

Transit-Oriented Development and Commercial Gentrification in the Netherlands

A Comparative Case Study of the Station Areas of Breda and Arnhem



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Master MSc. Management in the Built Environment
Course AR4MBE010
Theme Lab Entrepreneurship
Title Transit-Oriented Development and Commercial Gentrification in the Netherlands

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PREFACE

Before you is the master's thesis "Transit-Oriented Development and Commercial Gentrification in the Netherlands: A Comparative Case Study of the Station Areas of Breda and Arnhem." This thesis has been written to fulfil the graduation requirements of the Master's programme Management in the Built Environment, within the Faculty of Architecture, Urbanism, and Building Sciences at Delft University of Technology. This thesis was written between February and June 2026.

During my Master's at TU Delft, I followed the course Research Method 1. I wrote about Transit-Oriented Development, and that was the first time I came across the concept of gentrification. I did not explore it further at the time, but it stayed with me. This thesis gave me the chance to finally look into it properly. The process of writing this thesis was not always easy. Working with QGIS was completely new to me and took time to figure out. But looking back, I am glad I went through it because it taught me a lot.

I want to thank my supervisors, Herman Vande Putte and Erik Louw. Herman supervised me from the start and helped me at every stage. I am grateful for his patience and guidance. Erik joined halfway and brought a fresh perspective that pushed me to sharpen my work. I appreciated every feedback session with both of them.

I also want to thank my family and friends who have supported me throughout this entire period.

I enjoyed working on this thesis, and I hope you will enjoy reading it!

Ruben Lam

Delft, June 2026

Abstract

Transit-Oriented Development (TOD) is widely promoted as a strategy for sustainable urban development (Ibraeva et al., 2019). However, improved accessibility and rising land values around transit stations may reshape local commercial structures, potentially leading to commercial gentrification. Empirical evidence on this relationship remains limited, particularly in the Dutch context, where commercial environments and planning strategies differ from the American settings, in which most research has been conducted.

This study examines the extent to which changes in commercial structures in Dutch station areas are consistent with TOD-induced commercial gentrification, using the station areas of Arnhem Centraal and Breda station as case studies over the period 2000-2024. Commercial gentrification is operationalised using three indicators, derived from Chapple et al. (2018): store count, establishment types and establishment sizes. Data from the LISA Database is analysed at four-year intervals across a core station area (0-400m) and an outer station area (400-800m). National and local contextual factors are examined to distinguish TOD-related changes from broader structural trends.

The results show that both station areas experienced a significant decline in physical establishments over the study period, primarily driven by the financial crisis in 2008, the COVID-19 pandemic and the rise of e-commerce. In Breda, a strong shift from neighbourhood-oriented to consumption-oriented establishments was observed in the core station area, coinciding with the comprehensive CrossMark development programme. In Arnhem, where the comparable urban development programme Rijnboog was cancelled, no such shift was observed. Regarding establishment sizes, small businesses declined in Arnhem while large establishments remained stable. In Breda, both categories declined overall, but small businesses recovered in the core station area after the construction period.

The findings suggest that TOD alone is not sufficient to trigger commercial gentrification in the Dutch context. Improved transit accessibility may contribute to commercial restructuring, but only when combined with an urban development programme or municipal policies. The process observed in Breda is more state-led than market-driven commercial gentrification, which raises questions about the applicability of the American commercial gentrification indicators in the Dutch context.

Keywords: Transit-Oriented Development, Commercial Gentrification, Store Count, Establishment types, Establishment size, Netherlands.

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1. Introduction

In recent decades, urban planning in many countries has shifted towards creating compact, mixed-use developments, particularly around public transport stations. These developments aim to bring back higher density, walkability, and a mix of residential, commercial and leisure functions in urban areas. One strategy that reflects these principles is Transit-Oriented Development (TOD), which focuses on development within walking distance of transit stations to improve accessibility, stimulate economic activity, and reduce car dependency (Ibraeva et al., 2019).

While TOD is promoted as a strategy for sustainable urban development, its implementation may also produce unintended consequences. Improved accessibility and rising land values around transit stations can reshape the commercial environment of station areas (Handy, 2005; Ma et al., 2022). Existing local businesses may be replaced by larger or higher-value commercial establishments as rents increase. This process is described as commercial gentrification in the literature (Chapple et al., 2018). The *Death and Life of Great American Cities* by Jane Jacobs (1961) warned of a similar dynamic, referring to it as “The Self-Destruction of diversity” (p. 255). According to Jacobs (1961), successful urban areas lose their economic diversity due to rising rents, which, as a result, displace smaller local businesses that contributed to the area’s attractiveness. When neighbourhood-oriented establishments, such as local grocery stores or bakeries, are replaced by consumption-oriented establishments, such as boutique shops or cafés, this may result in reduced access to daily necessities for lower-income residents and eventually may change the character of the neighbourhood.

In the Netherlands, several major stations have undergone station redevelopment in the past decades as part of the Nieuwe Sleutelprojecten Programme. This programme aimed to improve both the accessibility and the spatial quality of the station areas (Huisman et al., 2016). These large-scale projects, which include Breda and Arnhem, provide relevant cases to examine whether TOD-related developments have influenced the commercial environment around stations. At the same time, the Dutch retail landscape has been undergoing structural changes driven by several factors, such as the rise of e-commerce, the financial crisis in 2008 and the COVID-19 pandemic. These broader trends make it more difficult to understand commercial changes in station areas because it is unclear whether these changes are caused by TOD or by external factors.

This study examines the relationship between TOD and commercial gentrification in the Netherlands, using Arnhem Centraal and Breda station areas as case studies. The next section presents the research problem addressed in this study.

1.1. Problem statement

Transit-Oriented Development (TOD) is widely adopted as an urban planning strategy that aims to foster urban and transport sustainability (Ibraeva et al., 2019). According to Litman (2003) and Kahn (2007), TOD can be defined as an urban development that focuses on a mixed-use, pedestrian-friendly, densely built environment around a public station, where residential, commercial, and leisure are all within walking distance. By concentrating development around transit nodes, TOD aims to reduce transportation costs, increase accessibility, and promote walkability and liveability.

Investment in transit infrastructure increases accessibility, which may raise land values and trigger changes in the spatial structure of economic activities (Ma et al., 2022). Increased foot traffic from transit users can attract more customers to local or existing businesses, potentially leading to economic growth (Meltzer, 2016; Litman, 2003). Since TOD aims to create a mixed-use, pedestrian-friendly, densely built environment around a public station, commercial areas play an important role in realising walkability and liveability (Chapple et al., 2018).

However, many researchers have argued that TOD interventions may contribute to gentrification and the eventual displacement of low-income groups (Kahn, 2007 & Padeiro et al., 2019). Rising land values associated with improved accessibility may not only stimulate economic development but also encourage higher-value land uses and commercial restructuring (Ma et al., 2022). These dynamics resemble the process described by Jacobs (1961), as she called it “The self-destruction of diversity” (p. 255), in which successful urban areas lose their economic and social diversity due to increasing rents and the displacement of smaller businesses (Chapple et al., 2018).

In the context of TOD, increased accessibility and investment around transit stations may not only stimulate economic development but also reshape local commercial structures (Handy, 2005). While the relationship between TOD and residential gentrification has been widely examined, less attention has been paid to its impact on commercial change. In particular, it remains uncertain whether changes in commercial structures in station areas can be attributed to TOD-related processes or whether they reflect broader structural transformations.

This highlights a key gap in the literature. TOD is often assumed to contribute to commercial gentrification. However, empirical evidence on this relationship remains limited. Moreover, establishing a direct causal relationship between TOD and commercial gentrification is quite challenging, since broader contextual factors may influence changes in urban areas around station areas.

An assumption that is made in the literature is that TOD triggers a causal chain in which improved accessibility leads to higher demand for that area. Eventually, this results in higher land values, which in turn result in commercial restructuring and potentially commercial gentrification (Knowles et al., 2020; Padeiro et al., 2019). However, this relationship is not direct. Similar changes in commercial structures may be driven by other broader structural processes. The rise of e-commerce has structurally reduced the demand for physical retail, regardless of local development. In addition, economic shocks, such as the 2008 financial crisis and the COVID-19 pandemic, have led to significant declines in consumer spending and business closures, especially among smaller retailers. Lastly, the changing behaviour of consumers is driven by an ageing population and an increase in the number of educated people. This change has shifted demand towards a more selective and experience-based consumption.

As a result, it remains difficult to isolate the specific impact of TOD from these developments. This raises a causal question: to what extent can observed commercial changes in station areas be attributed to TOD-related processes, rather than to external factors operating at larger spatial or temporal scales?

1.2. Research questions

This study examines whether patterns of commercial change in Dutch station areas are consistent with the processes of commercial gentrification and to what extent these changes may be related to TOD. Rather than establishing direct causality, this research assesses whether observed changes align with theoretical indicators of commercial gentrification, while accounting for external factors that may also have contributed to the commercial restructuring. The following main research question is formulated to address this problem:

To what extent are changes in commercial structures in Dutch station areas consistent with patterns of TOD-induced commercial gentrification?

To address the main research question, three sub-questions have been formulated;

1. How have the number, composition and size distribution of commercial establishments changed over time in the station areas of Arnhem Centraal and Breda?
2. To what extent do these changes differ between spatial zones?
3. To what extent can the observed commercial changes be explained by broader macroeconomic conditions, national structural trends, and local spatial factors?

1.3. Research output

The output of this research is a longitudinal comparative analysis of commercial change in two Dutch station areas, which have recently undergone redevelopment. This study produces three main outputs.

First, an empirical analysis of changes in the number, composition and size distribution of commercial establishments around station areas of Arnhem Centraal and Breda station is conducted. This analysis is done over the study period of 2000-2024, across multiple spatial scales, based on proximity to the station. This analysis provides insights into whether patterns of commercial change differ between proximity zones and between the Breda station and Arnhem Centraal.

Secondly, this study examines external factors, both local and national, to assess whether these factors may have influenced commercial dynamics in the study areas or not. This contextual analysis allows for a more informed interpretation of the observed patterns by distinguishing between changes that may be influenced by TOD or changes that are more likely driven by broader structural processes.

Lastly, a comparative evaluation of the extent to which observed commercial changes are consistent with the theoretical explanations of TOD-induced commercial gentrification as defined in the literature. This includes a reflection of the applicability of the American commercial gentrification indicators in the Dutch context.

Together, these outputs aim to contribute to both academic understanding of the relationship between TOD and commercial gentrification and the policy discussion on how to manage commercial change in station areas undergoing redevelopment.

1.4. Relevance

1.4.1. Societal relevance

TOD is widely promoted as an urban development strategy to improve accessibility, stimulate economic vitality, and reduce car dependency. In the Netherlands, municipalities continue to invest in station area development as part of broader sustainability strategies.

However, the improved accessibility and rising land values associated with TOD may contribute to commercial restructuring. This may lead to unintended consequences for social equality. When neighbourhood-oriented establishments, such as local grocery stores or bakeries, are displaced by more consumption-oriented establishments, such as boutique shops or chain retailers, which often cater for

the higher-income group. Access to daily necessities may be reduced for the lower-income residents and immigrant entrepreneurs, since they often depend on more affordable and nearby services.

Thus, this process can reinforce existing patterns of inequality. As the commercial environment changes, from providing necessities to its original residents, to catering for the more affluent consumer base, the neighbourhood character may change. Understanding whether or under what conditions this process occurs in Dutch station areas is therefore relevant for municipalities and urban planners when considering the implementation of TOD. If commercial gentrification occurs after the implementation of TOD, policymakers need to be aware of the risk and consider complementary measures, such as retail policy, to ensure that the benefits of TOD are shared with all income groups instead of just the high-income group.

1.4.2. Scientific relevance

The scientific relevance of this study is to strengthen the empirical evidence of commercial gentrification in relation to TOD. While the relationship between TOD and residential gentrification has been studied broadly (Kahn, 2007; Padeiro et al., 2019), empirical research in commercial gentrification and in TOD areas remains limited. A study by Chapple et al. (2018) examined the relationship between commercial gentrification and TOD in the United States, using NAICS codes. This study builds on their approach, but applies it to the Dutch context, using SBI-codes. This difference in geography is relevant because Dutch station areas may differ from American station areas, such as their urban structure or policy context.

Furthermore, this study contributes methodologically by employing a comparative case study design with a proximity analysis across two spatial zones. This approach allows for the identification of conditions under which TOD-related commercial change does or does not occur, rather than measuring a single case in isolation. By looking at the contextual factors, both at local and national levels, this study addresses the challenge of isolating TOD-specific effects from broader structural processes, such as the rise of e-commerce, changing consumer behaviour and economic crisis.

1.5. Scope

This thesis examines changes in the commercial structure of two Dutch station areas that are characterised as TOD and have recently undergone station area development. Longitudinal data from the LISA Database is used, from 2000 to 2024, to analyse the commercial establishments within an 800-meter zone around Arnhem Centraal and Breda Station, which is one of the characteristics of TOD. The study focuses on three indicators of commercial change: the total number of establishments, the composition of establishment types and the size distribution of establishments. The establishment types are classified into neighbourhood-oriented and consumption-oriented categories, based on the SBI-codes.

This research does not examine residential gentrification, business revenues and rent levels. In addition, this study does not establish a direct causal relationship between TOD and commercial gentrification. Instead, this study assesses whether the observed patterns of change are consistent with the indicators of commercial gentrification derived from the literature. The findings are then further contextualised with local and national factors that may have influenced commercial restructuring in the study areas.

1.6. Reading guide

This thesis is structured as follows. Chapter 2 presents the theoretical framework, discussing key concepts of TOD, gentrification, and commercial gentrification, and will conclude with the indicators that will be used to assess commercial gentrification. In Chapter 3, the methodology will be described, including case study design, data sources and the operationalisation of the indicators. Chapter 4 describes both case studies, Arnhem Centraal and Breda, including TOD characteristics and surrounding area developments. Chapter 5 presents the results, covering the changes in store count, establishment types and the size distribution across the spatial zones. Followed by an analysis of the national and local contextual factors. Chapter 6 discusses the findings in relation to the existing literature. In Chapter 7, the limitations of this study will be addressed, and finally, in Chapter 8, the conclusion, implications and recommendations will be presented.

2. Theoretical framework

2.1. Transit-Oriented Development

2.1.1. Definition of Transit-Oriented Development

The oil crisis in 1973 and 1979 triggered global concerns about the sustainability of automobile-dependent urban development (Serra-Coch et al., 2018). Rising fuel prices exposed the energy inefficiency of car-dependent cities and encouraged planners to reconsider alternative forms of urban mobility and spatial organisation. In addition to the environmental concern, social, health and economic issues were increasingly connected with this development (Jacobs, 1961). The first Transit-Oriented Development concept was introduced by Calthorpe in the 1980s, which became a planning reference in the United States (Serra-Coch et al., 2018).

TOD is an urban development approach that stimulates mixed-use community, where residential, retail, office open space and public uses are all brought together and are within walking distance, a 10-minute (800 meters) walk, from a public transportation station and commercial area, to facilitate shorter trips, better lifestyles and a more efficient use of the city resources (Carlton, 2009; Ibraeva et al., 2019; Renne, 2009). This has come from the growing awareness of the contribution of urban transport and mobility, such as pollution, congestion and public health challenges (Padeiro et al., 2019). These externalities have paved the way to a clear political objective.

Furthermore, TOD has been described as a planning approach that aims to integrate land use and transport planning. While there are many goals with TOD, the most common goal is to encourage people to walk, cycle and use public transport instead of cars, which is typically achieved by developing mixed-use communities around transit nodes, with moderate to high densities and walkable environments (Singh et al., 2017).

However, it is important to distinguish between areas that are physically located near transit and areas that are functionally integrated with transit. Renne (2009) describes this as the TAD-TOD spectrum. A TOD is a station area that is compact, mixed-use and facilitates transit connectivity through urban design. A TAD, by contrast, is physically near transit but fails to take advantage of this proximity, lacking functional connectivity to transit in terms of land-use composition, means of station access, or site design (Renne, 2009). Most station areas fall somewhere along this spectrum rather than representing a pure TOD or TAD (Renne, 2009). Importantly, station areas can transition from TAD to TOD through active redevelopment of the surrounding area. This implies that the presence of TOD characteristics alone, as further elaborated in Section 2.1.2, does not automatically mean that an area functions as a fully integrated TOD environment. Active development that connects transit infrastructure with the surrounding urban environment is required to move from TAD towards TOD along this spectrum.

2.1.2. Accessibility and land value effect

Transit-Oriented Development is a widely adopted urban planning strategy to foster urban and transport sustainability (Ibraeva et al., 2019). The 3Ds, Density, Diversity of land use and Design, suggested by Cervero and Kockelman (1997), have been shown to have a great impact on travel by reducing car dependence and increasing the use of more sustainable transport modes.

Density refers to compact urban development, where destinations are located closer together, reducing the need for car travel and encouraging walking and cycling. Higher densities are also associated with better public transport provision and lower car usage.

Diversity of land use enables a mix of functions such as residential, retail and services within a neighbourhood. This reduces the need for longer trips, as daily needs can be met locally, thereby encouraging active mobility. Land-use diversity can be divided into horizontal and vertical diversity (Zambon et al., 2019). Horizontal diversity refers to how different land uses are distributed across separate buildings within an area (Muallem et al., 2019). Vertical diversity refers to the proportion of land

parcels that combine more than one type of land use within the same building (Nyunt & Wongchavalidkul, 2020; Cervero & Kockelman, 1997).

Design focuses on the physical layout of the urban environment, particularly walkability. Well-designed, pedestrian-friendly environments improve accessibility and make it easier and more attractive for people to travel on foot or by bicycle. As noted by Jacobs (1961), well-used and active streets also contribute to safety and urban vitality.

Together, these three dimensions form a key foundation for understanding how TOD influences mobility patterns and the spatial organisation of urban areas. To successfully implement a TOD project, critical elements include facilitating access to sustainable transport and transit stations, densifying immediate station areas, and diversifying the functions of the area.

Furthermore, transport enables and shapes urban spatial development. Investment in urban transport enhances accessibility, stimulates activity and increases the value of land close to transit stations and stops (Knowles et al., 2020; Chapple et al., 2018; Handy, 2005). Furthermore, this can also affect home prices, since residents have a lower cost of travelling to the city centre. Accessibility plays a central role in TOD. The key to influencing residents' travel and location behaviour is access to essential goods and services (Olaru & Curtis, 2015). On top of that, due to the improved accessibility, public transport stations that are newly constructed will likely increase foot traffic in the local community as people walk more often in this area (Kahn, 2007; Chapple et al., 2018).

2.1.3. Socio-economic consequences

Apart from sustainable mobility patterns and dense built environments, TOD may also generate uneven socio-economic consequences (Knowles et al., 2020). Due to the increased foot traffic generated by public transport users, it results to increase in the number of customers, sales and employees. Besides, since this area offers a diverse set of services and goods, it makes it more convenient for the residents. As a result, more people from outside the area want to move into this area. Empirical literature generally agrees that, due to the improved transportation efficiency, accessibility and land value will be elevated and populations and industries will be relocated. These changes, however, will increase the living expenses because they usually increase the liveability and commercialisation (Lin et al., 2017). Furthermore, Lin et al. (2017) mention that these changes can attract people and businesses who can afford the increased land cost, which eventually displaces pre-existing low-income families and small businesses, which can be seen as gentrification. According to Knowles et al. (2020), urban land rent theory links improved accessibility from transport infrastructure investment to increasing land and property values. While TOD is primarily promoted as a strategy for sustainable mobility and compact urban development, its accessibility-induced increases in land and property values may also reshape local economic structures. As rising rents alter the viability of existing residential and commercial uses, station areas may become sites of reinvestment and socio-economic transformation (Kahn, 2007). These dynamics are closely linked to processes described in the gentrification literature.

2.2. Gentrification

Since TOD improves the accessibility of an area, it may also induce gentrification (Lin et al., 2017). Gentrification is commonly defined as “*the production of space for, and consumption by, a more affluent and very different incoming population*” (Knowles et al., 2020, p. 7). Beyond demographic change, it also involves capital reinvestment and the restructuring of urban space. In this context, TOD can attract and provide valuable capital investment towards the revitalisation of urban areas (Lin et al., 2017 & Knowles et al., 2020).

According to Ibraeva et al. (2019) and Padeiro et al. (2019), TOD likely provoke a price increase in adjacent properties. Because of this, low-income residents will be forced to leave an area, ceding it to well-off population groups, which may lead to displacement.

Kahn (2007) found that gentrification is greater in communities with easy access to “Walk and Ride” stations, which induce gentrification, compared to communities close to “Park and Ride” stations, which attract the poor to live nearby. There is one force that goes against the gentrification trend, which is the quality of the housing stock. If the ‘higher-income’ people have a strong taste for new and large housing, while the communities treated with a “Walk & Ride” have old, small housing, the higher-income people are less likely to move into that area. According to Hakworth & Rekers (2005), there are two types of theories for gentrification. The economic and cultural theory. The economic theory, which will be explained later in this Chapter, is focused on developers and capital. On the other hand, the cultural theory is focused on the consumers. Hereby, the ‘new’ middle-class choose inner-city neighbourhoods due to lifestyle preferences. For instance, the ‘new’ middle-class move to the inner-city, because they have a desire for diversity, authenticity and urbanity. Besides, they prefer the historic architecture to the newly constructed area in the suburbs, so culture can be produced to create a rent gap opportunity.

TOD often happens in gentrifiable areas. According to Lin et al. (2017), gentrifiable areas are areas with a below-average social status that could be measured through income, education, or the percentage of residents in professional occupations.

Knowles et al. (2020) mentioned that TOD is often designed to attract middle and higher-income households. However, less affluent residents are more likely to use and benefit from access to transit, whilst higher-income residents in a gentrified TOD area are less inclined to use public transit as they are more likely to have access to private cars (Knowles et al., 2020 & Ibraeva et al., 2019). Potentially, this shift may produce reverse effects on TOD efficiency in terms of transit use.

Most literature has focused on residential gentrification, but it has also been linked to significant changes in commercial landscapes.

While empirical studies demonstrate rising land values and displacement in TOD areas, a theoretical explanation for these dynamics can be found in rent gap theory. Improvements in accessibility increase the potential value of land surrounding transit stations. If existing land uses do not reflect this increased potential, a disparity emerges between actual and potential ground rent. Besides, gentrification can also disrupt commercially driven neighbourhood identities and introduce services and products that don't serve the current residents (Meltzer, 2016). Furthermore, the residential composition and the commercial activity of a neighbourhood are closely tied. When a neighbourhood gentrifies, there may be a shift in the consumer base and in the cost of operation for local businesses.

2.2.1. Bid Rent

Alonso (1964) introduced the 'Bid-Rent Theory,' which analyses how transportation affects land use. This theory describes urban land-use patterns shaped by land values relative to transportation costs (Chidi, 2019). The term *Bid-Rent*, according to Narvaez et al., (2013), refers to the amount of rent a user is willing to pay for a more central location, but is willing to accept a location further from the city centre at a lower rent cost in compensation. So the bid-rent theory is defined as the maximum amount that households or firms are willing to offer for a unit of land, given a level of services or benefits (Chidi, 2019).

In urban areas, various land users compete for locations based on accessibility and the benefits those locations offer. Land users who anticipate higher economic returns from a specific site are generally willing to pay higher rents for it. Thus, land uses that can generate greater revenue, such as retail or commercial activities, often outbid other land users for accessible locations (Narvaez et al., 2013).

Therefore, the better the accessibility of an urban area to desirable destinations, the higher the rent that is offered for that site. The rationale behind this is that consumers are assumed to prefer shops that are easily accessible (Netzel, 2012). Shops that are more accessible will get more customers; competition for accessible locations should drive up rents for shops that are accessible. Furthermore, the retailer is willing to pay more for a location where accessibility is high, but will not pay much for a location that is more than 500 meters away from a transportation hub, since shoppers are willing to walk a short distance.

This is in line with the theory that Meltzer (2016) mentioned, because she mentioned that when a neighbourhood gentrifies, the consumer base and costs of operation for local businesses can shift as well, which can affect the livelihood and composition of neighbourhood-based small businesses.

Changes in the consumer base can, either way, if it is an increase or a decrease in demand, put pressure on the existing businesses, because, due to the increased demand, the service or goods are being sold more than usual. This obviously causes an increase in the revenue of the existing business. However, since there is a lot of demand for the goods or services that are being provided by the existing business, other businesses outside the area are willing to move into that area. These businesses are often boutiques, large firms or chains (Meltzer, 2016). These businesses are often willing to pay more for that area, which may put pressure on the existing businesses and draw new businesses and services into the neighbourhood.

On the other hand, if the taste of the consumer is not in line with the services or goods that the existing businesses provide, which results in a decreasing demand, existing businesses are not able to afford the rising land values or rent prices, which results in them moving to a cheaper area or going bankrupt. To strengthen this, Netzel (2012) mentioned that profit-maximising behaviour among retail firms leads to higher rent for attractive retail space, while retailers renting less attractive space are compensated by a lower rent. Thus, Narvaez et al. (2013) argued that “*economy requires proximity and proximity creates opportunity for economic activity*” (p. 17).

While the bid-rent theory explains how accessibility influences land values and the spatial distribution of economic activities, it does not really explain why some neighbourhoods are undergoing reinvestment and redevelopment over time. The concept, which was introduced by Neil Smith (1979), the *rent gap*, will give a better understanding of these processes. The rent-gap refers to the gap between the actual ground rent and the potential ground rent when land is used to its full potential (Wu et al., 2016). When this gap is at its maximum, it creates opportunities for investors and developers to redevelop an area (Clark, 1988).

2.2.2. Rent Gap

Neil Smith founded the theory of rent gap in 1979 (Huang & Gu, 2023). The rent gap theory explains the difference between the potential ground rent (PGR) and the capitalised ground rent (CGR). The bigger the profit, the more attractive it is for developers or investors to develop in that specific area. This is a critical factor in attracting capital to trigger the emergence of gentrification, since gentrification has become a global strategy for attracting global capital investment driven by state and local governments (Huang & Gu, 2023). The rent gap theory still presents a strong explanation for the processes of gentrification.

However, according to Clark (1995), the rent gap can not be divorced from the societal relations and power struggles involved in the creation and capture of values in the built environment; this political power also has a big influence on the redevelopment of an area. This suggests that the emergence of a rent gap alone does not automatically lead to redevelopment, but policies and institutional actors can influence how and when development occurs. In this regard, processes of gentrification, including commercial gentrification, may be driven by both market mechanisms and government interventions (Smith, 2001; Lees et al., 2008). Market dynamics, such as competition for access to locations, rising demand or increasing purchasing power, can lead to higher rents and attract new businesses (Meltzer, 2016; Smith, 1979). Simultaneously, public policies like Transit-Oriented Development and urban (re)development can actively stimulate investment and accelerate these processes (Ibraeva et al., 2019; Knowles et al., 2020). That is because (re)development projects lead to the restoration and improvement of the built environment, resulting in rising rents (Chen & Zhang, 2024).

Smith (1979) distinguishes between four components of property and land value, which are house value, sale price, capitalised ground rent (CGR) and potential ground rent (PGR). However, the difference between CGR and PGR is the main focus of this research, since it constitutes the rent gap that creates incentives for reinvestment and redevelopment. According to Smith (1979), the CGR is the current value of the land in its current use. It is the value of the land that it is worth right now with the current business or buildings. The PGR is the value the land could produce if it were used more efficiently.

So when the current local coffee shop pays € 1.000 in rent per month, and a higher-revenue chain store is more able to pay € 3.000 in rent per month, since it is a larger firm and has a bigger consumer base, the potential value of the area is € 2.000 more, and when the gap becomes bigger, investors and developers are more likely to invest into that area.

In the context of TOD, improvements in accessibility around transit stations can increase the potential ground rent of surrounding land, thereby widening the rent gap and creating incentives for redevelopment or changes in commercial land use.

While rent gap theory explains why reinvestment and redevelopment may occur in urban areas, it does not fully explain how these processes affect local commercial environments. When redevelopment takes place, changes in land values and rising rents can alter the composition of businesses within a neighbourhood. As landlords seek tenants who are able to pay higher rents, existing local businesses may be replaced by firms that generate higher revenues, such as chain stores, boutiques, or upscale services. These changes in the commercial landscape are commonly referred to as commercial gentrification.

2.3. Commercial gentrification

Commercial gentrification refers to the transformation of neighbourhood retail environments, where existing small or locally owned businesses are replaced by higher-end, chain establishments or boutique shops that provide goods and services to a wealthier consumer base (Lin & Yang, 2019). These upgrades are usually to revitalise an urban area, but can also have a negative influence. Rising commercial rents may displace local and small businesses that can no longer afford the rising rents. This can lead to a loss of neighbourhood-serving functions and reduced accessibility for lower-income residents, transforming the economic and social character of the neighbourhood. Several literature studies noted that commercial gentrification is considered a process that is linked with residential gentrification (Yang et al., 2022). As more affluent residents move into an area, resulting in changes in consumption patterns and purchasing power that influence the types of goods and services demanded. Consequently, business owners adjust their business location and investment decisions, which can lead to transformations in the commercial landscape (Pastak et al., 2019). As a result, commercial gentrification can be a demand-driven process and a supply-driven process. The demand-driven process is shaped by consumer preferences, and the supply-driven process is influenced by investment and redevelopment dynamics.

Over the past years, a few researchers have explored whether and why commercial gentrification occurs. Several studies suggest that commercial gentrification is often linked to redevelopment projects, residential upgrading, and changes in urban public space (Zukin et al., 2009; Wang, 2011; Lim et al., 2013).

The most well-known commercial gentrification is changes to the retail composition of an area, or so-called 'upscaling' (Chapple et al., 2018). Hereby, the goods and services that are provided by the upscale businesses, 'boutiques', are often supplied to the more affluent residents and newcomers (Zukin et al., 2009). Therefore, Zukin et al. (2009) found that boutiques are in contrast with older stores, catering to a poorer, more traditional and less mobile customer.

Besides, Lim et al (2013) found that changes in urban public space have strongly impacted pedestrian flow patterns (Lim et al., 2013). Secondly, when urban public spaces are changing, the (re)development contributes to an increase in land prices and rents.

Since Transit-Oriented Development emphasises walkability and pedestrian-oriented environments around transit stations, similar improvements in urban public space may also increase pedestrian flows and activity levels in station areas. Similar to other urban redevelopment projects, improvements in accessibility and public space around transit stations may increase the attractiveness of surrounding areas, leading to rising land values and commercial change. Due to the increased pedestrian traffic from the transit riders, this could lead to more customers for businesses in the surrounding area, which eventually may lead to higher sales and more employees in commercial districts (Chapple et al., 2018).

Since TOD implements a mixed-use urban area located near a transit station, focusing on a pedestrian-oriented development, it often results in increased foot traffic in that area. This is not only because of the improved accessibility, but also because a mixed-use environment attracts a broader customer base (Edwards, 2011). In such environments, retailers are less dependent on customers making a dedicated trip to individual stores. Instead, the proximity of multiple functions and services encourages multipurpose trips, where visitors combine different activities within the same area. As a result, pedestrians passing through the area may make spontaneous purchases while visiting other destinations, increasing the potential customer base for local businesses (Edwards, 2011). Consequently, areas with higher pedestrian flows may become more attractive for retail investment, which can contribute to rising commercial rents and changes in the local business landscape.

However, the success of mixed-use environments may also have unintended consequences. Jacobs (1961) warned in her book 'The Death and Life of American Cities' that successful urban areas can experience what Jacobs described as 'The self-destruction of diversity' (p. 255). She mentions that a diversified mixture of uses at some place in the city becomes outstandingly popular and successful as a whole. But because of that, more businesses want to move into that area. In the end, only the most profitable businesses will stay, crowding out and overwhelming less profitable businesses. This will be repeated constantly until eventually one or a few businesses dominate that area. A successful area may eventually experience a decline in economic diversity as a result of the process. This process is reinforced by demand-side dynamics. As consumption-oriented establishments cluster in an area, they attract a consumer base that generates further demand for similar businesses, while reducing demand for neighbourhood-oriented services. Over time, this self-reinforcing cycle leads to a commercially homogeneous environment in which only higher-revenue establishments can sustain the increased rental costs, at the expense of the diverse local businesses that originally characterised the area.

Economic diversity refers to the range of economic activities present within a region and how these activities are distributed across sectors (Xiao & Drucker, 2013). A region characterised by high economic diversity has a wide variety of industries, with economic activity evenly spread among them. Nowadays, fostering economic diversity is often a key element in local economic development planning (Dissart, 2003). Besides, economic diversity is crucial in development planning, since a diverse economy increases economic stability, which is less sensitive to fluctuations outside an area (Wagner & Deller, 1998), resulting in lower unemployment rates.

Commercial gentrification is a slow, ongoing change in the commercial environment, not just a single event (Ocejo, 2011). Commercial gentrification can be explained in three stages. The first stage, or so-called the first wave, occurs in declining commercial or mixed-use areas (Chen & Zhang, 2024). These areas are often deteriorating, and therefore struggle to retain more affluent residents, leaving only the low-income residents in that area (Wang, 2011).

The second stage begins when investors take the risk of investing in a deteriorating area. According to Ryu et al (2020), residential buildings have been reduced and replaced by commercial buildings, since rents are low, thus restaurants are taking spaces from residential. At the same time, chain stores are starting to enter the area (Chen & Zhang, 2024).

In the third wave, there are nearly no residential buildings left and a high turnover rate of commercial facilities (Ryu et al., 2020), leading to a high vacancy rate. Eventually, large firms and chain companies are the main occupants, leading to a homogeneous commercial landscape, which is in line with the saying of Jacobs (1961), "The self-destruction of diversity."

2.3.1. Indicators

Several studies have used empirical indicators for commercial gentrification, such as:

1. *Store count*
2. *Turnover & Retention*
3. *Signal establishments*
4. *Chains and small businesses*
5. *Vacancy*

Store count

Store count refers to the total number of establishments present within a given area and is commonly used as an indicator to examine changes in local commercial activity (Kosta, 2019). Changes in the number of stores may reflect broader neighbourhood transformations such as economic decline, redevelopment, or increased commercial attractiveness. However, the relationship between neighbourhood change and store count is not always straightforward. Kosta (2019) argues that changes in store count may also be influenced by factors such as alterations in the built environment, the subdivision of larger commercial spaces into smaller units, or the reorganisation of existing retail spaces. In some cases, businesses may also shift toward lower-rent uses without changing the total number of establishments.

Because of these complexities, store count alone cannot fully capture neighbourhood commercial transformation. Researchers, therefore, often combine store count with additional indicators such as business turnover and changes in retail composition in order to better understand commercial change over time (Kosta, 2019).

Turnover & retention

Commercial gentrification is characterised by an influx of capital that manifests itself in changes to commercial establishments. These changes can be measured through the number of business establishments and their turnover over time.

Retention rates can also be used as indicators for commercial gentrification. Low retention rates mean that businesses have a hard time keeping up with the rising rents, which may force them to leave the area (Chapple et al., 2018). If the retention rate is high, businesses remain in the area for a longer period, suggesting a more stable commercial environment with less evidence of commercial restructuring. The importance of business longevity in understanding neighbourhood change (Kosta, 2019) is the duration. This shows how businesses adapt over time.

Establishments types

Chapple et al. (2018) mentioned that NAICS codes or other establishment-type classification may indicate commercial gentrification, called 'signal establishment'. These classifications allow researchers to identify changes in the types of businesses operating within a neighbourhood.

Establishments are divided into four categories: necessary, discretionary, frequent and infrequent. Necessary establishments provide goods and services required for everyday life, such as grocery stores. Frequent establishments provide regularly consumed services such as pharmacies or banks. Infrequent establishments serve larger market areas and attract customers from outside the neighbourhood, and discretionary establishments provide more luxurious or recreational goods and services.

Chapple et al. (2018) have found that necessary and frequent establishments have a higher retention rate than discretionary and infrequent establishments. So the increase in discretionary and infrequent, or the decrease in frequent and necessary, could indicate commercial gentrification.

To strengthen this, Kosta (2019) cited that commercial change at the street level often presents itself in terms of the transformation of the business composition. Whereby bodegas (necessary) are displaced by cafés or restaurants (discretionary) to serve the needs of the more affluent residents. Furthermore, most commercial gentrification studies employ an account of business composition over time to trace urban change, which relies on the categorisation of retail establishments (Kosta, 2019).

Chains & Small Businesses

Many researchers have noted that small businesses are vulnerable to being replaced by chain stores (Chapple et al., 2018). Besides, Meltzer & Capperis (2016) have found that chains are better capitalised than small businesses and are more able to enter gentrifiable neighbourhoods. Furthermore, Zukin et al. (2009) cited that once an urban area becomes more successful, chains are more likely to outbid current or existing businesses in the current area.

Although chains may provide improved working conditions, wages and benefits (Chapple et al., 2018), this

study focuses primarily on changes in neighbourhood retail composition rather than labour conditions. Previous research has used several methods to measure boutique-led gentrification. Zukin et al. (2009) used Cole’s Reverse Telephone Directories to count all the stores and divide them into three categories: Corporate capital (chain stores), new entrepreneurial capital (boutiques) and local capital (local businesses). If there is an increase in chain stores or boutiques, it indicates commercial gentrification (Kosta, 2019).

Vacancy

Vacancy is not often mentioned as an indicator of commercial gentrification, but Rye et al. (2020) noted that the short-term phenomenon of current shops evolving into other industries or changing due to building construction commonly occurs alongside the related vacancy phenomenon of rising rents due to progress in gentrification. Empty stores define vacancies. When storefronts are vacant for long periods in a neighbourhood, this can lead to significant problems (Talen & Park, 2021). Retail businesses located along streets with sidewalks are particularly valued for their contribution to the vibrancy of street life (Jacobs, 1961). Additionally, retail storefronts enhance the quality of urban design by promoting pedestrian-oriented environments. When streets are experiencing a high level of vacancies, the number and diversity of retail establishments will decline significantly and eventually lead to structural transformation of the retail industry and demographic change (Talen & Park, 2021). The decline of retail businesses has led to changes in the types of establishments present in neighbourhoods, shifting from grocery stores to boutique stores. This move from neighbourhood-oriented businesses to consumption-oriented ones has displaced existing residents and attracted more affluent newcomers. As a result, rising rents and land values are contributing to commercial gentrification (Meltzer, 2016).

Together, these indicators and theoretical explanations demonstrate how improvements in accessibility, rising land values and changing consumer dynamics may lead to the gradual transformation of local retail environments, a process commonly referred to as commercial gentrification. Although the majority of empirical research on commercial gentrification originates from the United States, the process of commercial gentrification has also been documented in the Dutch context. Sakizlioglu and Lees (2020) studied commercial displacement in the Javastraat in Amsterdam. They found that state-led redevelopment replaced local ethnic minority owned shops with boutiques, catering for the middle-class residents.

Furthermore, Doucet and Koenders (2018) found in their study that, although state-led gentrification is widespread in the Netherlands, the effects are more limited compared to Anglo-Saxon countries. This is due to the planned and regulated nature of Dutch urban development. Thus, these studies suggest that commercial gentrification is state-led rather than market-driven, which has implications for the applicability of the American indicators discussed above. This distinction will be further addressed in the discussion. These indicators are operationalised in the methodology to analyse commercial change in the selected case studies.

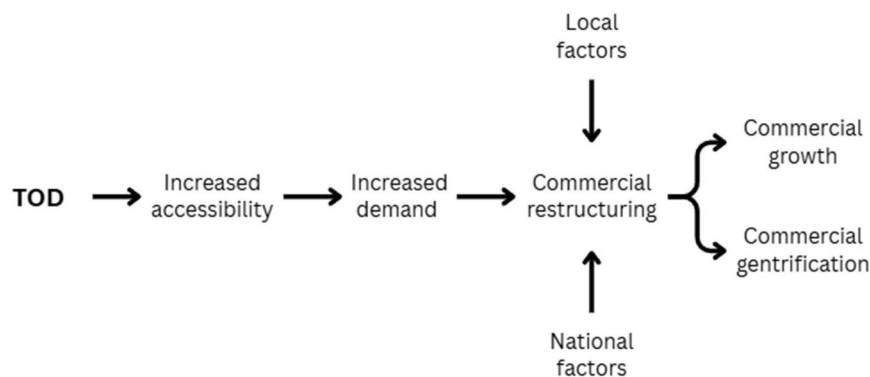


Figure 1 - Conceptual model: theoretical relationship between TOD and commercial outcomes (own work, 2026)

3. Methodology

3.1. Research design

This research examines the relationship between Transit-Oriented Development (TOD) and commercial gentrification in selected station areas in the Netherlands. A comparative case study design is adopted, as this approach is well-suited for examining complex, context-dependent phenomena in depth (Blaikie & Priest, 2019). The research question requires a detailed understanding of how and why commercial structures change within specific spatial settings, which necessitates an in-depth analysis that accounts for local conditions, policy contexts and broader economic trends. By comparing two cases with similar TOD characteristics, the study can assess whether observed patterns are consistent across contexts, thereby strengthening the robustness of its findings.

The research design combines quantitative spatial analysis with a qualitative contextual interpretation. This approach allows for both the identification of measurable patterns in commercial change and a more refined understanding of the mechanisms shaping these developments.

The research is structured into three parts. First, the spatial boundaries of the TOD areas are defined using buffer zones around the selected stations. Secondly, an empirical analysis is conducted using longitudinal data on commercial establishments to examine changes in the composition and distribution of businesses over time. With this step, patterns are identified that may indicate processes of commercial gentrification or alternative forms of economic change. Lastly, the quantitative findings are interpreted with contextual factors, such as local development strategies and broader economic trends. This is to provide a more comprehensive explanation of these observed dynamics.

The sub-questions are addressed through the operationalisation of key concepts derived from the theoretical framework. Indicators of commercial gentrification and TOD are operationalised and applied to the case study areas. The results are compared between the case studies to identify similarities and/or differences in commercial development projects. This comparative analysis provides insight into the extent to which TOD-related changes are consistent across contexts and whether observed developments can be attributed to TOD processes or to broader structural transformations.

3.2. Case study selection and justification

To select suitable cases for this study, station areas were evaluated based on four criteria: (1) classification as a TOD area in previous studies, (2) redevelopment timing compatible with the available LISA Data (1996-2024), (3) comparable daily commuters, and (4) comparable population and employment density.

Given the available LISA data for 1996–2024, it was necessary to select station areas that allowed for a sufficiently long observation period before and after redevelopment. Therefore, only stations with redevelopment starting after approximately 2006 and completed by around 2016 were considered suitable for analysis. Based on redevelopment timing and data availability (LISA, 1996-2024), several stations were identified as potential cases for analysis, which include: Rotterdam Centraal, Arnhem Centraal, Den Haag, Utrecht, Breda, Delft and Tilburg. See Table 1.

	<i>Start (re)development</i>	<i>Finished</i>	<i>Time period (in years)</i>
<i>Rotterdam Centraal</i>	2007	2014	7
<i>Arnhem Centraal</i>	2012	2015	3
<i>Den Haag</i>	2011	2016	5
<i>Utrecht Centraal</i>	2008	2015	7
<i>Breda</i>	2012	2016	4
<i>Delft</i>	2009	2015	6
<i>Tilburg</i>	2013	2015	2

Table 1 - Redevelopment periods of train stations in the Netherlands (Huisman & Linders., 2016)

Stations with significantly higher daily commuters, such as Rotterdam Centraal, Utrecht Centraal and Den Haag, were excluded to ensure comparability. Table 2 presents the daily ridership figures for all candidate stations.

<i>Daily transit riders</i>	
<i>Rotterdam Centraal</i>	102.866
<i>Arnhem Centraal</i>	43.362
<i>Den Haag</i>	80.091
<i>Utrecht Centraal</i>	229.788
<i>Breda</i>	36.131
<i>Delft</i>	34.989
<i>Tilburg</i>	31.144

Table 2 - Daily transit riders, 2025 (NS, 2025)

Population and employment density were also considered as indicators of urban density associated with TOD environments (Nyunt & Wongchavalidkul, 2020; Handy, 2005). Tilburg and Delft were excluded based on their population and employment density. Table 3 summarises the comparison.

<i>Station</i>	<i>Breda</i>	<i>Arnhem Centraal</i>	<i>Tilburg</i>	<i>Delft</i>
<i>Residents</i>	188.779 (CBS, n.d.)	169.364 (CBS, n.d.)	230.357 (CBS, n.d.)	110.173 (CBS, n.d.)
<i>Jobs</i>	118.230 (Lisa, n.d.)	112.390 (Lisa, n.d.)	134.580 (Lisa, n.d.)	61.540 (Lisa, n.d.)

Table 3 - Comparable population and employment density, 2025

Based on these criteria, Breda and Arnhem were selected as case studies. Both stations are comparable in terms of redevelopment period, daily transit riders and urban density. The selection is further supported by previous research.

Singh et al. (2014) identified Arnhem as an area with a high TOD level, indicating that the urban development characteristics of the area are favourable for transit use, see Figure 2. Breda station is identified as a TOD station by Van Ruijven et al. (2019).

It is important to note that the cases that are selected are not based on station redevelopment alone, but on the presence of TOD characteristics in the surrounding urban area. Station redevelopment serves as a practical temporal marker, while the classification as a TOD area is based on the urban development characteristics of the station environment, including density, diversity and design. A detailed description of both cases, including their TOD characteristics and their surrounding area developments, is provided in Chapter 4.

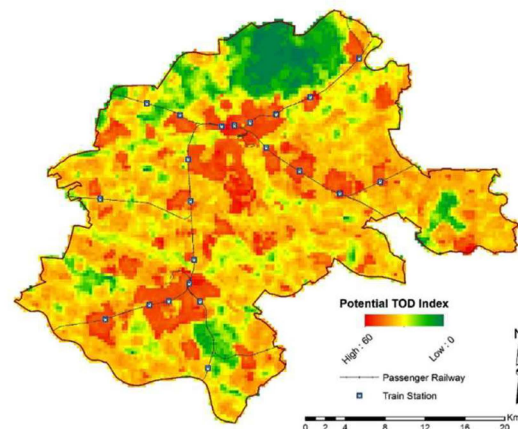


Figure 2 TOD value (Singh et al., 2014, p. 139)

3.3. Data sources

This study uses multiple data sources to analyse both spatial and economic characteristics of the station areas. The data sources are selected to operationalise the indicators of commercial gentrification, identified in Section 2.3.1. Out of the five indicators, three could be operationalised with the available data: store count, establishment types and establishment size. The remaining two indicators could not be measured due to data limitations. In Table 4, an overview is shown of how each indicator is linked to a data source and the corresponding sub-question.

The primary dataset is the LISA database, which contains longitudinal data on business establishments in the Netherlands from 1996 to 2024. This dataset provides detailed spatial information on individual

establishments and allows for the analysis of changes in the number, composition and size distribution of businesses over time.

Since NAICS codes are not applicable in the Dutch context, establishments are classified using SBI-codes (Standaard Bedrijfsindeling). Following Chapple et al. (2018), establishments are grouped into neighbourhood-oriented and consumption-oriented categories, as defined in Section 2.3. A complete overview of the SBI-code classification is provided in Appendix 12.2. For the establishment size indicator, an establishment is classified as a larger or chain establishment when it has 20 or more employees, following Chapple et al. (2018).

To provide a broader economic context, data from the Centraal Bureau voor de Statistiek (CBS) are used to contextualise developments at the national and city level. As CBS data are only available at aggregated spatial levels, they are not used for detailed spatial analysis but serve to identify broader macroeconomic conditions, national structural trends, and local factors that may have influenced the observed commercial changes.

<i>Indicator</i>	<i>Data Source</i>	<i>Sub-question</i>
<i>Store count</i>	LISA Database	SQ1, SQ2
<i>Establishment types</i>	LISA Database	SQ1, SQ2
<i>Size distribution</i>	LISA Database	SQ1, SQ2
<i>Macroeconomic context</i>	CBS	SQ3
<i>Local spatial factors</i>	Municipal policy documents, KSO reports, Centraal Planbureau reports	SQ3

Table 4 – Overview of indicators, data sources and corresponding sub-questions (own work, 2026)

In addition to the data used for the empirical analysis, several spatial datasets are used to characterise the case study area (Chapter 4). Population data are obtained from CBS, employment data from the LISA database, and built density is measured using the Floor Space Index (FSI) derived from RUDIFUN data. Diversity of land use is measured using the Mixed-Use Index (MXI), also obtained from RUDIFUN. Design and accessibility are evaluated using Walk Score, and supplementary mobility indicators are derived from PDOK and reports from the Ministry of Infrastructure and Water Management.

3.4. Data Management Plan

A Data Management Plan (DMP) was prepared in accordance with the TU Delft Data Management Plan template (2025). The primary dataset, the LISA Database, was obtained through a formal request via Erasmus University Rotterdam (EUR). All data are stored on TU Delft OneDrive. The full Data Management Plan is provided in Appendix 10.1.

3.5. Ethics

This study uses data from the LISA Database. The LISA data do not contain personal data of individuals or establishments. Furthermore, other data from CBS, RUDIFUN and Centraal Planbureau (CPB) are all publicly available.

Ethical approval was not needed, since human participants were not involved.

AI tools such as ChatGPT or Claude were used for the readability of this thesis. They were also used to help me with QGIS, since I had no prior experience with it. For more information, see Appendix 10.3.

3.6. Spatial delineation

To measure Transit-Oriented Development (TOD) around transit nodes, it is important to establish boundaries for the area being assessed. As previously noted in the theoretical framework, a 10-minute walking distance is commonly used to define TOD areas. In the Netherlands, this corresponds to approximately 800 meters. Therefore, to define the spatial extent of the TOD station area, a distance of 800 meters is used.

To operationalise this spatial boundary, Geographic Information Systems (GIS) are used. An 800-meter buffer is created around each station in QGIS, based on the geographic coordinates of Arnhem Centraal and Breda stations. Because the LISA Database contains spatial information on individual business establishments, establishments can be selected directly based on their geographic location within the buffer. This approach provides a precise and reproducible delineation of the station area and avoids reliance on aggregated spatial units such as postcode areas.

In addition to the 800-meter buffer zone, the station area is subdivided into two non-overlapping zones. A core zone (0-400 meters) and an outer zone (400-800 meters). The 400-meter zone represents the immediate station environment, while the 400-800-meter zone captures the surrounding area within walking distance. This subdivision allows for a comparison of the composition of establishments based on proximity to the station, without overlap between spatial units.

The 400m buffer allows for an examination of a more detailed spatial analysis of commercial changes within the station area. The subdivision into 0–400m and 400–800m allows for analysing spatial variation in commercial composition based on proximity to the station. Therefore, these areas may attract other types of businesses compared to areas further away from the station.

By looking at both zones (0-400m vs. 400-800m), it becomes possible to assess whether business change is occurring uniformly or in geographic clusters around the station. This is important in assessing the potential for commercial gentrification because it is relevant for identifying spatial concentrations of commercial change.

3.7. Temporal framework

One important aspect to consider is the development period of the station areas. Although the redevelopment of Arnhem Centraal started earlier and was carried out in multiple phases, the most significant transformation occurred between 2012 and its completion in September 2015. Similarly, the redevelopment of Breda station began in 2012 and was completed in 2016. As both stations experienced their main transformation during a comparable period, this study focuses on this phase to ensure consistency between the case studies.

To measure commercial change, this study applies periodic observations at four-year intervals: 2000, 2004, 2008, 2012, 2016, 2020 and 2024. Previous studies suggest that intervals of around five years are appropriate for capturing meaningful commercial change, as the overall lifespan of neighbourhood-oriented establishments is around five years (Meltzer, 2016). A four-year interval is adopted in this study because it aligns with the redevelopment timeline of both stations. Both stations started their construction in 2012, but Arnhem Centraal was completed in 2015 and Breda station in 2016. Making 2012 a natural observation point during construction and 2016 a natural first post-redevelopment observation point. This interval provides three pre-development observations (2000, 2008, 2012), one observation during the construction period (2012), and three post-development observations (2016, 2020, 2024), ensuring a balanced temporal structure for comparison.

Although Arnhem station opened in November 2015 and Breda station in September 2016, the year 2016 is retained as a post-redevelopment observation point to ensure consistency in the 4-year interval applied through the analysis. It is acknowledged that 2016 represents an incomplete year, particularly for Breda, where the station was only operational for part of the year.

However, this does not affect the overall analysis, as commercial changes are not expected to occur immediately but rather develop over time. Therefore, subsequent observation years (2020 and 2024) are included to capture the longer-term effects of redevelopment. In this context, 2016 serves as an initial post-redevelopment reference point within a consistent temporal framework.

3.8. Operationalisation of TOD

TOD is operationalised using three dimensions: *Density, Diversity and Design*, as defined in Section 2.1.2. Density is measured using population data (CBS), employment data (LISA Database), and the Floor Space Index (RUDIFUN). Diversity is measured using the Mixed-Use Index (RUDIFUN). Design and accessibility are evaluated using Walk Score, supplemented by data from PDOK and the Ministry of Infrastructure and Water Management. The results of this assessment are presented in the case study descriptions (Chapter 4).

4. Case study descriptions

This chapter provides a description of the two case study areas, Breda and Arnhem Centraal. In 1997 and 1998, the Dutch government, in collaboration with NS, ProRail, Municipalities and the provinces, decided to redevelop six major stations in the Netherlands. The goal of this programme was not only to improve the accessibility between cities, but also to enhance the spatial and urban quality of the surrounding station area (Huisman et al., 2016). Both Breda and Arnhem were part of this programme, and their redevelopment was completed in 2015 and 2016.

According to the Kennisinstituut voor Mobiliteitsbeleid (KiM, 2025), more than 50% of trips in both Arnhem and Breda are made by bike or on foot within the city. This reflects the favourable conditions for active mobility in both station areas, as shown in Figure 3. The following sections describe each case study area in terms of its TOD characteristics, surrounding area developments and spatial context.

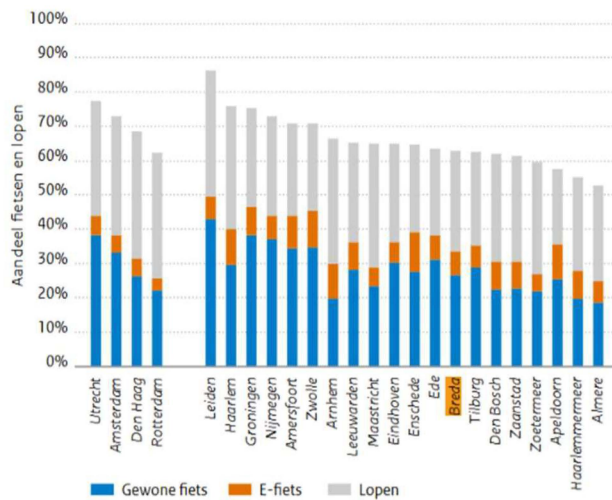


Figure 3 – Proportion of journeys made by bicycle and walking for inner-city travel in the 24 largest municipalities in the Netherlands by population, 2023 (KiM, 2025, p.42)

Table 5 provides a more detailed overview of transportation from and to the station. The transport to and from the station in both Arnhem and Breda is made by walking and cycling, confirming the importance of active mobility in station areas. While there are some differences, the overall patterns are comparable and further support the interpretation that both stations function within a transit-oriented mobility context.

Station	Breda	Arnhem Centraal
Redevelopment finished	September '16	November '15
Transport to the station	19% walk 44% bike (NS, n.d.)	25% walk 32% bike (NS, n.d.)
Transport from the station	44% walk 20% bike (NS, n.d.)	57% walk 11% bike (NS, n.d.)

Table 5 – Comparison between Breda and Arnhem, 2025 (NS, 2025)

4.1. TOD Characteristics

4.1.1. Density

The built density of both station areas is measured using the Floor Space Index (FSI). The FSI measures the ratio between the total floor area of buildings and the land area, providing a representation of the physical built density of an area (Harbers et al., 2019). A higher FSI value indicates a more intensely built environment.

Figure 4 presents the FSI value of both station areas, with Breda on the left and Arnhem on the right. Both stations exhibit relatively similar density patterns within the 800-meter zone. The majority of building blocks fall within the 0.4 – 1.0 FSI range, with several blocks near the station and in the direction of the city centre exceeding 1.0. In both stations, density increases in the direction of the city centre. Towards the south in Breda and towards the south-east in Arnhem. Both station areas also contain zones with lower FSI values (below 0.4), which can be explained by industrial land uses and green spaces that typically exhibit lower built density. The comparable FSI patterns indicate that both station areas have a similar level of built intensity, which is consistent with the density dimension of TOD.

Although no established FSI threshold exists for classifying an area as TOD, the comparable density patterns in both station areas are consistent with the expectation that TOD environments exhibit higher built densities than their surrounding areas (Cervero & Kockelman, 1997). The similar FSI patterns further support the comparability of the two cases for this study.

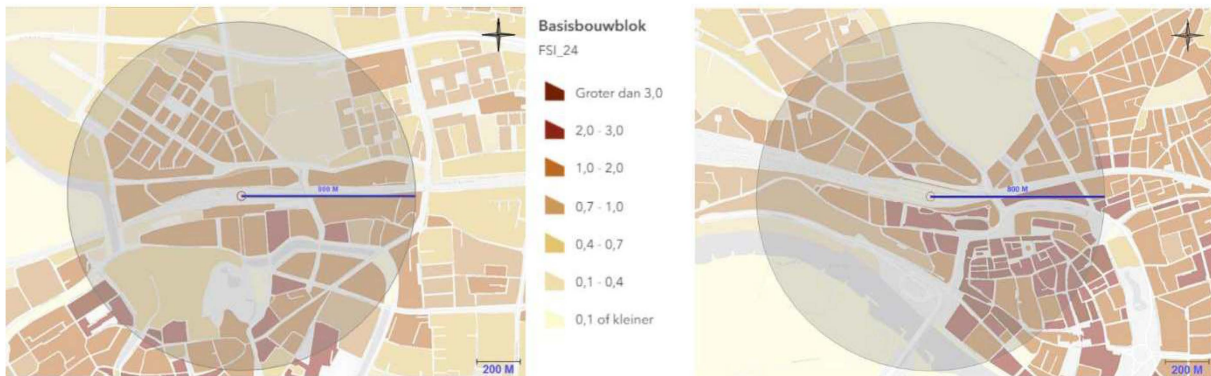


Figure 4 - Floor Space Index (FSI) values within the 800-meter station area of Breda (left) and Arnhem (right) (RUDIFUN, 2024)

4.1.2. Diversity

Land-use diversity is measured using the Mixed-Use Index (MXI). The MXI expresses the ratio between residential and non-residential floor space within building blocks (Harbers et al. 2019). Values above 0.85 indicate residential use, values between 0.45 and 0.55 indicate a balanced mix between residential and non-residential, and values below 0.15 indicate non-residential use. The MXI captures vertical diversity, meaning the degree to which different functions are combined within the same building block. Figure 5 presents the MXI values for both station areas, with Breda on the left and Arnhem on the right. Both station areas exhibit increasing levels of mixed-use in the direction of the city centre. In Breda, it is directed to the south, and Arnhem is directed to the south-east.

The areas surrounding both stations show a mix of residential and non-residential functions, with MXI values between 0.30 and 0.70. The most functionally mixed building blocks are concentrated in the central urban areas, while the peripheral parts of the 800-meter zone show more single-use structures, particularly residential. The comparable MXI patterns indicate that both station areas offer a diversity of functions within walking distance of the station, which is consistent with the diversity dimension of TOD. However, it should be noted that the MXI captures only vertical diversity and does not account for horizontal diversity, where different buildings within an area serve different functions. As a result, this indicator may underestimate the overall functional diversity of both station environments.

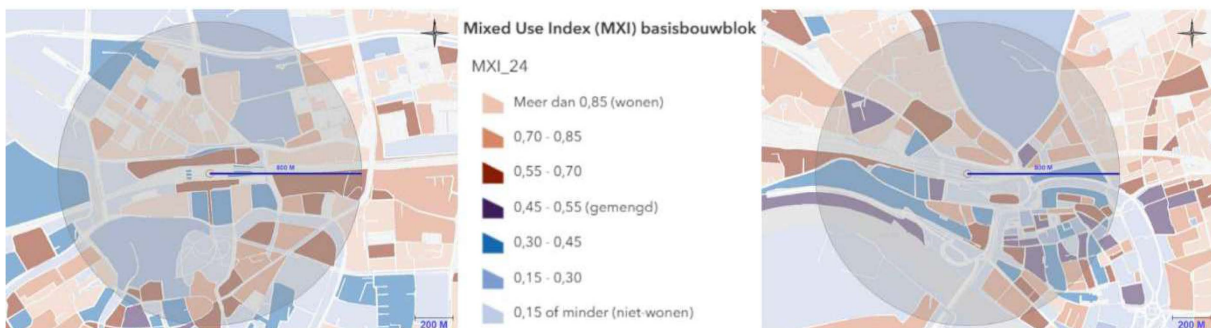


Figure 5 - Mixed-Use Index (MXI) values within the 800-meter station area of Breda (left) and Arnhem (right) (RUDIFUN, 2024)

4.1.3. Design

The design dimension is assessed through accessibility indicators, including Walk Score and active mobility data. Walk Score measures the walkability of a location by calculating the distance to nearby daily amenities across several categories, including dining, groceries, shopping, errands, parks and schools. Locations within a 5-minute walk (approximately 400 meters) receive the highest scores. A score between 90 and 100 is classified as “Walker’s Paradise”, indicating that daily errands do not require a car (Walk Score, n.d.).

Figure 6 presents the Walk Score results for both station areas, with Breda on the left and Arnhem on the right. Breda scores 93 and Arnhem scores 92, both classified as a Walker’s Paradise. The bar charts show that both station areas score consistently high across all amenity categories. Breda scores almost 100% for dining, groceries and shopping, while Arnhem scores almost 100% for groceries, parks, schools and culture. The remaining categories show comparable scores for both station areas. This indicates that most categories are accessible on foot from both stations, confirming a high level of walkability. The comparable Walk Score indicate that both station areas offer a similarly high-quality pedestrian environment.



Figure 6 Walk Score results for Breda and Arnhem (Walk Score, n.d.)

Active mobility and a mobility-friendly environment

In addition to the Walk Score, two spatial indicators from the Atlas Leefomgeving are used to assess the quality of the built environment for active mobility. The first indicator is the “Kernindicator Bewegvriendelijke Omgeving” (Movement-friendly environment). This indicator measures the extent to which the physical environment supports physical activity based on the proximity to amenities, sport and play facilities, and the presence of cycling and walking infrastructure (Atlas Leefomgeving, n.d.). Urban areas generally score higher than non-urban areas, particularly in terms of proximity to amenities and sports facilities.

Figure 7 presents the movement-friendly environment score for Breda and Arnhem. Breda scores mostly between 60 and 80%, with some areas reaching 80-100, indicating a high movement-friendly environment. However, some smaller zones within the buffer score between 40 and 60. Arnhem show a more mixed pattern, with the majority of the station area scoring between 40-60, while other surrounding areas score between 60-80. Despite these differences, both station areas score at or above the Dutch national average, indicating that the built environment in both cases supports walking and cycling.



Figure 7 - Movement-friendly environment scores within the 800-meter station area of Breda (left) and Arnhem (right), 2025 (Atlas Leefomgeving, n.d.)

The second indicator shows the percentage of residents aged between 18 and 65 who travel to work or school on foot or by bicycle in 2022. As shown in Figure 8, both station areas show active mobility rates mostly between 40% and 55%. These findings confirm that both station areas support and encourage active modes of transport, consistent with the Walk Scores results.

However, it should be noted that both indicators are based on aggregated data at the neighbourhood level and may not fully capture local variations within the immediate station area.



Figure 8 - Percentage of residents (18-65) commuting by foot or by bicycle in the station area of Breda (left) and Arnhem (right), 2022 (Atlas Leefomgeving, n.d.)

Indicator	Arnhem	Breda	Interpretation
Density (FSI)	Medium-high	Medium-high	Comparable built intensity
Mixed-use (MXI)	High	High	Strong functional mix
Movement-friendly environment	Medium-high	High	Supports active mobility
Active mobility	High	High	Strong non-car usage
Walk Score	92	93	Very high walkability

Table 6 – Summary of TOD characteristics for Arnhem and Breda (own work, 2026)

Although no established thresholds for TOD characteristics exist in the literature, the indicators presented in Table 6 show that both Arnhem and Breda exhibit TOD characteristics to a comparable degree. The following section describes the surrounding area developments of each station area.

4.2. Breda

Breda is a medium-sized city located in the province of Noord-Brabant. Despite its size, it plays an important role in international and national transportation. Before construction, the municipality of Breda aimed to improve its accessibility, with the ambition to connect Breda with major European cities, such as Paris, Berlin or London, within three hours. This redevelopment process of the station was part of a broader urban development project called 'Crossmark Breda'.

Crossmark Breda is a large-scale urban development project in which approximately 150 hectares around the station are being transformed into a mixed-use area. The programme includes around 7.000 dwellings, 110.000 m² for offices and 40.000 m² in facilities (Gemeente Breda, n.d.). In 2026, approximately 1,700 dwellings have been completed or are under construction, with an additional 3,000 dwellings planned for realisation before 2030.

Regarding the office space, 65,000 m² has been realised, and approximately 10,000 m² of facilities have been completed. The majority of these developments are located within the TOD zone (0-800 m), see Figure 9. In addition, the station hall integrates residential units (150 units) and commercial spaces (9,000 m²) (Gemeente Breda, n.d.). It should be noted that the residential units in the station hall are primarily targeted at the mid- and higher-income groups.

The programme consists of several projects, such as Breda Vooruit, 5-Tracks and 't Zoet, as shown in Figure 9. The majority of these developments are completed or are currently under construction, with a limited number of projects still in the planning phase.

The CrossMark programme represents a comprehensive approach to station area development, combining residential, commercial, office and leisure functions within walking distance of the station. The scale and concentration of these developments within the core zone are relevant for interpreting the commercial changes.

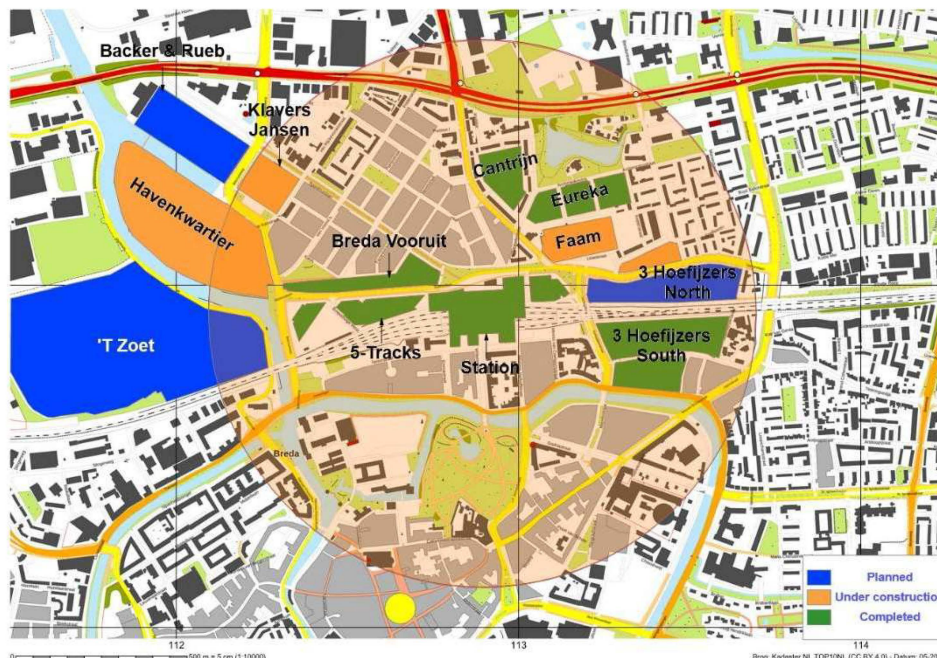


Figure 9 - Overview of CrossMark Developments within the 800-meter station area of Breda (own work, 2026)

4.3. Arnhem

Arnhem is a medium-sized city located in the province of Gelderland. Similar to Breda, Arnhem Centraal plays an important role in transportation since Arnhem station connects the Netherlands with German cities, such as Berlin and Frankfurt.

The station was redeveloped between 2012 and 2015, designed by UNStudio, to improve the integration of different transport modes, including train, bus, bicycle, taxi and car.

A large-scale urban development programme, Rijnboog, had been planned for the south area of the station, between the station and the Rhine River. This urban programme aimed to create a stronger connection between the station area, the city centre and the river through a comprehensive mixed-use transformation (Urhahn, n.d.). However, due to financial constraints and the economic crisis, large parts of the programme were cancelled or scaled back.

The Rijnboog programme consisted of several projects, see Figure 10. The Havenkwartier, which was intended to establish the connection between the city centre and the Rhine River, was cancelled. This plan included 15,255m² of commercial space and 22,308m² of residential space, but currently, one apartment block is under construction. Coehoorn North-East, which was planned for housing, offices and a hotel, has been partly cancelled, and a part is now under construction. Coehoorn Zuid, which envisioned high-rise residential towers, was not realised. Within this programme, only the Rozet cultural centre, Bartok, a residential project and Paradijs, combining work and residential, were realised.

In addition to the Rijnboog programme, several individual projects have been realised near the station, such as Pathé cinema and the ART building. The ART building is a mixed-use development with offices, retail and 27 residential units. However, these two projects were not part of the Rijnboog programme and remained limited in scale compared to CrossMark in Breda.



Figure 10 – Overview of urban developments within the 800-meter station area of Arnhem (own work, 2026)

4.4. Spatial differences between the station areas

Several spatial differences between the two station areas should be noted.

First, the position of the city centre relative to the station differs. In Arnhem, the city centre is located south-east of the station and partially falls within the 800-meter zone. This means that the study area includes a portion of the pre-existing city centre retail environment. In Breda, the city centre is located further south and largely falls outside the 800-meter zone. The area directly surrounding the station was predominantly undeveloped before the CrossMark redevelopment.

Second, the scale and location of urban developments differ. In Breda, the CrossMark developments are concentrated within the core zone (0–400m), directly adjacent to the station. In Arnhem, the Rijnboog programme was planned for the area between the station and the Rhine, extending from the core zone into the outer zone and beyond. However, as the majority of the programme was cancelled, the realised developments in Arnhem remained scattered and limited in scale.

Third, the Rhine forms a physical barrier south of Arnhem station, limiting pedestrian connectivity between the station area and the southern bank. In Breda, no comparable physical barrier exists between the station and its surrounding areas.

5. Results

This chapter presents the results of the analysis of commercial change in the station areas of Breda and Arnhem over the period 2000-2024. Section 5.1 examines changes in the total number of physical establishments (store count). Section 5.2 analyses changes in the composition of establishment types, distinguishing between neighbourhood-oriented and consumption-oriented establishments. Section 5.3 addresses changes in the size distribution of establishments. For each indicator, the results are presented at three spatial scales: the broader TOD area (0-800m), the core station area (0-400m), and the outer station area (400-800m), and are compared between Arnhem and Breda. Subsequently, Section 5.4 examines the national structural factors, and Section 5.5 examines the spatial factors that may have influenced the observed commercial changes. This chapter concludes with a synthesis, which summarises the key findings and draws together the main patterns observed across both station areas.

5.1. Store count

This section examines the changes in the total number of establishments for both Breda station and Arnhem Centraal across three spatial scales: (1) the broader TOD area, (2) the core station area (0-400m) and (3) the outer station area (400-800m), over the study period of 2000-2024. The store count is the first indicator of commercial change, to see whether the commercial activity has grown or declined in relation to the redevelopment of the two station areas.

If TOD were the primary driver of commercial change, the total number of establishments would increase in the post-development phase, or at least show a recovery, especially in the areas closer to the station. The following analysis examines whether this pattern is observed in the given data.

5.1.1. Broader TOD area (800m)

As shown in Table 7, both Arnhem and Breda exhibit a substantial and continuous decline in the total number of establishments within the 800-meter zone over the study period. In Arnhem, the number of establishments decreases from 496 to 289, representing a reduction of approximately 41.7%. Breda shows a similar but to a less extent, decreasing from 168 to 111 establishments, representing a decrease of approximately 33.9%.

	<i>Breda</i>	<i>Arnhem</i>
2000	168	496
2004	151	448
2008	140	452
2012	122	423
2016	109	344
2020	116	322
2024	111	289

Table 7 – Total number of establishments within the 800m TOD zone (LISA Database, 2026)

	<i>Breda</i>	<i>Arnhem</i>
2000-2004	-10.1%	-9.7%
2004-2008	-7.3%	+0.9%
2008-2012	-12.9%	-6.4%
2012-2016	-10.7%	-18.7%
2016-2020	+6.4%	-6.4%
2020-2024	-4.3%	-10.2%

Table 8 – Change in establishments per interval within the 800m TOD zone (LISA Database, 2026)

Two key observations can be drawn from these patterns. First of all, neither station area shows a steady increase in establishments in the post-development phase. If TOD were the primary driver of commercial change, an increase in the post-development phase would be expected, since improved accessibility and increased foot traffic are theoretically associated with greater commercial attractiveness. In Breda, there is a small recovery after the construction period, but this is followed by a decline of -4.3% by 2024.

Furthermore, the total number of establishments in the post-development phase remains below that of the pre-development phase. However, in Arnhem, there is no such recovery in the post-development phase, and the decline continues.

Secondly, the difference in periods between the two station areas is analytically significant. Breda station shows a small and temporary recovery after redevelopment, while Arnhem Centraal continues to decline throughout the post-development phase. Since both stations have similar TOD characteristics and are redeveloped around the same period, this difference suggests that station redevelopment alone does not determine commercial outcomes at the broader zone level. Other external factors may have contributed to this difference, which will be further examined in section 5.4. and 5.5.

Third, the period of the biggest decline in physical establishments for both station areas differs, which is relevant when assessing the role of construction disruption. Arnhem had its biggest decline during the construction phase (2012-2016). This may suggest that construction disruption may have contributed to the decline. However, Breda had its biggest decline before the construction phase (2008-2012). This suggests that broader structural or economic factors were the main drivers during this period.

Overall, the data that is observed for the broader TOD area does not support the expectation that TOD triggers an increase in commercial activity. Instead, both station areas show a decline in the total number of establishments in the physical environment over the study period. This raises the question of whether broader trends in the Dutch retail sector, rather than local development factors, are driving these changes. These broader trends in the Dutch retail sector will be further explained in section 5.4.

5.1.2. Core station area (0-400m)

The core station area represents the most accessible zone surrounding the station. This is the area where TOD effects would theoretically be most pronounced. As shown in Table 9, both station areas experienced a decline in the core station area over the study period, however, the dynamics differ between the two station areas.

In Arnhem, the number of establishments decreased from 59 in 2000 to 37 in 2024, representing a reduction of approximately 37.3%. This decline is relatively steady over the study period. The decline in Arnhem is relatively moderate and continuous, however, there are small fluctuations over the study period.

In Breda, the decline in the core zone is stronger in the pre-development phase compared to Arnhem, from 25 establishments in 2000 to 13 in 2012, with a reduction of 48.0%. This suggests that the biggest decline in commercial establishments had already taken place before the redevelopment.

During the construction phase (2012-2016), the two station areas show a different pattern. Breda’s core zone remained stable at 13 establishments, while Arnhem showed a slight increase of 2.3% from 44 to 45 establishments. However, given the small absolute numbers involved, this difference of a single establishment should be interpreted with caution and does not represent a meaningful commercial shift.

	<i>Breda</i>	<i>Arnhem</i>
2000	25	59
2004	26	52
2008	19	46
2012	13	44
2016	13	45
2020	18	39
2024	19	37

Table 9 – Total number of establishments within the core zone(LISA Database, 2026)

	<i>Breda</i>	<i>Arnhem</i>
2000-2004	4.0%	-11.9%
2004-2008	-26.9%	-11.5%

2008-2012	-31.6%	-4.3%
2012-2016	0.0%	+2.3%
2016-2020	38.5%	-13.3%
2020-2024	5.6%	-5.1%

Table 10 – Change in establishments per interval within the 400m core zone (own work, 2026)

Two observation points stand out from the data of the core station area. First of all, Breda had a significant recovery between 2016 and 2020, with an increase of 38.5%, followed by a further increase of 5.6% between 2020 and 2024. This is consistent with what TOD theory would predict. Due to the improved accessibility and a more dense, mixed-use station area, commercial demand in the closest zone to the station is generated. However, this pattern is observed in Breda, but not in Arnhem. In Arnhem, there is a continuous decline throughout the post-development period, with no recovery.

A more homogeneous post-development increase in establishment in the core zone of both stations would be expected if TOD-induced redevelopment were the primary driver of commercial change, however, such a pattern was not observed. While Breda shows a sign of recovery in the post-development phase, Arnhem exhibit a continuous decline, suggesting that the redevelopment had no impact on the core station area, since it is not consistent across the two cases.

This asymmetry between the two station areas in the core zone suggests that proximity to the station area alone does not determine commercial recovery. Other factors may have contributed to this difference.

5.1.3. Outer station area (400-800m)

The outer station area captures commercial activity within walking distance of the station, but outside its immediate surroundings. As shown in Table 11, both station areas experienced a consistent and gradual decline in the number of establishments. This pattern is almost similar to the broader TOD area.

In Arnhem, the number of establishments decreased from 437 in 2000 to 252 in 2024, representing a decrease of 42.3%. Breda shows a similar pattern, going from 143 establishments in 2000 to 92 establishments in 2024, representing a decrease of 35.7%.

	Breda	Arnhem
2000	143	437
2004	125	393
2008	121	406
2012	109	379
2016	96	299
2020	98	283
2024	92	252

Table 11 – Total number of establishments (LISA Database, 2026)

	Breda	Arnhem
2000-2004	-12.6%	-9.4%
2004-2008	-3.2%	2.5%
2008-2012	-9.9%	-6.7%
2012-2016	-11.9%	-21.1%
2016-2020	2.1%	-5.4%
2020-2024	-6.1%	-11.0%

Table 12 – Establishments in % compared to last year (LISA Database, 2026)

Unlike the core zone, neither city shows a recovery in the outer zone during the post-development period. Breda had a slight increase of 2.1% between 2016 and 2020, followed by a decline again. Furthermore, the number of establishments remains below the pre-development levels. Arnhem continues to decline in the post-development period.

If TOD were the main driver of commercial change, stronger differentiation between the core station area and outer station area would be expected, with the outer zone showing delayed or weaker effects of the

station-proximity. However, both zones show a similar long-term declining trend, which suggests that commercial change in the outer station area is less directly influenced by station redevelopment and more likely reflects broader structural trends affecting the Dutch retail sector.

5.1.4. Cross-zone synthesis

After comparing the three zones together, it reveals a pattern that is partly consistent with TOD theory, while also reflecting processes of commercial gentrification near the station areas. The outer station area and the broader TOD area show a similar long-term decline in both station areas, with no recovery in the post-development period. However, the core zone shows more fluctuations. In Arnhem, there was no post-development recovery, while Breda had a strong recovery in the post-development period.

The lack of a clear spatial gradient, where establishments closer to the station would show more recovery than establishments further away from the station, weakens the argument that proximity to the station is a determining factor in commercial change. In Arnhem, the decline is similar across all three zones, regardless of the proximity to the station. On the contrary, Breda showed a strong recovery in the core station area, while the outer station area and broader TOD area remained declining. This provides the only store count evidence in both cases, which is partly consistent with the station-proximity effect. However, even in Breda, the pattern remains weak, since the broader TOD area experienced a slight temporary increase followed by a decline afterwards.

Overall, the store count analysis highlights two key observations that guide the remainder of the results. First of all, the general decline in physical establishments in both station areas, across all three spatial zones, does not align with the TOD theory as a driver of commercial growth. Secondly, the outcomes of station redevelopment are context-dependent, since Breda's core station area had a recovery, while in Arnhem, there was a continuous decline over all three spatial zones. Other factors, apart from the station redevelopment, may have shaped these outcomes.

5.2. Establishment types

As mentioned in the methodology, establishments are classified into four categories: *Necessary*, *Frequent*, *Infrequent* or *Discretionary*, based on their SBI-codes. These categories are based on the conceptual framework used in previous studies (Chapple et al., 2016; Meltzer, 2016), which distinguishes between different types of commercial activities according to their function and consumption patterns. However, studies using NAICS codes are based in the US. Therefore, this research applied the same conceptual classification, but using Dutch SBI-codes.

5.2.1. Broader TOD area (800m)

Tables 13 and 14 present the distribution of establishments across these categories for Arnhem and Breda over time for the broader TOD area. A key observation is that discretionary establishments constitute the largest share of businesses in both station areas throughout the entire study period. This indicates that both areas were already strongly oriented towards consumption-based activities before redevelopment.

Over time, all categories show a general decline in absolute numbers, including discretionary, infrequent, and frequent establishments. This trend is consistent with the overall decrease in total establishments discussed in the previous section. Notably, necessary establishments show a slight increase in Arnhem, while in Breda they decline to very low levels.

A comparison between Arnhem and Breda reveals both similarities and differences over the study period of their commercial structures. In both station areas, discretionary establishments dominate throughout the entire study period, while infrequent establishments show a clear decline. These patterns suggest that broader structural changes in the retail sector are taking place, rather than localised effects of redevelopment.

However, differences between the cases are also observable. Arnhem displays a relatively stable commercial composition over time, with only minor changes in the relative distribution of establishment

types. In contrast, Breda shows a more noticeable increase in the share of discretionary establishments, rising from approximately 63.7% in 2000 to 74.8% in 2024. This indicates a gradual shift towards a more consumption-oriented structure in Breda.

Year \ Categories	Necessary	Frequent	Infrequent	Discretionary
2000	2.8 %	7.7 %	15.7 %	73.8 %
2004	2.7 %	8.3 %	15.0 %	74.1 %
2008	3.3 %	7.7 %	15.3 %	73.7 %
2012	3.5 %	6.1 %	12.5 %	77.8 %
2016	4.7 %	5.5 %	10.2 %	79.7 %
2020	5.9 %	6.2 %	10.9 %	77.0 %
2024	5.9 %	5.9 %	10.0 %	78.2 %

Table 13 – Categories division Arnhem (LISA Database, 2026)

Year \ Categories	Necessary	Frequent	Infrequent	Discretionary
2000	6.0 %	9.5 %	20.8 %	63.7 %
2004	4.6 %	8.6 %	20.5 %	66.2 %
2008	5.0 %	7.9 %	17.9 %	69.3 %
2012	4.9 %	6.6 %	17.2 %	71.3 %
2016	6.4 %	8.3 %	13.8 %	71.6 %
2020	8.6 %	8.6 %	11.2 %	71.6 %
2024	7.2 %	5.4 %	12.6 %	74.8 %

Table 14 – Categories division Breda (LISA Database, 2026)

When interpreting these results in relation to commercial gentrification, it is important to focus on relative composition rather than absolute numbers alone. Although discretionary establishments dominate in both station areas, this pattern is already present in the pre-redevelopment period. Furthermore, the absence of a consistent and substantial increase in discretionary or infrequent establishments suggests that there is no strong shift towards a more consumption-oriented commercial structure.

Instead, the findings point towards a general contraction of the commercial environment across all categories, rather than a targeted replacement of neighbourhood-oriented services by higher-end consumption. This suggests that broader structural changes, such as the rise of e-commerce and changing consumer behaviour, may play a more significant role than local redevelopment processes.

Tables 15 and 16 present the distribution of neighbourhood-oriented and consumption-oriented establishments for Arnhem and Breda over time. The results reveal contrasting developments between the two case studies.

In Arnhem, the neighbourhood-oriented establishments have slightly increased from 10.5% in 2000 to 11.8% in 2024, while the consumption-oriented establishments have decreased slightly in the same period. This indicates a stable commercial structure, with a small shift towards neighbourhood-oriented establishments.

	<i>Neighbourhood-oriented</i>	<i>Consumption-oriented</i>
<i>2000</i>	10.5 %	89.5 %
<i>2004</i>	10.9 %	89.1 %
<i>2008</i>	11.1 %	88.9 %
<i>2012</i>	9.7 %	90.3 %
<i>2016</i>	10.2 %	89.8 %
<i>2020</i>	12.1 %	87.9 %
<i>2024</i>	11.8 %	88.2 %

Table 15 – Consumption- and neighbourhood-oriented Arnhem (LISA Database, 2026)

In contrast, Breda shows a different pattern. The neighbourhood-oriented establishments have decreased from 15.5% in 2000 to 12.6% in 2024, while consumption-oriented establishments have increased from

84.5% to 87.4% over the same period. This indicates that the area shifts toward more consumption-oriented establishments.

	<i>Neighbourhood-oriented</i>	<i>Consumption-oriented</i>
2000	15.5 %	84.5 %
2004	13.2 %	86.8 %
2008	12.9 %	87.1 %
2012	11.4 %	88.5 %
2016	14.7 %	85.3 %
2020	17.2 %	82.8 %
2024	12.6 %	87.4 %

Table 16 – Consumption- and neighbourhood-oriented Breda (LISA Database, 2026)

Despite these differences, both station areas remain strongly in consumption-oriented establishments throughout the entire study period. However, the patterns observed in Arnhem and Breda differ, indicating that commercial change is not uniform across TOD areas.

These findings suggest that TOD does not lead to a consistent pattern of commercial gentrification, but rather interacts with broader structural changes in the retail sector. While Breda shows some indications of a shift towards consumption-oriented activities, Arnhem exhibits a slight movement in the opposite direction. This implies that broader contextual and local factors, rather than TOD alone, may play a more significant role in shaping commercial change in station areas.

In addition to the overall trends, the temporal development in relation to the redevelopment phases provides further insight. In both Arnhem and Breda, the share of neighbourhood-oriented establishments reaches its lowest point around 2012, which corresponds with the redevelopment phase of the stations. At the same time, consumption-oriented establishments peak during this period.

However, this pattern does not persist in the post-redevelopment period. From 2016 onwards, both station areas show a partial turnaround, with neighbourhood-oriented establishments increasing and consumption-oriented establishments slightly declining. These changes suggest that the fluctuations observed during the redevelopment phase may reflect temporary disruptions or transitional dynamics rather than long-term structural shifts.

5.2.2. Core station area (0-400m)

Tables 17 and 18 present the distribution of establishments across the four categories for Arnhem and Breda within the core station area. Similar to the broader TOD area, discretionary establishments constitute the largest share of businesses in both station areas throughout the entire study period. This indicates that both areas were already strongly oriented towards consumption-based activities before redevelopment.

However, clear observations can be made between the two station areas. In Arnhem, the discretionary establishments remain consistently high (approximately 83.0%), although it shows a slight decline over time. In contrast, Breda exhibits a significant increase in discretionary establishments, from 56.0% to 84.2%.

In both station areas, infrequent establishments show a clear decline over the study period. Simultaneously, Arnhem demonstrates a stable distribution of the four categories, with a slight increase in necessary establishments. This suggests a small strengthening of neighbourhood-oriented services within the core zone.

However, Breda shows a different pattern. While most categories decline over time, the discretionary establishments increase significantly. This indicates the dominance of consumption-oriented services. This shift is mainly visible in the post-development phase.

These findings suggest that for the core station area, Breda shows a strong increase in commercial restructuring towards consumption-oriented services, which may be caused by the TOD development,

while Arnhem exhibits a more stable commercial composition, with a shift more towards neighbourhood-oriented services.

Year \ Categories	Necessary	Frequent	Infrequent	Discretionary
2000	1.7 %	8.5 %	5.1 %	84.7 %
2004	0.0 %	9.6 %	5.8 %	84.6 %
2008	2.2 %	10.9 %	4.3 %	82.6 %
2012	2.3 %	15.9 %	2.3 %	79.5 %
2016	4.4 %	11.1 %	2.2 %	82.2 %
2020	5.1 %	15.4 %	2.6 %	76.9 %
2024	5.4 %	8.1 %	2.7 %	83.8 %

Table 17 – Categories division Arnhem (LISA Database, 2026)

Year \ Categories	Necessary	Frequent	Infrequent	Discretionary
2000	12.0 %	16.0 %	16.0 %	56.0 %
2004	11.5 %	11.5 %	19.2 %	57.7 %
2008	10.5 %	10.5 %	21.1 %	57.9 %
2012	15.4 %	7.7 %	7.7 %	69.2 %
2016	7.7 %	15.4 %	7.7 %	69.2 %
2020	16.7 %	5.6 %	5.6 %	72.2 %
2024	10.5 %	0.0 %	5.3 %	84.2 %

Table 18 – Categories division Breda (LISA Database, 2026)

Tables 19 and 20 present the distribution of neighbourhood-oriented and consumption-oriented establishments for Arnhem and Breda over time. The results reveal contrasting developments between the two case studies.

In Arnhem, the neighbourhood-oriented establishments have slightly increased from 10.2% in 2000 to 13.5% in 2024, while the consumption-oriented establishments have decreased slightly in the same period from 89.8% to 85.5%. This indicates a stable commercial structure, with a small shift towards neighbourhood-oriented establishments.

	<i>Neighbourhood-oriented</i>	<i>Consumption-oriented</i>
2000	10.2 %	89.8 %
2004	9.6 %	90.4 %
2008	13.0 %	87.0 %
2012	18.2 %	81.8 %
2016	15.6 %	84.4 %
2020	20.5 %	79.5 %
2024	13.5 %	85.5 %

Table 19 – Consumption- and neighbourhood-oriented Arnhem (LISA Database, 2026)

In contrast, Breda shows a different pattern. The neighbourhood-oriented establishments have decreased substantially from 28.0% in 2000 to 10.5% in 2024, while consumption-oriented establishments have increased from 72.0% to 89.5%. This indicates that the area shifts toward more consumption-oriented establishments.

	<i>Neighbourhood-oriented</i>	<i>Consumption-oriented</i>
2000	28,0 %	72,0 %
2004	23,1 %	76,9 %
2008	21,1 %	78,9 %
2012	23,1 %	76,9 %
2016	23,1 %	76,9 %
2020	22,2 %	77,8 %
2024	10,5 %	89,5 %

Table 20 – Consumption- and neighbourhood-oriented Breda (LISA Database, 2026)

Despite these differences, both station areas remain strongly in consumption-oriented establishments throughout the entire study period. However, the patterns observed in Arnhem and Breda differ, indicating that commercial change is not uniform across TOD areas, but it varies depending on the local context of development trajectories.

When analysing the dynamics in relation to development, there is not really a consistent pattern for both station areas. The neighbourhood-oriented establishments in Arnhem decline during the construction phase. Later on, it increases, and eventually it decreases again.

While in Breda, the neighbourhood-oriented establishments do not change during the construction phase, but it shows a stable pattern, while after 2020, there is a significant drop in neighbourhood-oriented establishments and a significant increase in consumption-oriented establishments. As these changes occurred several years after the completion, they are unlikely to be directly linked to the redevelopment phase itself.

Overall, Arnhem exhibit strong fluctuations in both neighbourhood-oriented and consumption-oriented establishments, without a clear long-term trend. Breda, on the other hand, shows a delayed shift towards consumption-oriented establishments.

5.2.3. Outer station area (400-800m)

In Tables 21 and 22, the distribution of the categories is shown for both station areas for the outer station area. Similar to both the broader TOD area (800 meters) and the core station area (0-400 meters), the discretionary establishments consist mostly of businesses in both station areas throughout the entire study period. This indicates, again, just like the other two zones, that both areas were already strongly oriented towards consumption-based activities before development.

Clear observations can be made for both station areas. Discretionary and necessary establishments increase during the study period, while frequent and infrequent establishments decrease. For Arnhem, the necessary establishments increase from 3,0% to 6,0%, showing a gradual increase, while Breda, although the increase, shows fluctuating numbers for the necessary establishments. Despite the increase, the development of both station areas does not really have an impact on the commercial restructuring of these establishments.

On the other hand, the share of frequent and infrequent establishments decreases over time for both station areas. Not gradually, but fluctuated. In Arnhem, the infrequent establishments decrease from 17,2% to 11,1%, while frequent establishments show a slight fluctuating decline. In Breda, infrequent establishments decreased from 21,0% to 14,1%, while frequent establishments, like Arnhem, showed a slight fluctuating decline, but did not show a long-term increase or decrease.

Discretionary establishments remain dominant in both station areas, with a slight increase in Breda and a more stable but fluctuating pattern in Arnhem. These patterns indicate that the overall structure of the outer station areas remains stable over time.

Year \ Categories	Necessary	Frequent	Infrequent	Discretionary
2000	3.0 %	7.6 %	17.2 %	72.3 %
2004	3.0 %	8.1 %	16.2 %	72.7 %
2008	3.4 %	7.4 %	16.5 %	72.7 %
2012	3.7 %	5.0 %	13.7 %	77.6 %
2016	4.7 %	4.7 %	11.4 %	79.3 %
2020	6.0 %	4.9 %	12.0 %	77.0 %
2024	6.0 %	5.6 %	11.1 %	77.4 %

Table 21 – Categories division Arnhem (LISA Database, 2026)

Year \ Categories	Necessary	Frequent	Infrequent	Discretionary
2000	4.9 %	8.4 %	21.0 %	65.7 %
2004	3.2 %	8.0 %	20.0 %	68.8 %

2008	4.1 %	7.4 %	17.4 %	71.1 %
2012	3.7 %	6.4 %	18.3 %	71.6 %
2016	6.3 %	7.3 %	14.6 %	71.9 %
2020	7.1 %	9.2 %	12.2 %	71.4 %
2024	6.5 %	6.5 %	14.1 %	72.8 %

Table 22 – Categories division Breda (LISA Database, 2026)

Tables 23 and 24 present the distribution of neighbourhood-oriented and consumption-oriented establishments. The results show similarities between the two station areas.

In Arnhem, the neighbourhood-oriented establishments have slightly increased from 10.5% in 2000 to 11.5% in 2024, while the consumption-oriented establishments have decreased slightly in the same period. This indicates a stable commercial structure, with a small shift towards neighbourhood-oriented establishments.

	<i>Neighbourhood-oriented</i>	<i>Consumption-oriented</i>
2000	10.5 %	89.8 %
2004	11.1 %	88.9 %
2008	10.8 %	89.2 %
2012	8.7 %	91.3 %
2016	9.4 %	90.6 %
2020	11.0 %	89.0 %
2024	11.5 %	88.5 %

Table 23 – Consumption- and neighbourhood-oriented Arnhem (LISA Database, 2026)

In addition, Breda shows a similar pattern. The neighbourhood-oriented establishments and consumption-oriented establishments show that it stays stable over time. The neighbourhood-oriented establishments decreased from 13.3% to 13.0% over the study period, and for the consumption-oriented establishments, increased from 86.7% to 87.0%.

For both station areas, the results indicate that the redevelopment of the station in the outer station area does not really have an impact on the businesses, since it remains stable over time.

	<i>Neighbourhood-oriented</i>	<i>Consumption-oriented</i>
2000	13.3 %	86.7 %
2004	11.2 %	88.8 %
2008	11.6 %	88.4 %
2012	10.1 %	89.9 %
2016	13.5 %	86.5 %
2020	16.3 %	83.7 %
2024	13.0 %	87.0 %

Table 24 – Consumption- and neighbourhood-oriented Breda (LISA Database, 2026)

Overall, a comparison across the three zones (broader TOD zone, core station area and outer station area) does not reveal a consistent relationship between proximity to the station and the concentration of consumption-oriented establishments. Although Breda experienced a strong increase in consumption-oriented businesses in the core station zone, this pattern was not observed in Arnhem, nor was it found for the broader TOD area or outer station area. This indicates that the proximity of the businesses to the station areas does not determine commercial restructuring patterns.

5.3. Establishment size

In addition to the establishment types and the number of establishments, this study examines changes in establishment size as a third indicator for commercial gentrification. Following Chapple et al. (2017), who defined non-chain businesses as establishments with fewer than 20 employees. This analysis distinguishes between small businesses and chain businesses. Since the LISA Database does not provide information on the number of related establishments, the threshold of 20 employees is used as a proxy

indicator for establishment size. A decline in small businesses and an increase in chain establishments is, according to the literature, consistent with the process of commercial gentrification, in which smaller businesses are replaced by larger and more capitalised establishments, since large businesses are more often able to withstand the rising rents.

5.3.1. Broader TOD zone (0-800m)

Within the 800-zone, the two station areas show contrasting patterns in establishment size. In Arnhem, the share of small businesses declined from 94,4% in 2000 to 90,7% in 2024. The number of larger establishments does not show a consistent trend. It declined from 28 in 2000 to 19 in 2004, followed by a recovery from 19 in 2004 to 29 in 2008, then it dropped again to 20 in 2012, and then it gradually increased to 27 in 2024. Larger establishments fluctuate but recover, while small businesses decline continuously without recovery over the study period. This results in an increase from 5,6% to 9,3% for the larger businesses over the study period. This is not because larger businesses enter the TOD area, but rather because smaller businesses disappear at a faster rate, while larger establishments recover to almost original levels.

	<i>Small businesses (1-19)</i>	<i>Larger businesses (20+)</i>	<i>Total</i>
2000	468	28	496
2004	429	19	448
2008	423	29	452
2012	403	20	423
2016	319	25	344
2020	296	26	322
2024	262	27	289

Table 25 – Establishment size Arnhem within 800m zone(LISA Database, 2026)

	<i>Small businesses (1-19)</i>	<i>Larger businesses (20+)</i>	<i>Total</i>
2000	162	6	168
2004	147	4	151
2008	135	5	140
2012	118	4	122
2016	105	4	109
2020	112	4	116
2024	107	4	111

Table 26 – Establishment size Breda within 800m zone (LISA Database, 2026)

However, in Breda, the pattern is different. Although the number of both larger businesses and small businesses declined, the number of small businesses remains stable at 96,4% in both 2000 and 2024. The same goes for the larger businesses, remaining stable at 3,6% in 2000 and 2024. This decline means that the size of the distribution of establishments in Breda’s station area has not changed over the study period for the broader TOD area.

This difference between the two station areas is remarkable. In Arnhem, the small businesses decline gradually, without recovery, while in Breda, both small and larger businesses decline at comparable rates. This indicates that commercial dynamics operating in the two station areas are fundamentally different in terms of their impact on establishment size.

5.3.2. Core station area (0-400m)

In the core zone, the number of larger businesses is too small for reliable trend analysis. Breda has 2 to 3 establishments per observation year on a total of 13 to 25 establishments, while Arnhem has 4 to 6 on a total of 37 to 59. The entry or exit of a single establishment can shift the percentage by 5% to 10% at these numbers. Therefore, the results for the core zone should be interpreted with caution.

In Arnhem, the share of small businesses declines gradually over the study period, with no recovery. Only staying at the same number of small businesses in 2008 and 2012. The number of larger establishments varies between 4 and 6 over the study period, returning to 5 in 2024, which was the same as in 2000. The

share of larger businesses increases from 8,5% to 14,5%, but this is entirely driven by the decline in total establishments rather than by an increase in larger businesses. This pattern mirrors the broader TOD zone. Small businesses decline continuously from 53 to 32, while large establishments remain stable, with fluctuations.

In Breda, the small businesses show a clear observation. The number of small establishments declined from 23 in 2000 to 10 in 2012, and then recovered to 17 by 2024. The lowest number of small businesses coincides with the construction period, which eventually increased to 17 small businesses in 2024. Larger businesses remained at 2, with a small increase in 2008, but they fluctuated between 4 and 6 establishments. But the peak of 23,1% in 2012, based on just 3 larger establishments out of 13 in total, illustrates how sensitive the percentage is to individual establishments at this scale.

Despite the limitation of small sizes, one observation stood out. In Breda, the small businesses recovered after the construction period, while in Arnhem, the small businesses continued to decline. This difference in the post-development phase is consistent with the patterns observed in the total number of establishments and establishment types.

	<i>Small businesses (1-19)</i>	<i>Larger businesses (20+)</i>	<i>Total</i>
2000	54	5	59
2004	48	4	52
2008	40	6	46
2012	40	4	44
2016	39	6	45
2020	33	6	39
2024	32	5	37

Table 27 – Establishment size Arnhem in core zone (LISA Database, 2026)

	<i>Small businesses (1-19)</i>	<i>Larger businesses (20+)</i>	<i>Total</i>
2000	23	2	25
2004	24	2	26
2008	16	3	19
2012	10	3	13
2016	11	2	13
2020	16	2	18
2024	17	2	19

Table 28 – Establishment size Breda in core zone (LISA Database, 2026)

5.3.2. Outer station area (400-800m)

The observed patterns in the outer station area are similar to the patterns for the broader TOD area (0-800m). In Arnhem, the number of small establishments declined significantly from 414 in 2000 to 230 in 2024, with a decrease of 44,4%, while the larger businesses remained relatively stable, with fluctuations between 15 and 23, without a consistent decline. Arnhem had a decline to 15 larger establishments in 2004, with a recovery in 2008 to 23, dropped again to 16 in 2012 and eventually increased to 22 by 2024. This pattern of fluctuation and recovery for larger establishments, while the small businesses continued to decline, confirms the observed decline in the broader TOD zone, with a decrease from 94,7% to 91,3%.

In Breda, the outer zone shows a stable distribution throughout the study period. The small businesses remain between 97,2% and 99,1% over the study period. It is important to note that the numbers for the larger establishments are very small, ranging from 1 to 4. This means that the changes in larger businesses affect the percentages significantly. Notably, the larger businesses reached their lowest point in 2012, before stabilising at 2 from 2016 onwards. However, since the total number of businesses in Breda declined from 143 in 2000 to 92 in 2024, the share of larger businesses remains stable between 0,9% and 2,8%, indicating no structural shift in size distribution.

	<i>Small businesses (1-19)</i>	<i>Larger businesses (20+)</i>	<i>Total</i>
2000	414	23	437

2004	381	15	396
2008	383	23	406
2012	363	16	379
2016	280	19	299
2020	263	20	283
2024	230	22	252

Table 29 – Establishment size Arnhem in outer station area (LISA Database, 2026)

	<i>Small businesses (1-19)</i>	<i>Larger businesses (20+)</i>	<i>Total</i>
2000	139	4	143
2004	123	2	125
2008	119	2	121
2012	108	1	109
2016	94	2	96
2020	96	2	98
2024	90	2	92

Table 30 – Establishment size Breda in outer station area (LISA Database, 2026)

5.3.3. Summary

The establishment size analysis reveals contrasting patterns between the two case studies across three spatial scales. In Arnhem, the small businesses declined significantly faster than larger businesses in both the 800-meter zone and the outer station area. Larger establishments fluctuate in short-term conditions, but recover to numbers almost the same as the start (year 2000), while small businesses decline continuously without any recovery. This results in a gradual shift in the size distribution. In the core station area, the same pattern is observed, but due to the small numbers, it limits the robustness of this finding. In Breda, small businesses and larger establishments decline at comparable rates across all three spatial scales, maintaining a stable size distribution throughout the study period. The only notable difference is in the core zone, where small businesses recover after the construction period, which was not observed in Arnhem.

This finding adds a third dimension to the analysis and completes the picture formed by the previous two indicators. The store count analysis in section 5.1 showed that both station areas experienced an overall decline in physical establishments over the study period, which points towards the fact that similar structural processes affect both station areas. The establishment types analysis in section 5.2 revealed a key difference. Breda's core zone shows a strong shift towards consumption-oriented establishments, while Arnhem remains stable. The establishment size analysis adds another layer. In Arnhem, small businesses declined disproportionately across all three zones, while larger businesses remained stable, resulting in a gradual shift in size distribution. In Breda, the size distribution remains stable for the broader TOD zone, as both small and larger businesses decline at similar rates.

Together, these three indicators suggest that the commercial change observed in the two station areas manifests in fundamentally different ways. In Breda, the change is primarily a shift in establishment type, from neighbourhood to consumption-oriented establishments, rather than a shift in establishment size. The businesses that replace neighbourhood-oriented establishments in the core zone are of comparable size but serve different functions. In Arnhem, there is no shift in establishment types, but there is a decline in small businesses over all across the three zones. These contrasting patterns cannot be explained by the quantitative analysis alone. The next sections examine the national and local contextual factors that may help explain both the similarities and differences between the two cases.

5.4. National and structural factors

The spatial analysis that was done previously does not reveal a consistent relationship between proximity to transit and commercial restructuring. The changes in establishment counts and the types of establishments still require further explanation. Due to the lack of indicators in proximity to transit, other factors may be influencing commercial dynamics in station areas, instead of commercial gentrification caused by TOD.

Therefore, besides TOD, broader contextual processes that may affect commercial changes must be considered. Think of changes in consumer demand, the rise of e-commerce, fluctuations in economic conditions and potential increases in rent prices in the commercial sector in urban areas.

To explore the alternative explanations, this section will be divided into two sections. The first section will examine national and structural factors that may have affected the Dutch retail sector as a whole, such as the economic crisis in 2008, the COVID-19 pandemic, changing consumer behaviour and the increase of online establishments or e-commerce. These factors are not station-related but are more shaped by the broader contextual factors in which commercial change has occurred.

In the second section, the local and spatial factors that are city-specific, including municipal retail policy, large-scale development programmes, real estate dynamics and construction disruption.

Together, these two sections provide a more comprehensive understanding of the extent to which observed changes can be attributed to TOD-related processes.

5.4.1. Economic crisis

Besides the decline in physical shops, Breda experienced its largest decrease in physical shops from 2008 to 2012, with a decline of 12,9%, while Arnhem experienced a decline in that same period of 6,4%. This period coincides with the start of the global financial crisis in 2008, which severely affected the Dutch economy. GDP declined by 3,7% in 2009 alone (CBS, 2025), while the construction sector was hit even harder. The added value of construction declined by 26,3% between 2008 and 2013 (CBS, 2023). Household consumption expenditure decreased by 1,9% in 2009, but after a small period of recovery (in both 2010 and 2011 by 0,1%), it declined again by 1,1% in 2012 and 1,0% in 2013 (CBS, 2024). Nationally, the number of physical shops declined from its peak of 97,100 in 2010 to 89,500 in 2016, which is a decline of 7,8% (CBS, 2022). The decline observed in both Breda (-12,9%) and Arnhem (-6,4%), between 2008 and 2012, therefore coincides with these broader macroeconomic conditions, suggesting that part of the commercial change may be attributed to external economic shocks, rather than TOD-related commercial gentrification.

Moreover, the continued decline in physical shops between 2012 and 2016 may also be linked to the effects of the 2008 global economic crisis. Although the Dutch economy began to recover after 2014, the upcoming years were characterised by reduced consumer spending, limited investment and economic uncertainty. These conditions could likely affect the survival of retail establishments, contributing to the observed decline in physical shops in both Arnhem and Breda.

	<i>Breda</i>	<i>Arnhem</i>
<i>2008-2012</i>	-12,9%	-6,4%

Table 31 - Decrease in physical establishments (brick&mortar business) during economic crisis within the 800m TOD zone (LISA Database, 2026)

5.4.2. COVID-19

Besides the global economic crisis in 2008, the COVID-19 pandemic represents another important factor that influenced the changes in establishments in the Netherlands between 2020 and 2022. As shown in Table 32, after the construction period, which was in 2016, Breda experienced an increase in physical shops of 6,4%. However, this growth was followed by a decrease of 4,3%. While Arnhem showed an even stronger decrease of 10,2%. This period coincides with the COVID-19 pandemic, during which strict lockdowns were implemented in the Netherlands. Non-essential shops were temporarily closed, and mobility was significantly reduced, see Table 32. This eventually led to a decrease in customer flows in station areas.

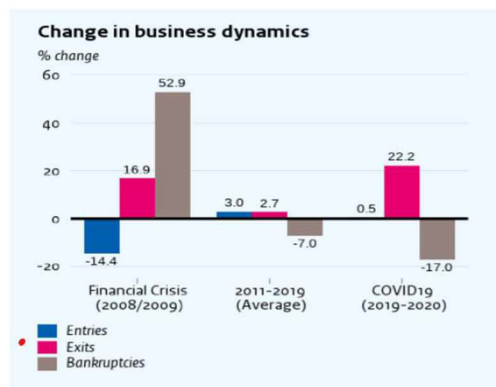


Figure 11 - Business dynamics during COVID-19 compared with other periods (Fareed & Overvest, 2021)

According to Fareed & Overvest (2021, from CPB), during COVID-19, the number of business exits is higher than during the financial crisis, with a 22,2% change. Reflecting the severity of the shock to retail establishments. Although a few establishments continued to emerge during the pandemic, the high increase in business exits suggests that many establishments that started, or started before COVID-19, could not withstand the sudden drop in demand and operational restrictions. As a result, the decline in establishments observed in both Breda and Arnhem after the redevelopment period may likely be influenced by the COVID-19 pandemic, rather than indicating commercial change or restructuring, like commercial gentrification.

	Breda	Arnhem
2016-2020	+6,4%	-6,4%
2020-2024	-4,3%	-10,2%

Table 32 - Decrease in physical establishments compared to the last period (own work, 2026)

While Breda experienced an increase after redevelopment, Arnhem experienced a decline in establishments of 6,4%. This difference suggests that the impact of the station is highly context-dependent, so it is not uniform but more likely dependent on local conditions, despite the increase in daily transit ridership. In Breda, the development was characterised by a large-scale development, including the addition of commercial establishments and improved accessibility to the city centre, which may have increased the attractiveness of the station area for businesses. However, the redevelopment of Arnhem station was more focused on the transport infrastructure and the design of the train station, with less focus on the commercial development. This indicates that TOD does not automatically lead to commercial gentrification, but the outcomes may be shaped by spatial or economic context.

5.4.3. Changing consumer behaviour

Another factor that might help explain the observed trends is the changing behaviour of consumers and transit users. As shown in Table 33, after the COVID-19 pandemic, the daily transit riders increased for both Arnhem and Breda. Despite the increase in the potential foot traffic in both station areas, the number of physical establishments decreased. This indicates that potentially higher foot traffic does not necessarily mean higher demand for physical establishments.

Although changes in consumer behaviour represent the national trend, the following analysis uses the statistics of Arnhem and Breda to illustrate how these broader shifts appear in the case study areas.

	Breda	Arnhem
2019	42.711	53.366
2020	18.903	24.176
2021	21.712	25.653
2022	32.844	37.482

2023	35.484	44.040
2024	36.131	43.362
2025	36.141	44.182

Table 33 – Daily transit riders per city, 2025 (NS, 2026)

One possible explanation is the changing socio-economic composition of the population. Over time, both cities experienced population growth, accompanied by an increase in the average age of residents. An ageing population is often associated with different consumption patterns. To strengthen this, van den Burg & van Knippenberg (2018) have found in their research that the ageing population will have the most impact on the Dutch retail sector. They tend to rely less on frequent, convenience-based retail near transit stations.

	Breda	Arnhem
2000	160.615	138.154
2012	176.401	149.271
2016	181.611	153.818
2024	188.078	167.632

Table 34 – Total number of residents per city (CBS, 2026)

In addition, the educational level has increased for both cities. With a growing share of highly educated individuals (HBO/WO) and a decline in lower educated individuals (basisonderwijs, VMBO and MBO1). As discussed in the theoretical framework, higher-educated and higher-income groups often show different consumption pattern/preferences. They have a more selective and less place-bound pattern, since they are more likely to be able to afford a car, and the dependence on nearby facilities, located near station areas, may be reduced.

	Breda	Arnhem
2000	38,8	38,0
2012	40,0	38,7
2016	40,9	39,6
2024	42,1	40,7

Table 35 – Average age per city (Home | Arnhem in Cijfers, n.d.)

Together, these changes in population size, average age and educational background indicate a shift in the socio-economic profiles of residents. As a result, this may influence the local consumption patterns. This could help explain why the increase in daily transit riders did not result in the corresponding increase in physical establishments around station areas.

	Basisonderwijs, VMBO, mbo1	Havo, VWO, mbo 2-4	HBO / WO
2013	27,0%	39,4%	33,5%
2016	25,8%	39,5%	34,7%
2024	22,1%	36,6%	41,3%

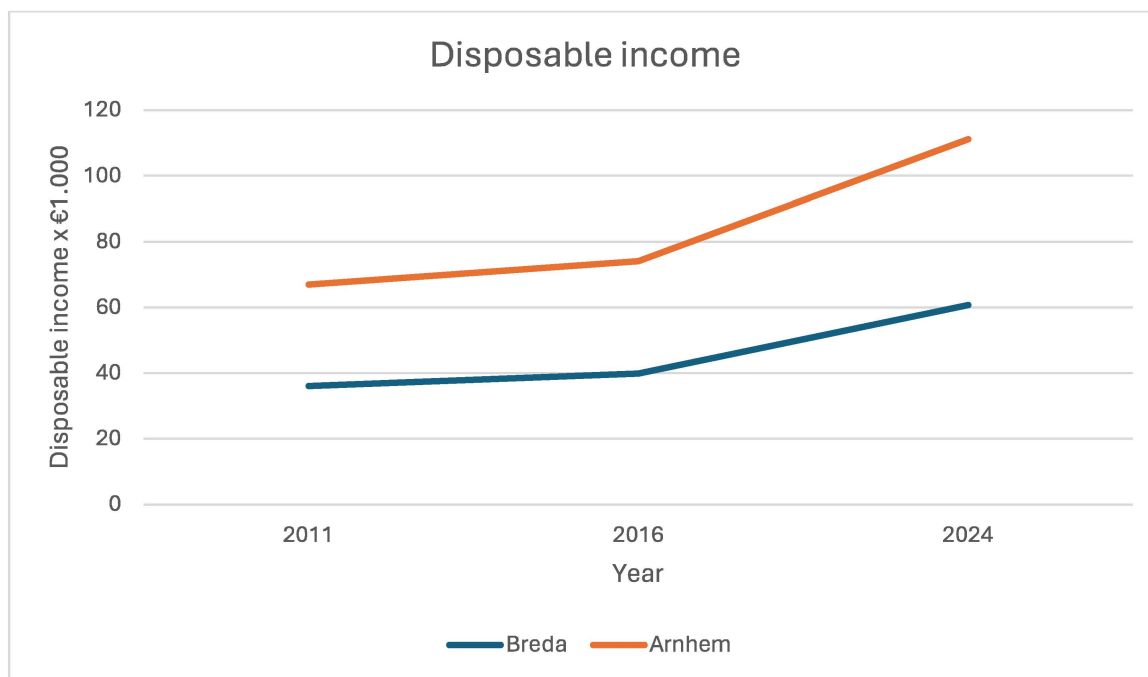
Table 36 – Highest achieved study background, Breda (CBS, 2026)

	Basisonderwijs, VMBO, mbo1	Havo, VWO, mbo 2-4	HBO / WO
2013	31,4%	37,3%	31,3%
2016	30,1%	37,8%	32,1%
2024	25,5%	36,7%	37,9%

Table 37 – Highest achieved study background, Arnhem (CBS, 2026)

Furthermore, the changes in income level also play an important role in the shift of consumer behaviour. Over time, the average disposable income (gemiddeld besteedbaar inkomen) has increased in both cities. This indicates a shift to a more affluent population. As mentioned in the theoretical framework, high-income households tend to have different consumption patterns, since they are more selective. They focus more on higher-quality, convenient and experience-based consumption. As a result, this may

influence the types of establishments around station areas. This could contribute to the mismatch that is observed between the increased footfall and the declining number of physical establishments. However, it should be noted that inflation may be related to the increase in disposable income. Nevertheless, the observed trends still reflect broader changes in the socio-economic profile of the residents.



Graph 1 – Disposable income Breda & Arnhem (Gemeente Arnhem, n.d.)

These changes in consumer behaviour are not just theoretical; broader structural transformations are also reflected within the retail sector. Particularly, the rise of e-commerce or online retail. This indicates a shift from physical shopping to online shopping.

5.4.4. Online establishments (e-commerce)

To further examine this shift from physical shopping to internet retail, SBI codes related to internet retail were used. The results show that across all three spatial scales (the broader TOD area, outer station area and core station area) there was a significant decline in the total amount of physical shops. In Breda, the total number of physical shops declined from 168 in 2000 to 111 in 2024, and in Arnhem, the number of physical shops declined from 496 to 289 over the same period.

	<i>Arnhem</i>	<i>Breda</i>
2000	1	2
2004	5	0
2008	9	4
2012	25	17
2016	26	34
2020	49	54
2024	110	106

Table 38 - Internet retail (LISA Database, 2026)

In contrast, the results in Table 38 show a significant increase in the number of online businesses in both station areas throughout the study period. In Arnhem, the number of online establishments increased from 1 in 2000 to 110 in 2024. Similarly, in Breda, the number rose from 2 to 106 over the same period. This growth accelerated particularly after 2012, and it escalated after 2020, coinciding with the rapid adoption of e-commerce during and after the COVID-19 pandemic.

This local pattern reflects a broader national trend. According to CBS (2024), there are more online establishments in the Netherlands than physical shops for the first time. As of January 2024, the

Netherlands had a total of 95.000 web shops, while there were only 83.000 physical shops. The number of physical shops has been declining, while online establishments have grown consistently since 2010. Furthermore, according to the Ham and Thuiswinkel (2025) report, Dutch consumers have spent 36 billion euros online in 2024, which is approximately 31% of all retail expenditures. This share has increased significantly during and after the COVID-19 pandemic. In 2020, 75% of online expenditures were on products, but by 2024 this had declined to 60%, indicating a broader shift in how consumers engage with online establishments (Ham & Thuiswinkel, 2025).

The impact of e-commerce is not evenly distributed across retail sectors. Van Duren et al. (2021) found that physical expenditures in the recreational sector declined by over 10% in five years, while online expenditures increased over the same period in all categories. However, the loss of physical shops was partly compensated by a 7,6% increase in hospitality establishments (consumption-oriented), such as hotels and cafés. This replacement from retail to hospitality is consistent with the shift from neighbourhood to consumption-oriented establishments, which was visible in Breda’s core zone. However, since the fact that this pattern is nationally visible, and not only in TOD areas, this reinforces the interpretation that the shift is at least partly driven by broader structural changes in the retail sector, rather than by TOD alone.

Ten Hoopen et al. (2023) found for Arnhem that the online shares of expenditures have increased significantly across all product categories compared to 2019. Even expenditures on daily groceries doubled from 2% in 2019 to 4% in 2023. These total expenditures are equivalent to the revenue of nearly 60 supermarkets (Ten Hoopen., 2023). However, recreational retail experienced the strongest growth in online commerce, particularly in fashion, electronics and household goods, see Figure 12.

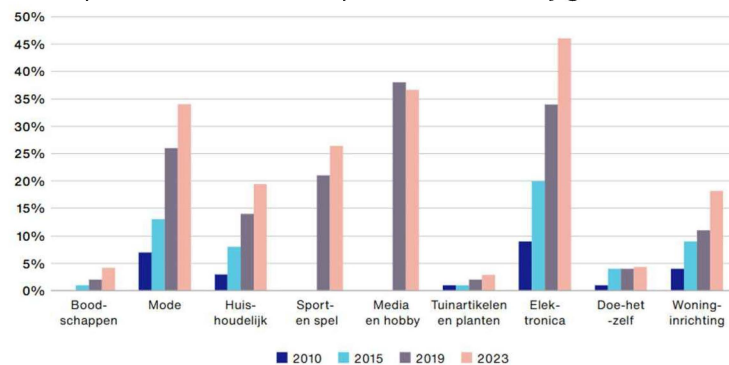


Figure 12 - Online expenditures Oost-Nederland (ten Hoopen et al., 2023)

Furthermore, the growth of e-commerce has also been accompanied by the decline of

visitors in Dutch shopping areas. According to Slob (2022), the number of visitors declined by 22% from 2004 to 2019. It declined further during the COVID-19 pandemic, with a 45% decline from 2019 to 2020. Eventually, there was an 8% recovery from 2021 to 2022 after the COVID-19 pandemic. However, these visitor numbers are just 59% of the total before the COVID-19 pandemic. This decline was most visible in big cities, but these are also often the cities with the strongest recovery. The strongest recovery was in Breda, with an increase of 54% in the total number of visitors.

Bankruptcies of retail chains have further accelerated the structural shift towards e-commerce. Between 2016 and 2024, several major chain establishments ceased their physical operations, such as V&D in 2016 and the Schoenenreus in 2015 and more recently, the Blokker and Game Mania, both in 2024. According to CBS, more than 230 establishments have closed their doors in recent years (CBS, 2024). These closures entail several socio-economic consequences. First, these specific establishments function as primary attractors for urban centres. Consumers visiting these specific establishments often generate spillover traffic for surrounding local shops. Consequently, the disappearance of these chain establishments reduces overall footfall, diminishing the vibrancy of the city centre.

Secondly, these chain establishments often have bigger spaces. Once vacant, these spaces are difficult to re-rent due to their substantial size and high rent costs, leading to increased vacancy rates and a decline in the area’s aesthetic and commercial appeal. In addition, loyal consumers who previously shopped at these chain establishments are forced to seek alternatives. According to van den Burg & Knippenberg (2018), almost 75% of consumers prioritise accessibility and affordability. The removal of top-tier physical locations leaves only less accessible or more expensive alternatives.

Furthermore, more than 75% of consumers have bought products through an online store. The main reason is that these online establishments offer the same products for a lower price. One of the main reasons why online establishments can offer their products for a lower price is that they don't have to pay rent, resulting in lower prices. This shift is reflected in the local data of Arnhem and Breda, since starting from 2016, the online establishments have started to increase significantly.

The simultaneous decline in physical shops and the increase in online establishments suggest that e-commerce may be the primary driver of the overall decline in physical shops in both station areas. The fact that both station areas experienced comparable declines in physical establishments, despite the differences in TOD implementation, supports the interpretation that e-commerce, rather than local development processes, is the dominant factor behind the decline in overall establishments. However, e-commerce alone does not explain why the remaining commercial activity differs between Breda and Arnhem. Breda's core zone had a strong shift towards consumption-oriented establishments, while Arnhem did not. This suggests that while e-commerce explains the shared decline, the local factors, which are discussed in the next section, may explain the divergent outcomes.

5.4.5. Change in retail composition

A more detailed examination of establishment types reveals additional insights into the changing commercial structure around the station areas. Both station areas experienced a notable decline in discretionary establishments, especially cafés. Arnhem experienced a decline in cafés, from 80 in 2000 to 46 in 2024, representing a decline of 42,5%, while Breda experienced a decline of 25,0%, from 47 to 36, over the same period. This is important to note, since cafés are often associated with leisure-oriented establishments and are frequently linked to processes of commercial gentrification.

Furthermore, establishments related to personal shopping, such as clothing and footwear stores, show a significant decrease in both station areas. This trend is consistent with the rise of online retail, where these goods can be purchased online. COVID-19 may have accelerated this process, since physical shops were temporarily closed, which resulted in customers moving to online consumption.

Similar patterns can be observed in infrequent establishments, such as furniture shops, which also experienced a decline. However, necessary establishment experienced a slight decline or stability. This indicates that essential services remain resilient, while discretionary establishments and non-essential retail are more vulnerable to structural changes.

Overall, these patterns indicate a restructuring of retail composition rather than a clear shift toward more consumer-oriented establishments. This provides further evidence that the observed changes around station areas do not align with processes of commercial gentrification, but may be influenced by broader structural and contextual factors.

5.5. Local & spatial factors

While the national and structural factors discussed in the previous section affect the Dutch retail sector as a whole, several local and spatial factors may have influenced the commercial composition of Arnhem Centraal and Breda station. These factors operate at different spatial scales. Some factors are within the 800-meter buffer zone, while other factors are more broadly. Identifying these factors is essential to assessing the extent to which the observed commercial changes can be attributed to TOD-related processes or to other local influences.

5.5.1. Construction disruption

Between the period of 2012 and 2016, both stations were undergoing construction. Arnhem Centraal had a major reconstruction of the train platforms and the station hall. The complete station of Breda was redeveloped.

Large-scale (re)developments in station areas often result in decreased accessibility, lower pedestrian flow, noise, visual disruption and temporary barriers that negatively affect existing businesses (Lim et al.,

2013). Therefore, retailers may experience a decline in customer traffic, leading to reduced revenues, resulting in non-renewal of lease contracts or permanent closure. This ‘construction dip’ is relevant for the study period of 2012-2016.

As discussed in section 5.1.1. Arnhem experienced its biggest decline in establishments between 2012 and 2016, with a ‘construction dip’ of 18,7%. This coincides with the aftermath of the financial crisis in 2008 and the main construction period. However, in Breda, their biggest decline was between 2008 and 2012, before the construction phase, suggesting that the financial crisis had a bigger impact than the construction phase. Nevertheless, the construction period may have contributed to the continuous decline.

	<i>Breda</i>	<i>Arnhem</i>
2012-2016	-10,7%	-18,7%

Table 39 - Decrease in physical establishments compared to the last period 0—800m (LISA Database, 2026)

This factor depends on the spatial zone. The effects of the construction disruption are expected to be more influential in the core zone (0-400m) than in the outer station zone (400-800m), since, for example, noise and reduced accessibility are more pronounced. If the data show that the number of establishments increased after the construction phase, this pattern reflects the temporary disruption of the construction, rather than structural commercial gentrification. In fact, Breda showed a recovery in the post-development period, from 13 establishments in 2016 to 18 in 2020. In contrast, Arnhem core zone continued to decline, from 45 in 2016 to 39 in 2020. This suggests that since the patterns for both station areas do not show similarities, the construction disruption alone cannot explain the differences in numbers.

As mentioned in the introduction of the cases, section 4, this may indicate that Breda, with the broader urban development programme of Breda, has attracted new commercial activity to the core zone, which would be consistent with the TOD-related effect. Conversely, the decline after construction in Arnhem may reflect the limited scope of surrounding urban development plans.

5.5.2. Municipal retail and area development policy.

Both municipalities have pursued retail policies that influence the composition and location of commercial establishments within the study area directly. These policies operate at the city centre level, but may have spatial consequences for station areas, since both stations are located near the city centre.

Arnhem

The municipality of Arnhem has adopted the ‘Detailhandelsvisie’ (Gemeente Arnhem, 2016). Herein, they elaborated on how the municipality could aim to create a more compact core shopping area, which is called in Dutch ‘Kernwinkelgebied’. Since the number of visitors in the inner-city increased in 2015, the length of stay and expenditures of visitors decreased. The municipality of Arnhem mentioned that this is because of the change in consumer behaviour, which was elaborated in 5.3.3. In this policy, further expansion of retail establishments in peripheral shopping streets was prohibited, aiming to cluster peripheral shopping in the current city centre, to effectively steer commercial activity. Furthermore, vacant commercial properties are being converted into other functions, such as residential, offices or hospitality. As a result of this policy, Arnhem’s city centre becomes more vibrant, which attracts more visitors.

Furthermore, the municipality also adopted the ‘Horecavisie’ (König, 2017), which acknowledged the growing importance of hospitality as a driver of inner-city attractiveness. In addition, hospitality establishments were facilitated in areas where retail was declining.

These combined policies may account for a part of the shift in establishments. Since the shift from neighbourhood-oriented establishments to consumption-oriented establishments was actively encouraged by the municipality.

Breda

The municipality of Breda has also adopted a retail policy. In the Detailhandelsbeleid 2022 (Gemeente Breda, 2022), the municipality is focusing on maintaining a compact core shopping area and increasing functional diversity. However, this policy states that in the station area, the vacant properties should be addressed through non-retail functions such as offices and hospitality. In addition, convenience retail (Gemaksretail) and grocery stores will also be stimulated, due to the increase in residents and travellers.

The Crossmark urban development programme continues to shape the commercial character around the station area. This programme envisions a new urban area, with mixed-use functions, including residential, office, cultural and care functions, with the station in the middle (Gemeente Breda, 2022).

These municipal policies represent a disturbing factor in this study. Both municipalities actively steer the commercial environment through policies and development programmes. Focusing on a compact city centre and encouraging hospitality and mixed-use development could independently produce patterns that resemble commercial gentrification, regardless of the station redevelopment itself.

It is important to note that these policies were developed in response to the station redevelopment itself. The Detailhandelsvisie of Arnhem and the Crossmark programme of Breda were formulated during or after the construction of both stations. This suggests that TOD and municipal policies are not fully independent factors, but could have reinforced each other. The station redevelopment improved accessibility and increased foot traffic, which made the objectives of the municipalities feasible, while the policy shaped the commercial environment in response to the redevelopment. This makes it difficult to determine whether policies shaped the commercial environment or whether TOD influenced the commercial environment. So the policies are considered as part of the broader TOD dynamics, which collectively shape the commercial outcomes in station areas.

5.5.3. Large urban development projects

As described in section 4, the two station areas were both part of a broader urban development programme. In Breda, a comprehensive mixed-use transformation was introduced within the broader TOD area (0-800m), with the CrossMark programme, while in Arnhem, the comparable Rijnboog urban development programme was cancelled due to the financial crisis. This section examines how this difference in scale may help explain the difference in commercial outcomes that is observed in the analysis.

The CrossMark developments are distributed across the broader TOD area (0- 800m), with a few developments falling outside the 800-meter zone, such as 't Zoet, Havenkwartier and Backer & Rueb. The new developments around the station area include new residential units, offices, a courthouse and cultural functions, which generate foot traffic and create demand for consumption-oriented establishments, such as cafés and leisure-oriented retail. Breda experienced a strong shift from neighbourhood-oriented establishments to consumption-oriented establishments in the core station area (0-400m), from 72.0% to 89.5%, while in the outer station area (400-800m) the composition remained stable at approximately 87.0%. As shown in Figure 13, several key CrossMark projects are located within or adjacent to the core zone, which may partly explain this spatial concentration.

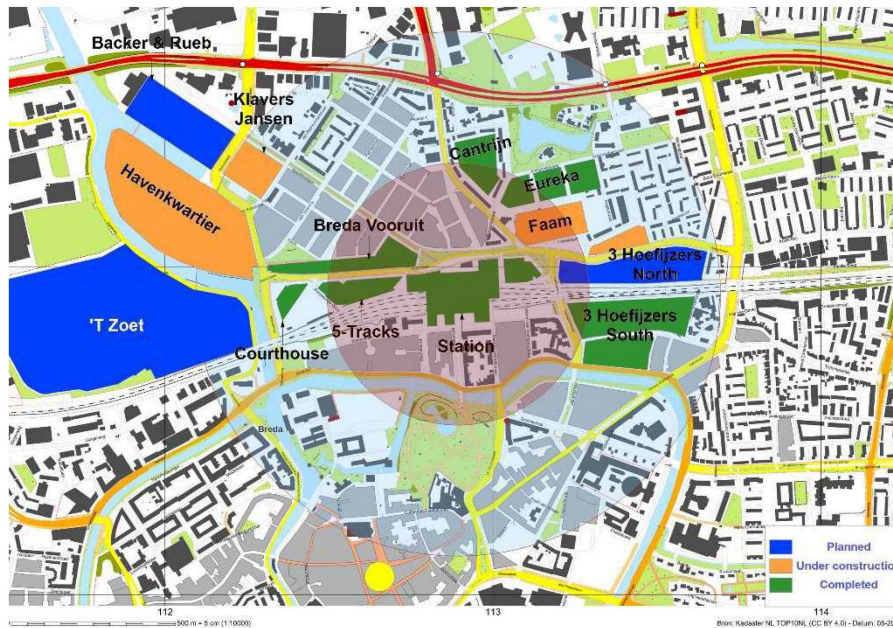


Figure 13 - CrossMark developments in relation to the core zone (0-400m) and outer zone (400-800m) of Breda station (own work, 2026)

In Arnhem, the surrounding development remained more limited to individual projects such as Rozet, Bartok and Paradijs. No comparable demand-generating effect was observed (see Figure 14). The commercial composition in both the core station area and the outer station area remained stable. This suggests that individual developments near station areas are not sufficient to trigger commercial restructuring without a comprehensive urban development programme.

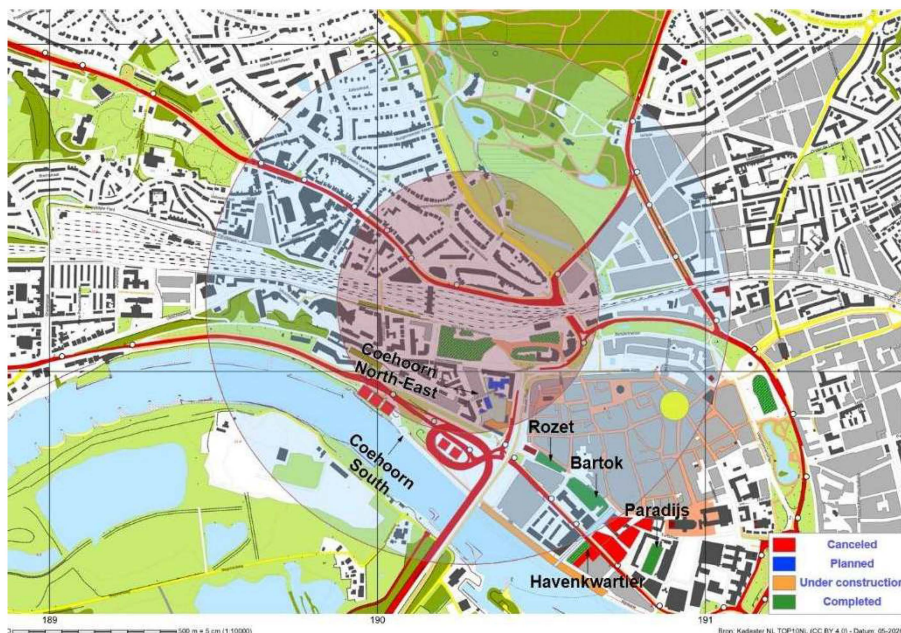


Figure 14 - Urban developments in relation to the core zone (0-400m) and outer zone (400-800m) of Arnhem station (own work, 2026)

This interpretation is consistent with the different development approaches. Breda pursued a comprehensive mixed-use area development, while Arnhem’s comparable development programme remained limited, with the focus on the station itself. This suggests that station redevelopment without a surrounding comprehensive urban development programme may not produce comparable commercial effects.

5.5.4. Real Estate market dynamics

The redevelopment around both train stations has significantly influenced the local real estate market, which in turn has changed the commercial environment around these areas. As property values or rent prices increase, this may put pressure on current businesses to relocate or close, while attracting new businesses that are able to afford the higher costs. This process helps to explain how urban development leads to changes in commercial activity, which is consistent with the rent gap theory, as discussed in the theoretical framework (Smith, 1979).

Breda

Centraal Planbureau (CPB) have analysed the causal effects of Transit-Oriented Development on residential property values in Breda, Tilburg and Arnhem in their research, using the synthetic control method (Van Ruijven et al., 2019).

This study found that TOD had no significant effect on the residential property value. However, the within-city analysis revealed a significant spatial heterogeneity. In this context, within-city refers to how people in Breda navigate to the station and move through the city more easily, such as by having improved roads. On the northern side of Breda station, where there is an urban transformation to a mixed-use area, there has been a positive effect on the property values. In contrast, the southern side of the station experienced a negative effect, this may reflect the urban development programme, which is mainly focused on the north side of the station, instead of the south side, resulting in less attractiveness on the south side.

These spatially uneven price effects are relevant to this study. Rising property value or increasing rents on the northern side of the station, where the new mixed-use developments are being developed, create upward pressure on commercial rents. Higher rents favour businesses with higher revenue over smaller businesses, often neighbourhood-oriented establishments, which can't keep up with the rising rents or increased property values. These businesses with higher revenues are often chain retailers or hospitality establishments. This is consistent with the decline in neighbourhood-oriented establishments observed in the core station area of Breda and supports the interpretation that real estate dynamics are contributing to commercial restructuring.

Arnhem

Van Ruijven et al. (2019) found contrasting results for Arnhem. The Transit-Oriented Development produced significant temporary negative effects on residential property values. These negative effects were mainly on the southern side of the station, due to the construction delays, which created uncertainty and visual disruption. However, after four years of development, the willingness to pay dropped significantly. Furthermore, the northern side of Arnhem experienced a temporary positive effect, but this was not enough to offset the negative impact in the south.

In addition to these property value effects, Arnhem has experienced high retail vacancy rates. Recent data shows that Arnhem experienced a retail vacancy rate of 7,2% over several years. Compared to a national average of 4,2% (Arnhemse Courant, 2024). Furthermore, the departure of De Bijenkorf, a key establishment that generated significant foot traffic, further transformed the retail character of the area. The pattern of declining property values, high vacancy rates and construction disruption helps explain why the observed data for Arnhem did not show a clear shift towards consumption-oriented establishments. The theoretical expectation from the rent gap theory would be that the implementation of TOD will increase accessibility, resulting in a higher potential ground rent. However, the combination of construction delays, economic crisis, and limited urban development programmes prevented property values or rents from rising to trigger commercial restructuring, due to the high uncertainties.

5.5.5. High-speed line connection

An important structural difference between Arnhem and Breda is their position within the national rail network. Breda station was part of the 'De Nieuwe Sleutelprojecten' programme, which is directly linked with the construction of HSL-Zuid (Huisman et al., 2016). Breda station serves as a stop on the high-speed line, providing connections with Amsterdam, Schiphol, Rotterdam and to Paris and London via Brussels.

As described in 4.1, the municipality of Breda aimed to connect the city with major European cities within three hours, which was realised with the construction of the HSL-Zuid line. While Arnhem functions as a regional intercity hub with connections to Utrecht, Nijmegen and German cities, such as Düsseldorf, it does not offer high-speed international services.

This difference has implications for the types of economic activities attracted to the station area. The HSL connection provides Breda with an additional function as an international transport hub. This may attract business travellers or international visitors who generate demand for hotels, business services and higher-end hospitality. Hotels and business services were included in the broader urban development plan (Crossmark Breda), which may have contributed to the rising rents and property values, since the rising commercial rents and private investment increased in the station area (Van Ruijven et al., 2019).

This factor should be considered when comparing the changes in the two cases. If Breda shows a stronger shift from neighbourhood-oriented establishments to consumption-oriented establishments than Arnhem, this may be explained by the additional economic stimulus provided by the HSL connection rather than by differences in TOD characteristics alone. The HSL connection relates to the quality and connectivity of the transit service rather than to the urban design, density, or diversity around the station, which are the core dimensions of TOD as defined in the theoretical framework (Cervero & Kockelman, 1997).

In contrast, if both stations showed similar patterns of commercial change despite the HSL connection, this would strengthen the interpretation that the observed changes are driven by common factors rather than station-specific factors. However, in this study, the results are different. Breda shows a strong commercial shift in the core station zone (0-400m) compared to Arnhem. This is partly consistent with the introduction of the HSL line.

5.5.6. Educational institutions and student-driven demand

Arnhem and Breda both have a high amount of student population and have invested in their cities to attract these students. Research suggests that student populations contribute to the development of the urban leisure economy, generating demand for consumption-oriented establishments, such as cafés or entertainment venues (Zasina, 2021). However, the extent to which this demand affects the station area depends on the spatial proximity of higher education institutions.

Arnhem is home to two universities of Applied Sciences, HAN University of Applied Sciences and ArtEZ University of the Arts. HAN alone serves around 35,000 students (HAN University of Applied Sciences, n.d.). However, neither university is located near Arnhem Centraal, the main campuses are situated over 3 km from the station, falling entirely outside the study area map. This spatial separation limits the direct impact of the student population on the commercial composition around the station area.

Breda is home to two universities of Applied Sciences, Avans Hogeschool and Breda University of Applied Sciences, with a combined total of around 35,000 students. In contrast to Arnhem, Breda University of Applied Sciences is located just outside the 800-meter zone, while Avans is situated further away, just outside the study area map, see Figure 15. This means that at least one major institution is within close proximity of the station area, contributing to student foot traffic through the study area.

The difference in campus proximity between the two station areas is notable. In Breda, the closer proximity of educational institutions to the station area contributes to higher foot traffic and local demand for consumption-oriented establishments (Zasina, 2021). In Arnhem, the greater distance limits this effect. This may partly explain the higher concentration of consumption-oriented establishments in the core station area of Breda, apart from the TOD effect. Nevertheless, improved accessibility through station area redevelopment may itself attract more students to study or live near station areas, making it difficult to fully separate the student population effect from the TOD effect.

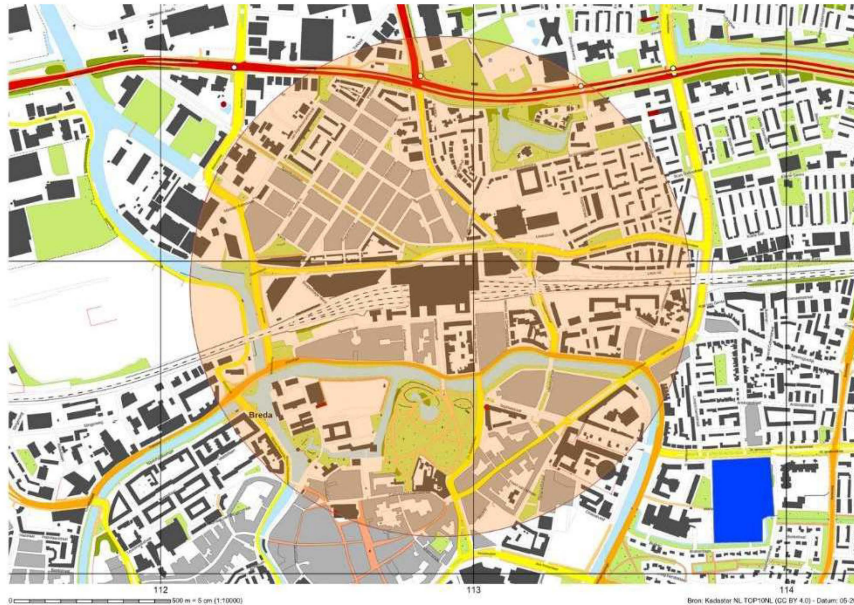


Figure 15 - Location of higher educational institutions, Breda (own work, 2026)

5.5.7. Regional purchasing power dynamics

Regional purchasing power dynamics are relevant to this study because they shape the demand base for commercial establishments in station areas. A stronger regional inflow of expenditures can sustain consumption-oriented establishments even during periods of national retail decline, potentially reinforcing the shift from neighbourhood-oriented to consumption-oriented establishments that is associated with commercial gentrification.

The previous section, section 5.4.4, examined e-commerce as a structural factor for reducing demand in physical retail establishments. This section examines the geographical dimensions. Where do the remaining expenditures flow to, and how does this differ between Arnhem and Breda? This difference is important to know because Breda and Arnhem can have the same patterns for e-commerce, yet experience different commercial outcomes, depending on their regional position. Specifically, whether they attract visitors or lose visitors from surrounding areas.

Breda

Breda has a unique position within the regional retail network of the Randstad and North-Brabant. Breda was the largest recipient of purchasing power from Randstad, receiving approximately €25 million in retail expenditures from Randstad consumers, according to Reijmer et al. (2011). From the €25 million, €21 million was in the non-daily sector and €4 million was in the daily sector. Van Duren et al. (2021) confirm that besides Breda, 's Hertogenbosch and Eindhoven function as primary locations for recreational shopping within the province of North-Brabant, attracting not only residents from their cities, but also visitors from outside the city.

Furthermore, Breda benefits from cross-border purchasing power. van Duren et al. (2021) found that the inflow from Belgium to North-Brabant was approximately 60% greater than the outflow from North-Brabant to Belgium. Belgians are more attracted to Dutch cities because of the lower prices and better quality of retail.

This regional positioning has direct effects on Breda's commercial environment around the station areas. The combination of Randstad outflow, provincial inflow, cross-border spending from Belgian consumers and the HSL-connection discussed in section 5.5.5 creates a diverse demand base that supports consumption-oriented establishments around the station. This may explain why Breda's establishments in the core zone shifted from 72.0% to 89.5% consumption-oriented establishments. Even though retail is shrinking nationally, Breda still performs well, since it attracts customers from several surrounding areas, which supports the viability of local businesses.

Arnhem

In contrast to Breda, Arnhem faces a more competitive regional landscape. According to Ten Hoopen et al. (2024), Arnhem's binding (expenditures from its own residents within the municipality) for recreational retail is 57%, meaning that 43% of the expenditures of its residents are outside the municipality. Ten Hoopen et al. (2024) have found that the expenditures in German cities have doubled since 2019 because of the lower grocery prices. Unlike in Breda, where the expenditures from Belgium are positive, Arnhem's proximity to the German border results in negative cross-border effects. Furthermore, according to Esselink et al. (2016), 7% of Arnhem's non-daily expenditures are to the municipality of Duiven, due to a large peripheral retail concentration that competes directly with Arnhem's city centre for purposeful retail spending. Despite the challenges, Arnhem remains a regional attractor, since it had a positive inflow of over €100 million for non-daily expenditures in 2016, but this is continuously declining as e-commerce and peripheral competition grow.

Interpretation

This analysis reveals a fundamental asymmetry between the two case studies. Breda's demand base is reinforced by multiple sources, creating conditions that sustain consumption-oriented establishments, even when the national retail sector declines. Arnhem's demand base is eroding from multiple directions: e-commerce, peripheral retail concentrations in surrounding municipalities and cross-border outflow to Germany. This may explain why the same decline in physical establishments results in different patterns of establishment type shifts. It also helps explain why Breda's core zone experienced a recovery in total establishments after redevelopment, while Arnhem continued to decline. On top of that, the decline in expenditures in Arnhem may hurt small businesses the most. Small businesses often lack financial reserves to absorb prolonged declines in customer traffic, which is consistent with the pattern observed in section 5.3.

5.5.8. Tourism

Although neither Arnhem nor Breda are neither primary tourist destination, tourism-related demand contributes to the commercial environment in both station areas, despite the differences.

Burgers' Zoo and the Nederlands Openluchtmuseum are the two largest tourist attractions in Arnhem, attracting approximately 1.7 million visitors per year. In 2025, the Openluchtmuseum attracted around 600.000 visitors, making it the most visited museum in the Netherlands besides Amsterdam (Nationale Recreatiegids, 2026). Burgers' Zoo attracted 1.1 million visitors in the same year (Nationale Recreatiegids, 2026). However, both attractions are located on the north side of the city, adjacent to the Veluwe, which is accessible by bus rather than on foot from the station. Another museum, the Airborne Museum, is located in Oosterbeek, outside the municipality entirely. This means that visitors arriving at Arnhem Centraal will likely pass through the station, instead of spending time and money in the commercial environment in the surrounding station area.

The Detailhandelsvisie Arnhem (2016) confirms this pattern. The municipality of Arnhem observed that although the visitor numbers to the inner city increased in 2015, the length of stay and expenditures per visitor declined (Gemeente Arnhem, 2016). This suggests that even visitors who do enter the city centre are not generating the sustained spending that would support the consumption-oriented establishments.

Furthermore, to strengthen this, the KSO reports that Arnhem ranks among the top municipalities in the East of the Netherlands for tourism-related hospitality inflow. However, the GPS-based tracking data for

visitors shows that tourists often visit smaller towns in natural and recreational areas, rather than large city centres. This indicates that the expenditures of tourists in Arnhem are spread across destinations beyond the city centre.

Breda's main tourist attractions are located in the city centre, which is within walking distance from the train station, such as the Grote Kerk and the Kasteel van Breda. Furthermore, the Valkenberg Park connects the station with the historic city centre with a pedestrian route for visitors arriving by train. This means that the tourists spend time and money in or around the study area. As discussed in 5.5.5, the HSL connection further reinforces this by connecting Breda with major European cities for day or business trips. The Detailhandelsbeleid (2022) stimulates Breda as a place to be, or in Dutch, *Gastvrije stad*, with the ambition to attract (international) visitors and to create a viable and inclusive community (Gemeente Breda, 2022). While there is no visitor expenditure data at the city-centre level, the tourist attractions near the station area of Breda make it reasonable that tourist spending contributes to commercial demand in the study area.

The key difference between Arnhem and Breda is not which city is attracting more tourists, but where the tourists spend their money. In Arnhem, most tourist attractions are farther away from the station area, resulting in expenditures at destinations kilometres away, while in Breda, the tourist attractions are located in or around the station area, meaning that expenditures directly support the commercial environment within the study area. This spatial difference reinforces the contrasting commercial dynamics observed for Arnhem and Breda.

It should be noted that detailed tourism expenditure data at the station-area level is not available for Arnhem and Breda. These observations are based on the spatial distribution of attractions, municipal reports and regional purchasing power from KSO Reports.

Table 40 provides a summary of the national and local contextual factors analysed in Sections 5.4 and 5.5, and their observed effects on the station areas of Breda and Arnhem. The overview illustrates that while both station areas were affected by the same national trends, the local factors produced different outcomes. These differences are further discussed in the synthesis below.

5.6. Synthesis

The national and local factors that are discussed in this chapter demonstrate that the observed commercial changes over time in the station areas of Breda and Arnhem cannot entirely be attributed to Transit-Oriented Development. At the national level, the COVID-19 pandemic, the financial crisis in 2008, the rise of e-commerce and the changing consumer behaviour all may have influenced the general decline in physical retail establishments across the Netherlands. At the local level, large-scale urban developments in the city, municipal regulations, construction disruption, HSL connection, real estate market dynamics, the student population, regional purchasing power dynamics, and tourism have all contributed to the commercial environment within the study area.

All these factors operate at different spatial scales within the city. Construction disruption and the real estate dynamics are concentrated in the TOD station zone, while municipal retail policy and urban development programmes are broader and are beyond the station area. Student population and retail trends are at the city or national level. These distinctions are important when interpreting the results. Changes that happen across all spatial scales are most likely driven by national processes, while changes that occur around the station area reflect more station-specific dynamics. In Breda, the shift from neighbourhood-oriented establishments to consumption-oriented establishments was more concentrated in the core station area (0-400m) than in the outer zone (400-800m), which is consistent with a station-proximity effect. In Arnhem, no such patterns were observed.

Importantly, some of the local factors discussed above may have been influenced by TOD. For example, the municipal policies were developed in response to the opportunities that are created by the redevelopment of the stations. The improved accessibility has influenced the real estate dynamics (Van

Ruijven et al., 2019). This suggests that the relationship between TOD and Commercial Change is more complex, with external factors that reinforce these processes, rather than a cause-and-effect mechanism.

The regional purchasing power further reinforces this interpretation. Breda’s demand is based on the inflow from the Randstad, cross-border spending, HSL business and tourist travellers, creating conditions that sustain consumption-oriented establishments even as national retail declines. Arnhem’s demand base is eroding from multiple directions: e-commerce, peripheral retail concentrations in surrounding municipalities and cross-border outflow to Germany. This asymmetry explains why both station areas experienced a decline in physical shops, while Breda had a strong shift towards consumption-oriented establishments, and Arnhem’s decline continued. Similarly, the spatial distribution of tourist attractions differs. Breda’s tourist attractions are in or adjacent to the station area, contributing to the commercial environment, while Arnhem’s tourist attractions are farther away from the station area, generating transit rather than spending around the station area.

The findings of this study should be interpreted as the effect of the overall redevelopment of the station area, rather than the effect of the station alone. The contrasting outcome of the two cases strengthens this interpretation. Breda’s broader urban development programme, combined with the station redevelopment, has produced stronger indications towards commercial restructuring around the station area. While Arnhem’s development is more focused on the integration of the various transport modes and the architectural design, combined with the limited redevelopment programme, it has not produced similar patterns. This suggests that TOD is not the key driver of commercial change, but the local and national context plays an equally important role.

Factor	Type	Effect Breda	Effect Arnhem
<i>Financial crisis 2008</i>	National	Decline in establishments	Decline in establishments, cancellation of Rijnboog
<i>E-Commerce</i>	National	Decline in physical shops	Decline in physical shops
<i>COVID-19</i>	National	Accelerated decline	Accelerated decline
<i>Urban development programme</i>	Local	CrossMark, mixed-use development around the station area	Cancelled in 2008, limited developments
<i>Municipal retail policy</i>	Local	Shift from retail to hospitality	Shift from retail to hospitality
<i>Regional purchasing power</i>	Local	Inflow from Randstad, Belgium and HSL-travellers	Outflow to Germany and peripheral competition
<i>Tourism</i>	Local	Attractions close to the station	Attractions outside 800m zone
<i>Property Values</i>	Local	Increase on the north side of the station	Negative effects due to construction delays
<i>HSL-connection</i>	Local	Increased accessibility, business travellers, and regional demand	Not applicable
<i>Student population</i>	Local	University of Applied Sciences close to the station, demand for hospitality and leisure	The University of Applied Sciences is far from the station

Table 40 – Overview of national and local contextual factors and their effects on station areas of Breda and Arnhem (own work, 2026).

6. Discussion

This study examined whether changes in commercial structures around station areas of Breda and Arnhem are consistent with patterns of TOD-induced commercial gentrification. The findings show that the commercial outcomes are influenced by a combination of several factors, such as national trends, local policy choices, and regional economic conditions. In this discussion, the main findings, their relationship to the existing literature, the applicability of American commercial gentrification indicators in the Dutch context, and how important TOD is compared to other influencing factors are discussed.

6.1. Commercial gentrification in the Dutch context

The indicators that are used for this study, which are the store count (number of establishments), the establishment types and the establishment sizes, were derived from the framework developed by Chapple et al. (2017) in the context of American cities. The main question for this study is whether the framework by Chapple et al. (2017) is applicable in the Dutch context, since commercial gentrification in the United States is typically characterised by the displacement of neighbourhood-oriented establishments (grocery stores or local services) by consumption-oriented establishments (boutiques or cafés). This leads to rising rents or property values, which are driven by market dynamics.

The findings suggest that commercial gentrification, as described in the American context, does not translate directly to the context of the Netherlands. In both case study areas, Breda and Arnhem, consumption-oriented establishments already constituted a high share of the commercial environment at the start of the study period in 2000. This means that the baseline differs from the American context, where neighbourhood-oriented establishments are often more dominant in and around transit station areas. A high share of consumption-oriented establishments in Dutch station areas does not necessarily indicate commercial gentrification, but it may simply reflect the pre-existing commercial structure of a Dutch city centre.

However, processes that resemble commercial gentrification have been documented in the Netherlands. Sakizlioglu & Lees (2020) studied the Javastraat in Amsterdam, in the “Indische Neighbourhood”. In this neighbourhood, state-led redevelopment displaced local ethnic minority-owned businesses by hip cafés, restaurants and boutiques, focused on the middle-income segment. Doucet and Koenders (2018) have found that, although state-led gentrification is common in the Netherlands, the effects are softer or more moderate compared to Anglo-Saxon countries. These studies suggest that commercial gentrification in the Netherlands exists, but is driven by a different mechanism. The process itself is comparable, the shift from neighbourhood-oriented to consumption-oriented establishment, but the driving force is different. Studies suggest that, where commercial gentrification occurs, it tends to be more state-led rather than market-driven (Sakizlioglu & Lees, 2020; Doucet & Koenders, 2018).

This distinction is relevant for this study. Both policies, Detailhandelsbeleid Breda (Gemeente Breda, 2022) and the Detailhandelsvisie Arnhem (Gemeente Arnhem, 2016), describe objectives that correspond to the indicators of commercial gentrification, without using the term. Breda’s policy focuses on the city centre as a ‘place to be’ rather than a ‘place to buy’. Furthermore, Breda promotes gastvrijheid (hospitality) as a central value, while Arnhem focuses on a shift from local presence (lokale aanwezigheid) towards consumer experience. Furthermore, Arnhem promotes mixed functions combinations of retail with horeca, leisure and culture. Thus, both cities actively steer towards the replacement of neighbourhood-oriented establishments by consumption-oriented establishments. This is called commercial gentrification in the academic literature, while the municipal policy frames this as the revitalisation of an urban area.

This has implications for how the results of this study should be interpreted. In Breda, the shift from neighbourhood-oriented establishment to consumption-oriented establishment, going from 72.0% to 89.5% in the core station area, is consistent with the pattern that Chapple et al. (2017) associate with commercial gentrification. However, this shift cannot be attributed to the market forces alone. This is partly the intended outcome of the municipal policy and the CrossMark development programme.

Therefore, the question is not only whether TOD causes commercial gentrification, but whether TOD reinforces a process that is already being steered by policy.

6.2. External factors and divergent outcomes

The theoretical assumption of this study is that TOD triggers a causal chain between TOD and commercial gentrification. Since TOD increases and improves accessibility, it leads to higher demand, resulting in rising rents or land values. This eventually results in commercial restructuring. However, the findings of this study provide limited support for this assumption. This finding is consistent with broader observations in the TOD literature. Cervero and Kockelman (1997) argued that density, diversity, and design all shape travel behaviour and land-use outcomes around transit stations. However, their framework does not specify how these three dimensions influence commercial composition. Despite the high characteristics of TOD in Arnhem (Singh et al. 2017), limited commercial effects are observed in Arnhem. This suggests that TOD characteristics are not sufficient to trigger commercial restructuring. This aligns with Renne (2009), who argues that proximity to a transit station does not guarantee integrated urban development. Furthermore, van Ruijven et al. (2019) found that property value effects of TOD are spatially uneven and depend on surrounding development programmes, rather than station development alone. The findings of this study support the interpretation that commercial outcomes appear to be shaped by the interaction between transit investment and local development conditions, rather than by TOD in isolation.

Both Arnhem and Breda experienced an overall decline in physical establishments in the TOD area over the study period, regardless of differences in TOD implementation. This suggests that the overall decline is primarily driven by structural processes operating at the national level. In this case, e-commerce may be the dominant factor behind the reduction in physical retail establishments in both station areas. Given that both station areas experienced comparable declines despite differences in TOD investments, this interpretation is supported. As discussed in section 5.4.4, e-commerce alone could explain the overall decline in physical establishments without requiring any TOD effect.

However, e-commerce is not sufficient to explain why the remaining commercial activities differ between the two study areas. Breda's core zone experienced a strong shift from neighbourhood-oriented establishments to consumption-oriented establishments, while Arnhem had no strong shift and remained relatively stable. This difference points to the role of local factors.

The most reasonable explanation for the contrasting outcomes is the difference in the scale and comprehensiveness of the surrounding urban development programme. The urban development programme of Breda, CrossMark, transforms approximately 150 hectares around the station with mixed-use developments, including residential units, offices, a courthouse and hospitality functions. Most of these developments are within the core zone (0-400m). This urban development programme generated demand for consumption-oriented establishments. On the contrary, Arnhem's urban development programme, Rijnboog, which had envisioned a comparable mixed-use development, was cancelled in 2008 due to the financial crisis. Despite the few projects that were completed, Rozet and Bartok, these singular projects were too small in scale to generate a comparable shift.

This explanation is strengthened by the proximity analysis. If TOD were the primary driver, both Arnhem and Breda would have experienced a strong shift from neighbourhood-oriented establishments to consumption-oriented establishments, which was not the case. In Breda, the shift was indeed concentrated in the core station area (0-400m), where the CrossMark developments are located, rather than the outer station area (400-800m). While in Arnhem, no such spatial concentration is observed. This suggests that the commercial shift in Breda's core zone is better explained by the CrossMark development programme than by proximity to the station.

Local factors further reinforce this asymmetry. Breda's purchasing power is strengthened by the inflow from the Randstad, Belgian visitors and HSL business travellers. This results in creating a demand base that sustains consumption-oriented establishments even as national retail declines. Arnhem's demand base is eroding from multiple directions: the rise of e-commerce, peripheral retail concentration in

surrounding cities and outflow to Germany. The spatial distribution of tourist attractions further differentiates the cases. The tourist attractions in Breda are closer to the station area, while Arnhem's tourist attractions are farther away, outside the 800-meter zone.

Although there were some projects around the Arnhem station, these were singular projects, such as the Pathé cinema and the ART building. However, these projects have not produced a comparable shift in the core station area. This further strengthens the interpretation that individual developments near station areas are not sufficient to trigger commercial restructuring without a comprehensive surrounding development programme. In the absence of a comprehensive development programme, no significant rent gap developed in Arnhem's station area, which would attract investment in new consumption-oriented establishments. While in Breda, with the CrossMark development programme, introducing residential, office, a courthouse and leisure functions, created demand conditions for such a gap to materialise (Smith, 1987).

6.3. Interpreting the role of TOD

The findings of this study provide limited evidence of commercial gentrification as defined in the American literature. Patterns that share characteristics of commercial gentrification were only observed in the core station area of Breda, specifically the shift from neighbourhood-oriented to consumption-oriented establishments. However, this shift is better understood as state-led commercial restructuring than market-driven commercial gentrification. Such a pattern was not observed in Arnhem. Therefore, the question is not whether TOD causes commercial gentrification, but whether station area redevelopment contributes to broader processes of commercial restructuring under specific local conditions. The combination of station redevelopment, HSL-connection, municipal policy, strong regional purchasing power and mixed-use development in Breda has produced conditions in which the shift from neighbourhood-oriented to consumption-oriented establishments was concentrated in the core station area. The evidence from this study is insufficient to conclude that TOD independently functions as an accelerating factor of commercial gentrification. What the comparison between Breda and Arnhem suggests is that station area redevelopment, when embedded within a comprehensive urban development programme and supported by favourable regional demand conditions, can contribute to commercial restructuring in the immediate station area. Without these conditions, as observed in Arnhem, station redevelopment alone does not produce measurable commercial effects. This suggests that TOD should not be understood as an independent driver of commercial change, but rather as part of a broader set of factors that collectively shape commercial outcomes in station areas.

This is consistent with the findings of Renne (2009), who distinguishes between Transit-Adjacent development and Transit-Oriented development. While Arnhem Centraal fulfils the TOD characteristics, as discussed in section 4, the scope of the surrounding development programme remained limited, which means that the station area in Arnhem functions more as what Renne (2009) describes as a Transit-Adjacent development rather than a Transit-Oriented development. The transportation was redeveloped, but the surrounding commercial and residential environment was not transformed sufficiently to create the integrated mixed-use environment typically associated with TOD.

Notably, several of the local factors that are discussed in this study are not independent of the station redevelopment. The national decision to invest in station infrastructure, including the HSL connection to Breda, created conditions to which local municipalities responded with spatial and retail policies. The Crossmark programme and the Detailhandelsbeleid in Breda were developed in response to the opportunities arising from this national transport investment. This means that the relationship between station area redevelopment and commercial change operates across two policy levels: national transport investment creates accessibility conditions, while municipal spatial policy shapes the commercial response. These two levels reinforce each other, making it difficult to isolate the independent contribution of either.

7. Limitations

This study has several limitations that should be taken into account when interpreting the findings. These limitations concern the data sources, methodological choices and the indicators applied.

7.1. Data limitations

The theoretical framework (section 2.3) identified five indicators of commercial gentrification: store count, establishment types, establishment size, vacancy, turnover and retention rate. Out of these five indicators, only the first three could be operationalised using the available LISA Database. The LISA Database does not record unoccupied commercial properties, which is why the vacancy rates could not be measured. Furthermore, the turnover and retention rates were also unavailable at the station area level. These two indicators are relevant, since vacancy rates provide insight into the displacement process, and turnover and retention rates allow for distinguishing between natural business turnover and displacement driven by commercial gentrification (Rye et al., 2020; Meltzer, 2016). The absence of these indicators limits the ability to fully assess whether commercial gentrification has occurred.

A further limitation concerns the nature of the LISA Database itself. The LISA Database provides consistent longitudinal data on establishment counts, types, and the total number of employees per establishment. It measures net change per four-year interval rather than tracking individual business entry and exit. A decline of five establishments could reflect five closures, or 15 openings and 20 closures. As a result, the data do not allow for distinguishing between displacement and natural turnover, a distinction that is central to identifying commercial gentrification.

Furthermore, data on tourism expenditure at the station-area level are not available for either city. The tourism analysis in section 5.5.8. is therefore based on the spatial distribution of tourist attractions and regional purchasing power data from the KSO reports, rather than on direct measurements of tourist spending within the study area. The KSO 2016 report for Arnhem also warns that the comparison with the 2009 measurement is methodologically limited due to the differences in how internet purchases were accounted for across the two years (Esselink et al., 2016).

7.2. Methodological limitations

This study employs a comparative case study design, which has methodological limitations. First of all, the findings of this study are based on two cases, which limit the generalisability of the results to other Dutch station areas. The patterns that are observed in Arnhem or Breda may not apply to other stations with different characteristics, such as smaller stations or stations in the Randstad with higher passenger volumes. The findings of a case study cannot be statistically generalised beyond the selected station areas. However, the findings can contribute to analytical generalisations, in which the results are used to support or challenge broader theoretical propositions (Blaikie & Priest, 2019). Secondly, while this study identifies patterns that are consistent with commercial gentrification, the case study approach does not allow for establishing direct causal relationships between TOD and commercial gentrification.

Furthermore, the study area is defined as a circular 800-meter buffer zone, with both stations as the centre. Eventually, this 800-meter buffer zone is divided into a core station area (0-400m) and an outer station area (400-800m). While this approach is consistent with the TOD literature, it simplifies the spatial reality. Commercial activity is usually concentrated along streets and in shopping areas, rather than evenly spread in circular zones around the station. An establishment which is 750 meters from the station along a busy shopping street may be more functionally connected with the station than an establishment which is 300 meters on a residential street. The 800-meter buffer zone does not capture this distinction.

A more important limitation is the lack of a control case. This study compares two stations, Breda and Arnhem, that recently underwent station redevelopment and are characterised as TOD areas. It is therefore not possible to determine with certainty whether the observed patterns would have occurred in a station area that did not undergo redevelopment, or in an area that lacks comparable TOD characteristics such as density, mixed-land use and accessibility. The external factors analysis in sections

5.4 and 5.5 attempts to address this by identifying national trends that affect all cities, but a true comparison case is still missing.

Additionally, isolating the effects of TOD from the broader urban development programme is not possible with this research design. The Crossmark programme and the station redevelopment in Breda overlap each other in both time and space. The share of the observed commercial shift is attributable to improved transit accessibility, and the share attributable to the introduction of new mixed-use functions cannot be determined. The cancellation of the Rijnboog programme in Arnhem makes it equally difficult to determine whether the absence of commercial change is due to the limited development in the surrounding area or due to the station redevelopment itself being insufficient to trigger commercial restructuring. Hereby, the proximity analysis provides an indication. In Breda, the strong shift towards consumption-oriented establishments in the core station area, where CrossMark development projects are located, is not conclusive evidence that station proximity is the driving factor, rather than development proximity.

7.3. Indicator limitations

The three indicators that are used in this study, derived from Chapple et al. (2017), have limitations in the Dutch context. Based on the SBI-codes (Standaard Bedrijfsindeling), the classification of establishments is divided into consumption-oriented and neighbourhood-oriented. The SBI-codes capture the registered economic activity but not the actual consumer experience or the price level. A discount clothing store and a luxury boutique may share the same SBI-code, but serve a different market segment. The same goes for second-hand shops or thrift stores, which may share the same SBI-code as other non-daily retail, placing them in the consumption-oriented category. In reality, these establishments, second-hand shops or discount clothing stores, often serve a 'lower-income' group segment compared to a luxury boutique and function more as neighbourhood-oriented services. The presence of these establishments may have contributed to the already high share of consumption-oriented establishments around both station areas at the start of the study period. This eventually makes it harder to detect a meaningful shift over time.

The establishment size indicator uses a threshold of 20 employees to distinguish between small establishments and larger or chain establishments. This is a broad measure, since it does not distinguish between a family-owned bakery with three employees and a franchise café with eighteen employees, while both companies fall under the same category. Factors which are relevant to commercial gentrification, such as ownership structure, length of tenancy and price level, are not captured by this measure. Additionally, some spatial zones contain small numbers of establishments, especially in Breda's core station area. In such cases, the entry or exit of a single establishment can produce a large percentage change, which may overstate the significance of observed shifts.

Lastly, as discussed in section 6.1, the American assumption that areas around transit stations are predominantly characterised by neighbourhood-oriented establishments does not apply to the Dutch context. Dutch city centres already have a high share of consumption-oriented establishments, which reduces the usefulness of this indicator. Despite the strong shift in the core station area of Breda towards consumption-oriented establishments, which is consistent with the theory of Chapple et al. (2017), it may also reflect a broader national shift towards hospitality and leisure rather than a station-specific gentrification process.

8. Conclusion

This study set out to examine the extent to which changes in commercial structures in Dutch station areas are consistent with patterns of TOD-induced commercial gentrification, using Arnhem Centraal and Breda station as case studies. By analysing changes in the total number of establishments, the composition of establishments and the size distribution of establishments over time, this research aimed to determine whether TOD leads to commercial restructuring or whether broader processes better explain observed changes.

The results showed that both station areas experienced a significant decline in the total number of physical establishments over the study period of 2000-2024, visible across all three spatial scales. However, the patterns differed between the two station areas, and no consistent relationship with the timing of redevelopment was observed. The following sections address each sub-question in turn.

SQ1: How have the number, composition and size distribution of commercial establishments changed over time in the station areas?

Both Breda Station and Arnhem Centraal experienced a significant decline in the total number of physical establishments. In Arnhem, the number of establishments declined continuously, from 496 in 2000 to 289 in 2024. In Breda, the number of establishments declined from 168 to 111 over the same study period, with a dip in the construction period, but followed by a recovery in the core station area and the broader TOD area. Thus, both station areas experienced a similar decline, although the pattern differed.

Regarding establishment types, in Breda's core station area, there was a strong shift from neighbourhood-oriented establishments to consumption-oriented establishments, increasing from 72,0% to 89,5% over the study period. In Arnhem, the composition of establishment types remained relatively stable, with fluctuations but no strong shift across the three spatial zones.

Regarding establishment size, Arnhem experienced a decline in small businesses (fewer than 20 employees), while the larger establishments remained stable. On the contrary, Breda experienced a decline in both small businesses and larger establishments, without any change in size distribution.

Thus, the two station areas show contrasting patterns. Breda experienced a continuous decline, followed by a recovery and had a strong shift from neighbourhood to consumption-oriented establishments, while Arnhem experienced a continuous decline without recovery and without a shift in establishment types. The most notable difference between Breda and Arnhem is the strong shift in Breda's core station area, which was not observed in Arnhem.

SQ2: To what extent do these changes differ between spatial zones?

In Breda, the strong shift in establishment types was concentrated in the core station area (0-400m), while in the outer station area, establishment types remained stable at approximately 87.0%. This spatial concentration aligns with the location of CrossMark developments within the core zone. The decline in physical establishments was visible across all three zones, but the recovery of the physical establishments was only experienced in the core station area.

However, in Arnhem, no meaningful differences were observed across the three spatial zones. The decline in establishment count, stability of establishment types and the loss of small businesses were all consistent across the three spatial zones. The lack of clear patterns and spatial differentiation suggests that the station proximity did not produce commercial effects in Arnhem.

Regarding establishment size, no meaningful spatial differentiation was observed in Arnhem. Small businesses declined across all three zones, while large businesses remained stable with fluctuations. This pattern was consistent in all three zones. In Breda, both small and large businesses declined across all zones, maintaining a stable size distribution. However, in the core station area, small businesses showed a recovery after the construction period. In the outer zone, a small recovery was observed between 2016

and 2020, but this was not sustained as the number declined again by 2024. This further supports the finding that commercial dynamics in Breda were primarily concentrated in the core station area.

SQ3: To what extent can the observed commercial changes be explained by broader macroeconomic conditions, national structural trends, and local spatial factors?

The analysis demonstrates that a significant part of the observed commercial changes can be attributed to factors beyond TOD. At the national level, the 2008 financial crisis coincided with the largest decline in establishments in both station areas. GDP declined by 3.7% in 2009, the construction sector's added value declined by 26.3% between 2008 and 2013 (CBS, 2023), and the number of physical shops fell by 7.8% between 2010 and 2016 (CBS, 2022). The growth of e-commerce became an important factor in the overall decline of physical shops, with online establishments in both station areas growing significantly over the study period. The COVID-19 pandemic further accelerated this trend.

However, these national factors do not explain the divergent outcomes between the two station areas. The most reasonable explanation is the difference in scale of the surrounding urban development programme. The Crossmark programme in Breda introduced mixed-use development within the core station area, generating demand for consumption-oriented establishments. In Arnhem, the comparable Rijnboog programme was cancelled during the financial crisis. In addition, municipal policies in both cities actively encouraged the shift from retail to hospitality and leisure functions (Gemeente Breda, 2022; Gemeente Arnhem, 2016). The policy in Breda was reinforced by the CrossMark programme, resulting in a strong shift. In Arnhem, similar policy objectives did not produce comparable outcomes due to the absence of a comprehensive urban development programme. Additional local factors reinforced this asymmetry: Breda benefits from stronger regional purchasing power (inflow from the Randstad, Belgium and HSL-travellers) and closer proximity of tourist attractions to the station area. Arnhem's demand base is eroded by e-commerce, peripheral retail competition, and cross-border expenditures to Germany.

Furthermore, the Universities of Applied Sciences in Breda are located closer to the station area than those in Arnhem, contributing to higher foot traffic and local consumption demand in the station area (Zasina, 2021).

Main RQ: To what extent are changes in commercial structures in Dutch station areas consistent with patterns of TOD-induced commercial gentrification?

The findings of this study are partly consistent with the indicators of commercial gentrification according to the literature, but only in the core station area of Breda. The shift observed in Breda's core station area corresponds to the pattern described by Chapple et al. (2017). This shift is partly the intended outcome of municipal policy and the urban development programme. In Arnhem, patterns that are consistent with commercial gentrification were not observed.

The indicator for the establishment size provided limited evidence. In Arnhem, small businesses declined unevenly, but they were not replaced by the larger establishments, the small businesses just disappeared. This is commercial decline rather than commercial gentrification, in the sense of displacement and replacement. In Breda, the balanced decline of all size categories suggests that construction disruption and national trends have affected all businesses equally. Following the recovery, new small businesses were introduced.

It is important to note that the indicators used in this study were developed in the American context, where neighbourhood-oriented establishments dominate in Transit-Adjacent areas. In the Dutch context, station areas already have a high share of consumption-oriented establishments, which may limit the sensitivity of these indicators to detect meaningful change. Furthermore, not all indicators identified in the theoretical framework could be measured as discussed in section 7.1. This limits the ability to fully assess the extent of commercial gentrification in both station areas.

The evidence suggests that TOD alone is not sufficient to trigger commercial gentrification in the Dutch context. The overall decline in physical establishments is better explained by the rise of e-commerce and

broader changes in the retail sector than by TOD. In Breda, the shift towards consumption-oriented establishments in the core station area is better explained by the comprehensive urban development programme, supportive local policies and strong regional demand than by station proximity alone.

Improved transit accessibility may function as a contributing factor, improving accessibility and generating foot traffic, which supports the commercial environment, but only when combined with a comprehensive urban development programme, local policies and strong regional purchasing power. Without these conditions, as observed in Arnhem, station redevelopment alone does not produce commercial gentrification.

Furthermore, the process observed in Breda more closely reflects state-led commercial restructuring than market-driven commercial gentrification. Both Arnhem and Breda actively promote the shift from retail to hospitality and leisure functions, presenting it as urban revitalisation rather than gentrification. This raises questions of whether the concept of commercial gentrification, as defined in the American literature, fully applies to the Dutch context, where commercial change around station areas is often driven by policy instead of market forces alone.

9. Implications and recommendations

The findings of this study have practical implications for municipalities in planning developments around station areas. Station (re)development alone is not sufficient to stimulate commercial vitality. As seen in the CrossMark programme in Breda, the integration of residential units, commercial function and cultural functions around the station area appears to be necessary for commercial restructuring. So municipalities should not only consider the redevelopment of the station or the improved transport infrastructure, but also the surrounding developments, the regional demand base and the spatial distribution of complementary functions such as tourism.

Several directions for future research emerge from this study. First, comparative studies with station areas of a similar size without recent station redevelopment would help strengthen the causal conclusions that this study could not fully establish. Second, longitudinal studies that track individual business entry and exit, rather than total business counts. This would provide clearer evidence of displacement. Third, future research could examine whether the shift towards consumption-oriented establishments affects the accessibility of affordable daily services for different income groups around the station area. Lastly, the concept of state-led commercial gentrification, mentioned by Sakizlioglu and Lees (2020), deserves further research in the Dutch context. Especially in cities where station redevelopment coincides with an active municipal commercial policy.

10. Reflection

Looking back at my research process, there are several things that I have learned and several things that I would do differently.

Coming from an HBO background (HZ University of Applied Sciences), the transition to academic research was one of the biggest challenges I faced. Writing a theoretical framework based on scientific literature and connecting abstract concepts to measurable indicators was something I had not done before at this level. It took me a long time to understand what was expected and to develop a coherent theoretical argument. This is a skill that I have developed throughout my graduation process, although I recognise that there is still room for improvement.

I found that the early stages of the research were the most difficult. Selecting case studies was more complex than I had expected. There were many criteria to consider, such as the redevelopment period, ridership and TOD characteristics. Because of the many criteria, I tried to account for everything at once, which caused me to lose sight of the bigger picture and contributed to delays in my planning. Looking back, I should have defined my selection criteria more clearly at the start and followed a more structured approach.

Another challenge for me during my research period was the writing process. I often wrote down everything that seemed relevant to my research topic. On the one hand, this helped me to find my direction and develop my arguments. On the other hand, since I wrote so much down, I found it difficult to distinguish the main issues and the side issues. Furthermore, since there was so much information, I had no idea where each argument should be placed in the thesis. Learning to separate the main and side issues was one of the most valuable skills I have developed throughout this period. This was also something that Erik pointed out in his feedback on structure and focus.

At the start of the research, I was too focused on the LISA Database, assuming that the LISA Database would provide all the data needed to answer my research question. During the research, it became clear that the LISA Database alone could not explain the patterns I observed. I am grateful to Herman for pushing me to look beyond the LISA Database and to consider contextual factors at both the national and local levels. This broader perspective strengthened the analysis and led to one of the key findings of this study: commercial change in station areas cannot be understood through establishment data alone, but requires an understanding of the wider economic, spatial and policy context.

Learning to work with QGIS was a challenge on a practical level. It took considerable time to learn how to create buffer zones, link data to spatial locations, and produce the maps used in this study, since I had no prior experience with spatial analysis software. Despite this challenge, it gave me a new skill that I did not have before.

Looking back, one of the areas where I struggled the most was time management. At the beginning of the graduation process, the amount of work was overwhelming, and at one point, it was uncertain whether I would be able to graduate within the planned timeframe. The combination of learning new tools, selecting case studies and building a theoretical framework all at once made the early phase particularly demanding. Over time, I found my rhythm and managed to get back on track, but the experience taught me to plan more realistically and to break large tasks into smaller, manageable steps from the start.

Despite the challenges, I am satisfied with the outcome of this research. The finding that TOD alone does not trigger commercial gentrification, but that local conditions such as municipal policies and regional demand play a decisive role, is something I consider a meaningful result. I hope this study can be useful for municipalities and urban planners involved in station area development who want to understand its potential commercial effects.

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12. Appendices

1. Data Management Plan
2. SBI-codes division
3. Use of AI tools
4. Detailed establishment category distribution per spatial zone for Breda and Arnhem (2000-2024)

12.1. DMP

Plan Overview

A Data Management Plan created using DMPonline

Title: Transit-Oriented Development of Commercial Gentrification in the Netherlands

Creator: Ruben Lam

Affiliation: Delft University of Technology

Template: TU Delft Data Management Plan template (2025)

ID: 193398

Start date: 09-02-2026

End date: 26-06-2026

Last modified: 27-05-2026

Transit-Oriented Development of Commercial Gentrification in the Netherlands

0. Administrative questions

1. Provide the name of the data management support staff consulted during the preparation of this plan and the date of consultation. Please also mention if you consulted any other support staff.

Janine Strandbergen, Faculty of Architecture, Urbanism and Building Science.

2. Is TU Delft the lead institution for this project?

- Yes, the only institution involved

I. Data/code description and collection or re-use

3. Provide a general description of the types of data/code you will be working with, including any re-used data/code.

Type of data/code	File format(s)	How will data/code be collected/generated? <i>For re-used data/code: what are the sources and terms of use?</i>	Purpose of processing	Storage location	Who will have access to the data/code?
LISA Database	.csv files .gkpg files	Through a request form - Erasmus UPT	To operationalise Commercial Gentrification within TOD areas.	TU Delft OneDrive	TUD Researcher

II. Storage and backup during the research process

4. How much data/code storage will you require during the project lifetime?

- < 250 GB

5. Where will the data/code be stored and backed-up during the project lifetime? (Select all that apply.)

- TU Delft OneDrive

III. Data/code documentation

6. What documentation will accompany data/code? (Select all that apply.)

- Data – Methodology of data collection

IV. Legal and ethical requirements, code of conducts

7. Does your research involve human subjects or third-party datasets collected from human participants?

If you are working with a human subject(s), you will need to obtain the HREC approval for your research project.

- No

9. Will you work with any other types of confidential or classified data or code as listed below? (Select all that apply and provide additional details below.)

If you are not sure which option to select, ask your [Faculty Data Steward](#) for advice.

- No, I will not work with any other types of confidential or classified data/code

10. How will ownership of the data and intellectual property rights to the data be managed?

For projects involving commercially-sensitive research or research involving third parties, seek advice of your [Faculty Contract Manager](#) when answering this question.

This project is an internal TUD MSc thesis project, in the context of the ongoing research project Transit-Oriented Development and Commercial Gentrification in the Netherlands.

The ownership of the output the researcher produces is of the researcher.

V. Data sharing and long term preservation

26. What data/code will be publicly shared?

Please provide a list of data/code you are going to share under 'Additional Information'.

- All data/code produced in the project

28. How will you share your research data/code?

Select all that apply and provide additional details below.

- I am a Bachelor's/Master's student at TU Delft and I will share the data/code in the body and/or appendices of my thesis/report in the TU Delft Repository

30. How much of your data/code will be shared in a research data repository?

- < 100 GB

31. When will the data/code be shared?

- As soon as corresponding results (papers, theses, reports) are published

32. Under what licence(s) will the data/code be released?

- Other – please explain below

All thesis in the TU Delft Repository are automatically placed under copyright.

VI. Data management responsibilities and resources**33. If you leave TU Delft (or are unavailable), who is going to be responsible for the data/code resulting from this project?**

My supervisor,

Ir. H.J.M. Vande Putte,

From the Department of Management in the Built Environment, course Real Estate Management, with email address;

H.J.M.VandePutte@tudelft.nl

34. What resources (for example financial and time) will be dedicated to data management and ensuring that data will be FAIR (Findable, Accessible, Interoperable, Re-usable)?

- 4TU.ResearchData is able to archive 1TB of data/code per researcher per year free of charge for all TU Delft researchers. We do not expect to exceed this and therefore there are no additional costs of long term preservation.

35. Which faculty do you belong to?

- Faculty of Architecture and the Built Environment (ABE)

12.2. SBI-codes division

Establishments types:

Necessary establishments provide goods and services required for everyday life. In this study, necessary establishments are identified using SBI codes such as 4711 (supermarkets), 4721 (fruit and vegetable stores), 4722 (butchers), 4723 (fish stores), 4724 (bakeries), and 4730 (fuel stations). These businesses typically serve the immediate needs of residents and are therefore considered essential neighbourhood services.

Frequent establishments provide services that residents use regularly, but that are not necessarily daily necessities. Examples include 8690 (healthcare services), 6419 (banks), and 6622 (insurance services). These establishments usually depend on local demand and are frequently visited by residents within the neighbourhood.

Discretionary establishments provide goods and services that are often considered non-essential or lifestyle-oriented. These businesses are commonly associated with consumption-oriented retail environments and may cater to a more affluent consumer base. In this study, discretionary establishments include SBI codes such as 4771 (clothing stores), 4772 (shoe stores), 4776 (flower shops), 4777 (jewellery stores), and 5630 (cafés).

Infrequent establishments are businesses that attract customers from a wider geographic area and are visited less frequently. These establishments often function as destination retail and may serve a broader market beyond the local neighbourhood. Examples include 4761 (bookstores), 9620 (hairdressers), 4764 (sports equipment stores), 4759 (household goods stores), and 90310 (cultural venues).

SBI – codes used for this research;

Description	Category
4711: Supermarkten en dergelijke winkels met een algemeen assortiment voedings- en genotmiddelen	Necessary
47191: Warenhuizen	Discretionary
47192: Winkels met een algemeen assortiment non-food (geen warenhuizen)	Discretionary
4721: Winkels in aardappelen, groenten en fruit	Necessary
47221: Winkels in vlees en vleeswaren	Necessary
47222: Winkels in wild en gevogelte	Necessary
4723: Winkels in vis	Necessary
47241: Winkels in brood en banket	Necessary
47242: Winkels in chocolade en suikerwerk	Discretionary
4725: Winkels in dranken	Discretionary
4726: Winkels in tabaksproducten	Discretionary
47291: Winkels in kaas	Necessary
47292: Winkels in natuurvoeding en reformartikelen	Discretionary
47299: Gespecialiseerde winkels in overige voedings- en genotmiddelen (rest)	Discretionary
4741: Winkels in computers, randapparatuur en software	Infrequent
4742: Winkels in telecommunicatieapparatuur	Infrequent
47431: Winkels in audio- en videoapparatuur	Infrequent
47432: Winkels in een algemeen assortiment van wit- en bruingoed	Infrequent
47511: Winkels in kledingstoffen	Infrequent
47512: Winkels in huishoudtextiel	Infrequent
47521: Winkels in ijzerwaren en gereedschappen	Infrequent
47522: Winkels in verf, verfwaren en behang	Infrequent
47523: Winkels in houten bouw- en tuinmaterialen	Infrequent
47524: Winkels in tegels	Infrequent
47525: Winkels in keukens	Infrequent
47526: Winkels in parket-, laminaat- en kurkvloeren	Infrequent
47527: Winkels gespecialiseerd in overige doe-het-zelfartikelen	Infrequent
47528: Bouwmarkten en andere winkels in bouwmaterialen algemeen assortiment	Infrequent
4753: Winkels in vloerbedekking en gordijnen	Infrequent
47542: Winkels in naai- en breimachines	Infrequent
47543: Winkels in overige elektrische huishoudelijke apparatuur	Infrequent
47591: Winkels in meubels	Infrequent
47592: Winkels in verlichtingsartikelen	Infrequent
47593: Winkels in artikelen voor woninginrichting algemeen assortiment	Infrequent
47594: Winkels in muziekinstrumenten	Infrequent
47595: Winkels in glas-, porselein- en aardewerk	Infrequent
47596: Winkels gespecialiseerd in overige huishoudelijke artikelen (rest)	Infrequent
47597: Winkels in huishoudelijke artikelen algemeen assortiment	Infrequent
4761: Winkels in boeken	Discretionary
4762: Winkels in kranten, tijdschriften en kantoorbehoeften	Frequent
4763: Winkels in audio- en video-opnamen	Discretionary
47641: Winkels in fietsen en bromfietsen	Infrequent
47643: Winkels in sportartikelen (geen watersport)	Infrequent

4765: Winkels in speelgoed	Discretionary
47711: Winkels in herenkleding	Discretionary
47712: Winkels in dameskleding	Discretionary
47713: Winkels in bovenkleding en mode-artikelen (algemeen assortiment)	Discretionary
47714: Winkels in baby- en kinderkleding	Discretionary
47715: Winkels in babyartikelen algemeen assortiment	Discretionary
47716: Winkels in onderkleding, foundations e.d.	Discretionary
47717: Winkels in mode-artikelen	Discretionary
47718: Textielsupermarkten	Discretionary
47721: Winkels in schoenen	Discretionary
47722: Winkels in lederwaren en reisartikelen	Discretionary
4773: Apotheken	Frequent
47741: Winkels in drogisterij-artikelen	Frequent
47742: Winkels in medische en orthopedische artikelen	Frequent
4775: Winkels in parfums en cosmetica	Discretionary
47761: Winkels in bloemen en planten, zaden en tuinbenodigdheden	Frequent
47763: Winkels in dieren, dierbenodigdheden en hengelsportartikelen	Discretionary
4777: Winkels in juweliersartikelen en uurwerken	Discretionary
47781: Winkels in fotografische artikelen	Discretionary
47782: Winkels in optische artikelen	Discretionary
47783: Winkels in schilderijen, lijsten, prenten, kunstvoorwerpen en religieuze artikelen	Discretionary
47789: Winkels gespecialiseerd in overige artikelen (rest)	Discretionary
47791: Winkels in antiek	Discretionary
47792: Winkels in tweedehands kleding	Discretionary
47793: Winkels in tweedehands goederen (geen kleding)	Discretionary
47819: Markthandel in overige voedings- en genotmiddelen	Discretionary
4782: Markthandel in textiel, kleding en schoenen	Discretionary
47899: Markthandel in overige goederen	Discretionary
47999: Detailhandel via overige distributievormen	Discretionary
55101: Hotel-restaurants	Discretionary
55102: Hotels (geen hotel-restaurants), pensions en conferentie-oorden	Discretionary
5630: Cafés	Discretionary
64191: Coöperatief georganiseerde banken	Frequent
64194: Algemene banken	Frequent

Kamer van Koophandel. (n.d.) Overview of Standard Industrial Classification (SBI) codes for activities. KVK. <https://www.kvk.nl/over-het-handelsregister/overzicht-standaard-bedrijfsindeling-sbi-codes-voor-activiteiten/>

12.3. Use of AI tools

When working on this thesis, AI tools were used to support several aspects of the research process. The AI tools that were used are ChatGPT and Claude. These AI tools were used to improve the academic writing and the readability of the thesis. This included rephrasing sentences, improving grammar and ensuring consistency in terminology throughout the document.

Furthermore, AI was used to support the restructuring of the thesis. AI tools helped to reorganise sections, identify overlaps in information between chapters, and it was used to improve the logical flow of the argumentation. In addition, AI was used for QGIS. Since the author had no prior experience with the spatial analysis software, AI tools were used for technical guidance, such as creating buffer zones, extracting Excel sheets from QGIS, or deleting SBI-codes that were not relevant for this study.

Lastly, AI was used to get feedback on draft texts. This included identifying weak arguments, suggesting where additional evidence was needed, highlighting inconsistencies between sections and evaluating whether written sections were relevant and necessary for the report. This helped to identify and remove content that did not contribute to the argumentation or that overlapped with other sections.

All AI-generated suggestions were evaluated by the author before being incorporated. The content, data analysis, interpretations and conclusions in this thesis are entirely the author's own work.

12.4. Detailed establishment category distribution per spatial zone for Breda and Arnhem (2000-2024)

55102: Hotels (geen hotel-restaurants), pensions en conferentie-oorden	1	1	1	2		2	4	11
5630: Cafés	48	41	39	32	29	33	36	258
Frequent	16	13	11	8	9	10	6	73
4730: Benzinstations	2	2	2	2	2	2	1	13
4762: Winkels in kranten, tijdschriften en kantoorbehoeften	2	2	2	1	2	3	1	13
4773: Apotheken	1	1	1	1	1	1	1	7
47741: Winkels in drogisterij-artikelen	4	4	4	3	3	2	1	21
47742: Winkels in medische en orthopedische artikelen		1						1
47761: Winkels in bloemen en planten, zaden en tuinbenodigdheden	7	2	1	1	1	2	2	16
47762: Tuincentra			1					1
64194: Algemene banken		1						1
Infrequent	35	31	25	21	15	13	14	154
4741: Winkels in computers, randapparatuur en software	1	2						3
4742: Winkels in telecommunicatieapparatuur			1		1			2
47431: Winkels in audio- en videoapparatuur	1			1				2
47511: Winkels in kledingstoffen	1				1	1	1	4
47512: Winkels in huishoudtextiel						1		1
47521: Winkels in ijzerwaren en gereedschappen	1							1
47522: Winkels in verf, verfwaren en behang	1	1	1	1	1	1	2	8
47525: Winkels in keukens	1	1	2	1				5
47526: Winkels in parket-, laminaat- en kurkvloeren	1	1		1	2	1	1	7
47527: Winkels gespecialiseerd in overige doe-het-zelfartikelen		1			1	1	1	4
47528: Bouwmarkten en andere winkels in bouwmaterialen algemeen assortiment	1							1
4753: Winkels in vloerbedekking en gordijnen	2	2	1	1	1	1	1	9
47542: Winkels in naai- en breimachines	1	1						2
47544: Winkels in onderdelen voor elektrische huishoudelijke apparatuur	2	1						3
47591: Winkels in meubels	8	6	5	4	2	1	3	29
47592: Winkels in verlichtingsartikelen	2	3	3	3	2	1	1	15
47593: Winkels in artikelen voor woninginrichting algemeen assortiment	5	5	4	4		1	1	20
47594: Winkels in muziekinstrumenten		1	1	1	1	1		5
47595: Winkels in glas-, porselein- en aardewerk	1	1	1	1				4
47596: Winkels gespecialiseerd in overige huishoudelijke artikelen (rest)	1	2	1		1	1	1	7
47597: Winkels in huishoudelijke artikelen algemeen assortiment			2	1				3
4763: Winkels in audio- en video-opnamen	4	1	1					6
47641: Winkels in fietsen en bromfietsen	1	2	2	1	2	2	2	12

47642: Winkels in watersportartikelen				1				1
Necessary	10	7	7	6	7	10	8	55
4711: Supermarkten en dergelijke winkels met een algemeen assortiment voedings- en genotmiddelen	2	3	4	4	3	5	5	26
4721: Winkels in aardappelen, groenten en fruit	1	1		1	1	1	1	6
47221: Winkels in vlees en vleeswaren	3				1	2	1	7
4723: Winkels in vis	2	2	2	1	1	1	1	10
47241: Winkels in brood en banket	1	1	1		1	1		5
47291: Winkels in kaas	1							1
Eindtotaal	168	151	140	122	109	116	111	917

SBI - Codes Breda 0-400 Categories	Years							Eindtotaal
	2000	2004	2008	2012	2016	2020	2024	
Discretionary	14	15	11	9	9	13	16	87
47242: Winkels in chocolade en suikerwerk	1							1
4725: Winkels in dranken	1							1
4726: Winkels in tabaksproducten	1	1	1	1	1	1	1	7
47299: Gespecialiseerde winkels in overige voedings- en genotmiddelen (rest)	1	1						2
4761: Winkels in boeken	1	1		1			1	4
4763: Winkels in audio- en video-opnamen	1	1	1					3
47711: Winkels in herenkleding					1			1
47712: Winkels in dameskleding	1	2						3
47713: Winkels in bovenkleding en modeartikelen (algemeen assortiment)					1			1
47715: Winkels in babyartikelen algemeen assortiment						1	1	2
47721: Winkels in schoenen							1	1
47763: Winkels in dieren, dierbenodigdheden en hengelsportartikelen						1	1	2
47782: Winkels in optische artikelen			1					1
47791: Winkels in antiek		1	1	1	1	1	1	6
47793: Winkels in tweedehands goederen (geen kleding)	1	1	1	1	1	1	1	7
47819: Markthandel in overige voedings- en genotmiddelen						1	1	2
4782: Markthandel in textiel, kleding en schoenen			1					1
47899: Markthandel in overige goederen	1	1	1					3
47999: Detailhandel via overige distributievormen							1	1
55101: Hotel-restaurants	1	1	1	1	1	2	2	9
55102: Hotels (geen hotel-restaurants), pensions en conferentie-oorden	1	1	1	1			1	5
5630: Cafés	3	3	3	3	3	5	4	24
Frequent	4	3	2	1	2	1		13
4762: Winkels in kranten, tijdschriften en kantoorbehoeften					1	1		2
47741: Winkels in drogisterij-artikelen	2	2	2	1	1			8
47761: Winkels in bloemen en planten, zaden en tuinbenodigdheden	2							2
64194: Algemene banken		1						1
Infrequent	4	5	4	1	1	1	1	17
4741: Winkels in computers, randapparatuur en software		1						1
47525: Winkels in keukens	1	1						2

4753: Winkels in vloerbedekking en gordijnen		1			1	1	1	4
47591: Winkels in meubels	3	2	3	1				9
47643: Winkels in sportartikelen (geen watersport)			1					1
Necessary	3	3	2	2	1	3	2	16
4711: Supermarkten en dergelijke winkels met een algemeen assortiment voedings- en genotmiddelen	1	2	2	2	1	2	2	12
47221: Winkels in vlees en vleeswaren						1		1
47241: Winkels in brood en banket	1	1						2
47291: Winkels in kaas	1							1
Eindtotaal	25	26	19	13	13	18	19	133

SBI - Codes Breda 400-800 Categories	Years							Eindtotaal
	2000	2004	2008	2012	2016	2020	2024	
Discretionary	94	86	86	78	69	70	67	550
4725: Winkels in dranken	1	1			1	1	1	5
4726: Winkels in tabaksproducten	1	1				1	1	4
47293: Winkels in buitenlandse voedingsmiddelen	2	3	3	4	3	2	2	19
47299: Gespecialiseerde winkels in overige voedings- en genotmiddelen (rest)	2	2	3	2	3	3	3	18
4761: Winkels in boeken	3	4	3	4	2	2	1	19
47643: Winkels in sportartikelen (geen watersport)	1	2	2	1			1	7
4765: Winkels in speelgoed	2	1	1	1	1			6
47711: Winkels in herenkleding	1	1	1					3
47712: Winkels in dameskleding	6	5	8	4	5	5	4	37
47713: Winkels in bovenkleding en mode-artikelen (algemeen assortiment)	4	2	4	4	5	6	5	30
47714: Winkels in baby- en kinderkleding	1	2	1	1	1	1	1	8
47716: Winkels in onderkleding, foundations e.d.		1	1	1	1	1	1	6
47717: Winkels in mode-artikelen	2	2	2	2	1	1	1	11
47721: Winkels in schoenen	1				1			2
47722: Winkels in lederwaren en reisartikelen						1		1
47763: Winkels in dieren, dierbenodigdheden en hengelsportartikelen	3	2	1		1			7
4777: Winkels in juweliersartikelen en uurwerken	1							1
47782: Winkels in optische artikelen	2	1	1	1	1	1		7
47783: Winkels in schilderijen, lijsten, prenten, kunstvoorwerpen en religieuze artikelen	3	4	3	4	2	2	1	19
47789: Winkels gespecialiseerd in overige artikelen (rest)	4	4	6	4	4	3	1	26
47791: Winkels in antiek	3	5	3	3	2	2		18
47792: Winkels in tweedehands kleding	1			1	1			3
47793: Winkels in tweedehands goederen (geen kleding)	1	1	1	2	1	1	1	8
47819: Markthandel in overige voedings- en genotmiddelen	2	2	2	3	3	3	3	18
4782: Markthandel in textiel, kleding en schoenen	1	1				1	1	4
47899: Markthandel in overige goederen			2	4	2	2	2	12
47999: Detailhandel via overige distributievormen			1	1	1	1	2	6
55101: Hotel-restaurants	1	1	1	1	1			5
55102: Hotels (geen hotel-restaurants), pensions en conferentie-oorden				1		2	3	6
5630: Cafés	45	38	36	29	26	28	32	234

Frequent	12	10	9	7	7	9	6	60
4730: Benzinstations	2	2	2	2	2	2	1	13
4762: Winkels in kranten, tijdschriften en kantoorbehoefte	2	2	2	1	1	2	1	11
4773: Apotheken	1	1	1	1	1	1	1	7
47741: Winkels in drogisterij-artikelen	2	2	2	2	2	2	1	13
47742: Winkels in medische en orthopedische artikelen		1						1
47761: Winkels in bloemen en planten, zaden en tuinbenodigdheden	5	2	1	1	1	2	2	14
47762: Tuincentra			1					1
Infrequent	30	25	21	20	14	12	13	135
4741: Winkels in computers, randapparatuur en software	1	1						2
4742: Winkels in telecommunicatieapparatuur			1		1			2
47431: Winkels in audio- en videoapparatuur	1			1				2
47511: Winkels in kledingstoffen	1				1	1	1	4
47512: Winkels in huishoudtextiel						1		1
47521: Winkels in ijzerwaren en gereedschappen	1							1
47522: Winkels in verf, verfwaren en behang	1	1	1	1	1	1	2	8
47525: Winkels in keukens			2	1				3
47526: Winkels in parket-, laminaat- en kurkvloeren	1	1		1	2	1	1	7
47527: Winkels gespecialiseerd in overige doe-het-zelfartikelen		1			1	1	1	4
47528: Bouwmarkten en andere winkels in bouwmaterialen algemeen assortiment	1							1
4753: Winkels in vloerbedekking en gordijnen	2	1	1	1				5
47542: Winkels in naai- en breimachines	1	1						2
47544: Winkels in onderdelen voor elektrische huishoudelijke apparatuur	2	1						3
47591: Winkels in meubels	5	4	2	3	2	1	3	20
47592: Winkels in verlichtingsartikelen	2	3	3	3	2	1	1	15
47593: Winkels in artikelen voor woninginrichting algemeen assortiment	5	5	4	4		1	1	20
47594: Winkels in muziekinstrumenten		1	1	1	1	1		5
47595: Winkels in glas-, porselein- en aardewerk	1	1	1	1				4
47596: Winkels gespecialiseerd in overige huishoudelijke artikelen (rest)	1	2	1		1	1	1	7
47597: Winkels in huishoudelijke artikelen algemeen assortiment			2	1				3
4763: Winkels in audio- en video-opnamen	3							3
47641: Winkels in fietsen en bromfietsen	1	2	2	1	2	2	2	12
47642: Winkels in watersportartikelen				1				1
Necessary	7	4	5	4	6	7	6	39
4711: Supermarkten en dergelijke winkels met een algemeen assortiment voedings- en genotmiddelen	1	1	2	2	2	3	3	14

4721: Winkels in aardappelen, groenten en fruit	1	1		1	1	1	1	6
47221: Winkels in vlees en vleeswaren	3				1	1	1	6
4723: Winkels in vis	2	2	2	1	1	1	1	10
47241: Winkels in brood en banket			1		1	1		3
Eindtotaal	143	125	121	109	96	98	92	784

SBI - Codes Arnhem 0-800 Categories	Years							
	2000	2004	2008	2012	2016	2020	2024	Eindtotaal
Discretionary	366	332	333	329	274	248	226	2108
47191: Warenhuizen	2	2	2	3	3	3	3	18
47192: Winkels met een algemeen assortiment non-food (geen warenhuizen)						3	1	4
47242: Winkels in chocolade en suikerwerk	5	5	4	4	3	4	3	28
4725: Winkels in dranken	3	3	3	3	4	3	4	23
4726: Winkels in tabaksproducten	3	3	3	3	3	3	2	20
47292: Winkels in natuurvoeding en reformartikelen	2	2	1	3	4	3	3	18
47299: Gespecialiseerde winkels in overige voedings- en genotmiddelen (rest)	6	6	4	4	8	14	10	52
4761: Winkels in boeken	7	7	6	6	4	3	4	37
4763: Winkels in audio- en video-opnamen	6	5	5	3				19
4765: Winkels in speelgoed	5	4	5	5	4	2	1	26
47711: Winkels in herenkleding	6	7	9	8	8	9	10	57
47712: Winkels in dameskleding	37	39	42	47	29	23	24	241
47713: Winkels in bovenkleding en mode-artikelen (algemeen assortiment)	69	60	57	57	52	39	37	371
47714: Winkels in baby- en kinderkleding	8	9	8	3	5	4	2	39
47715: Winkels in babyartikelen algemeen assortiment	2	2	1	1		1	1	8
47716: Winkels in onderkleding, foundations e.d.	5	4	4	5	2	3	4	27
47717: Winkels in mode-artikelen	4	4	5	7	7	6	5	38
47718: Textielsupermarkten	5	5	4	3	3	1	1	22
47721: Winkels in schoenen	27	25	30	32	16	16	11	157
47722: Winkels in lederwaren en reisartikelen	3	4	1	1	1	1	1	12
4775: Winkels in parfums en cosmetica	1	2	5	5	5	5	5	28
47763: Winkels in dieren, dierbenodigdheden en hengelsportartikelen	2	2	2	3	4	3	2	18
4777: Winkels in juweliersartikelen en uurwerken	13	13	16	13	10	11	9	85
47781: Winkels in fotografische artikelen	5	4	2		1	1	1	14
47782: Winkels in optische artikelen	8	9	9	9	8	5	8	56
47783: Winkels in schilderijen, lijsten, prenten, kunstvoorwerpen en religieuze artikelen	7	3	4	3	4	3	2	26
47789: Winkels gespecialiseerd in overige artikelen (rest)	24	14	15	19	16	16	12	116
47791: Winkels in antiek	5	7	7	5	1	1		26
47792: Winkels in tweedehands kleding	2	1	2	2	2	1	2	12
47793: Winkels in tweedehands goederen (geen kleding)	2			1				3

47819: Markthandel in overige voedings- en genotmiddelen	1	1						2
4782: Markthandel in textiel, kleding en schoenen	1	1		1	1	1	1	6
47899: Markthandel in overige goederen	2	1	2	2		2	1	10
47999: Detailhandel via overige distributievormen	1			1			1	3
55101: Hotel-restaurants	4	4	4	4	5	4	3	28
55102: Hotels (geen hotel-restaurants), pensions en conferentie-oorden	3	3	6	7	7	6	6	38
5630: Cafés	80	71	65	56	54	48	46	420
Frequent	38	37	35	26	19	20	17	192
4762: Winkels in kranten, tijdschriften en kantoorbehoeften	8	7	6	7	3	4	3	38
4773: Apotheken	3	3	4	2	1	1	1	15
47741: Winkels in drogisterij-artikelen	10	11	10	8	7	7	7	60
47742: Winkels in medische en orthopedische artikelen			1	1	2	2	3	9
47761: Winkels in bloemen en planten, zaden en tuinbenodigdheden	10	10	8	3	2	3	2	38
64191: Coöperatief georganiseerde banken	1	1	1	1	1	1		6
64194: Algemene banken	6	5	5	4	3	2	1	26
Infrequent	78	67	69	53	35	35	29	366
4741: Winkels in computers, randapparatuur en software	3	3	3	3	2	1	1	16
4742: Winkels in telecommunicatieapparatuur	5	7	11	10	4	4	3	44
47431: Winkels in audio- en videoapparatuur	2	2	3					7
47432: Winkels in een algemeen assortiment van wit- en bruingoed	4	3	3	3		1	1	15
47511: Winkels in kledingstoffen	1							1
47512: Winkels in huishoudtextiel				2	2			4
47521: Winkels in ijzerwaren en gereedschappen	1				1	1	1	4
47522: Winkels in verf, verfwaren en behang						1		1
47523: Winkels in houten bouw- en tuinmaterialen			1	1			1	3
47524: Winkels in tegels	2	1					1	4
47525: Winkels in keukens	1	1					1	3
47526: Winkels in parket-, laminaat- en kurkvloeren	1							1
47527: Winkels gespecialiseerd in overige doe-het-zelfartikelen	1	1	1	1	1	1		6
47528: Bouwmarkten en andere winkels in bouwmaterialen algemeen assortiment	1	1	2	1	1	1	1	8
4753: Winkels in vloerbedekking en gordijnen	3	3	3	1				10
47542: Winkels in naai- en breimachines	1							1
47543: Winkels in overige elektrische huishoudelijke apparatuur				1	1	1	1	4
47591: Winkels in meubels	14	10	6	3	5	4	3	45
47592: Winkels in verlichtingsartikelen	2	2	2					6

47593: Winkels in artikelen voor woninginrichting algemeen assortiment	4	4	6	4	3	4	3	28
47594: Winkels in muziekinstrumenten	2	2	1	1				6
47595: Winkels in glas-, porselein- en aardewerk	2	2	2	1	1	1	1	10
47596: Winkels gespecialiseerd in overige huishoudelijke artikelen (rest)	4	4	4	2	1	2	2	19
47597: Winkels in huishoudelijke artikelen algemeen assortiment	6	6	4	3	3	3	3	28
47641: Winkels in fietsen en bromfietsen	4	3	3	3	2	3	3	21
47643: Winkels in sportartikelen (geen watersport)	14	12	14	13	8	7	3	71
Necessary	14	12	15	15	16	19	17	108
4711: Supermarkten en dergelijke winkels met een algemeen assortiment voedings- en genotmiddelen	3	6	9	6	8	9	6	47
4721: Winkels in aardappelen, groenten en fruit	2	1	1	1				5
47221: Winkels in vlees en vleeswaren	2	1	1	1	1	2	1	9
47222: Winkels in wild en gevogelte	1							1
4723: Winkels in vis	1	1	1	1	1	1	1	7
47241: Winkels in brood en banket	4	2	2	5	5	6	8	32
47291: Winkels in kaas	1	1	1	1	1	1	1	7
Eindtotaal	496	448	452	423	344	322	289	2774

SBI - Codes Arnhem 0-400 Categories	Years							Eindtotaal
	2000	2004	2008	2012	2016	2020	2024	
Discretionary	50	44	38	35	37	30	31	265
47191: Warenhuizen				1				1
47242: Winkels in chocolade en suikerwerk				1				1
4726: Winkels in tabaksproducten	1	1	1	1	1	1	1	7
47292: Winkels in natuurvoeding en reformartikelen	1	1						2
47299: Gespecialiseerde winkels in overige voedings- en genotmiddelen (rest)				1	1	1	1	4
4761: Winkels in boeken	2	1						3
4763: Winkels in audio- en video-opnamen	1	1	1					3
47712: Winkels in dameskleding		1						1
47713: Winkels in bovenkleding en mode-artikelen (algemeen assortiment)				1	2	2	2	7
47714: Winkels in baby- en kinderkleding			1					1
47716: Winkels in onderkleding, foundations e.d.				1				1
47717: Winkels in mode-artikelen	1							1
47718: Textielsupermarkten	1	1						2
4777: Winkels in juweliersartikelen en uurwerken				1				1
47781: Winkels in fotografische artikelen					1	1	1	3
47782: Winkels in optische artikelen	1	1	1	1	2	1	1	8
47783: Winkels in schilderijen, lijsten, prenten, kunstvoorwerpen en religieuze artikelen				1	1	1	1	4
47789: Winkels gespecialiseerd in overige artikelen (rest)			1	1	1	1	1	5
47791: Winkels in antiek	1	1	1					3
4782: Markthandel in textiel, kleding en schoenen	1			1				2
47899: Markthandel in overige goederen							1	1
47999: Detailhandel via overige distributievormen							1	1
55101: Hotel-restaurants	4	4	4	4	5	4	3	28
55102: Hotels (geen hotel-restaurants), pensions en conferentie-oorden	2	2	3	2	2	1	2	14
5630: Cafés	34	30	25	18	21	17	16	161
Frequent	5	5	5	7	5	6	3	36
4762: Winkels in kranten, tijdschriften en kantoorbehoeften	1	1	1	4	1	1	1	10
47741: Winkels in drogisterij-artikelen			1	1	1	2	1	6
47761: Winkels in bloemen en planten, zaden en tuinbenodigdheden	2	2	1					5
64191: Coöperatief georganiseerde banken		1	1	1	1	1		5

64194: Algemene banken	2	1	1	1	2	2	1	10
Infrequent	3	3	2	1	1	1	1	12
4741: Winkels in computers, randapparatuur en software		1						1
47521: Winkels in ijzerwaren en gereedschappen					1	1	1	3
47597: Winkels in huishoudelijke artikelen algemeen assortiment	1	1	1					3
47641: Winkels in fietsen en bromfietsen	1							1
47643: Winkels in sportartikelen (geen watersport)	1	1	1	1				4
Necessary	1		1	1	2	2	2	9
4711: Supermarkten en dergelijke winkels met een algemeen assortiment voedings- en genotmiddelen			1	1	2	2	2	8
47241: Winkels in brood en banket	1							1
Eindtotaal	59	52	46	44	45	39	37	322

SBI - Codes Arnhem 400-800 Categories	Years							Eindtotaal
	2000	2004	2008	2012	2016	2020	2024	
Discretionary	316	288	295	294	237	218	195	1843
47191: Warenhuizen	2	2	2	2	3	3	3	17
47192: Winkels met een algemeen assortiment non-food (geen warenhuizen)						3	1	4
47242: Winkels in chocolade en suikerwerk	5	5	4	3	3	4	3	27
4725: Winkels in dranken	3	3	3	3	4	3	4	23
4726: Winkels in tabaksproducten	2	2	2	2	2	2	1	13
47292: Winkels in natuurvoeding en reformartikelen	1	1	1	3	4	3	3	16
47299: Gespecialiseerde winkels in overige voedings- en genotmiddelen (rest)	6	6	4	3	7	13	9	48
4761: Winkels in boeken	5	6	6	6	4	3	4	34
4763: Winkels in audio- en video-opnamen	5	4	4	3				16
4765: Winkels in speelgoed	5	4	5	5	4	2	1	26
47711: Winkels in herenkleding	6	7	9	8	8	9	10	57
47712: Winkels in dameskleding	37	38	42	47	29	23	24	240
47713: Winkels in bovenkleding en mode-artikelen (algemeen assortiment)	69	60	57	56	50	37	35	364
47714: Winkels in baby- en kinderkleding	8	9	7	3	5	4	2	38
47715: Winkels in babyartikelen algemeen assortiment	2	2	1	1		1	1	8
47716: Winkels in onderkleding, foundations e.d.	5	4	4	4	2	3	4	26
47717: Winkels in mode-artikelen	3	4	5	7	7	6	5	37
47718: Textielsupermarkten	4	4	4	3	3	1	1	20
47721: Winkels in schoenen	27	25	30	32	16	16	11	157
47722: Winkels in lederwaren en reisartikelen	3	4	1	1	1	1	1	12
4775: Winkels in parfums en cosmetica	1	2	5	5	5	5	5	28
47763: Winkels in dieren, dierbenodigdheden en hengelsportartikelen	2	2	2	3	4	3	2	18
4777: Winkels in juweliersartikelen en uurwerken	13	13	16	12	10	11	9	84
47781: Winkels in fotografische artikelen	5	4	2					11
47782: Winkels in optische artikelen	7	8	8	8	6	4	7	48
47783: Winkels in schilderijen, lijsten, prenten, kunstvoorwerpen en religieuze artikelen	7	3	4	2	3	2	1	22
47789: Winkels gespecialiseerd in overige artikelen (rest)	24	14	14	18	15	15	11	111
47791: Winkels in antiek	4	6	6	5	1	1		23
47792: Winkels in tweedehands kleding	2	1	2	2	2	1	2	12
47793: Winkels in tweedehands goederen (geen kleding)	2			1				3

47819: Markthandel in overige voedings- en genotmiddelen	1	1						2
4782: Markthandel in textiel, kleding en schoenen		1			1	1	1	4
47899: Markthandel in overige goederen	2	1	2	2		2		9
47999: Detailhandel via overige distributievormen	1			1				2
55102: Hotels (geen hotel-restaurants), pensions en conferentie-oorden	1	1	3	5	5	5	4	24
5630: Cafés	46	41	40	38	33	31	30	259
Frequent	33	32	30	19	14	14	14	156
4762: Winkels in kranten, tijdschriften en kantoorbehoeften	7	6	5	3	2	3	2	28
4773: Apotheken	3	3	4	2	1	1	1	15
47741: Winkels in drogisterij-artikelen	10	11	9	7	6	5	6	54
47742: Winkels in medische en orthopedische artikelen			1	1	2	2	3	9
47761: Winkels in bloemen en planten, zaden en tuinbenodigdheden	8	8	7	3	2	3	2	33
64191: Coöperatief georganiseerde banken	1							1
64194: Algemene banken	4	4	4	3	1			16
Infrequent	75	64	67	52	34	34	28	354
4741: Winkels in computers, randapparatuur en software	3	2	3	3	2	1	1	15
4742: Winkels in telecommunicatieapparatuur	5	7	11	10	4	4	3	44
47431: Winkels in audio- en videoapparatuur	2	2	3					7
47432: Winkels in een algemeen assortiment van wit- en bruingood	4	3	3	3		1	1	15
47511: Winkels in kledingstoffen	1							1
47512: Winkels in huishoudtextiel				2	2			4
47521: Winkels in ijzerwaren en gereedschappen	1							1
47522: Winkels in verf, verfwaren en behang						1		1
47523: Winkels in houten bouw- en tuinmaterialen			1	1			1	3
47524: Winkels in tegels	2	1					1	4
47525: Winkels in keukens	1	1					1	3
47526: Winkels in parket-, laminaat- en kurkvloeren	1							1
47527: Winkels gespecialiseerd in overige doe-het-zelfartikelen	1	1	1	1	1	1		6
47528: Bouwmarkten en andere winkels in bouwmaterialen algemeen assortiment	1	1	2	1	1	1	1	8
4753: Winkels in vloerbedekking en gordijnen	3	3	3	1				10
47542: Winkels in naai- en breimachines	1							1
47543: Winkels in overige elektrische huishoudelijke apparatuur				1	1	1	1	4
47591: Winkels in meubels	14	10	6	3	5	4	3	45
47592: Winkels in verlichtingsartikelen	2	2	2					6
47593: Winkels in artikelen voor woninginrichting algemeen assortiment	4	4	6	4	3	4	3	28

47594: Winkels in muziekinstrumenten	2	2	1	1				6
47595: Winkels in glas-, porselein- en aardewerk	2	2	2	1	1	1	1	10
47596: Winkels gespecialiseerd in overige huishoudelijke artikelen (rest)	4	4	4	2	1	2	2	19
47597: Winkels in huishoudelijke artikelen algemeen assortiment	5	5	3	3	3	3	3	25
47641: Winkels in fietsen en bromfietsen	3	3	3	3	2	3	3	20
47643: Winkels in sportartikelen (geen watersport)	13	11	13	12	8	7	3	67
Necessary	13	12	14	14	14	17	15	99
4711: Supermarkten en dergelijke winkels met een algemeen assortiment voedings- en genotmiddelen	3	6	8	5	6	7	4	39
4721: Winkels in aardappelen, groenten en fruit	2	1	1	1				5
47221: Winkels in vlees en vleeswaren	2	1	1	1	1	2	1	9
47222: Winkels in wild en gevogelte	1							1
4723: Winkels in vis	1	1	1	1	1	1	1	7
47241: Winkels in brood en banket	3	2	2	5	5	6	8	31
47291: Winkels in kaas	1	1	1	1	1	1	1	7
Eindtotaal	437	396	406	379	299	283	252	2452