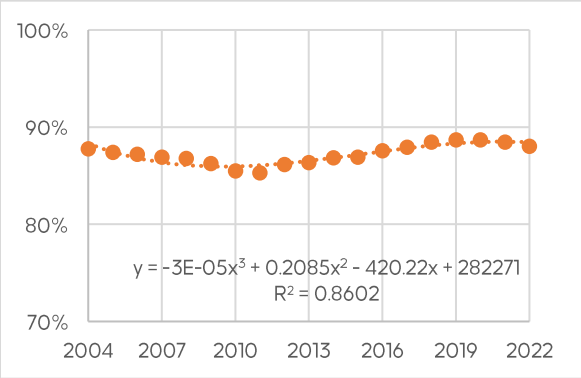

Figure 38: Trendline - number of hospitality facilities relative to the total number of experience facilities

In Figure 37 and Figure 38, the diagrams of (the share of) the number of hospitality facilities are presented. From the trendline in the diagram about the total number of hospitality facilities, it can be derived that the number is linearly increasing since 2011. However, from the literature it can be derived that the experience economy emerged from 2000 (Pine & Gilmore, 1999; Coca-Stefaniak & Carroll, 2014). This is not in line with the start of the increase of hospitality facilities in medium-sized cities about ten years later.

Between 2015 and 2018, after the financial crisis, an accelerated increase in the number took place. During the COVID-19 pandemic, the number of hospitality facilities still increased slowly. Looking at the share of hospitality facilities, it fluctuates over the years with the lowest point in 2011 and a peak in 2020. This means that the number of culture & recreation facilities decreased in share until 2011 and increased again until 2020. The increase in the number of hospitality facilities is mainly due to the increase in the number of delivery/takeaway restaurants, fast food restaurants, and lunchrooms.

Culture & recreation – experience

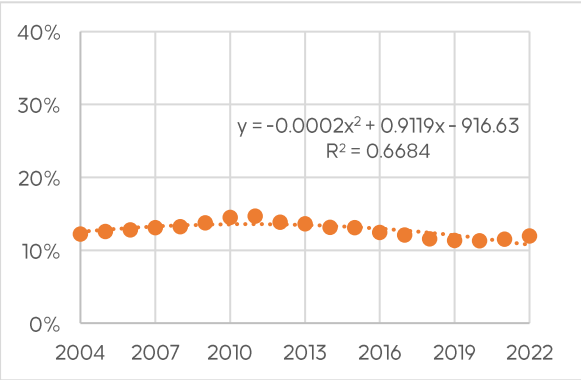

Figure 39: Trendline - number of culture & recreation facilities relative to the total number of experience facilities

The trendline of the share of the number of culture & recreation facilities (Figure 39) is completely the opposite of that of hospitality facilities, which is discussed under the header above. The increase in share between 2004 and 2011 is mainly due to an increase in the number of galleries and the number of fitness centres. However, the decrease in share after 2011 can be linked to a decrease in galleries.

Department stores

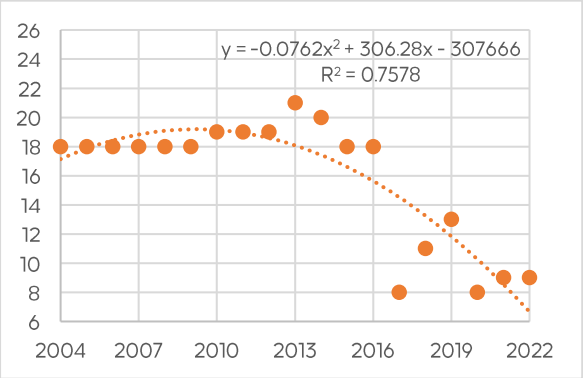

Figure 40: Trendline - number of department stores

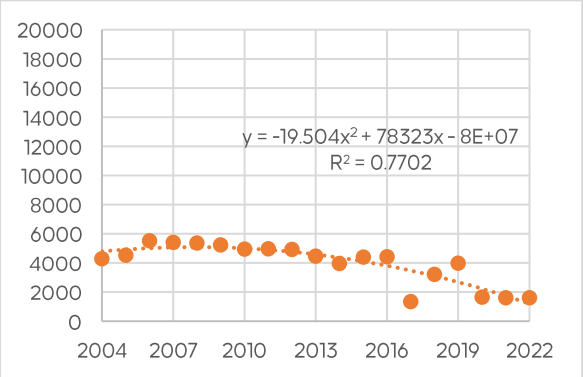

Figure 41: Trendline - average RFA of department stores

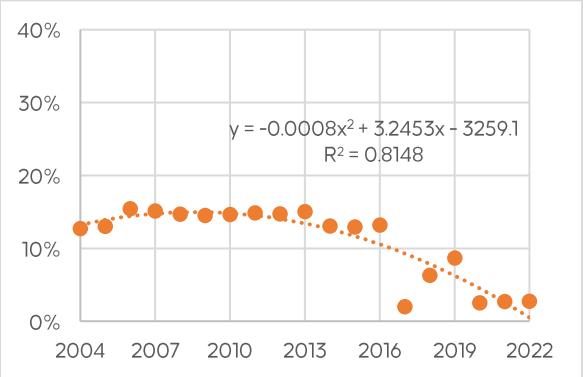

Figure 42: Trendline - RFA of department stores relative to the total RFA of all stores

The trendlines belonging to the number and (share of the) RFA of department stores can be found in Figures 40 to 42). Here, it is important to mention that the sample size is small, only a maximum of 21 department stores per year spread across seven cities. Of these stores, the vast majority is part of a retail-chain. One decision by a single retail chain could therefore cause major developments in the number or RFA of department stores.

When looking at the number of department stores, it remains stable between 2004 and 2009 while the average RFA increases and decreases again during this period. The number of department stores increased between 2009 and 2013, during the emergence of e-commerce and the start of the financial crisis. This is contrary to the expectations from the literature that the number of stores would decrease (e.g. Tangpong et al., 2009). After 2013, the number started to decrease with an acceleration between 2015 and 2016, after the end of the financial crisis in 2014. However, from 2016 the number of department stores increased again until the start of the COVID-19 pandemic in 2019. Hereafter, the number decreased and remained stable until 2022. The development in the number between 2015 and 2022 can also be seen in the development of (the share of) the RFA of department stores.

When looking at the data, most of the department store retail facilities in the selected cities housed a Bijenkorf or V&D store. Since 2017, both retail-chains disappeared from the streetscape of the seven medium-sized cities. From the data, it can be concluded that eight out of eleven of the retail facilities that housed a Bijenkorf or V&D store, house a fashion department store in 2022. This implies a shift from department stores to fashion department stores.

Fashion department stores

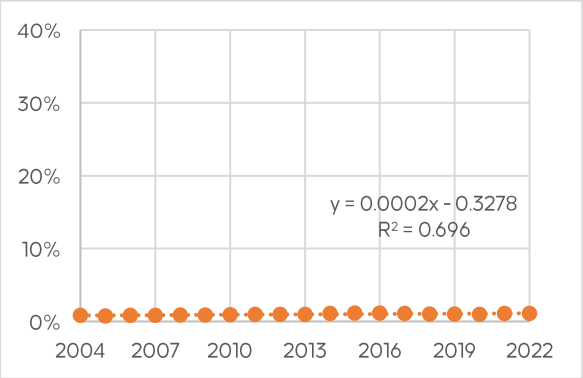

Figure 43: Trendline - number of fashion department stores relative to the total number of all stores

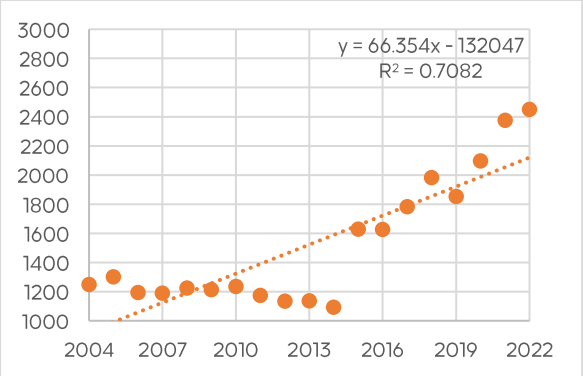

Figure 44: Trendline - average RFA of fashion department stores

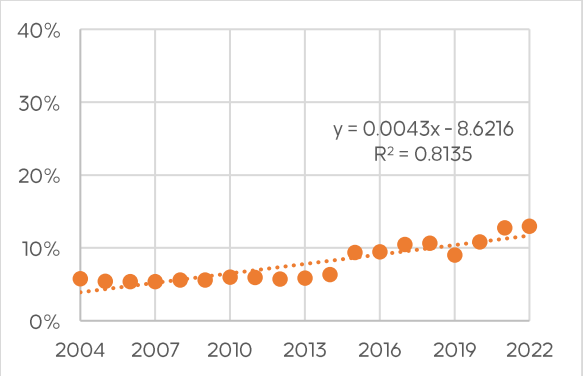

Figure 45: Trendline - RFA of fashion department stores relative to the total RFA of all stores

The figures about the (share of the) number and RFA of the attribute fashion department store are presented in Figures 43 to 45. Although the results of the Friedman show that the share of the number of fashion department stores differs over the years, a visual inspection of Figure 43 shows a stagnation around 1%.

When looking at the RFA of fashion department stores, the average, as well as the share, increased from 2014 onward. This confluences with the end of the financial crisis in 2014. Also during the COVID-19 pandemic both the number as well as the share of RFA increases, which is contrary to the findings from literature showing that stores were struggling due the restrictions imposed by the government (Cushman & Wakefield, 2021). Furthermore, the developments in the RFA of fashion department stores is clearly in contrast to the developments regarding the conventional department stores. This reinforces the idea that department stores are being replaced by fashion department stores.

Stores linked to a retail-chain

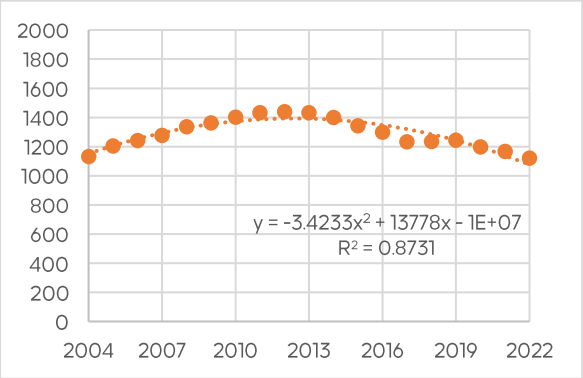

Figure 46: Trendline - number of retail-chain stores

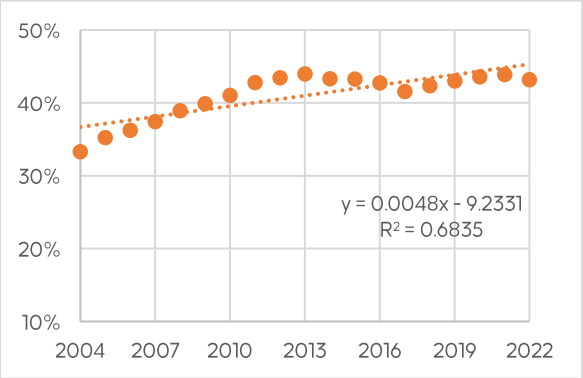

Figure 47: Trendline – number of retail-chain stores relative to the total number of all stores

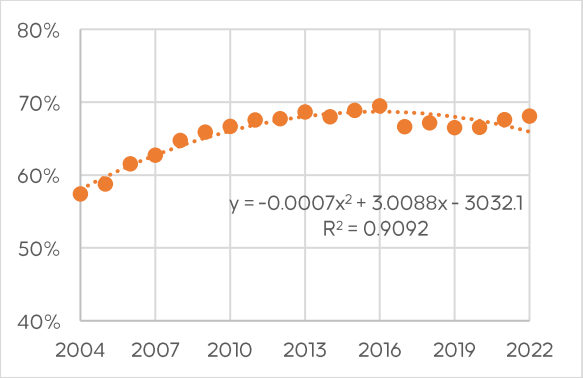

Figure 48: Trendline - RFA of retail-chain stores relative to the total RFA of all stores

Based on the current trends that follow from the literature, it is expected that the number and RFA of stores related to a retail chain is increasing through the years (Rabbiosi, 2015). However, when looking at Figures 46 to 48, it can be seen that this is not true for medium-sized cities in the Netherlands. The trendline about the (share of the) total number of stores related to a retail chain shows that both the number and the share increases until 2013, after which the total number decreases and its share fluctuates around 42%. A similar trend can be seen in the share of the RFA of retail-chain stores.

Independent stores

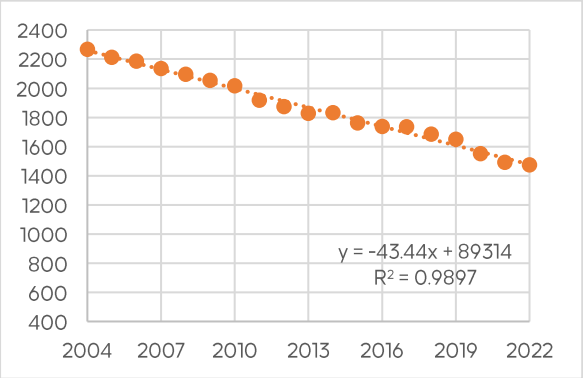

Figure 49: Trendline - number of independent stores

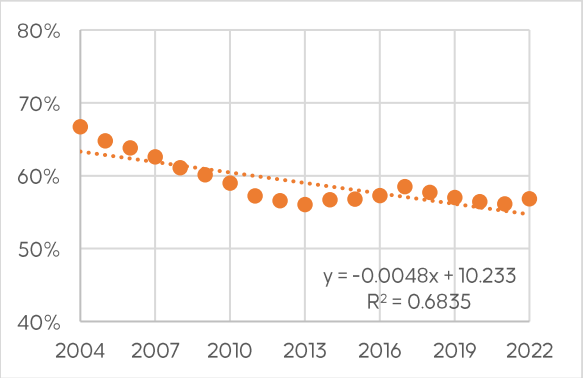

Figure 50: Trendline - number of independent stores relative to the total number of all stores

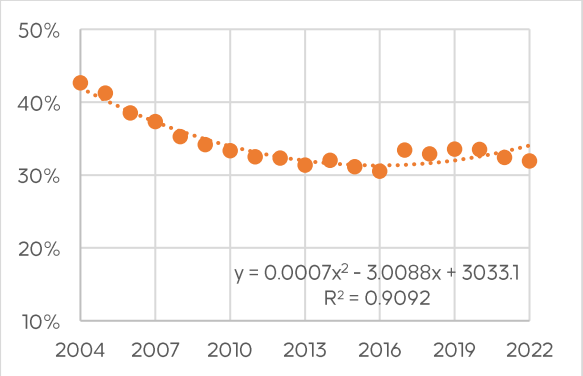

Figure 51: Trendline - RFA of independent stores relative to the total RFA of all stores

When looking at the trendlines of the independent stores in Figures 49 to 51, it can be seen that both the total number of independent stores as well as the share of the number of independent stores follow a negative linear trendline. This decrease in share is in line with the decrease in the number of stores in combination with findings from the literature review which implies that the number of retail-chain stores is increasing over the years (Rabbiosi, 2015).

The diagrams of the share of both the number and the RFA of independent stores are the complete opposite of the diagrams of the share of both the number and RFA of retail-chain stores. More than half of the stores is independent over the years while less than half of the stores is a retail-chain store. However, the share of independent is decreasing while the share of retail-chain stores is increasing in general. The data on the share of RFA shows an opposite trend as of 2016.

4.1.3 Confluences in developments

To evaluate the confluences between changes in (the share of) the number or RFA, Spearman rank-order correlation tests are executed per unit of measurement. The results of these tests can be found in Appendix A. In this sub-section, only significant (P<0.05) and very strong correlations will be described (r_s > 0.81), and exceptionally if relevant also significant and strong correlations (r_s > 0.61). The results will be presented under two headings: number of retail facilities, and retail floor area.

Number of retail facilities

The results of the correlation tests of the number of retail facilities are presented in Table A.1, Appendix A. From this table it can be seen that while the number of stores is decreasing, the number of experience facilities is increasing (r_s= -0.916). This is in line with previous findings from the trendline analyses and the literature (e.g., Mikalef et al. 2013). Furthermore, the decrease in the number of stores confluences with the decrease in the number of leisure time stores (r_s= 0.945) and the in/around house stores (r_s = 0.934). In contrast, the number of daily stores is increasing (r_s= -0.832). The results of the literature review suggest a shift from independent stores to retail-chain stores. However, there is no correlation between the number of retail-chain stores and independent stores.

From the results of the correlation test of the share of the number of retail facilities (Table A.2, Appendix A), the same results can be derived. However, from the correlations with the share of vacant retail facilities, it can be seen that when the share of vacant retail facilities increases, the share of in/around stores (r_s=-0.821), leisure time stores (r_s=-0.712), and independent stores decreases (r_s=-0.635). Furthermore, there is a strong negative correlation between the share of fashion department stores and independent stores (r_s= -0.739), while there is a strong positive correlation between the share of fashion department stores and retail-chain stores (r_s= 0.739). This implies that most of the new fashion department stores belong to a retail-chain.

Retail floor area

The correlations regarding the average retail floor area are presented in Table A.3, Appendix A. This table shows only three very strong positive correlations between three types of stores: daily, leisure time, and other stores. This can also be seen in the correlations between the share of the retail floor area (Table A.4). When looking at the strong correlations, there is a strong negative correlation between the average RFA of department stores and the average RFA of fashion department stores (r_s= -0.682). This means that while the average RFA of department stores is decreasing, the average RFA of fashion department stores is increasing. This is in line with the findings of the literature review, from which it can be derived that there is a shift from department stores to fashion department stores (e.g., Burayidi & Yoo, 2021). The average RFA of all stores and vacant facilities together positively correlates very strongly with the average RFA of daily stores (r_s= 0.812) and other stores (r_s= 0.818). From the correlations between the share of RFA of retail facilities (Table A.4, Appendix A), no new results can be derived.

4.1.4 Conclusions

The analyses of the developments in the retail facility mix in inner-city shopping areas of Dutch medium sized cities between 2004 and 2022 reveals several interesting findings. These findings help to give an answer to sub-question b: “Can a development in the retail facility mix in inner-city shopping areas in Dutch medium-sized cities be observed at the beginning of the 21st century and what macro-occurrence may influ-enced these changes?”. The retail landscape has undergone significant developments during this time, sometimes deviating from the expected findings that are outlined in the literature review. The total number of all retail facilities shows a decreasing linear trend, especially since 2010, while the story is nuanced when considering the different functions, types, and attributes. The development in the retail facility mix is marked by accelerations, and shifts, which often confluence with the emergence of macro-occurrences, such as the emergence of e-commerce, the financial crisis and the COVID-19 pandemic.

When looking closer to the developments in stores (part of the retail facility mix), a decreasing linear trend can be seen in (the share of) the number of stores since 2010. This shift seems to confluence with the delayed effects of the rise of e-commerce since 2000 and the start of the financial crisis in 2008. Furthermore, accelerations can be seen during the period after the financial crisis (2014-2015) and during the start of the COVID-19 pandemic (2019-2020).

As for the developments in the composition in the number of stores, it can be concluded that the number of daily stores is increasing over the years (supermarkets and delis in particular). This is in contrast with the

decreasing number of fashion & luxury stores, leisure time stores, and in/around house stores. However, it is in line with the findings from the literature, where it is stated that there is a shift from non-food stores to food stores. Looking at the trendline analyses it shows that the change in the composition of stores confluences with the emergence of e-commerce, the occurrence or the ending of the financial crisis and the occurrence of the COVID-19 pandemic. This is especially true for daily stores, fashion & luxury stores, and leisure time stores. Furthermore, an increase in scale can be seen at least from 2004 for daily stores, leisure time stores, in/around house stores, and other stores.

The literature review implies a shift from department stores to fashion department stores, which is supported by the analyses of the trendlines and correlations. In the most literal sense, the buildings that previously housed a department store, now house a fashion department store. Furthermore, the average RFA of department stores is declining, while the average RFA of fashion department stores is increasing which is due the fact that fashion department stores are moving to larger buildings, since the number does not develop over the years. Furthermore, the development in the share of the number of fashion department stores confluences with the developments in the share of retail-chain stores. While literature suggests a shift from independent stores to retail-chain stores, no results prove this shift. Furthermore, the developments in the number and RFA of retail-chain stores are likely influenced by macro-occurrences, while independent stores seem not to be influenced by these occurrences.

The number of experience facilities is increasing over the years which is due to the increase in the number of hospitality facilities in particular. The increase in the share of experience facilities in combination with the decrease in the share of stores reinforces the assumption of the shift from convenience shopping to leisure shopping in medium-sized cities and thus the emergence of the experience economy as described in the literature review. An acceleration in the increase of the number of experience facilities took place between the end of the financial crisis and the beginning of the COVID-19 pandemic, which makes it seem that both macro-occurrences have slowed down the increase of the experience facilities and thus the experience economy.

From data about vacant facilities and stores, it can be concluded that stores in particular transform into vacant facilities over the years, and that vacant facilities mainly transform back into stores. Furthermore, based on the analyses on all retail facilities together, all stores, and all vacant facilities, it can be concluded that either retail facilities will be merged together with other retail facilities, or that smaller retail facilities are transformed into another function than retail facilities.

The change in the retail facility mix will be compared with the changes in the spatial pattern of retail facilities utilizing correlation tests in section 4.3.

4.2 Developments in spatial pattern

The results of the analyses of the developments in spatial patterns of retail facilities will be presented in this section. For these analyses, geographical data is imported into the computer program QGIS. Utilizing the Nearest neighbour analysis in QGIS, the mean nearest neighbour distance is calculated for each function, type, and attribute per city, and every three years (2004, 2007, 2010, 2013, 2016, 2019, and 2022).

To prevent the calculations from being incorrect, it is checked if the geographical datapoints are correct. For this, the location of facilities is checked in QGIS along with a map from Open Street Maps. When datapoints were projected outside the boundaries of the inner-city shopping area, they are removed. In total, there were eleven geographical outliers, displayed in Table B.1 in Appendix B. These outliers are vacant retail facilities and are all from the year 2004.

Subsequently, the mean nearest neighbour distance is calculated for each function, type, and attribute per city and every three years starting from 2004. The results of these calculations are firstly compared for significant differences over the years with the Friedman tests per function, type, and attribute. These results are presented in the first sub-section of this section. Hereafter, trendline analyses are conducted per function, type, and attribute for which a significant difference has been found. Through the trendline analyses it is analysed how the mean nearest neighbour distance develops over the years. The results of the trendline analyses are presented in sub-section 4.2.2. The last test conducted to analyse the developments in the spatial pattern of retail facilities is the Spearman rank-order correlation test. This test is executed only for the functions, types, and attributes with a clear trend in the development of the spatial pattern (a trendline with a significant determination coefficient). The results of this correlation test gives information about the confluences between developments and can be found in sub-section 4.2.3. In the last sub-section of this section, the conclusions of the analyses of the change in the spatial pattern of retail facilities are given.

4.2.1 Difference over time

To see if there is a difference in the mean nearest neighbour distance over the years, Friedman tests are conducted for every function, type, and attribute. The results of these Friedman tests are summarized in Table 6.

Table 6: Summary results trendline analyses - change in spatial pattern

	Average distance found	
	Fr	P
Function		
Total	23.82	0.00
Store	27.00	0.00
Experience	21.73	0.00
Service	3.24	0.78
Vacant	11.27	0.08
Type - store		
Daily	6.55	0.36
Fashion & luxury	20.33	0.00
Leisure time	27.98	0.00
In/around house	24.00	0.00
Other stores	6.00	0.42
Type - experience		
Hospitality	20.20	0.00
Culture & recreation	6.86	0.33
Attributes		
Department store	6.43	0.38
Fashion department store	15.34	0.02
Retail-chain store	19.29	0.00
Independent store	18.86	0.00

With k = 7 (years) and n =7 (cities)
Critical value for α = 0.05 and with k-1=6 dfis 12.59 (Riffenburgh, 2006)

If Fr > critical value = H0 rejected, there is a change over the years
If Fr < critical value = H0 accepted, there is no change over the years

Looking at the results for the functions, it can be concluded that the mean nearest neighbour distance develops over the years for stores, experience facilities, and all retail facilities together. The mean nearest neighbour distance of vacant facilities and service facilities do not change over the years. As for the different type of stores, only the spatial pattern of daily stores and other stores does not change over the years, while the spatial pattern of fashion & luxury stores, leisure time stores, and in/around house stores does change over the years. When looking at the two types of experience facilities, only the spatial pattern of hospitality facilities significantly changes over the years, while the pattern of culture & recreation facilities does not change. Lastly, as for the attributes, only the spatial pattern of department stores does not change over the years. This is probably because the number of department stores per city remains the same over several years. The spatial patterns of fashion department stores, stores that are linked to a retail-chain as well as independent stores does significantly change over the years.

Based on these results the following functions, types, and attributes are excluded from the trendline analyses: vacant facilities, service facilities, daily stores, other stores, culture & recreation stores, and department stores.

4.2.2 Trendlines

From the Friedman test, it can be concluded that the mean nearest neighbour distance of ten out of sixteen functions, types, and attributes does change over the years. For these functions, types, and attributes, the average mean nearest neighbour distance of all seven cities together is calculated every three years. The results of these calculations are presented in diagrams, including trendlines. These trendlines are used to analyse how the mean nearest neighbour distance changes over the years. A summary of the trendlines, including the R-squared value, per function, type, and attribute is given in Table 7.

Table 7: Summary results trendline analyses – change in spatial pattern

	Average distance found	
	TL	R2
Function		
Total	Pol (2nd)	0.94
Store	Lin	0.66
Experience	Lin	0.76
Service	x	x
Vacant	x	x
Type - store		
Daily	x	x
Fashion & luxury	Pol (2nd)	0.87
Leisure time	Lin	0.92
In/around house	Lin	0.88
Other stores	x	x
Type - experience		
Hospitality	Lin	0.78
Culture & recreation	x	x
Attributes		
Department store	x	x
Fashion department store	Lin	0.83
Retail-chain store	Pol (2nd)	0.85
Independent store	Lin	0.78

TL = type of trendline
R2 = determination coefficient

If R2 > 0.64 = strong correspondence
If R2 < 0.64 = no correspondence

Lin = linear trendline
Pol (2nd) = polynomial trendline, 2nd degree
Pol (3rd) = polynomial trendline, 3rd degree

From this table, it can be concluded that none of the ten functions, types and attributes are excluded. This is because the changes in all spatial patterns correspond to a linear, 2nd-polynomial, or 3rd-degree polynomial function with an R^2 of more than 0.64. On the following pages, the trendlines are described. Maps are also presented with these descriptions, including the geographical midpoints of the relevant retail facilities.

All retail facilities together

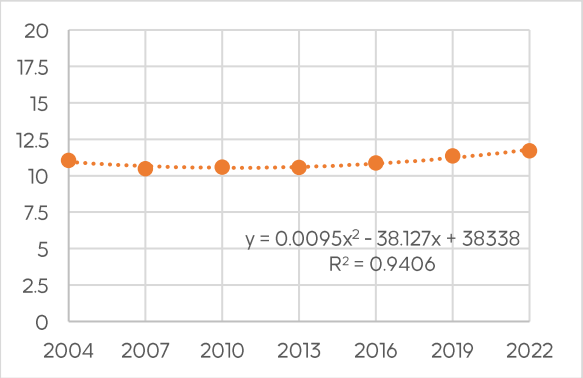

Figure 52: Trendline - average nearest neighbour distance between all retail facilities in meters

The trendline of the mean nearest neighbour distance of all retail facilities together is presented in Figure 52. In this polynomial trendline, the mean distance decreases between 2004 and 2010, after which it increases. Although the change is small in absolute terms, retail facilities were agglomerating until 2010 and were moving away from each other since 2010. A turning point can also be seen in the number of all retail facilities together which started to decrease in the same year. The developments in the number of all retail facilities confluences with the delayed effects of the emergence of e-commerce in combination with the financial crisis. So, when the number of retail facilities decreases, the mean nearest neighbour distance increases.

When looking at the maps of all retail facilities in the inner-city shopping area of Haarlem in 2004, 2010, and 2022 (Figure 53), there is an agglomeration of retail facilities in the core of the inner-city shopping area. Furthermore, there appears to be some agglomeration near the main train station of Haarlem. However, there are also some retail facilities which are located outside the core of the retail area. It seems like there are fewer retail facilities outside this agglomeration in 2022 than in 2004 or 2010. A decrease in the number of retail facilities outside the agglomeration may lead to both an increase and a decrease in the mean nearest neighbour distance. In this case, it seems like it led to an increased mean nearest-neighbour distance between these retail facilities in 2022. Furthermore, from the trendline analyses it follows that the average RFA of stores and vacant facilities is increasing through the years. This increase in the RFA of retail facilities may also lead to a larger mean nearest neighbour distance.

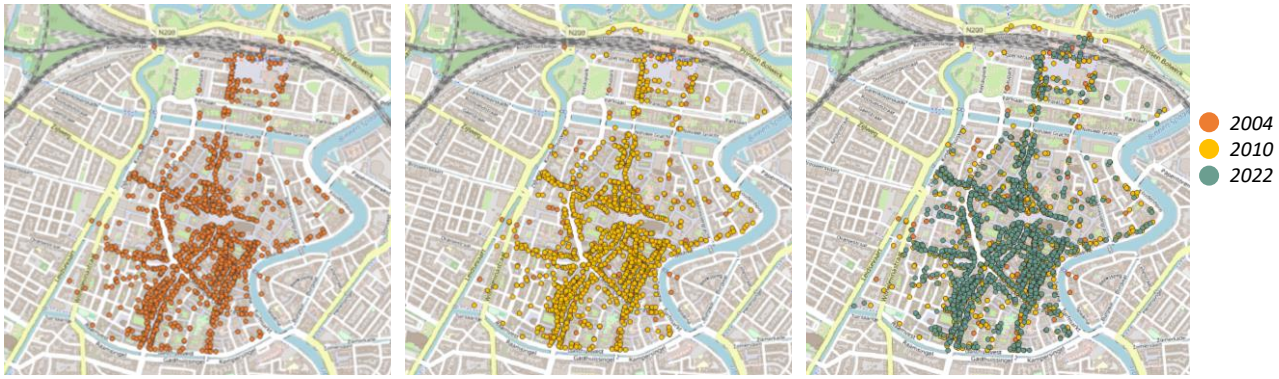

Figure 53: All retail facilities – Haarlem – 2004 / 2010 / 2022

Stores

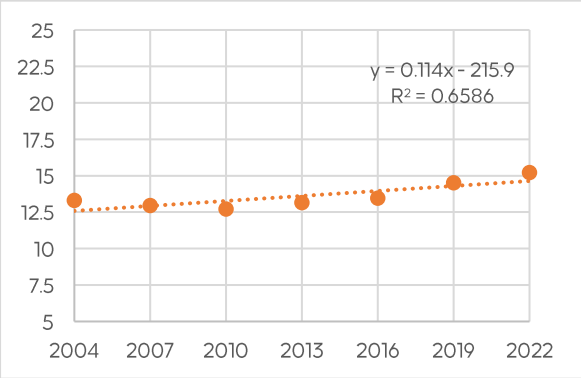

Figure 54: Trendline – average nearest neighbour distance between stores in meters

The diagram of the mean nearest neighbour distance of stores over the years can be found in Figure 54. In this diagram, a positive linear trendline is projected. This implies that the mean distance increases between 2004 and 2022. However, the datapoints show a decrease between 2004 and 2010 and an increase after. This is roughly in line with the change in the spatial pattern of all retail facilities together. When looking at the development in the number of stores, a turning point can be seen in the same year (2010). This trend confluences with the delayed effects of both the emergence of e-commerce since 2000 and the start of the financial crisis in 2008. Therefore, the change in the spatial pattern of stores may also be linked to the effects of the same macro-occurrences. Although an acceleration in the decrease in the number of stores can be seen during the start of the COVID-19 pandemic, this confluence cannot be seen in the developments of the spatial pattern. A decrease in the number of stores leads to an increase in the mean nearest neighbour distance.

When looking at the development of the locations of stores between 2004, 2010, and 2022 in the inner-city shopping area of Den Bosch (Figure 55), the same development can be seen in the change of the retail facilities together in the inner-city of Haarlem (see Figure 53). This means that there is an agglomeration of stores within the core of the inner-city shopping area. The number of stores outside this agglomeration has also thinned out over the years. This in combination with the increasing average RFA of stores and vacant facilities together may have led to an increase in the mean nearest neighbour distance since stores are located further away from each other.

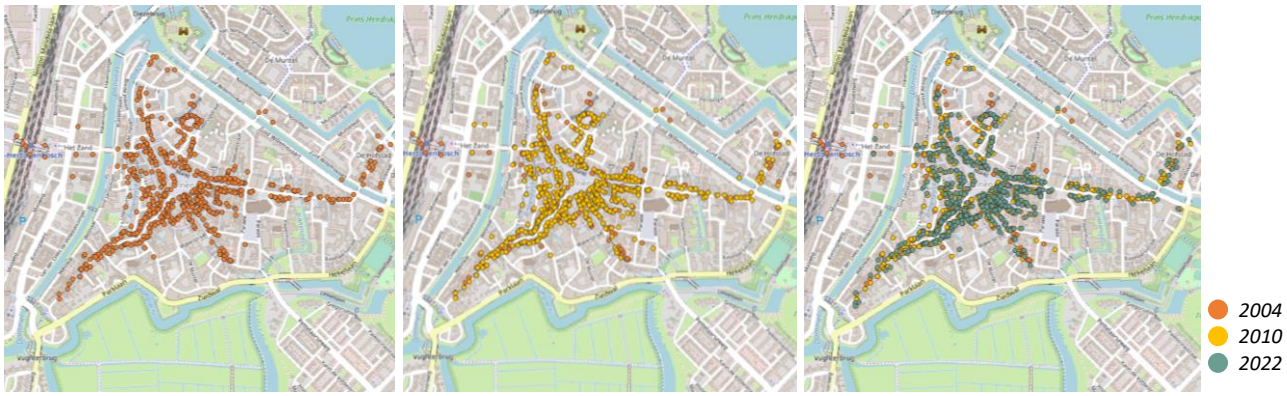

Figure 55: Stores - Den Bosch – 2004 / 2010 / 2022

Experience facilities

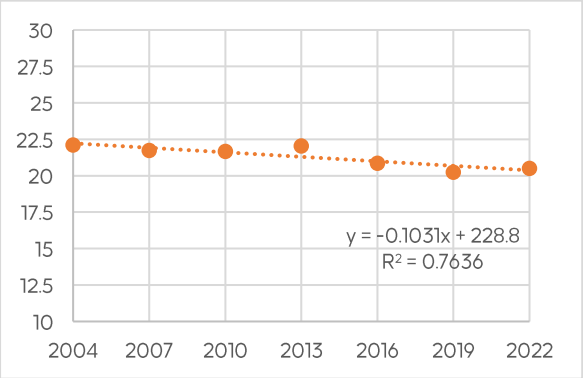

Figure 56: Trendline - average nearest neighbour distance between experience facilities in meters

The diagram of the mean nearest neighbour distance of experience facilities is shown in Figure 56. The trendline in this diagram is decreasing in a straight line over the years. This means that experience facilities are agglomerating over the years since 2004. When looking at the developments in the number of experience facilities, an increase can be seen since 2004 which is in line with the emergence of the experience economy. This implies that while the number of experience facilities is increasing, the mean neighbour distance between these facilities decreases. However, there is one outlier in 2013 which is higher than expected. This means that the mean nearest neighbour distance increased between 2010 and 2013. When looking at the previous described developments, it is expected that the number of experience facilities decreased between 2010 and 2013, however, this is not the case.

In Figure 57, the spatial pattern of the experience facilities in the inner-city shopping area of Nijmegen is presented for the years 2004, 2013, and 2022. By comparing these spatial patterns over the years, it can be seen that experience facilities are scattered over the inner-city but also agglomerate with each other at certain places. These places are in/around a shopping mall in the south, around squares, and in main streets. Furthermore, it can be seen that the number of experience facilities increases through the years and settle near other experience facilities.

Figure 57: Experience facilities - Nijmegen – 2004 / 2013 / 2022

Fashion & luxury stores

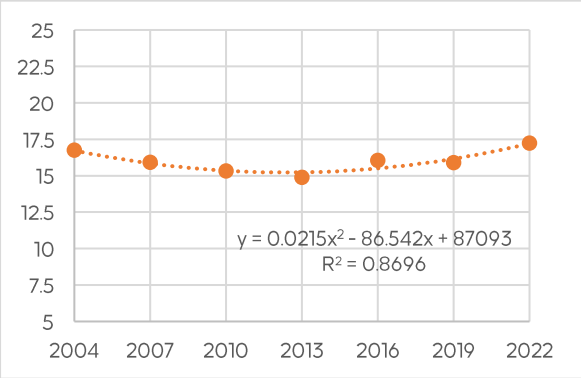

Figure 58: Trendline - average nearest neighbour distance between fashion & luxury stores in meters

As for fashion & luxury stores, the change in the spatial pattern can be described with a second-degree polynomial trendline (see Figure 58). Between 2004 and 2013, the distance is decreasing while it is increasing afterwards. The trendline corresponds to the trendlines of the change in the spatial pattern of both all retail facilities together and stores. However, the lowest point for fashion & luxury stores does not take place in 2010, but in 2013. This is also deviating from the development in the number of fashion & luxury stores, which increases until 2010 and decreases afterwards. So while the number of fashion & luxury stores was decreasing between 2010 and 2013, the mean nearest neighbour distance also decreases. This implies that the fashion & luxury stores that disappeared, were located outside agglomerations of fashion & luxury stores. since the developments in the number of fashion & luxury stores confluence with the emergence of e-commerce and the financial crisis, it also may affect the spatial pattern of fashion & luxury stores only later. Furthermore, the outlier in 2016 may be linked to the increase in the average RFA of fashion department stores between 2013 and 2016 as well as the decrease in the number of department stores between 2013 and 2016.

In Figure 59, the spatial pattern of Fashion & luxury stores in the inner-city shopping area of Amersfoort throughout the years is displayed. For the development in this pattern over the years, it also applies that the number of fashion & luxury stores is decreasing outside the main retail core in the inner city. The agglomeration of these stores in Amersfoort settles around the main street and in/around the shopping mall. Furthermore, some of the fashion & luxury stores in the centre also disappeared or have increased in size (RFA). This leads to an increase in the mean nearest neighbour distance between the remaining fashion & luxury stores.

Figure 59: Fashion & luxury stores – Amersfoort – 2004 / 2016 / 2022

Leisure time stores

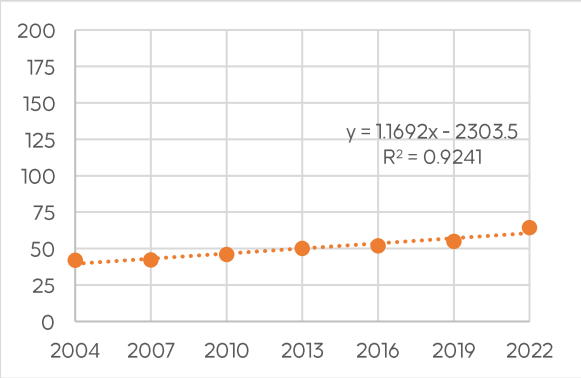

Figure 60: Trendline – average nearest neighbour distance between leisure time stores in meters

The diagram of the average nearest neighbour distance between leisure time stores including the increasing trendline is presented in Figure 60. The distances between leisure time stores are rising linearly over the years. However, the difference in mean nearest neighbour distance between 2004 and 2022 is relatively high compared to the change in the spatial pattern of other functions, types, and attributes. This means that the distance between leisure time stores is increasing over the years. when looking at both the developments in the number as well as the RFA of leisure time stores, it can be seen that the number of stores is decreasing while the average RFA is increasing. Both developments create larger gaps between centre points of the remaining leisure time stores and thus a larger mean nearest neighbour distance.

From the change in the spatial pattern of leisure time stores over the years in the inner-city shopping area of Breda (Figure 61), it can be seen that leisure time stores were already scattered in 2004. This has not changed over the years. As can be seen in the maps, the number of leisure time stores decreases over the year. This creates more gaps between these type of stores which automatically leads to a higher mean nearest neighbourhood distance.

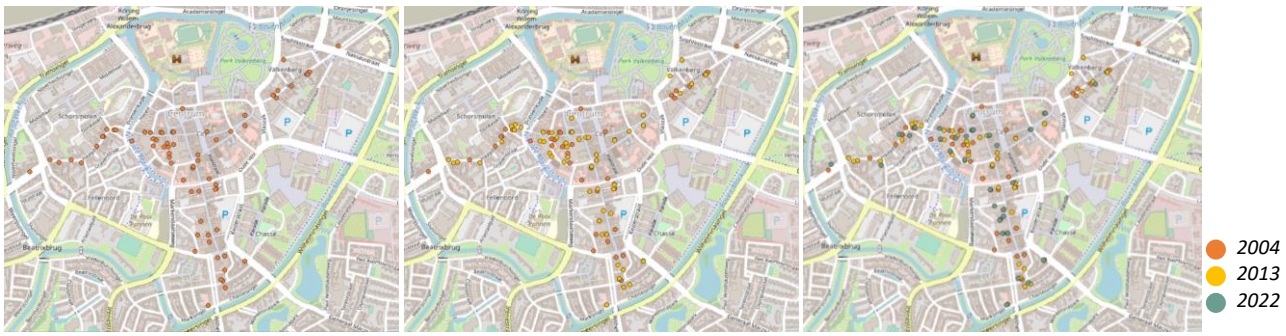

Figure 61: Leisure time stores - Breda – 2004 / 2013 / 2022

In/around house stores

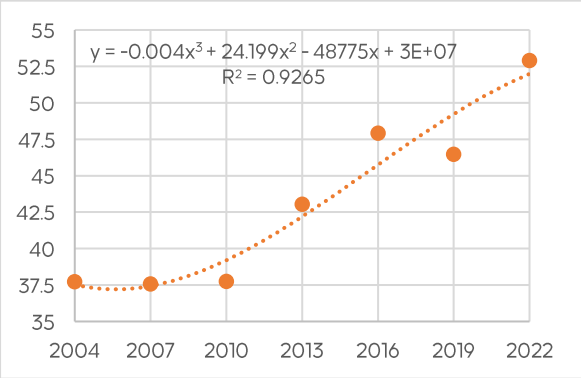

Figure 62: Trendline - average nearest neighbour distance between in/around house stores in meters

The development of the mean nearest neighbour distances of in/around house stores can be explained by a third degree polynomial function (see Figure 62). While the datapoints fluctuate over the years, an increase is visible after the year 2010. Furthermore, a dip in the increase can be seen in 2019. When comparing this result with the developments in both the number as well as the average RFA of in/around house stores, few similarities can be seen. The number of in/around house stores is constantly decreasing while the average RFA is also fluctuating over the years. This implies that the development in the spatial pattern cannot be explained by the developments in the number or RFA of in/around house stores.

When looking at the change in the spatial pattern of in/around house stores in the inner-city shopping area of Arnhem (Figure 63), it can be seen that the number of in/around house stores decreases over the years, while the in/around house stores are not moving closer to each other. This leads to a higher mean nearest-neighbour distance. This also explains the fluctuation of the datapoints as described above, since the mean nearest neighbour distance is sensitive to the closure of stores.

Figure 63: In/around house stores - Arnhem – 2004 / 2013 / 2022

Hospitality facilities

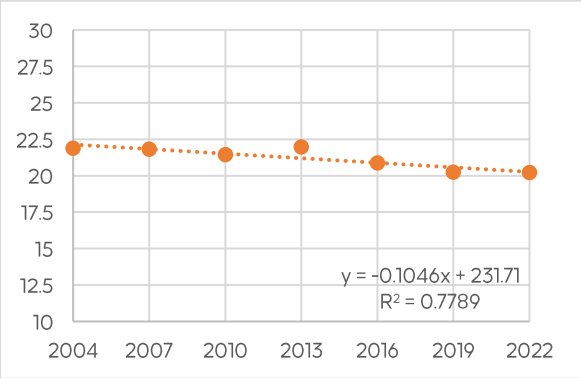

Figure 64: Trendline - average nearest neighbour distance between hospitality facilities in meters

Figure 64 shows the diagram of the average nearest-neighbour distance between hospitality facilities over the years. The trendline in this diagram is a linear decreasing line, which means that hospitality facilities are agglomerating with each other over the years. When comparing this development with the development in the number of hospitality facilities, it can be concluded that an increase in the number of hospitality leads to a decrease in the mean nearest neighbour distance. This means that new hospitality facilities settle near existing hospitality facilities.

The change in the spatial pattern of hospitality facilities in the inner-city shopping area of Haarlem over the years is presented in Figure 65. From the maps, it can be seen that the number of hospitality facilities increases over the years. Furthermore, these hospitality facilities agglomerate with each other, mainly near the river 'Binnen Spaarne' and around squares. This leads to a lower mean nearest-neighbour distance.

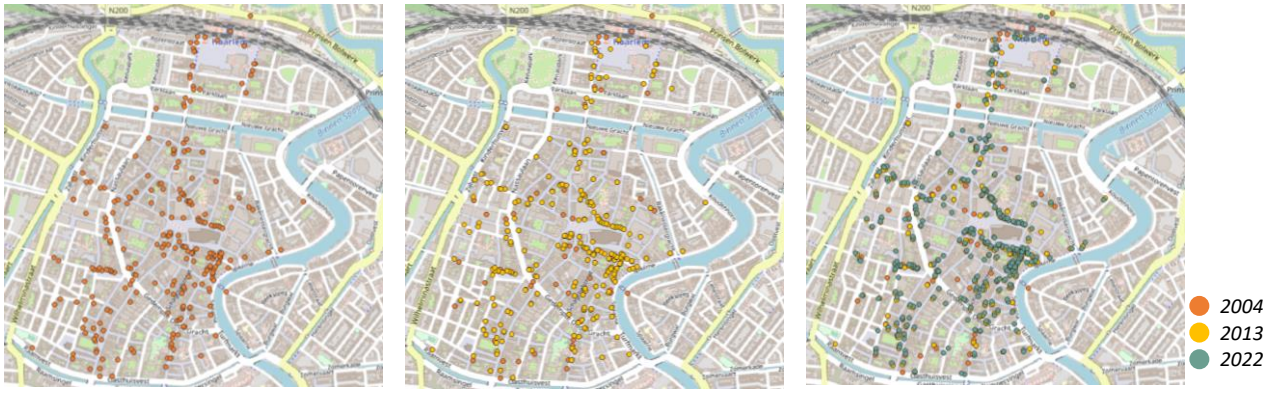

Figure 65: Hospitality facilities - Haarlem – 2004 / 2013 / 2022

Fashion department stores

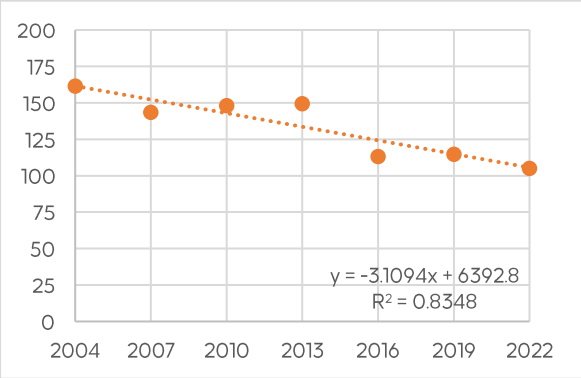

Figure 66: Trendline - average nearest neighbour distance between fashion department stores in meters

When looking at the diagram representing the mean nearest neighbour distance of fashion department stores in Figure 66, the mean distance linear decreases over the years. However, looking at the datapoints it can be seen that the mean distance remains relatively the same from 2004 to 2013 and from 2016 to 2022. This decrease between 2013 and 2016 confluences with an increase in the average RFA of fashion department stores. However, this is in contrast with each other since it is expected that a larger RFA leads to a larger distance between the centre points of fashion department stores. However, the sample size is quite low, for example in Enschede there are a maximum fashion department stores in a years is six.

Figure 67 presents the change in the spatial pattern of fashion department stores in the inner-city shopping area of Enschede for the years 2004, 2013 and 2022. This figure shows that the number of fashion department stores decreases over the years. In 2004, fashion department stores were scattered across the core of the inner-city, located directly on pedestrian streets. However, the remaining stores agglomerate with each other around a large square in the city of Enschede. This may explain the decrease in the mean nearest neighbour distance described above.

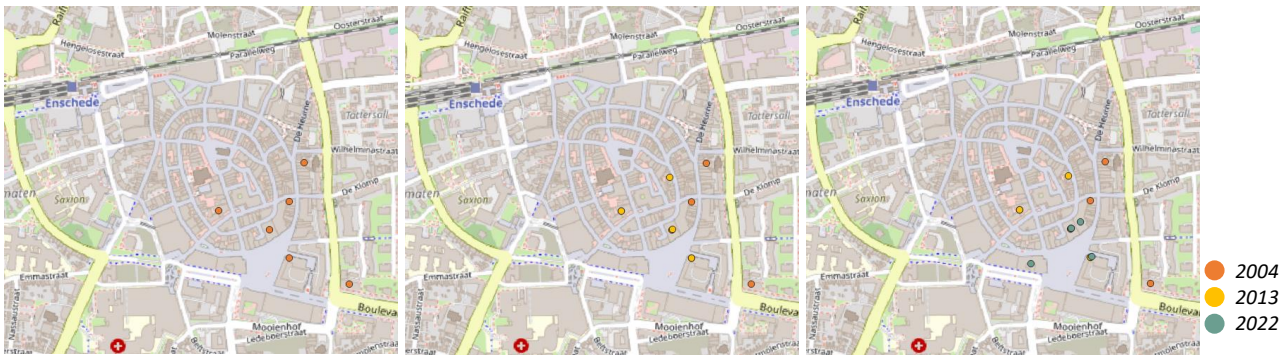

Figure 67: Fashion department stores - Enschede – 2004 / 2013 / 2022

Stores linked to a retail-chain

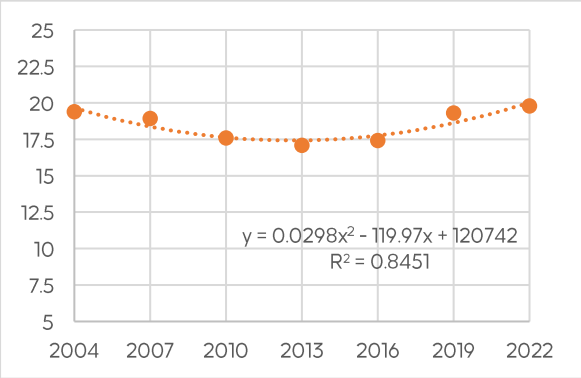

Figure 68: Trendline - average nearest neighbour distance between retail-chain stores in meters

When looking at the diagram of the change in mean nearest neighbour distance of stores related to a retail-chain in Figure 68, it shows a U-shaped trendline over the years. Firstly, the distance decreases between 2004 and 2013. Between 2013 and 2022, the mean nearest neighbour distance increases to the same level as it was in 2004. This development is in line with the development in the number of retail-chain stores, which increases between 2004 and 2013 and decreases afterwards. This means that when the number of retail-chain stores increases, the mean nearest neighbour distance between these chain-stores decreases. Retail-chain stores are more likely to settle near existing retail-chain stores.

In Figure 69, changes in the spatial pattern of retail-chain stores are given for the years 2004, 2013, and 2022 in the inner-city shopping area of Den Bosch. From these maps, it can be seen that retail-chain stores first agglomerate in the core shopping area of the inner-city between 2004 and 2013. The agglomeration is mainly seen around the square in the middle and the shopping streets that lead towards this square. However, between 2013 and 2022, the number of retail-chain stores decreased which created space between retail-chain stores. This leads to a larger mean nearest-neighbour distance.

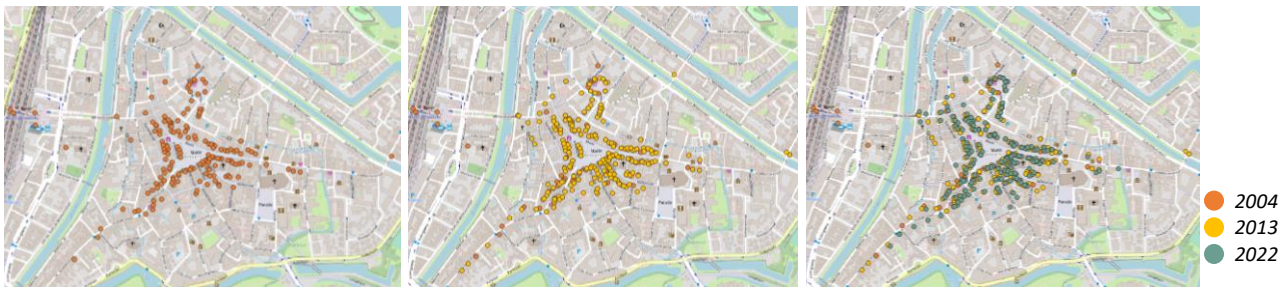

Figure 69: Retail-chain stores - Den Bosch – 2004 / 2013 / 2022

Independent stores

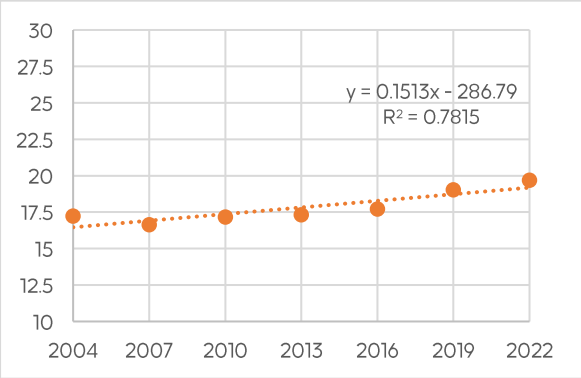

Figure 70: Trendline - average nearest neighbour distance between independent stores in meters

The diagram with the average nearest neighbour distance between independent stores over the years is presented in Figure 70. The diagram shows a positive linear trend, which means that the mean nearest neighbour distance increases over the years. However, the datapoints fluctuate relatively little over time. when comparing the development in the mean nearest neighbour distance with the development in the number of independent stores, it can be seen that while the number is decreasing, the mean distance is increasing. This implies that the independent stores that close, leave gaps between the remaining stores. When comparing the development in mean distance between independent stores with the development in mean distance of retail-chain stores, both show an average nearest neighbour distance of around twenty meters at the end of the measurements, in 2022. This means that at the moment, both the independent and the retail-chain stores have a matching dispersion of retail facilities.

When looking at the change in the spatial pattern of independent stores in the inner-city shopping area of Breda for the years 2004, 2013, and 2022 (Figure 71), it can be seen that independent stores are spread over the inner-city shopping area. However, an agglomeration can be seen at the core of the inner-city and on three streets leading to this centre. Furthermore, it can be seen that independent stores disappeared through the years and created space between the remaining stores. This results in a higher mean nearest-neighbour distance between these remaining stores.

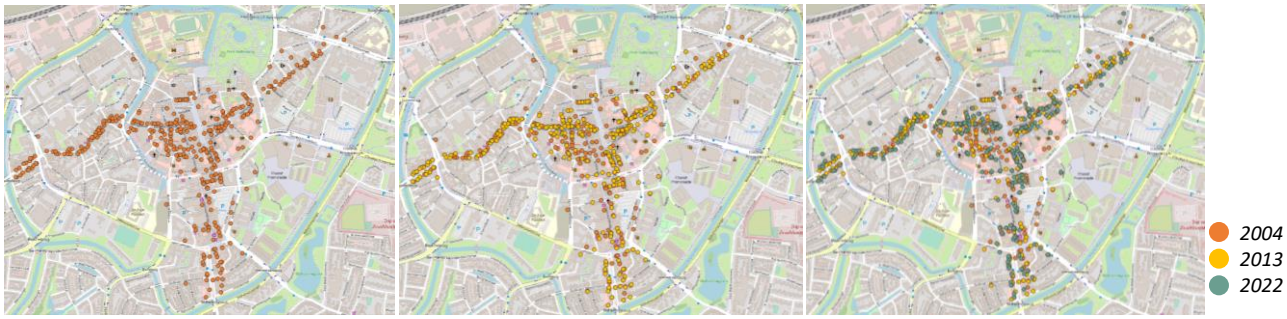

Figure 71: Independent stores - Breda – 2004 / 2013 / 2022

4.2.3 Confluences in developments

In total, the diagrams and accompanying trendlines of ten of the functions, types, and attributes are analysed, see results in the previous sub-section. The confluence between these developments are measured using the Spearman rank-order correlation tests. The results are described in this sub-section and summarized in Table C.1 in appendix C. Only significant (P<0.05) and (very) strong correlations will be described (r_s > 0.61) in the results below.

From the results of the correlation test, it can be derived that the spatial pattern of all retail facilities together confluences positively very strongly with the spatial pattern of both stores (r_s = 0.828) and independent stores (r_s = 0.834). This can be explained by the fact that a large share of the retail facilities consists of stores as well as independent stores. As a result, both influence the spatial pattern of all retail facilities together. Also, a very strong positive confluence can be seen between the change in the spatial pattern of stores and independent stores (r_s = 0.925). This may imply that mainly independent stores influence the spatial pattern of stores.

4.2.4 Conclusions

By analysing results of the nearest neighbour analyses that are calculated using the computer program QGIS, it is aimed to answer sub-question c: “Can a development in the spatial pattern of retail facilities in inner-city shopping areas in Dutch medium-sized cities be observed at the beginning of the 21st century and what macro-occurrences may influenced these changes?”. In the first place, it is striking that the spatial pattern of some functions, types, and attributes does not develop over time. This is especially true for daily stores, other stores, and departments stores since these show clear developments in the number of retail facilities.

From the results of these analyses in combination with previous findings in this thesis, in most cases it can be seen that developments in the retail facility mix, that confluence with macro-occurrences, lead to developments in the spatial pattern of retail facilities. When the number of retail facilities decreases, the spatial pattern of these retail facilities becomes more scattered, while the spatial pattern of retail facilities becomes more agglomerated when the number of retail facilities increases. However, the developments in the spatial pattern do not occur as fast as the developments in the retail facility mix.

The developments in the mean nearest neighbour distance of the functions, types, and attributes, can be divided into three types: linearly increasing, linearly decreasing, and a U-shape.

The linear trendlines imply that the increase or decrease in the mean nearest neighbour distance is increasing or decreasing at least since 2004. It can therefore be stated that this change in the spatial pattern is caused by a macro-occurrence that started or happened before 2004, such as the emergence of e-commerce or the emergence of experience economy. A linear decrease can be seen in the development of the mean nearest neighbour distance between experience facilities, hospitality facilities, and fashion department stores. The first two trends are supported by an increase in the number of experience and hospitality facilities, which can be linked to the emergence of the experience economy. The negative development in the mean nearest neighbour distance of fashion department stores experienced a large decrease between 2013 and 2016 while in contrast the average RFA of this type of stores increased during that time which implies that the increase in RFA did not influence the spatial pattern of fashion department stores.

The linear increases in the mean nearest neighbour distances can be seen in leisure time stores, in/around house stores, and independent stores. All mean distances of these stores, except for in/around house stores, are increasing since 2004 while the number of these types of retail facilities is decreasing since 2004. The developments result in the closure of brick-and-mortar stores and created gaps between these types of stores which led to an increase in the mean nearest-neighbour distance. The change in the pattern of independent stores may be linked to the shift from independent stores to retail-chain stores, causing independent stores to disappear. As for the in/around house stores, the increase started from 2010, however, this increase cannot be explained by developments in the number or RFA of these type of stores.

An U-shaped trendline can be seen in the change in the spatial pattern of all retail facilities together, all stores together, fashion & luxury stores, and retail-chain stores. All four trends start with a decrease and then change in an increasing line. As for the development of the number of these retail facilities, it follows a contrary trend with first an increase or stagnation and after a turning point a decrease. The turning point of the trendline of all retail facilities together and all stores together is in 2010, while the trendline of fashion & luxury stores, and retail-chain stores make a reversal in 2013. Only for the fashion & luxury stores, the turning point in development of the mean distance differs from the turning point in the development in the number. This may be explained

by an increase in the average RFA of fashion department stores and a decrease in the number of department stores. A decrease in the number of a certain retail facilities leads to an increase in the mean nearest neighbour distance of the same type of retail facilities.

The changes in the spatial pattern of retail facilities will be compared to the changes in the retail facility mix in the next section (4.3).

4.3 Confluences in developments of the retail facility mix and spatial pattern

As for the confluences between the developments in both the retail facility mix and the spatial pattern of retail facilities, Spearman rank-order correlation tests are conducted. For these tests, the developments in the mean nearest neighbour distance of types, functions, and attributes are compared with the corresponding (share of the) total number or RFA of retail facilities. For these tests, only the developments that show a significant trendlines are used. A summary of the results of this correlation test can be found in Appendix D, Table D.1 and Table D.2.

In the first table, Table D.1, the results of the correlation test between the developments in the mean nearest neighbour distance and the (share of) number of retail facilities are presented. As for the very strong negative correlations, it can be concluded that while the number of stores is decreasing, the average distance between stores increases (r_s = -0.880). The same is true for in/around house stores (r_s = -0.918), leisure time stores (r_s = -0.973), retail-chain stores (r_s = -0.829), and independent stores (r_s = -0.905). Furthermore, a strong negative correlation can be found between the distance between hospitality facilities and the number of hospitality facilities (r_s = -0.729). The same is true for the correlation between the total number of all retail facilities and the distance between all retail facilities (r_s = -0.661), and the correlation between the total number of fashion department stores and the distance between fashion department stores (r_s = -0.702). This means in general that when the number of retail facilities is increasing, the distance between them decreases and vice versa. This is also in line with expectations. There are no positive correlations between the number of retail facilities and the mean nearest neighbour distance.

When looking at the confluences between the developments in both the average RFA and the mean nearest neighbour distances (Table D.2), it is expected that the mean nearest neighbour distance increases when the average RFA is increasing since the geographical coordinates represent the middle points of the retail facilities. However, this is only true for leisure time stores (r_s = 0.880). While the average RFA increases, the mean nearest neighbour distance also increases. As for in/around house stores (r_s = -0.631) and fashion department stores (r_s = -0.741), there is a negative correlation between the RFA and the mean nearest neighbour distance. However, only the RFA of stores and vacant facilities are analysed in this thesis, so the conclusion may be different for experience facilities or service facilities.

4.4 Conclusion

The results of the analyses of developments in the retail facility mix as well as the spatial pattern of retail facilities in the inner-city shopping areas in medium-sized cities in the Netherlands show the dynamics between both developments and macro-occurrences.

From this section, it can be concluded that the retail facility mix has developed through the years, often in line with the findings from literature. Some developments can be explained by an linear trendline. It is likely that these developments are shaped by previously initiated macro-occurrences like the emergence of e-commerce or the experience economy. Other developments seem to confluence with sudden macro-occurrences, such as the financial crisis and the COVID-19 pandemic, visible in shifts or accelerations in the developments in number or RFA of retail facilities. There are also developments that are almost invisible and seem not to merge with macro-occurrences.

Most developments in the retail facility mix impacts the spatial pattern. This can be seen in the negative correlations between the developments in the number of retail facilities and the developments in the mean nearest neighbour distance. This implies that when the number of retail facilities increases, the mean nearest neighbour distance decreases. This means that the spatial pattern becomes less scattered and thus more agglomerated when the number of retail facilities increases. Conversely, the spatial pattern of retail facilities becomes more scattered when the number of retail facilities decreases. Furthermore, it is expected that the developments in the average RFA positively correlates with the developments in the mean nearest neighbour distance: when the average RFA of retail facilities rises, the distance between these retail facilities also rises. However, this is only

true for leisure time stores. In contrast, when the average RFA of in/around house stores and fashion department stores increases, the mean nearest neighbour distance between these stores decreases.

5. Conclusions and recommendations

In this research, it is tried to give an answer to the main research question: "What retail-related developments have taken place in inner-city shopping areas in medium-sized cities in the Netherlands at the beginning of the 21st century, and how have macro-occurrences influenced these developments?". Therefore, three sub-questions have been answered throughout this study by conducting a mixed method approach, including a qualitative research and a quantitative research. The quantitative research is based on a dataset containing information about the geographical coordinates, and the function, type, and attributes of all retail facilities in the seven selected mid-sized cities in the Netherlands between 2004 and 2022. The conclusions of all three sub-questions together will give an answer to the main research question and are presented in the first sub-section (5.1).

Subsequently, the recommendations will be presented in section 5.2. In section 5.3, the relation with ongoing research will be described, while the critical reflection will be written down under 5.4. Suggestions for future research can be found in section 5.5. This chapter closes with the managerial implications in section 5.6.

5.1 Conclusions

First, a literature review has been conducted to answer sub-question a: "What (recent) macro-occurrences and retail-related academic perspectives follow from literature and how did they affect both the retail facility mix and the spatial distribution of retail facilities in cities in western Europe?". From this literature review, it can be concluded that several macro-occurrences have led to four major changes affecting retail in western European cities in the past twenty years. The emergence of e-commerce around 2000 has led to a decrease in the number of stores. This decrease accelerated during the financial crisis between 2008 and 2014 and the COVID-19 pandemic between 2019 and 2022. Furthermore, the emergence of the European Union around 1960 has led to an increased competition between (inter)national retail-chain stores, since this EU allowed free trade between European companies. The emergence of free trade led to the emergence and increase in (inter)national retail-chain stores. This caused the third major change: the shift in anchor stores. The number of traditional department stores (e.g., V&D or Bijenkorf) is decreasing, while the number of fashion department stores is increasing since the emergence of international chain-stores (e.g., H&M or Zara). The last macro-occurrence is the emergence of the experience economy, since the emergence of e-commerce, which led to the increase in the number of experience facilities.

Utilizing Friedman tests, trendline analyses, and correlation tests, an answer is sought to sub-question b: "Can a development in the retail facility mix in inner-city shopping areas in Dutch medium-sized cities be observed at the beginning of the 21st century and what macro-occurrence may have influenced these changes?". During the period of research (2004-2022), the retail facility mix has undergone several developments. These developments often align with the findings in the literature. The total number of retail facilities declined during the period of research, while the developments in the functions, types, and attributes often differ from this decreasing line. The shifts and accelerations in these developments often confluence with macro-occurrences such as the emergence of e-commerce, the financial crisis, and the COVID-19 pandemic. For example, a close look at the development in the number of stores shows that the decrease in the number accelerates during the end of the financial crisis (2014-2015) and during the start of the pandemic (2019-2020). Also the increasing development in the number of experience facilities seems to be subjected by these macro-occurrences. Developments in the share of both the service and the vacant facilities are nihil during this period. The composition of stores also changes between 2004 and 2022. While fashion & luxury stores, leisure time stores, and in/around house stores declined, the number of daily stores increased. This is in line with the shift from non-food stores to food-stores as stated in literature. The shifts and accelerations in the developments also confluence with macro-occurrences. Furthermore, an increase in scale occurred for daily stores, leisure time stores, in/around house stores, and other stores. As literature suggests, the department stores are literally replaced by fashion department stores. However, the shift from independent stores to retail-chain stores seems less evident from the analyses. Furthermore, the developments in retail-chain stores appear to confluence with macro-occurrences, while the development in the number of independent stores seem to be constant and not subjected to macro-occurrences.

Sub-question c: "Can a development in the spatial pattern of retail facilities in inner-city shopping areas in Dutch medium-sized cities be observed at the beginning of the 21st century and what macro-occurrences may have influenced these changes?" is answered by analysing the developments in the mean nearest neighbour distance between facilities of different functions, types, and attributes. An increasing mean nearest neighbour distance implies that the spatial pattern becomes more scattered, while an decreasing mean nearest neighbour distance

implies an agglomeration in the spatial pattern. Firstly, it is striking that some spatial patterns are not significantly developing at all from 2004 to 2022. These include vacant facilities, service facilities, daily stores, other stores, culture & recreation facilities, and department stores, while the number of some of these retail facilities do develop through the years. From the analysis it became clear that an increase in the number of retail facilities leads to a more agglomerated spatial pattern, while a decrease in the number of retail facilities leads to a more scattered spatial pattern. As for experience facilities and hospitality facilities, the mean nearest neighbour distance decreases between 2004 and 2022. This is in line with the increasing number of experience and hospitality facilities, which is probably due to the emergence of the experience economy. While the mean nearest neighbour distance is also decreasing for fashion department stores, this cannot be linked to developments in the number of this kind of store. In contrast, the mean nearest neighbour distance between leisure time stores, in/around house stores, and independent stores is increasing, while the number of these kind of stores is decreasing. This implies that the spatial pattern becomes more dispersed over the years. Furthermore, the average nearest neighbour distance of all retail facilities together, all stores together, fashion & luxury stores, and retail-chain stores firstly is decreasing until 2010 or 2013 and is increasing afterwards. The development in the mean nearest neighbour distance of all these kind of facilities is in line with the development in number, except for fashion & luxury stores. So, developments in spatial patterns seem to be closely related to and even influenced by developments in the number of facilities which confluence with the happening of macro-occurrences.

Based on the results of the literature review in combination with the analyses of the developments in both the retail facility mix and the spatial pattern of retail facilities, an answer to the main research question can be given: "What retail-related developments have taken place in inner-city shopping areas in medium-sized cities in the Netherlands at the beginning of the 21st century, and how have macro-occurrences influenced these developments?". In this study, the confluences between the developments in the retail facility mix and the spatial pattern of retail facilities have been analysed. These confluences are described below.

The total number of all retail facilities together is decreasing since 2010. This change leads to a more scattered spatial pattern of the retail facilities. The developments in the total number of all retail facilities together are mainly influenced by the decrease in the number of stores and the increase in the number of experience facilities. In the next paragraphs, the change in the composition of all retail facilities together (the retail facility mix) will be explained.

Although the total number of retail facilities is decreasing, the number of experience facilities is increasing since 2004. This can mainly be explained by the increase in hospitality facilities. This development confluence and therefore may be linked to the emergence of e-commerce and the emergence of the experience economy. The experience economy concerns the sale of memorable experiences rather than buying physical objects, making the inner-city more a place to be than to buy. The emergence of delivery/takeaway and fast food restaurants plays a relative large role in this development. An acceleration in the increase has taken place between the end of the financial crisis and the start of the COVID-19 pandemic. This implies that these macro-occurrences slowed down the emergence of the experience economy. The increase in the number of experience facilities resulted in a more agglomerated spatial pattern of these facilities in the inner-city shopping areas.

From the literature it can be derived that stores profit from hospitality facilities (RetailSonar, 2020), however, the number of stores is decreasing over the years. According to the literature, it is expected that the closure of stores increased since the emergence of e-commerce around the year 2000. However, from the data analyses in this study, it can be concluded that the number of stores started to decrease ten years later. During this time, there was a financial crisis in the Netherlands and people made fewer non-daily purchases and avoided recreational shopping which led to a sharp drop in sales in 2009 (Statistics Netherlands (CBS), 2023). This can be directly linked to the start of the decrease in the number of stores since 2010 in inner-city shopping areas of medium-sized cities. This decrease persisted even after this crisis which implies that the emergence of e-commerce and the experience economy brought about a change in the way of shopping as well as the motivation for shopping. Also, the fact that people are more likely to borrow or rent products rather than buy them may amplify this decrease. According to the literature people preferred local shopping and mainly went to shopping areas for convenience rather than experience. However, the decrease in the number of stores accelerated at the beginning of the COVID-19 pandemic, resulting in a more scattered spatial pattern. Consequently, many stores transformed into vacant facilities.

When looking at the findings from the literature for service facilities, it is expected that the number of service facilities is increased over the past 20 years (Pine & Gilmore, 1999). However, the number of service facilities in

medium-sized cities is fluctuating over the years and shows a relatively small increase only since after the financial crisis. Furthermore, no development in the spatial pattern can be seen in the seven analysed cities.

Although the findings from the literature review show that the share of vacant facilities increases (GfK, 2015), the analysis of the trendline of the share of this function shows a fluctuation and no clear trend. Also, no development can be seen in the spatial pattern of vacant facilities through the years. However, based on the analyses on vacant facilities, stores and all retail facilities together, it seems plausible that retail facilities either will be merged with another retail facility (which corresponds to the increasing average RFA of stores and vacant facilities together), or will be transformed into another function than a retail facility such as housing.

When looking at the development in the composition of stores in the inner-city shopping area of Dutch medium-sized cities, the increasing online sale of clothes and shoes (Statistics Netherlands, 2023) confluence with decrease in the number of fashion & luxury stores. Furthermore, the number of perfumery stores is also decreasing, while the number of stores for personal care is increasing over the years. The last is in line with the findings from the literature, since personal care products are bought the least online (Statistics Netherlands, 2023). The findings from the analyses for medium-sized cities in the Netherlands show also an increase in the number of food stores, especially in the number of supermarkets and delicatessens stores. This, in combination with the decline in non-food stores, is in line with the literature in which it is stated that non-food stores are replaced by food-stores (Statistics Netherlands, 2022). However, although printed books, electronics, and devices are in the top three least bought goods online (Statistics Netherlands, 2023), it does not lead to an increase in the stores that sell these goods. In contrast, the number of leisure time stores is decreasing over the years.

In addition to results that can be linked to the findings from the literature, some other conclusions can be derived from the data analyses in this thesis. Firstly, it can be concluded that the decrease in the number of fashion & luxury stores, leisure time stores, and in/around house stores negatively correlates with the development in the mean nearest neighbour distance, meaning that a decrease in the number of retail facilities leads to a more scattered spatial pattern of these retail facilities. Furthermore, the number of daily stores is increasing while it does not lead to a development in the spatial pattern. This is in contrast to most results from the spatial pattern analyses in which the mean nearest neighbour distance decreases when the number of retail facilities increases. Also, an increase in the average RFA, and thus the scale, of stores can be found for daily stores, leisure time stores, in/around house stores, and other stores. While it is expected that the mean nearest neighbour distance increases when the average RFA increases, this is only true for leisure time stores. The development in spatial pattern even negatively correlates with the development in RFA for in/around house stores and fashion department stores. Therefore, it can be concluded from these findings that a decrease in the number of stores results in larger gaps between the remaining stores. However, an increase in the average RFA of retail facilities does not lead to a larger distance between retail facilities.

Looking closer at the development of the number of stores, accelerating effects can be seen in the increase in daily stores between the end of the financial crisis and the start of the COVID-19 pandemic. Furthermore, an acceleration in the decrease in fashion & luxury, and leisure time stores can be seen during the financial crisis and the COVID-19 pandemic. The number of in/around house stores is constantly decreasing and does not seem to be much affected by sudden macro-occurrences such as the financial crisis or the pandemic. However, ongoing macro-occurrences may have influenced this development, such as the emergence of e-commerce and/or experience economy.

When looking at the developments in (fashion) department stores, in line with the findings from the literature review (e.g. Burayidi & Yoo, 2021), there is a shift from the department store to the fashion department store. This can be seen quite literally in the fact that the number of department stores is decreasing while retail facilities that housed a department store are now housing a fashion department store. The decrease in the number of department stores started during the financial crisis. Furthermore, there is also a significant negative relation in the average RFA between department stores and fashion department stores, which shows that while the average RFA of department stores is decreasing, the average RFA of fashion department stores is increasing. Since the number of fashion department stores is not developing through the years, it seems plausible that the increase in the average RFA is the result of the relocation of the in 2004 already existing fashion department stores.

Subsequently, a positive strong relation is found between the change in the share of fashion department stores and the change in the share of retail-chain stores, which confirms the finding from the literature that states that the shift from department stores to fashion department stores is fuelled by the emergence of (inter)national retail-chain stores (Boesveldt, 2017). When looking closer at the composition of independent stores and retail-

chain stores, it can be seen that independent stores are in the majority over time, however, both the number and the share of the number of independent stores is decreasing over the years. In contrast, retail-chain stores do occupy more than half of the total RFA over the years. Although the development in independent stores does not seem to be subject to sudden macro-occurrences, it may be influenced by ongoing macro-occurrences that started prior to 2004, such as the emergence of e-commerce. However, the shift in the development of the number of retail-chain stores confluences with the delayed effects of e-commerce. The accelerations in the development may be linked to sudden macro-occurrences such as the financial crisis and the pandemic.

In short the number of stores in inner-city shopping areas of Dutch medium-sized cities started decreasing around 2010, which confluences with a combination of the delayed effects of the emergence of e-commerce and the financial crisis. In contrast, only the number of stores that sell daily goods such as food and personal care products is increasing. The number of experience facilities is increasing throughout the years since 2004, which may be linked to the emergence of the experience economy around 2000. This is mainly reflected in the increase in takeout/delivery and fast-food restaurants. The increase in experience facilities has experienced delays, during the same time periods as the occurrences of both the financial crisis and the COVID-19 pandemic. Furthermore, a shift from department stores to fashion department stores has taken place. Looking at the results of the trendline analyses, it seems plausible that this development is caused by a combination of the emergence of e-commerce, the financial crisis and the emergence of (inter)national retail-chain stores. The retail-chain stores are also replacing the independent stores, especially when looking at the RFA of these stores. The decrease after 2013 in retail-chain stores also confluences with macro-occurrences such as the delayed effects of the emergence of e-commerce and the financial crisis, and the pandemic.

From the results of the analyses on both the retail facility mix and the spatial pattern, it can be concluded that the change in the spatial pattern of retail facilities can be explained by the developments in the retail facility mix. Evidence is found that the decrease in the number of retail facilities leads to an increase in the mean nearest neighbour distance and thus a more scattered spatial pattern. This can be explained by the idea that when a retail facility closes, it leaves a gap between remaining retail facilities. Furthermore, while the number of experience and hospitality facilities increases, the mean nearest neighbour distance between these facilities decreases. This means that new experience or hospitality facilities settle near existing experience or hospitality facilities. Although it is expected that an increase in the average RFA also leads to larger gaps between retail facilities, no evidence is found for this assertion.

From this research, it can be concluded that developments in the retail facility mix often confluence with ongoing or sudden macro-occurrences. Constant, linear trends may be influenced by ongoing macro-occurrences such as the emergence of e-commerce and the emergence of the experience economy. However, some developments are characterised by shifts, accelerations, and delays, which often confluences with sudden macro-occurrences such as the financial crisis, and the COVID-19 pandemic. These developments in the retail facility mix (especially in the number) often result in a change in the spatial pattern of retail facilities. An increase in the number, leads to a more agglomerated spatial pattern and vice versa.

5.2 Recommendations

Medium-sized cities in the Netherlands face the most challenging changes, such as the increase in vacancy (Locatus, 2023). Furthermore, they serve the local population in particular and do not benefit from tourism (Chatterjee, et al., 2020; Clols, 2021). However, medium-sized cities are seen as important player in a country's economic structure (Leeuwen & Rietveld, 2011). Therefore, it is important to create and keep the inner-cities of medium-sized cities attractive to create positive consumer experiences. A positive experience of consumers often leads to a revisit of the in er-city or additional expenditure due to a longer stay at the inner city (Kirkup & Rafiq, 1994), and retail is the most important attribute for inner-city attractiveness (Karlsson & Nilsson, 2017). The retail-related developments in the inner-city shopping area affect consumer experience the most (Birkin, et al., 2002). Therefore, recommendations are made based on the developments found in this thesis and their causes, but also on the current retail facility mix and spatial pattern of retail facilities in combination with the consumer preferences emerged from the literature review. Since both the retail facility mix and spatial pattern of retail facilities in inner-city shopping areas of medium-sized cities in the Netherlands depends on the decisions of retailers, retail facility owners, as well as the municipality, the recommendations are tuned on these three stakeholders.

First of all, according to the literature review in this thesis, consumers prefer compact inner-city shopping areas, making it easier to compare goods (Brown, 1989). However, at this moment the spatial pattern of most retail facilities is becoming more scattered through the years. Therefore, municipalities should encourage the

transformation of vacant retail facilities in the core of inner-city shopping areas into another (temporary) retail-related function that brings activity. Examples of such functions are pop up stores or flagship stores, supporting the diversity in the inner-city shopping area which positively impacts the consumers' experience (Arentze, 1999). This also ensures a lively and attractive street scene and facilities no longer remain vacant but become part of the retail facility agglomeration.

Furthermore, it is recommended for retail facility owners to sell retail facilities on the edge of the inner city shopping area or to transform these facilities into a completely different function such as an office or living. In that way, the scattered pattern of retail facilities becomes more agglomerated which has positive effects on the consumers' experience (Brown, 1989).

From the literature review, it is recommended to invest in properties or locate near fashion department stores and hospitality facilities since these facilities provide additional consumer traffic. Furthermore, housing a culture & recreation facility is sensible, since no change in the number or spatial pattern of these facilities has been detected, which implies that these facilities will rent for a long time. Also, experience is becoming more important over the years. Consumers prefer to be entertained and to be able to compare goods (Arentze, 1999; Brown, 1989).

As the retail environment is changing rapidly subjected to macro-occurrences, retailers need to negotiate for a flexible renting contract. When the current location of the retail facility is becoming unpopular, it must be easier to move to a better location within the retail agglomeration, where the retailer can benefit from nearby occupied retail facilities. Furthermore, it is not recommended to start a business in fashion & luxury stores, leisure time stores, and in/around house stores since these type of stores is becoming less popular, this is reflected in the decreasing number of these types. Daily stores and hospitality facilities on the other hand are becoming increasingly popular, this is reflected in the increasing number of these types. Therefore, at this moment, it is interesting to start a business in daily goods or hospitality.

5.3 Relation to ongoing research

Recent research on the long-term change in the spatial pattern of retail due to urban decline in inner-city shopping areas of large cities explains that the closure risk of an establishment increases with fewer surrounding establishments (Kickert, et al., 2020). The results in this thesis are supporting this conclusion, since a decrease in the number of stores confluences with an increase in the mean nearest neighbour distance and thus a more scattered spatial pattern with fewer surrounding establishments. This is especially true for leisure time stores, and in/around house stores, since the increase in the mean nearest neighbour distance is an ongoing trend between 2004 to 2022. Furthermore, an example of research on the impact of the emergence of e-commerce on in-store shopping is the research of Weltevreden & Rietbergen (2009). Surveys were conducted for this research. The resulting data has been analysed using regression analyses. They conclude with their research that in the Netherlands, neighbourhood and convenience centres will be less affected by the effects of e-commerce, while city and city district centres will face substitution of e-shopping for in-store shopping. The probability of this substitution is influenced by personal and geographical factors. The conclusion of the research of Weltevreden & Rietbergen (2009) partly corresponds with the findings of this thesis, since a confluence is found between the decrease in the number of stores and the delayed effects of the emergence of e-commerce. However, in addition, the start of the decrease in the number of stores also confluences with the start of the financial crisis. So, it is plausible that both macro-occurrences have led to this decrease. According to research of Ossokina, et al. (2016) on the effects of the financial downturn on vacancy in shopping areas, it can be concluded that vacancy concentrates at the edges of shopping areas. To come to this conclusion, the researchers have compared data about the consumption of goods, rental prices of stores, and vacancy in the Netherlands but also in other countries. In this thesis, also the developments in the spatial pattern of vacant facilities have been analysed, based on the development of the mean nearest neighbour distance. From this analysis, it can be concluded that vacant facilities do not agglomerate more or scatter more through the years.

The methods in this study are inspired by the methods of ongoing research. However, the used methods in this study do differ from the methods used in the research presented above. For example, the changes in the spatial pattern are measured by analysing the changes in the agglomeration of retail facilities. However, agglomeration is measured differently. Instead of counting the number of retail facilities within a radius of 50 meters (Kickert, et al., 2020), the mean nearest neighbour distance is calculated. This nearest neighbour analysis appears to be suitable for analysing the development of the spatial pattern of retail facilities in inner-cities. However, for future research it is recommended to try other methods for the same research purpose to substantiate the conclusions made in this thesis. Furthermore, the Friedman test is mostly used in the research field of medicine and not

commonly used in spatial research. The trendline analysis method appears to be a good way to quickly assess certain trends in changes over the years.

The results and recommendations of this thesis correspond to the results of ongoing research. However, the findings are still new and usable, since it proves that most of the changes in medium-sized cities correspond with the changes in large cities. It can therefore be concluded that the conclusions and recommendations for large cities to a great extent apply to medium-sized cities as well. Furthermore, in addition to ongoing research, the results of this research provide a more detailed view of the changes in the composition of the retail facility mix. It also contributes to a broadening of knowledge about the consequences of a change in the retail facility mix on the change in the agglomeration (spatial pattern) of retail facilities.

5.4 Critical reflection

When looking at the validity of this study, firstly, it can be doubted if the sample of seven cities is big enough. In total, there are eighteen medium-sized cities in the Netherlands, but only seven have been analysed. To improve the validity of this study, it would be better to analyse all eighteen medium-sized cities to be sure that the results also apply to the eleven other medium-sized cities. Furthermore, in this study, a medium-sized city is a city with between 100,000 to 250,000 inhabitants. However, in other studies, a medium-sized city is a city with less than 100,000 inhabitants (e.g. Delage, et al., 2020). Therefore, it is important to keep in mind the definition of medium-sized cities. Furthermore, sources that are used for the historical review of the development of retail were scarce. As a result, statements from these sources may be context specific. Also, this research needs replication in order to compare the results from this study with other studies, e.g., in other countries and also to compare with other research approaches. Especially the method of nearest neighbour analysis needs further investigation as it may not be sensitive to certain changes in spatial configurations.

The interpretation of the results of this study is mainly based on the confluences of the occurrence of macro-occurrences and the change in the retail facility mix and the spatial pattern of retail facilities during the same time. However, no hard evidence can be provided that only the macro-occurrences considered in this study influenced these results. Nevertheless, based on the literature review in combination with the analyses of the data, it can be stated with a reasonable degree of certainty that the findings are correct. Furthermore, for the analyses of the changes in spatial analyses utilizing maps, only one city has been analysed per function/type/attribute. However, no firm conclusions are drawn from these analyses.

One of the limitations is the fact that some factors that may affect the retail facility mix and the spatial pattern of retail facilities are excluded. These factors include policy measures and changes regarding mobility, tourism, and demography. From the literature review, it can be concluded that these factors do influence the changes in both the mix and the spatial pattern. However, these factors are excluded in this study. The biggest limitation of this research is the fact that the change in the spatial pattern of retail facilities only has been exploratively investigated. First of all, only the agglomeration between the same type of retail facilities is measured. The change in agglomeration around, for example, anchor stores is missing. Furthermore, the mean nearest neighbour distance is only calculated every three years, which makes it hard to conclude when the change in spatial pattern started. Lastly, there are limitations in the calculation of the mean nearest neighbour distance. In this study, the distance as the crow flies is taken between the centre points of retail facilities. From a geographical point of view, this may be correct, but it differs from how shoppers experience the retail environment. To measure the agglomeration experienced by consumers, the walking distances between retail facility entrances should be taken into account.

5.5 Future research

The results of this thesis provide an overview of the developments in both the retail facility mix and the spatial pattern of retail facilities, and the confluence of macro-occurrences with these developments. Some of the conclusions from this research can be used for future research. Based on the results and conclusions in combination with the critical reflection, three concrete suggestions for future research will be discussed.

The first suggestion is to investigate the influence of the developments in tourism, policies, mobility, and demography on the changes in the retail facility mix and the spatial pattern of retail facilities. According to the literature, these factors play a role in these changes. However, the influences of the factors of tourism and demography have only been studied for large cities, and not for medium-sized cities. It is therefore interesting to see if these factors also influence the changes in the retail facility mix and spatial pattern of medium-sized cities. Furthermore, the influence of policies and mobility is city dependent since the retail and mobility policies and

visions may differ for every city. Hence, the consequences of these policies for the liveability and future-proofness of inner-city shopping areas in medium-sized cities are important to know. In that way, medium-sized cities can learn from each other.

Furthermore, in this study, the changes in the spatial pattern have been analysed in an explorative way. It is therefore recommended to investigate these changes more extensively in the future. For this purpose, it is important to investigate the changes in agglomeration, perceived by consumers. This entails walking distance between store entrances. Furthermore, this future research should include the effects of the opening or closing of specific retail facilities. For example, what is the effect of the opening of a fashion department store on the agglomeration of retail facilities around this fashion department store. Or does the opening of a type of store influence the agglomeration of the same type of stores around this new store. For example, is it true that when an optician opens on a certain location, other opticians will settle in the vicinity of this optician? Lastly, it would be interesting to see if the agglomeration of retail facilities is affected by the average retail floor area of retail facilities. For a small part, this is included in this research. However, for some functions and types the retail floor area was unknown. Also, a small sample size is used, which also may affect the results of the correlation between the average RFA and the mean nearest neighbour distance. This all can be analysed using high-fidelity data about retail facilities produced by companies such as Locatus in the Netherlands.

The last future research suggestion builds on the finding that the spatial pattern of retail facilities is changing. In most cases, the mean nearest neighbour distance increases due to disappearing retail facilities. Also, the department store has disappeared from the streetscape as an important anchor. Since the distance between retail facilities is increasing and the retail facility mix is changing, it is interesting to find out how these changes affect the shopping circulation in inner-city shopping areas in medium-sized cities. For example, do consumers visit fewer retail facilities while visiting a city if retail facilities are located further apart. Furthermore, can fashion department stores now be regarded as the new anchors in these shopping areas? Answers to these questions may support strategic decision making, policy making, and portfolio management, it can help create a viable and future-proof city centre.

5.6 Managerial implications

The conclusions that follow from this thesis lead to several important managerial implications for both businesses and policy makers that operate in the retail industry, and in particular in inner-city shopping areas of Dutch medium-sized cities.

Firstly, the emergence of e-commerce has significantly affected the shopping behaviour of people. This macro-occurrence shifts the focus from convenience shopping to experience shopping. To keep up with consumers, retail businesses need to adapt their strategies. For example, they need to enhance the experiential aspects of their retail facility, by creating immersive and engaging shopping environments. In this way, customers will be attracted beyond just the consuming part of their visit to the retail facility (Sit et al., 2003). Furthermore, retail businesses need to diversify their products and service offerings to move along with the emergence of the experience economy (Pine & Gilmore, 1999). For example by adding interactive displays, events, and demonstrations to provide unique experiences for their customers.

Sudden macro-occurrences such as the financial crisis and the COVID-19 pandemic impact the retail industry. Therefore, retail businesses should focus on creating resilience in their business by building and maintaining robust supply chains and exploring alternative revenue streams, such as delivery services, or online sales. In that way, the negative effects of these macro-occurrences may be limited.

Currently, the spatial pattern of the retail facilities is more scattered than before. This is not in line with the ideal shopping centre, which is compact (Brown, 1989). Retail businesses should carefully consider their store locations. For this purpose, they need to take into account the changing shopping behaviour and circulation. Retailers need to understand the customers' needs and preferences to improve the shopping experience of these customers.

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Appendix A: Confluence - developments in retail facility mix

Table A.1: Results correlation tests – developments in the number of retail facilities

Spearman's rho		Total	Store	Experience	Service	Daily	Fashion and luxury	Leisure time	In/around house	Other	Hospitality	Department store	Retail-chain store	Independent store
Total	r_s	1.000												
	Sig. (2-tailed)													
Store	r_s	0.915	1.000											
	Sig. (2-tailed)	0.000												
Experience	r_s	-0.867	-0.916	1.000										
	Sig. (2-tailed)	0.000	0.000											
Service	r_s	0.704	0.715	-0.734	1.000									
	Sig. (2-tailed)	0.001	0.001	0.000										
Daily	r_s	-0.888	-0.832	0.906	-0.741	1.000								
	Sig. (2-tailed)	0.000	0.000	0.000	0.000									
Fashion and luxury	r_s	*-0.179*	*-0.338*	*0.434*	*-0.434*	*0.138*	1.000							
	Sig. (2-tailed)	***0.464***	***0.157***	***0.063***	***0.063***	***0.574***								
Leisure time	r_s	0.861	0.945	-0.972	0.700	-0.844	*-0.453*	1.000						
	Sig. (2-tailed)	0.000	0.000	0.000	0.001	0.000	***0.052***							
In/around house	r_s	0.907	0.934	-0.977	0.763	-0.899	*-0.439*	0.962	1.000					
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	***0.060***	0.000						
Other	r_s	*0.330*	*0.372*	*-0.328*	*-0.145*	*-0.233*	*-0.024*	*0.350*	*0.260*	1.000				
	Sig. (2-tailed)	***0.168***	***0.117***	***0.171***	***0.555***	***0.337***	***0.923***	***0.142***	***0.282***					
Hospitality	r_s	-0.828	-0.892	0.976	-0.696	0.906	*0.320*	-0.942	-0.934	*-0.331*	1.000			
	Sig. (2-tailed)	0.000	0.000	0.000	0.001	0.000	***0.181***	0.000	0.000	***0.167***				
Department store	r_s	0.656	0.585	-0.539	*0.240*	-0.620	*0.308*	0.545	0.525	0.509	-0.590	1.000		
	Sig. (2-tailed)	0.002	0.008	0.017	***0.322***	0.005	***0.200***	0.016	0.021	0.026	0.008			
Retail-chain store	r_s	*0.440*	*0.422*	*-0.273*	*-0.056*	*-0.382*	0.553	*0.297*	*0.253*	0.530	*-0.350*	0.819	1.000	
	Sig. (2-tailed)	***0.060***	***0.072***	***0.258***	***0.819***	***0.107***	0.014	***0.218***	***0.296***	0.019	***0.142***	0.000		
Independent store	r_s	0.889	0.927	-0.988	0.729	-0.894	*-0.453*	0.982	0.985	*0.322*	-0.952	0.543	*0.248*	1.000
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	***0.052***	0.000	0.000	***0.179***	0.000	0.016	***0.305***	

= very strong correlation (>0.81)

= strong correlation (>0.61)

Significance level >0.05 = there is no correlation

Table A.2 Results correlation tests – developments in the share of the number of retail facilities

Spearman's rho		Stores	Experience	Service	Vacant	Daily	Leisure time	In/around house	Hospitality	Culture and recreation	Fashion department store	Retail-chain	Independent
Stores	r_s	1.000											
	Sig. (2-tailed)												
Experience	r_s	-0.975	1.000										
	Sig. (2-tailed)	0.000											
Service	r_s	*0.265*	*-0.322*	1.000									
	Sig. (2-tailed)	***0.273***	***0.180***										
Vacant	r_s	-0.810	0.723	*-0.390*	1.000								
	Sig. (2-tailed)	0.000	0.000	***0.099***									
Daily	r_s	-0.976	0.965	*-0.304*	0.734	1.000							
	Sig. (2-tailed)	0.000	0.000	***0.205***	0.000								
Leisure time	r_s	0.926	-0.937	*0.295*	-0.712	-0.891	1.000						
	Sig. (2-tailed)	0.000	0.000	***0.220***	0.001	0.000							
In/around house	r_s	0.841	-0.851	0.615	-0.821	-0.826	0.855	1.000					
	Sig. (2-tailed)	0.000	0.000	0.005	0.000	0.000	0.000						
Hospitality	r_s	-0.684	0.664	*-0.168*	0.485	0.724	-0.525	*-0.403*	1.000				
	Sig. (2-tailed)	0.001	0.002	***0.492***	0.035	0.000	0.021	***0.087***					
Culture and recreation	r_s	0.684	-0.664	*0.168*	-0.485	-0.724	0.525	*0.403*	-1.000	1.000			
	Sig. (2-tailed)	0.001	0.002	***0.492***	0.035	0.000	0.021	***0.087***	0				
Fashion department store	r_s	-0.804	0.824	-0.661	0.850	0.761	-0.763	-0.904	*0.376*	*-0.376*	1.000		
	Sig. (2-tailed)	0.000	0.000	0.002	0.000	0.000	0.000	0.000	***0.113***	***0.113***			
Retail-chain	r_s	-0.608	0.640	-0.577	0.635	0.569	-0.748	-0.882	*0.045*	*-0.045*	0.739	1.000	
	Sig. (2-tailed)	0.006	0.003	0.010	0.004	0.011	0.000	0.000	***0.856***	***0.856***	0.000		
Independent	r_s	0.608	-0.640	0.577	-0.635	-0.569	0.748	0.882	*-0.045*	*0.045*	-0.739	-1.000	1.000
	Sig. (2-tailed)	0.006	0.003	0.010	0.004	0.011	0.000	0.000	***0.856***	***0.856***	0.000	0.000	

= very strong correlation (>0.81)

= strong correlation (>0.61

Significance level >0.05 = there is no correlation

Table A.3 Results correlation tests – developments in the average retail floor area

Spearman's rho		Total	Daily	Leisure time	In/around house	Other	Department store	Fashion department store
Total	r_s	1.000						
	Sig. (2-tailed)							
Daily	r_s	0.812	1.000					
	Sig. (2-tailed)	0.00						
Leisure time	r_s	0.623	0.853	1.000				
	Sig. (2-tailed)	0.004	0.000					
In/around house	r_s	-0.349	-0.530	-0.604	1.000			
	Sig. (2-tailed)	*0.143*	0.020	0.006				
Other	r_s	0.818	0.921	0.860	-0.579	1.000		
	Sig. (2-tailed)	0.000	0.000	0.000	0.009			
Department store	r_s	-0.413	-0.742	-0.749	0.527	-0.782	1.000	
	Sig. (2-tailed)	*0.079*	0.000	0.000	0.020	0.000		
Fashion department store	r_s	0.591	0.630	0.481	*-0.074*	0.639	-0.682	1.000
	Sig. (2-tailed)	0.008	0.004	0.037	*0.764*	0.003	0.001	

= very strong correlation (>0.81)

= strong correlation (>0.61)

Significance level >0.05 = there is no correlation

Table A.4 Results correlation tests – developments in the share of the retail floor area

Spearman's rho		Daily	In/around house	Other	Department store	Fashion department store	Retail-chain	Independent
Daily	r_s	1.000						
	Sig. (2-tailed)							
In/around house	r_s	-0.931	1.000					
	Sig. (2-tailed)	0.000						
Other	r_s	0.765	-0.806	1.000				
	Sig. (2-tailed)	0.000	0.000					
Department store	r_s	-0.791	0.720	-0.694	1.000			
	Sig. (2-tailed)	0.000	0.001	0.001				
Fashion department store	r_s	0.903	-0.905	0.665	-0.804	1.000		
	Sig. (2-tailed)	0.000	0.000	0.002	0.000			
Retail-chain	r_s	0.541	-0.665	0.502	*-0.126*	0.483	1.000	
	Sig. (2-tailed)	0.017	0.002	0.028	*0.606*	0.036		
Independent	r_s	-0.541	0.665	-0.502	*0.126*	-0.483	-1.000	1.000
	Sig. (2-tailed)	0.017	0.002	0.028	*0.606*	0.036		

= very strong correlation (>0.81)

= strong correlation (>0.61)

Significance level >0.05 = there is no correlation

Appendix B: Outliers geographical data

Table B.1: Outliers geographical data

City	Year	Function	Type	Retail-chain	Department store	X-coordinate	Y-coordinate
Arnhem	2004	Experience	Hospitality	No value	No value	5.00	50.00
Breda	2004	Vacant	Vacancy	No value	No value	5.00	50.00
Breda	2004	Vacant	Vacancy	No value	No value	5.00	50.00
Breda	2004	Vacant	Vacancy	No value	No value	5.00	50.00
Breda	2004	Vacant	Vacancy	No value	No value	5.00	50.00
Den Bosch	2004	Vacant	Vacancy	No value	No value	5.00	50.00
Nijmegen	2004	Vacant	Vacancy	No value	No value	5.00	50.00
Nijmegen	2004	Vacant	Vacancy	No value	No value	5.00	50.00
Nijmegen	2004	Vacant	Vacancy	No value	No value	5.00	50.00
Nijmegen	2004	Store	Fashion & luxury	Independent	No value	5.00	50.00
Nijmegen	2004	Store	In/around house	Independent	No value	5.00	50.00

Appendix C: Confluence– developments in spatial pattern

Table C.1: Results correlation tests – developments in spatial pattern

Spearman's rho		Total	Store	Experience	Fashion and luxury	Leisure time	In/around house	Hospitality	Fashion department store	Retail-chain store	Independent store
Total	r_s	1.000									
	Sig. (2-tailed)										
Store	r_s	0.828	1.000								
	Sig. (2-tailed)	0.000									
Experience	r_s	-0.624	-0.603	1.000							
	Sig. (2-tailed)	0.004	0.006								
Fashion and luxury	r_s	0.522	0.544	*-0.190*	1.000						
	Sig. (2-tailed)	0.022	0.016	***0.437***							
Leisure time	r_s	0.651	0.775	-0.828	*0.109*	1.000					
	Sig. (2-tailed)	0.003	0.000	0.000	***0.657***						
In/around house	r_s	0.694	0.785	-0.689	*0.265*	0.925	1.000				
	Sig. (2-tailed)	0.001	0.000	0.001	***0.273***	0.000					
Hospitality	r_s	-0.742	-0.657	0.946	-0.458	-0.764	-0.689	1.000			
	Sig. (2-tailed)	0.000	0.002	0.000	0.049	0.000	0.001				
Fashion department store	r_s	-0.474	-0.630	0.844	-0.496	-0.758	-0.716	0.877	1.000		
	Sig. (2-tailed)	0.040	0.004	0.000	0.031	0.000	0.001	0.000			
Retail-chain store	r_s	0.635	0.463	*-0.302*	0.662	*0.109*	*0.023*	-0.506	*-0.254*	1.000	
	Sig. (2-tailed)	0.003	0.046	***0.208***	0.002	***0.657***	***0.925***	0.027	***0.294***		
Independent store	r_s	0.834	0.925	-0.678	*0.292*	0.914	0.925	-0.678	-0.608	*0.259*	1.000
	Sig. (2-tailed)	0.000	0.000	0.001	***0.226***	0.000	0.000	0.001	0.006	***0.284***	

= very strong correlation (>0.81)
= strong correlation (>0.61)
Significance level >0.05 = there is no correlation

Appendix D: Confluence - developments in retail facility mix and spatial pattern

Table D.1: Results correlation tests – mean nearest neighbour distance X (share of) number of retail facilities

Spearman's rho	(share of the) number of retail facilities	All retail facilities	Store	Store	Experience	Experience	Fashion & luxury store	Leisure time store	Leisure time store	In/around house store	In/around house store	Hospitality	Hospitality	Fashion department store	Retail-chain store	Retail-chain store	Independent store	Independent store
Distance		RF	RF	RF %	RF	RF %	RF	RF	RF %	RF	RF %	RF	RF %	RF %	RF	RF %	RF	RF %
All retail facilities	Correlation Coefficient	**-0.661**	-0.760	-0.743	0.646	0.704	*0.058*	-0.726	-0.664	-0.617	-0.582	0.649	0.684	*0.421*	-0.681	*0.323*	-0.645	*-0.323*
	Sig. (2-tailed)	**0.002**	0.000	0.000	0.003	0.001	***0.815***	0.000	0.002	0.005	0.009	0.003	0.001	***0.073***	0.001	***0.177***	0.003	***0.177***
Store	Correlation Coefficient	-0.847	**-0.880**	**-0.890**	0.772	0.813	*0.019*	-0.806	-0.708	-0.762	-0.730	0.806	0.849	0.614	-0.683	*0.454*	-0.767	*-0.454*
	Sig. (2-tailed)	0.000	**0.000**	**0.000**	0.000	0.000	***0.940***	0.000	0.001	0.000	0.000	0.000	0.000	0.005	0.001	***0.051***	0.000	***0.051***
Experience	Correlation Coefficient	0.741	0.708	0.712	**-0.806**	**-0.774**	*-0.201*	0.781	0.839	0.798	0.739	-0.782	-0.574	-0.617	*0.331*	-0.482	0.820	0.482
	Sig. (2-tailed)	0.000	0.001	0.001	**0.000**	**0.000**	***0.409***	0.000	0.000	0.000	0.000	0.000	0.010	0.005	***0.167***	0.037	0.000	0.037
Fashion & luxury store	Correlation Coefficient	*-0.315*	*-0.249*	*-0.271*	*0.108*	*0.166*	**-0.586**	*-0.147*	*-0.142*	*-0.140*	*-0.114*	*0.165*	0.553	*0.106*	-0.815	*-0.233*	*-0.108*	*0.233*
	Sig. (2-tailed)	***0.188***	***0.303***	***0.262***	***0.660***	***0.496***	**0.008**	***0.548***	***0.561***	***0.568***	***0.641***	***0.500***	0.014	***0.667***	0.000	***0.337***	***0.660***	***0.337***
Leisure time store	Correlation Coefficient	-0.879	-0.924	-0.932	0.985	0.965	*0.435*	**-0.973**	**-0.932**	-0.975	-0.945	0.963	0.547	0.853	*-0.245*	0.780	-0.990	-0.780
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	***0.063***	**0.000**	**0.000**	0.000	0.000	0.000	0.015	0.000	***0.313***	0.000	0.000	0.000
In/around house store	Correlation Coefficient	-0.815	-0.905	-0.916	0.910	0.916	*0.408*	-0.934	-0.856	**-0.918**	**-0.925**	0.894	0.503	0.915	*-0.261*	0.726	-0.916	-0.726
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	***0.083***	0.000	0.000	**0.000**	**0.000**	0.000	0.028	0.000	***0.281***	0.000	0.000	0.000
Hospitality	Correlation Coefficient	0.723	0.690	0.694	-0.743	-0.732	*-0.033*	0.739	0.798	0.741	0.678	**-0.729**	**-0.611**	-0.555	0.525	*-0.363*	0.756	*0.363*
	Sig. (2-tailed)	0.000	0.001	0.001	0.000	0.000	***0.894***	0.000	0.000	0.000	0.001	**0.000**	**0.005**	0.014	0.021	***0.126***	0.000	***0.126***
Fashion department store	Correlation Coefficient	0.746	0.653	0.683	-0.737	-0.705	*0.017*	0.691	0.745	0.767	0.723	-0.740	-0.569	**-0.702**	*0.420*	*-0.403*	0.751	*0.403*
	Sig. (2-tailed)	0.000	0.002	0.001	0.000	0.001	***0.945***	0.001	0.000	0.000	0.000	0.000	0.011	**0.001**	***0.073***	***0.087***	0.000	***0.087***
Retail-chain store	Correlation Coefficient	*-0.273*	*-0.220*	*-0.208*	*0.113*	*0.161*	-0.485	*-0.147*	*-0.182*	*-0.082*	*0.010*	*0.146*	0.539	*-0.235*	**-0.829**	***-0.225***	*-0.108*	*0.225*
	Sig. (2-tailed)	***0.258***	***0.365***	***0.392***	***0.645***	***0.511***	0.036	***0.548***	***0.457***	***0.740***	***0.968***	***0.550***	0.017	***0.332***	**0.000**	***0.355***	***0.660***	***0.355***
Independent store	Correlation Coefficient	-0.865	-0.959	-0.961	0.906	0.933	*0.325*	-0.944	-0.843	-0.890	-0.873	0.907	0.681	0.768	*-0.445*	0.675	**-0.905**	**-0.675**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	***0.174***	0.000	0.000	0.000	0.000	0.000	0.001	0.000	***0.056***	0.002	**0.000**	**0.002**

RF = The total number of retail facilities per function, type or attribute
RF % = Total share of retail facilities per function/type/attribute compared to the total number of facilities (with a certain function)

= very strong correlation (>0.81)
= strong correlation (>0.61)
Significance level >0.05 = there is no correlation

Table D.2: Results correlation tests – mean nearest neighbour distance X (share of) RFA of retail facilities

Spearman's rho	(share of the) the RFA of retail facilities →	All retail facilities	Leisure time store	In/around house store	In/around house store	Fashion department store	Fashion department store	Retail-chain store	Independent store
Average nearest neighbour distance↓		RFA	RFA	RFA	RFA %	RFA	RFA %	RFA %	RFA %
All retail facilities	Correlation Coefficient	**0.526**	0.507	*-0.133*	-0.565	0.873	0.768	*0.110*	*-0.110*
	Sig. (2-tailed)	**0.021**	0.027	***0.588***	0.012	0.000	0.000	***0.655***	***0.655***
Leisure time store	Correlation Coefficient	0.820	**0.880**	-0.581	-0.948	0.650	0.918	0.612	-0.612
	Sig. (2-tailed)	0.000	**0.000**	0.009	0.000	0.003	0.000	0.005	0.005
In/around house store	Correlation Coefficient	0.679	0.795	**-0.631**	**-0.921**	0.647	0.900	0.693	-0.693
	Sig. (2-tailed)	0.001	0.000	**0.004**	**0.000**	0.003	0.000	0.001	0.001
Fashion department store	Correlation Coefficient	-0.677	-0.567	*0.278*	0.742	**-0.741**	**-0.768**	*-0.353*	*0.353*
	Sig. (2-tailed)	0.001	0.011	***0.249***	0.000	**0.000**	**0.000**	***0.139***	***0.139***
Retail-chain store	Correlation Coefficient	*0.161*	*0.002*	0.585	*0.042*	0.671	*0.262*	**-0.511**	0.511
	Sig. (2-tailed)	***0.510***	***0.994***	0.009	***0.866***	0.002	***0.278***	**0.025**	0.025
Independent store	Correlation Coefficient	0.693	0.781	-0.503	-0.861	0.735	0.897	0.493	**-0.493**
	Sig. (2-tailed)	0.001	0.000	0.028	0.000	0.000	0.000	0.032	**0.032**

RFA = Average RFA per retail facility per function/type/attribute
RFA % = RFA share per type/attribute compared to the total RFA overall retail facilities per function

= very strong correlation (>0.81)
= strong correlation (>0.61)
Significance level >0.05 = there is no correlation