More business in more diverse neighborhoods?

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Abstract

As a result of technological change and structural changes in the economy, the amount of freelance and self-employed workers has rapidly increased in the past decade and many of these operate their business from their home. This relates to four design principles conceived by Jane Jacobs (1961) to diversify and improve neighborhoods, as these home-based businesses add to the diversification of the neighborhoods. The four 'generators of diversity' by Jacobs are: mixed primary uses of real estate, small blocks of streets, the mingling of real estate that varies in age, and a sufficiently dense concentration of people. Empirically, these design principles have mainly been tested for their effects on livability and not on business dynamics. Furthermore, there has been a wide array of business research on the effects of the diversity of industrial sectors but not on the effects of the functional diversity of neighborhoods. With linear regression models using multiple datasets this thesis measures the degree of influence that diversity, in terms of Jacobs' generators of diversity, has on the business dynamics in residential neighborhoods. Outcomes are that the diversity of real estate age and the population density in the neighborhoods were found to significantly influence business dynamics. The diversity of real estate uses and short building blocks were not found to be of significant influence on business dynamics in the models.

Foreword

Upon your eyes is my masterthesis for the master Economic Geography at the University of Groningen. This marks the end of my time as a student, which I started at the at the Faculty of Business and Economics, after which I went on to the Faculty of Spatial Sciences and the bachelor Human Geography and Urban and Regional Planning. I really enjoyed my time as a student, a time in which I got to know lots of people and learned a lot about my field of study.

I am very grateful for the tips and guidance by my supervisor, Dr. Sierdjan Koster. He provided good insights and motivated me by setting good time frames in which I had to finish certain parts to be able to present at the Graduate Research Day and to graduate this study year. Secondly, I would like to thank him because he essentially thought of the subject of this thesis.

Finally, I would like to thank the people at the university's Geodienst who helped me a bit with the data and gave me some pointers on the GIS analysis.

Enjoy reading my thesis!

Nick Klappe
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Contents

1. Introduction

1.1. Relevance

Labor market in advanced economies are changing rapidly because of fundamental and structural economic and technological changes which results in the decline of permanent employment and in the growth of freelance and self-employed workers (Kleinhans et al., 2017). Also, changes in the organization of production in the current post-Fordist economy have led to a shift in dominant secors and a shift in firm size. The shift towards knowledge intensive sectors that rely greatly on human capital has diminished the importance of internal economies of scale and opened up opportunities for small- and medium sized firms. This allows more of these firms to settle in residental urban areas (Folmer & Risselada, 2012). Over the last decade the amount of independent entrepreneurs in the Netherlands has steadily grown from 994.800 in 2007 to 1.205.900 in 2016 (CBS, 2018a). Many of these self-employed workers operate their business from their home. The recovery of the economy after the financial crisis in The Netherlands, as well of the United Kingdom, was largely generated by these self-employed workers (Kleinhans et al., 2017). Primarily two types of small businesses have been emerging in residential neighborhoods in big Dutch cities: “cognitive-cultural” businesses that create high-end product for national or even international markets, and local businesses, mostly set up by non-western immigrants, that cater to the local market (Folmer, 2013).

The advancement of entrepreneurship and business in the neighborhood is seen as a means to increase the economic and social upsurge of the population. By investing in the neighborhood economy, municipalities hope to make ooptimal use of the economic potential of their neighborhoods and their residents (Hospers, 2009). With these developments residential neighborhoods are becoming more diverse and more important to the national economy. This begs the question: is there a way to design residential neighborhoods to best facilitate the formation of new business? This relates to Jacobs (1961) and her concept of diversifying neighborhoods to improve them. She asserted that by designing neighborhoods around four design principles, the four generators of diversity, the social cohesion, safety and attractiveness will improve and ultimately this will contribute to the socio-economic makeup of the neighborhood.

These four generators of diversity are: mixed primary uses of real estate, small blocks of streets, the mingling of real estate that varies in age, and a sufficiently dense concentration of people. The mixing of different uses makes sure that people are up and about at different times of the day to create a sort of natural surveillance by ‘the eyes on the street'. Furthermore, mixed use increases the amenities in close proximity and this contributes to the economic livelihood and attractiveness of a neighborhood. Most blocks of streets have to be short so opportunities to turn corners are be frequent. This is to create opportunities for contact between people but also for people come in contact with different economic activities and amenities. Real estate has to vary in age and it also has to include a good proportion of old buildings. This is for people to identify with different parts of the neighborhood but most importantly to accommodate activities that can afford different types of rents since old buildings do not need to levy the high cost of new construction. Finally, a sufficiently dense concentration of people, for whatever purpose they may be there, is needed to promote city life and to make use of the diverse range of facilities that the city offers.

These four generators of diversity were described by Jacobs (1969) as a precursor for a diverse and well developed city economy. The proper physical arrangements can increase the attractiveness, safety and social cohesion, and can attract business or even generate new businesses, this in turn contributes to the economy of cities, which make up the biggest part of a nation’s economy. There has been a long range of studies about the effects of, on the one hand, a diverse economy and, on the other hand, a specialized economy. The former will have Jacobs externalities, external effects caused by knowledge spillovers between firms across different industries that generate innovation through the cross-fertilization of ideas. The latter will show Marshall-Arrow-Romer externalities, the

external effects of knowledge spillovers between firms in the same industry caused by the principles of sharing, matching and learning (Glaeser et al., 1992). These concepts have mainly been studied on high spatial levels with industrial sectors as the subject of analysis (Beaudry and Schiffauerova, 2009), while Jacobs (1961) was concerned with a much lower spatial scale; the neighborhood, and its physical and functional diversity.

One of the first to study the effects of specialization versus diversity were Glaeser et al. (1992) and they did so by analyzing the growth of large industries within 170 U.S. cities. Another influential study on diversity and specialization has been done by Duranton and Puga (2001), who studied innovation among French employment areas. In the Dutch context, firm innovativeness in diversified and specialized regions was studied by Van der Panne and Van Beers (2006). As can be seen, these studies all researched diversity of the industrial sectors and not diversity of the environment or the diversity of functions. Furthermore, they did so on a high spatial scale as opposed to the low spatial scale of the neighborhood.

In contrast to the application in business and economics, Jacobs' ideas (1961) have been widely used in livability studies (for example: Schmidt, 1977; Browning et al., 2010). Her work has been of influence on zoning policies (Wickersham, 2001) and regional place-making and community design (Grant & Perrott, 2009) and even led to a subfield of environmental criminology (Sohn, 2016a). While there has been scientific work on the effects of Jacobs' generators of diversity on livability factors, there has been none on the formation or the attraction of business.

In short, studies on business growth or innovation as a result of the diversity of the economy were based on Jacobs (1969) whereas studies on livability as a result of a physical and functional diverse neighborhood were based on Jacobs (1961). The contribution of this thesis is therefore twofold: it studies the effects of the Jacobs' generators of diversity on business dynamics and it does so on the spatial scale level of the neighborhood.

1.2. Research questions

This thesis is about the effects of the Jacobs' generators of diversity on the location choice of new business and the relocation choice of existing business in residential neighborhoods. Therefore, the main research question is: What influence does the degree of diversity, in terms of Jacobs' generators of diversity, have on the business dynamics in residential neighborhoods? Sub questions are:

- What is the influence of the mixed use of primary functions on the business dynamics in residential neighborhoods?
- What is the influence of real estate of mixed age on the business dynamics in residential neighborhoods?
- What is the influence of population density on business dynamics in residential neighborhoods?
- What is the influence of the size of the housing blocks on business dynamics in residential neighborhoods?
- What influence does the size of the city have on the business dynamics in residential neighborhoods in relation to the diversity of the neighborhoods?

1.3. Thesis layout

The following chapter is about the theoretical background to the proposed research. First, attention will be paid to the work on Jacobs externalities versus Marshall-Arrow-Romer externalities. Secondly, work on the generators of diversity will be described. The relation to livability factors as well as business formation and performance will be made clear. Chapter three will be about the research methodology, first describing the research data and secondly explaining the methods to calculate the

required variables for the statistical analysis. Chapter four will explain the results and will include a discussion about these results. Finally, chapter five will conclude the thesis.

2. Theoretical framework

2.1. Agglomeration externalities

Key subjects in economic geography are localized external economies or agglomeration economies, which can be divided in "Marshall-Arrow-Romer" (MAR) and Jacobs externalities. Both refer to location-specific externalities or spill-overs, firms need to be spatially proximate or close to each other to be affected by them. MAR externalities or "localization economies" focus on spill-overs within specific sectors. Geographical proximity of firms in the same industry enables specialized ideas and innovations to diffuse. Jacobs' externalities or "urbanization economies" are spill-overs within specific cities that work across the boundaries of specific sectors. Spatial co-location of firms from different industries fosters diversity and the cross-fertilization of ideas which is the generation and diffusion of innovations across economic activities (Pike et al., 2017).

Empirical work on agglomeration externalities

The seminal work of Glaeser et al. (1992) looks at the dynamic externalities (MAR- and Jacobs' externalities) and also the static external scale economies, whereas past research only looked at the latter in comparing localization and urbanization economies (Henderson (1986), for example). The static external scale economies address the formation of cities while the dynamic externalities explain city growth. Glaeser et al. (1992) researched specialization, diversity and monopoly effects using a data set on the growth of large industries in 170 U.S. cities between 1956 and 1987. The conclusions are that at the city-industry level, specialization hurts, competition helps, and city diversity helps employment growth. Apparently, using their data, interindustry knowledge spillovers are less important for growth than spillovers across different industries. An important objection to these results is that they were looking at very mature cities and at a period in U.S. history in which traditional manufacturing industries have fared poorly. Furthermore their model assumes that knowledge spillovers are constant over time and therefore affect both mature and young industries. It can be argued that industries have a life cycle, and externalities are important only at the beginning, when new products are introduced. This drawback is addressed by Henderson et al. (1995). They researched the two types of dynamic externalities using data that describes employment growth patterns in eight specific manufacturing industries in 224 U.S. metropolitan areas between 1970 and 1987. Of these industries five were key traditional capital goods industries and three were new high-tech industries. They found that employment growth in the traditional manufacturing industries is higher in cities with high past employment concentrations in the own industry, thus confirming the importance of MAR externalities. For the newer (high-tech) industries, unlike the traditional manufacturing industries, they found that high levels of past industrial diversity increase the probability that a city will attract a high-tech industry; suggesting that Jacobs externalities play an important role in the development of the newer high-tech sector. However, the MAR externalities were also found to play a role in the development of the high-tech sector: while Jacobs' externalities are important in attracting new industries, MAR externalities are important for retaining the industry.

Whereas the studies by Glaeser et al. (1992) and Henderson et al. (1995) were about MAR externalities versus Jacobs' externalities regarding employment growth, Feldman and Audretsch (1999) relate them to innovation. Their research stems from earlier studies about the geographically boundedness of knowledge creation but this relation also draws back on Jacobs (1969), who stated that innovation is the basis for development. "Innovating economies expand and develop. Economies that do not add new kinds of goods and services, but continue only to repeat old work, do not expand much nor do they, by definition, develop" (Jacobs, 1969, p. 55). Feldman and Audretsch (1995) found evidence that innovative activity, expressed by the development of new products reported by trade journals in the U.S., is not promoted by specialization but rather by diversity across complementary economic activities sharing a common science base. Furthermore, their level of

analysis was, next to the industry level, the firm level. The results suggest that diversity across complementary industries sharing a common base results in greater returns to research and development. The qualification 'complementary industries sharing a common base' is important, for both levels of analysis, because they tested for this using the identification of six groups of industries which rely on a common underlying scientific base. The result that diversification leads to more innovation is in line with the results by Henderson et al. (1995) because one can argue that newer, high-tech industries are more innovative than firms in more traditional industries. Paci and Usai (1999) researched the debate in a different context, using patent data for Italy they found that both specialization and diversification externalities positively affect regional innovativeness, the latter was however more pronounced for high-technology industries and metropolitan environments. These results are different but also somewhat comparable with the results from studies done with data from the United States. Another study about the two dynamic types of externalities with regards to innovation is done by Duranton and Puga (2001). A strong point about this research is that they combine this with the firm and product life cycle, something that was researched earlier by Henderson et al. (1995). Duranton and Puga (2001) however incorporated the innovative activity and relocation of French companies in different sectors. They assert that there is a place for either economic structure, specialization or diversification, in a region and that the answer is not one or the other. There is a role for each type of local economic environment but at different stages of a product life cycle as their results indicate that newer, more innovative firms start in diversified areas and later relocate to a more specialized environment to reduce the costs. In this sense the diversified areas act a 'nursery'. They state that a balanced urban system may thus not be one where all cities are equally specialized or equally diversified, but one where both diversified and specialized cities coexist.

So far, it can be established that diversification probably leads to more innovative activity and also more employment growth in newer industries. These findings are however also somewhat dependent on the specific context that is being researched. This is also the case for the question if local competion or local monopoly is best for development. Results from Gleaser et al. (1992) and Feldman and Audretsch (1999), using U.S. data, indicate that this local competition is best for development, in line with the hypotheses by Jacobs (1969) and Porter (1990). Research by Van Oort (2002) using data from The Netherlands however indicates that local competition hampers innovation, consistent with the Marshallian model. A lot of research about the MAR-Jacobs controversy uses data from the U.S., a large and heterogeneous country in many regards and also regarding general business conditions. This is why Van der Panne and Van Beers (2006) state it as an advantage that their analysis deals with the Netherlands, a country that is more homogeneous across the regions regarding general business conditions. They test whether regions endowed with specialized or diversified production structures accommodate more innovators. Their results favor the MAR externalities; an increase in regional specialization toward a particular industry positively affects regional innovativeness in that particular industry more than proportionally. They also found that Jacobian diversification externalities and more innovations also go together but to a lesser extent than Marshallian specialization externalities. Van der Panne and Van Beers (2006) did however find an advantage for Jacobs' externalities on the firm level, new product launches performed commercially better in diversified regions than in specialized regions. So they found that there is a case for both Marshallian and Jacobian externalities, but at different stages in new product development. This result is in line with Duranton and Puga's (2001) argument.

Despite the multitude of studies on the subject of agglomeration externalities there is not yet a definitive answer in the debate. It can however be said that in regions with mature, low-tech industries, regional policy should emphasize specialization whereas in high-tech regions, on the other hand, policy should focus on diversification (Beaudry and Schiffauerova, 2009). Beaudry and Schiffauerova (2009) conclude in their meta-analysis on the subject that the wide breadth of findings is generally not explained by differences in the strength of agglomeration forces across industries,

countries or time periods, but by measurement and methodological issues. As also can be seen in the reviewed articles, the levels of industrial and geographical aggregation differ a lot, together with the choice of performance measures and the specialization and diversity indicators. These are the main causes for the lack of resolution in the debate.

2.2. Jacobs' generators of diversity

As outlined in the previous section, the Jacobs externalities have always been studied at the level of industrial sectors as this is based on *The economy of cities* by Jacobs (1969). However, Jacobs (1961) originally discussed diversity in a different context and on a lower level; the local or neighborhood level. She posits that a diverse neighborhood will be more vibrant and more successful, this success is defined by the absence of problems such as delinquency, crime, disease, high mortality and severe poverty. An important aspect of a diverse neighborhood is the diversity of land use. The potential attractiveness of the neighborhood for business and residents will increase with the presence of a variety of land uses and this will, in turn, contribute to greater diversity in the socioeconomic make-up of the neighborhood population. The physical arrangements have to be considered in order to promote the greatest abundance of duplicate and diverse businesses serving the population of a city. This leads to the greatest opportunities for an ample division of labor that can potentially lead to new work (Jacobs, 1969).

These physical arrangements were named 'the generators of diversity' by Jacobs (1961) and are described as: mixed primary uses of real estate, small blocks of streets, the mingling of real estate that varies in age, and a sufficiently dense concentration of people. Districts have to have more than one primary function to make sure that people are present at different times. This will make sure that at all times there are 'eyes on the street' to prevent crime and to increase the collective feeling of security. Secondly, blocks should be short to increase path options and therefore enhance social development. Enough interaction on the streets leads to loose neighborhood networks which contribute to the social cohesion. The increasing of path options also results in the economic development, keeping in mind the first generator of diversity. Third, buildings should vary in age and size because this accommodates different people and businesses which can afford different levels of rents. The presence of older buildings would accommodate new businesses because these buildings have lower rents than new buildings that have higher rents to compensate for the construction costs. Fourth, a dense concentration of people, including residents, is necessary to promote visible city life. Jacobs states that it is important that all of these four conditions are present to generate diversity, and absence of one of the four would frustrate a district's potential.

This reasoning for city diversity was written as a reaction and an attack on the city planning at that time, which was segregated by use, homogenous and broad in design. This was implemented to accommodate the use of cars and was attributed to the design principles of the Radiant City by Le Corbusier and the Garden City by Ebenezer Howard. Jacobs' (1961) arguments are for the most part based on participatory observation in neighborhoods in Eastern cities in the U.S. like Boston, Philadelphia and New York, and predominantly Greenwich Village in Manhattan, New York. These are all enormous cities when compared to Dutch cities so how does this relate to the Dutch context? Moreover, as Jacobs was mainly concerned with the neighborhood as the unit of analysis, what is a neighborhood and what size should it be? Jacobs (1961) saw three kinds of neighborhoods that are useful: the city as a whole, the street neighborhoods and districts of large, sub-city size. The city as a whole is rarely called neighborhood but is important because it is the parent community from which the most public money flows, and from which the most administrative and policy decisions are made. At the other end of the spectrum are a city's streets and the small neighborhoods they form. These have a self-governing function in the way they provide public surveillance and in how they help grow networks. The primary function of a successful district is to mediate between the small and powerless street neighborhoods and the powerful city as a whole. A district should have enough

residents to have influence on the city's government but not so much that street neighborhoods are not able to draw its attention. This means that districts have different sizes in different cities, depending partly on the size of the city as a whole. For the U.S. cities this amounts to about 30,000 to 150.000 residents. In terms of geographical size, Jacobs (1961) states that the maximum seems to be about 2.4 square kilometers but emphasizes that boundaries do not make a district, but the cross-use and life do. In the Netherlands the division of neighborhoods is in principle determined by the municipalities, the national bureau of statistics provides the nationwide coordination. Municipalities in The Netherlands are divided into 'wijken' and 'buurten', the latter forms the lowest regional level. 'Wijken' are parts of a municipality where certain types of land use or buildings dominate, and are made up of one or more 'buurten'. 'Buurten' are areas that are delineated by the built structures or by the social-economical characteristics (CBS, 2017). 'Wijken' and 'buurten' are both Dutch translations of 'neighborhoods', however 'buurt' would be the best direct translation whereas 'wijk' would be more like 'district'. Considering this, together with their size, it can be established that the concept of 'wijk' is most similar to Jane Jacobs' neighborhood.

Although "Jane Jacobs wrote at a time when social science research was in its infancy and certain observation techniques were considered cutting-edge" (Cozens and Hillier, 2012, p. 200), her arguments do not contain scientific, quantifiable, verification. Jacobs saw the world from the concrete, visible and everyday, describing the things as they are (Hospers, 2006). Nowadays there is a great availability of data and using this a number of studies have sought this verification, some of them test all four generators of diversity while most of them only study one or a couple.

Empirical work on Jacobs' generators of diversity

The first studies that tested Jacobs' generators of diversity used neighborhoods in Chicago (Weicher, 1973) and Denver (Schmidt, 1977) as research areas regarding the influence of these factors on crime, disease and death rates. The results offer little support for Jacobs's theory that neighborhoods containing the generators of diversity are more successful. They in fact find that diversity of land uses is associated with higher rates of delinquency, disease, and death. These results could however been influenced by the inadequate choice of data or the poor availability of data, for example: the indicator for the disease rate was the admission rate to mental institutions. Furthermore, as the authors point out, the diversity generators are maybe more applicable to the older and more densely populated cities on the east coast of the U.S.A., that are also described in detail in *The Death and Life of Great American Cities.* In the title of Jacobs' book (1961) *death* stands for city design for automobiles and the implementation of large-scale urban developments, whereas *life* stands for a city design that facilitates vibrant city life by walking. This is why two recent studies researched the influence of the four generators of diversity on the urban vibrancy, in Seoul (Sung et al., 2015) and six large Italian cities (De Nadai et al., 2016), and verified that all the diversity requirements for the built environment indeed lead to a more vibrant urban life. In the context of Seoul, the land use mix for five land use categories and the ratio between residential and non-residential uses was not found to be significant. However the diversity of housing types was found to potentially increase the probability of choosing walking over driving. The proximity to commercial uses is more important than proximity to office uses when promoting walking over driving. The number of aged buildings was found to increase the probability of people choosing walking over driving and there was also some evidence found for Jacobs' observation that older, smaller, buildings will be more suitable for small enterprises. A higher number of employees per firm in a district decreased the probability of people choosing walking over driving during the morning peak travel time. The measure for population density was not significant but the employment density was associated with a preference of walking in the morning peak time and in the night. The study by Sung et al. (2015) confirmed that the physical environment measures coined by Jacobs (1961) were interconnected and had different impacts within different contexts in terms of the physical environment and at different times of the day. De Nadai et al. (2016) used mobile phone data as a proxy to study the urban vibrancy in Bologna, Florence, Milan, Palermo, Rome, and Turin. The mix of land use in this Italian context is

interesting because the most cities have a mixed land use, only in Milan the functional uses were historically separated, so this measure only mattered for this city and it was found that the mixed districts were more vital than others. As De Nadai et al. (2016) found, the mix of different types of housing was important, but the most vibrancy was created by public places in which people can hang out and meet people like pubs, coffee shops and taverns. Continental European cities do not have big blocks of houses that are typical for American cities, so this does not really matter in a European context but the density of intersections does. Urban areas with dense streets were found to be more vibrant. Since about the year 1500 the idea of preservation appeared in Western Europe and retention of real estate is by far preferred over removal. Because of this, as the Italian districts are defined by age and by a certain era, the mixing of buildings of different eras is not as important, or rather as possible as, in the American context. The mixing of buildings of different ages was however significant for the vibrancy. Just as in De Nadai et al. (2016) the population density was not found to be associated with the vibrancy but the employment density was.

As aforementioned, in Jacobs' (1961) view, a vibrant city life with sidewalks that are used fairly continuously provides eyes on the street that will prevent or reduce crime. Next to this, she puts forward that there has to be a clear distinction between what is public space and what is private space. These ideas about elements of design that can generate a safer and more secure city life, along with work by some others, led to the concept of crime prevention through environmental design (CPTED). This, as the name implies, draws on ideas that reason that it is possible to reduce opportunities for crime by using or altering the built urban form (Cozens & Love, 2015). The foundation of modern CPTED was formed by Newman (1972). He suggested the creation of 'defensible space', in which residents are able to provide for their own security through the environmental design. This is made up of four elements: (1) territoriality: a physical definition of ownership of space, (2) surveillance: providing opportunities for surveillance, (3) Image and milieu: influencing perception and promoting clean, well-ordered placed, and (4) geographical juxtaposition: surrounding spaces influence the safety of adjacent areas. Clearly, Newman (1972) was inspired by Jacobs (1961). In contrast with Jacobs, (1961) Newman (1972) advocated low-density, residential-dominated environments with restricted access to strangers. In general, CPTED literature has found that mixed use in residential areas increases crime rates. Crimes against persons mainly take place at home or in and around bars, and property crimes are concentrated at or near major personal attractors, where people congregate, this includes shopping centers, work/school, sports areas, parks, transport nodes and the routes that connect these attractors (Cozens, 2008). In this relationship between density, crime and the diversity of a neighborhood we can see the importance of the interrelatedness of the different factors of diversity. For violent crimes, aggravated assault and homicide, it has been found that low levels of density indeed led to increases of these crimes but beyond a threshold of density mixed land use led to a decrease of violent crimes. Robbery on the other hand increases with higher levels of density in mixed use neighborhoods. This may be because of the nature of these crimes. Homicide and aggravated assault may involve escalating disputes that draw attention while robbery may have a more strategic component, unfolds quicker and can be more easily hidden (Browning et al., 2010). In this regard the 'eyes on the street' are still relevant because it has also been found that more crimes occur near business locations but less crimes occur near businesses that are open longer, for most business types. Furthermore, neighborhoods with more vacancy have an overall higher crime rate but interestingly within those neighborhoods, crimes tend not to be located near those vacant properties (Humphrey et al., 2017). As mentioned, in general it is found that mixed use in residential areas increases crime rates but this is about mixed use overall and does not disentangle the effects of different types of businesses. Different types of businesses have a different effect on crime rates. Furthermore, these past studies focused mostly on potentially 'criminogenic' commercial facilities related to alcohol or drug sales and places that attract large crowds into the neighborhood (Sohn, 2016b; Humphrey, 2017). A higher ratio of shopping center areas in neighborhoods was found to increase neighborhood residential burglary, whereas a higher ratio of grocery stores, restaurants and offices has been found to reduce residential burglary.

The presence of these commercial uses could have a positive role in improving neighborhood safety because these establishments generally attract 'legitimate activities' by 'honest people', and most likely local residents, who can serve as potential preventers of neighborhood crime (Sohn, 2016b).

An important aspect of city design to facilitate new businesses in Jacobs (1961) is the presence of older, smaller buildings as these offer lower rents compared to new buildings. Powe et al. (2016) studied the effects of small-scaled building stock, older building age, and a greater mix of building age on population density, density of jobs and the diversity of residents and economic activity in Seattle, San Francisco, Tucson and Washington DC. Their results offer support for Jacob's observations. Links between the presence of older buildings and a mix of old and new buildings and job and population density were found and areas with a greater degree of older, smaller buildings were found to have a greater diversity of resident age and, in support of Jacobs' most important observation regarding new firms, to have greater proportions of new and small businesses. These new firms are launched and take risks in old buildings and, if successful, 'grow into' new buildings as business matures. The areas with older, smaller buildings were however found to have lower proportions of Hispanic and non-White residents, thus frustrating the population diversity in these neighborhoods. Jacobs (1961) asserted that "great diversity in age and types of buildings has a direct, explicit connection with diversity of population, diversity of enterprises and diversity of scenes" (p. 212). While Powe et al. (2016) verified this link with the diversity in age of buildings and diversity of enterprises, this link was not found with diversity of the population. This could be because the analysis only featured the diversity of the age and not the type of buildings. So although this link was not found for the diversity of ethnicity, there is indeed some connection between the diversity of building age and the diversity of the population. Cities that do not feature sidewalk public contact and sidewalk public safety can have a much harder time to overcome segregation and discrimination (Jacobs, 1961, p. 72). A large amount of research has supported this notion that greater levels of intergroup contact typically correspond with greater levels of tolerance. Even if explicit contact does not occur, tolerance is likely to be a function of diversity. How superficial contact affects tolerance is undetermined. One explanation is that superficial contact increases tolerance through a changing perception of normality and abnormality (Wessel, 2009).

2.3. Measures of Jacobs' generators of diversity and business formation and performance

In Jacobs' (1961) view neighborhoods that contain the generators of diversity are more vibrant and in these areas there will be more opportunities for contact between people. This can lead to the formation of neighborhood networks and these networks form the city's social capital. Nowadays individuals are more and more exposed to entrepreneurial role models through the media. These 'icons' are however rarely considered role models for entrepreneurs as these role models tend to be next-door examples. Most of the time, entrepreneurs know the other entrepreneurs who influenced them personally, through personal or professional networks (Bosma et al., 2012). This also holds for neighborhood networks. There is a significant feedback effect in the way that existing entrepreneurs in a neighborhood breed new local entrepreneurs. It is estimated that a neighborhood with a 5% higher entrepreneurial intensity produces between six and seven additional entrepreneurs per square kilometer each year. Such an effect may reinforce local rates of entrepreneurship and stimulate the development of a 'local entrepreneurship culture' (Andersson & Larsson, 2016).

One of the main intended consequences of the generators of diversity is a diverse population. Lee et al. (2004) studied the effects of a diverse population on new business formation in Metropolitan Statistical Areas and Labor Market Areas in the U.S. The population diversity was measured as the Melting Pot index, a measure of the percentage of the population that is foreign born, and the Gay index, a measure of the concentration of same-sex male unmarried partners. The latter was used because a high concentration of gay men in a region would signal a broader openness towards those who are different, creating lower entry barriers to human capital of different kinds and backgrounds.

This measure of diversity was in general found to be moderately related to new firm birth. Results were however different for different industries. The index was found to be significantly related to new firm formation in the service industry. They found though that this measure of diversity was closely related to a more skilled workforce. Their Melting Pot index was not found to be significantly related to new firm formation in the analysis.

One of the generators of diversity is the population density. To allow for the cross-fertilization of ideas it would be helpful to live in a densely populated area so you can have more interaction with others. Knudsen et al. (2008) studied the joint and separate effects of population density and creativity on innovation for 240 metropolitan areas in the U.S. As to be expected, the density of creative individuals was found to be positively and significantly related to the amount of patent applications. Taken apart however, density and creativity were both found to be related to metropolitan patenting.

Another major intended consequence of the generators of diversity is that people will walk more because the neighborhood is perceived safer, more attractive and in general better suited for walking through shorter streets. This relation does indeed exist, as proven by Sung et al. (2015) and De Nadai et al. (2016), but is a walkable environment also better for business performance? Specific features of walkable built environments are indeed positively associated with business performance. However, the relationship between walkable built environments and business performance varies greatly depending on the type of business and city-level context being studied (Credit & Mack, 2017).

2.4. Hypotheses

In this section hypotheses that will be tested will be presented, these will be preceded by a small recap of the most important theory they are based on.

Mixed use of real estate will make sure that there are 'eyes on the street' at all times to prevent crime and to increase the collective feeling of security (Jacobs, 1961). A higher ratio of grocery stores, restaurants and offices in residential neighborhoods has been found to reduce residential burglary. They attract potential preventers of neighborhood crime (Sohn, 2016b) and it is assumed that this is positive for business formation. This gives rise to hypothesis 1.

Hypothesis 1: Neighborhoods with a higher degree of diversity of functions of real estate will generate more positive business dynamics.

Buildings should vary in age and size because this accommodates different people and businesses which can afford different levels of rents (Jacobs, 1961). Areas with a greater degree of older, smaller buildings were found to have a greater diversity of resident age and to have greater proportions of new and small businesses (Powe et al., 2016). This gives rise to hypothesis 2.

Hypothesis 2: Neighborhoods with a higher degree of diversity of real estate age will generate more positive business dynamics.

A dense concentration of people, including residents, is necessary to promote visible city life (Jacobs, 1961). Increased density was found to be related to innovation in the form of patenting (Knudsen et al., 2008). This gives rise to hypothesis 3.

Hypothesis 3: Neighborhoods with a higher population density will generate more positive business dynamics.

Blocks should be short to increase path options and therefore enhance social development. The increasing of path options also results in the economic development by increasing the exposure to the economic establishments (Jacobs, 1961). Shorter blocks were proved to increase the probability of people choosing to walk (Sung et al., 2015; De Nadai et al., 2016). This gives rise to hypothesis 4.

Hypothesis 4: Neighborhoods with shorter housing blocks will generate more positive business dynamics.

"Towns, suburbs and even little cities are totally different organisms from great cities. We are in enough trouble already from trying to understand big cities in terms of the behavior, and the imagined behavior, of towns. To try to understand towns in terms of big cities will only compound confusion" (Jacobs, 1961, p. 16). Nascent entrepreneurs are influenced through personal or professional networks (Bosma et al., 2012) and by entrepreneurs in their immediate neighborhood (Andersson & Larsson, 2016). In bigger cities there may be more opportunities to build these networks, this gives rise to hypothesis 5.

Hypothesis 5: Neighborhoods in bigger cities will for benefit more from the generators of diversity in generating more positive business dynamics

3. Methodology

3.1. Introduction

The hypotheses will be tested through statistical analysis using datasets from various sources. This section describes what data will be needed and the following section is about the datasets that will be used and about the choices that were made regarding the use of these datasets. The last section of this chapter will be about the data grouping and calculations in preparation to the analysis.

3.1.2. Municipalities

First, the cases that will be analyzed must be established and secondly, data on the business dynamics and the generators of diversity in these neighborhoods is needed. Jacobs (1961) emphasized that her arguments are about big cities and that her observations should not be transferred into guides as to what goes on in towns, little cities, or suburbs which are still suburban. Because of this, this research will study the Dutch municipalities that have more than 100.000 inhabitants, these are 31 municipalities. Seeing as The Netherlands has 380 municipalities (CBS, 2018b), it can be understood that in the Dutch context these 31 municipalities are seen as big municipalities. These are presented in table 1. As the framework of this thesis is based on big U.S. cities it is fitting to compare this choice of Dutch municipalities to the United States. The U.S. is an enormous and highly populated country with very big cities when compared to The Netherlands, so a city with 100.000 inhabitants would not be classified as a big city as 307 U.S. cities have more than 100.000 inhabitants. 35 U.S. cities have a population of more than 500.000 (U.S. Census bureau, 2018), so it can be said that these are the big U.S. cities. This number of big cities is comparable to the number of big Dutch municipalities.

Rank number in size	Municipality	Rank number in size	Municipality
1	Amsterdam	16	Zaanstad
2	Rotterdam	17	's-Hertogenbosch
3	's-Gravenhage	18	Haarlemmermeer
4	Utrecht	19	Zwolle
5	Eindhoven	20	Zoetermeer
6	Tilburg	21	Leiden
7	Groningen	22	Maastricht
8	Almere	23	Dordrecht
9	Breda	24	Ede
10	Nijmegen	25	Alphen aan den Rijn
11	Apeldoorn	26	Leeuwarden
12	Haarlem	27	Alkmaar
13	Enschede	28	Emmen
14	Arnhem	28	Westland
15	Amersfoort	30	Delft
		31	Venlo

Table 1: the municipalities that will be analyzed, ranked according to population size in 2017 (CBS/Kadaster, 2017a).

To analyze the hypotheses on the neighborhood level the division of neighborhoods in the 31 municipalities will be needed. Data on the functions that are housed in the real estate and the ages of the real estate will be needed to test the influence of the diversity of the real estate age and its functions. Data on the neighborhood population density will also be needed and to calculate or approximate the length of the housing blocks a road network map will be needed. To test the influence all these variables have on the business dynamics, data on the establishment of business in

the neighborhoods is needed. Lastly, additional information about the neighborhoods like average income level will be needed to be used as variables to control for the differences in neighborhoods.

3.2. Data

3.2.1. Business dynamics

For the main variable of business dynamics data of the 'Landelijk Informatiesysteem van Arbeidsplaatsen' (LISA) wil be used. This is a dataset with information on all establishments where paid work is being carried out, and was obtained through Dr. Koster of the Faculty of Spatial Sciences of the University of Groningen. The LISA is made by the cooperation of 18 regional organizations (LISA, 2018), because of this it can be the case that when a firm moves to a different municipality it gets a new identification number. When this is the case it may seem that this is a newly established firm while in reality it is not. For this practical reason the net change in establishments will be used. Data from 2008 till 2016 will be used. This is chosen because this is the period after the global financial crisis up until the most recent numbers. This net change of establishments encompasses the establishment of new business and the relocation and the death of existing business. So it can tell us what neighborhoods attract and generate most businesses, taken together. A disadvantage is that these differences cannot be disentangled.

3.2.2. Generators of diversity

The basis for the analysis is the division of neighborhoods in the municipalities, for this the map and data in the 'wijk- en buurtkaart' of the national bureau of statistics of The Netherlands (CBS) will be used. The spatial level of the 'buurt' is the lowest spatial scale in this division. However, as Jacobs (1961) was most interested in the type of neighborhoods that are districts of large, sub-city size, the spatial level of the 'wijk' will be used because this is more in line with this definition. Jacobs did use the lowest spatial scale of neighborhoods but she studied big American cities that have bigger neighborhoods and also the U.S. system of neighborhood classification and census is different. The neighborhood that is most often described by Jacobs is Greenwich Village in New York which had a population of 80.000 residents, while Manhattan had about 1.7 million and NYC had about 7.8 million residents in 1960 (The City of New York, 2018). The 31 biggest Dutch municipalities had a mean resident population of 198.738 in 2015 and the average resident population of the neighborhoods in these municipalities was 12619 (CBS/Kadaster, 2017c). When comparing the ratio of these numbers to the population of Greenwich Village and Manhattan, the ratios are quite similar.

The CBS wijk- en buurtkaart data contains the population density of the neighborhoods. The density of employment will be calculated by dividing the sum of jobs in a neighborhood, obtained from the LISA dataset, with the total surface area of a neighborhood, obtained from the CBS wijk- en buurtkaart. For information on the age and functions of real estate, data from the 'basisregistratie adressen en gebouwen' (BAG) will be used. This contains information on addresses and buildings in The Netherlands. The municipalities are responsible for this data and it is compiled by Kadaster. This data is offered by ESRI Netherlands through the open data platform of the University of Groningen. Eleven different functions are specified, these are: housing, gathering, penitentiary, health care, manufacturing, office, accommodation (hotel/B&B), education, sport, retail and other. The diversity of these functions and the diversity of the real estate age in the neighborhoods will have to be expressed in numbers.

As an expression of diversity the Herfindahl-Hirschman index will be used. This is a measure that is most commonly used in economics to establish the diversity of market shares of an industry (Calkins, 1983), but has also been used to express urban diversity (Powe et al., 2016). To calculate this index the share of each case is squared and the resulting amounts are then totaled, this is presented in a formula in equation 1. The percentages will be expressed as decimals, in this way the index will range from 0 to 1. A low index score, close to 0, signifies that the neighborhood is very diversified whereas

a high score, close to 1, signifies that the area is not. In addition to using this index to express the diversity of functions and the diversity of real estate age in the neighborhoods, the Herfindahl-Hirschman index will also be used to express the diversity of the neighborhood economy. To calculate the index for the real estate age, the ages of the real estate will first be divided into classes to establish the shares, the neighborhood economy will be covered in the next subsection.

Equation 1:

$$Herfindahl - Hirschman\ index = \sum_{i=1}^{N} S_i^2$$

Where N is the number of units and $S(i{=}1 \text{ to N})$ is the share of a unit

The data of the BAG is updated monthly and the version used for thesis was downloaded the end of may 2018. This poses an important drawback on the use of this data as the influence of the diversity of the neighborhoods in 2018 is tested on the net change of business establishments from 2008 till 2016. This is of particular importance to the diversity of functions in the neighborhoods as the positive business dynamics change the diversity of functions in the neighborhoods. There is however not much to do about this since the BAG is the only reliable source on houses and the functions that are in them. Furthermore, a diverse neighborhood probably also was a diverse neighborhood in the past since diverse neighborhoods generate even more diverse neighborhoods. This does however mean that the results need to interpreted with caution.

For information on the length of the housing blocks the 'Nationaal Wegenbestand' (NWB) will be used, this is a digital geographical file containing almost all roads in The Netherlands. This data is offered by ESRI Netherlands through the open data platform of the University of Groningen. With this data the street intersection density of each neighborhood will be calculated as this has been widely used as a proxy variable to represent average block size in an area. A high street intersection density indicates an area with smaller blocks (Sung, Lee & Cheon, 2015). It has to be noted that this method of counting intersections in the NWB has one drawback, roundabouts are counted as four intersections. This however does not have major consequences for the analysis because Jacobs' main argument for short building blocks is that this increases the opportunities for contact and by design roundabouts are more open than regular intersections, and with this they could give more opportunities for contact. It however remains a slight deficiency as neighborhoods with disproportionately high amounts of roundabouts will be counted as having more intersections, even though roundabouts could be a good design for intersections in Jacobs' eyes.

3.2.3. Control variables

Additional variables will be included in the analysis to control for differences in neighborhood characteristics. The first of these is a measure of the diversity of the neighborhood economy. As covered in the theoretical framework, a diverse economy helps employment growth and fosters innovation through the cross-fertilization of ideas and as Jacobs wrote: innovation is the basis for development and growth. Therefore the Herfindahl-Hirschman index of the diversity of the economy of the neighborhoods will be calculated. For this the SB0I_sectie sector division in the LISA dataset will be used, this classifies a firm in one of 22 sectors. The amount of firm establishments per neighborhood in 2008 will also be taken into account as the analysis is about the net change in establishments and neighborhoods with more firms can show more business dynamics.

The CBS data includes data that says a lot about the characteristics of the neighborhoods; the ethnic diversity, the percentage of occupied houses and the average income levels. Immigrants tend to be more self-employed than non-immigrants because they usually lack skills, resources and networks. They also bring new ideas and cultures to a region and create new business opportunities (Lee et al., 2004). Housing vacancy has a negative impact on a neighborhood's livability as it is conducive to

criminality and it is generally unattractive (Jacobs, 1961). Because of this the percentage of occupied houses, the opposite of housing vacancy, will be included in the analysis. The average income levels will be included because people with higher income can have more opportunities, from a financial perspective, to create businesses. The most recent dataset that contains the average income levels of the neighborhoods is the one from 2015 so the data from this year will be used. However, in 2016 the national bureau of statistics reclassified the division of neighborhoods in Amsterdam to be better suited with the classification of the rest of the neighborhoods in the country. In 2015 the eight boroughs of Amsterdam were classified as 'wijken', which were subdivided into 97 'buurten'. As of 2016, this was changed to 99 'wijken', which are subdivided into 479 'buurten'(CBS/Kadaster, 2017b; CBS/Kadaster, 2017c). Because of this, for Amsterdam the 2015 division of 'buurten' will be used. With this in mind, there were a total of 577 neighborhoods in 31 biggest municipalities in The Netherlands in 2015 (CBS/Kadaster, 2017c).

3.3. Method

3.3.1. Neighborhood selection and variable calculation

Since this thesis is about residential areas, areas that are, or are in large part, industrial areas or (air)ports will not be taken into account. The (air)port areas are the Amsterdam Airport (Schiphol), the Amsterdam harbor (Westelijk Havengebied) and the Rotterdam harbor (Botlek-Europoort-Maasvlakte). Intially industrial areas were found by selecting neighborhoods of which their name signifies that these are specialized industrial areas. These were seven neighborhoods. Other neighborhoods with disproportionate amounts of industry, making them less applicable for the analysis, were found using the percentages of the manufacturing sector in the neighborhoods obtained from the LISA data. Figure 1 depicts a histogram of the added shares of firms in the agriculture, mineral extraction and manufacturing sectors per neighborhood, sectors that are not typically located in residential neighborhoods. On the basis of this histogram it was chosen to exclude all neighborhoods of which the added percentages of agriculture, mineral extraction and manufacturing exceeded 10%. These were 42 neighborhoods in total.

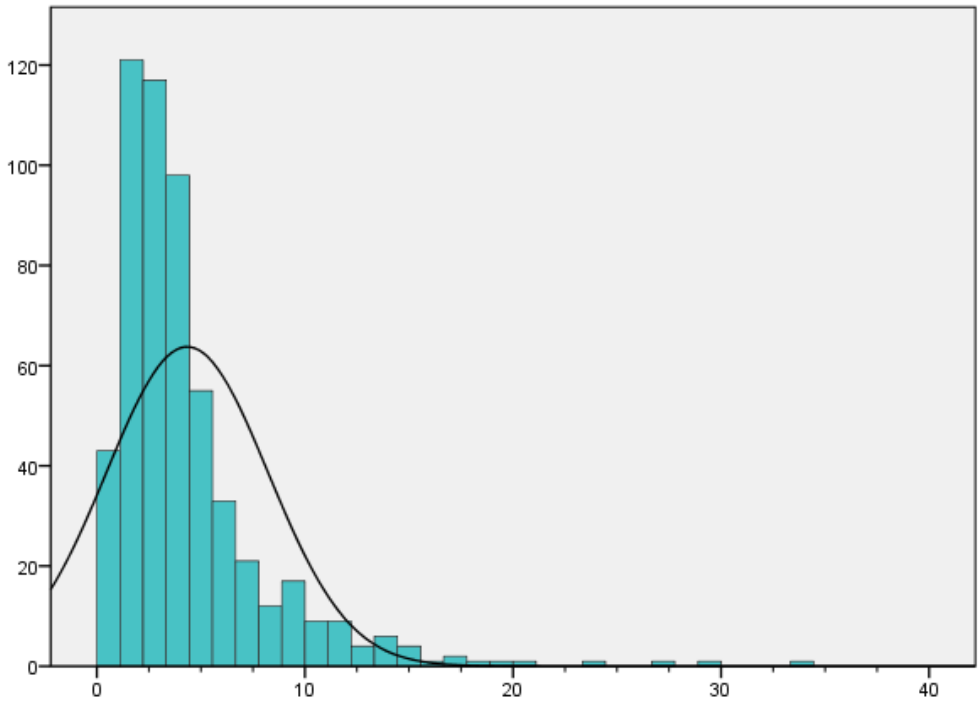

Figure 1: histogram of the cumulative percentages of the sectors agriculture, mineral extraction and manufacturing, the X-axis represents the percentages and the Y axis represents the frequencies (data adapted from LISA).

Neighborhoods of which the average income data is not available will also not be taken into account, 14 of these were not included in the already mentioned types of neighborhoods to be omitted. Furthermore, to test the influence of housing vacancy neighborhoods of which this data is missing will also be excluded. Fortunately this means only one extra neighborhood has to be excluded, namely Amstel III/Bullewijk in Amsterdam.

To group all different data in the appropriate neighborhoods AcrGIS software will be used. First a layer containing all neighborhoods in the 31 biggest municipalities will be created from the wijkenkaart. The net change in firm establishment from 2008 to 2016 from the LISA dataset will be created by excluding all cases that have a duplicate LISA identification number, using the 'identify duplicate cases' tool in SPSS. These firms were visualized using their XY coordinates. An unavoidable drawback of this method is that is it not fully accurate as not all data on the firms was complete and so not all coordindates of all firms were known. This means the numbers regarding business are not fully reliable but they are a good representation. Because of this drawback the whole municipality of Haarlemmermeer and the neighborhood Vathorst-De Bron in Amerfoort will not be included in the analysis because all coordinates of the firm establishment in 2008 in those neighborhoods were missing. This means the analysis will be about 502 neighborhoods. A total of 75 neighborhoods were excluded from the analysis, a list of these neighborhoods can be found in the appendix. In spite of the goal of suburbs of the Vinex-model to make compact and urban suburbs, they are too monofunctional, too rapidly built, too homogeneous and have too little density to comply with the principles of Jacobs (Nio, 2009). Neighborhoods like these are included in the analysis however because they can contain elements of Jacobs' principles and because neighborhoods like these could be the forming ground for a big portion of home-based businesses .

After visualizing the point data of firm establishments the 'join by location' or 'spatial join' tool will be used to group all data into their neighborhoods using the 2015 'wijken' division of neighborhoods in the 31 biggest Dutch municipalities (excluding Haarlemmermeer). With this the net change of firm establishments per neighborhood will be counted. To calculate the relative net change in firm establishment, the establishment figures per neighborhood in 2008 and 2016 will be obtained through the visualization of the coordinates and the consequent spatial joining. In this process also information about the sector in which the firms operate will be obtained, which will be used to calculate the Herfindahl-Hirschman index of the neighborhood economy in 2008.

Following this, the data on the different functions was joined in order to count the amount of different functions in the neighborhoods. As the BAG data contains dummy values for each different function, the amounts can be counted in the spatial join. By doing so the percentages of the functions in the neighborhoods could be calculated, which were needed to calculate the Herfindahl-Hirschman indexes for the functions. To calculate the Herfinhdal-Hirschman indexes for the real estate age in the neighborhoods, dummy values for real estate age categories had to be created. Each century from 1000 to 1900 was made into a category, as well as each decade from 1900 to 2020. In this way 20 categories of real estate buildings periods were created, this was done with the field calculator in Arcmap using the years of construction. Buildings with the value of 1005 as year of construction were not counted as this number is the value that signifies that the year of construction is unknown (Municipality of Amsterdam, 2018). Most of these buildings with unknown ages are situated in the inner city of Amsterdam so data on the real estate age in these neighborhoods is not accurate. Furthermore the BAG data can contain some errors, and two obvious mistakes were corrected. Two buildings in Maastricht had the value of 1197 while they were situated in buildings blocks that were constructed in the late 1980's and the beginning of the 1990's. These mistakes were notified to Kadaster through the BAG viewer (Kadaster, 2018). Following this, the municipality of Maastricht researched the matter and in the BAG database the construction years for the buildings were corrected to 1997.

The street intersection density will be calculated on the basis of the total length of streets per neighborhood instead of the total surface per neighborhood to negate the effects of possible large parks or private property. To count the amount of intersections per neighborhood, the street intersections will be converted to points using the 'intersect (analysis)' tool with the output type set to points. To gather the total length of streets in the neighborhoods, the streets that cross neighborhood borders must be split at the border. To do this, first there will be points created in the streets that cross neighborhood borders using the 'intersect (analysis)' tool, again with the output type set to points, but as inputs the NWB as well as the CBS neighborhoods layer. To then split the lines the 'split line at point' tool will be used. The amount of street intersections will be gathered and will be divided by the total length of the neighborhoods to get the street intersection density.

This process of spatially joining the data and consequent calculations will be replicated on the 2015 'buurt' level for Amsterdam to get the variables of its neighborhoods.

3.3.2. Statistical analysis

Following the data grouping and variable calculations a dataset containing all required variables of the neighborhoods will be made. The neighborhood variables will be analyzed with a linear regression analysis using SPSS software. The main variables per neighborhood are two variables on the net change in firm establishment, expressed in absolute as well as in relative numbers. Independent variables are the Herfindahl-Hirschman index for functions of real estate, the Herfindahl-Hirschman index for real estate age, population density (residential density and job density) and the street intersection density. The average income per inhabitant, the percentage of non-western foreign born inhabitants, the percentage of occupied houses, the Herfindahl-Hirschman index of the neighborhood economy and the amount of firm establishments per neighborhood in 2008 will be control variables in the models, these were described in section 3.2.3.

With the net business dynamics expressed in relative numbers a problem occurs: a couple neighborhoods only had one or a few companies in 2008 and because of this, when expressed in percentages have enormous growth numbers that skew the analysis. The top four cases in terms of relative net change (Techum, Blitseard, IJburg Zuid and Almere Poort) are definitely outliers as these show growth numbers that are between three and twenty times that of the other top neighborhoods in terms of relative firm establishment growth. Table 2 illustrates this point. These four cases will be excluded in models containing the business dynamics in relative figures as the dependent variable. It is worth noting however that the two neighborhoods with highest net change in percentages are both suburbs in the Northern city of Leeuwarden.

The regression models will first be run for all municipalities in the analysis. After this, the model will be run again for the 15 biggest municipalities of the Netherlands. This will be done to test the influence of the size of the cities where the neighborhoods are situated in.

Neighborhood	Municipality	Net change in business establishments 2008 - 2016
Wijk 54 Techum	Leeuwarden	6000%
Wijk 24 Blitsaerd	Leeuwarden	3100%
IJburg Zuid	Amsterdam	1553,33%
Wijk 04 Almere Poort	Almere	922,33%
Schuytgraaf	Arnhem	305,26%
Wijk 31 Vathorst-De Laak	Amersfoort	295,59%
De Kolenkit	Amsterdam	295,35%
Wijk 26 Hooglanderveen	Amersfoort	259,57%
Wijk 49 Delftlanden	Emmen	238,46%
IJburg West	Amsterdam	236,55%

Table 2: Top 10 neighborhoods regarding net change in business establishments in relative terms

4. Results

4.1. Descriptive statistics

Before going into the regression models we will take a look at the descriptive statistics of the variables. This information gives a first assesment at how the neighborhoods of the biggest Dutch municipalities perform in relation the Jacobs' generators of diversity and how the business dynamics are. This will be visualized with maps[1]. The maps are pictured as page-filling because some neighborhoods are relatively small and in this way all neighborhoods can be properly seen. The data in all maps is divided in eight quantiles because this a good representation to see the division. Eight classes can however make it difficult to distinguish the different colors and this is why two different kinds of colors are used. The 50% highest or best scoring neighborhoods are represented by the green colors and the 50% lowest or worst scoring neighborhoods are represented by the red colors. These choices were made to represent the most of the data, in the best way. A downside of this is that the maps need to be printed in color because they cannot be read when printed in black and white. Maps on the business dynamics in the neighborhoods are pictured on page 23 through 25 and maps on the generators of diversity in the neighborhoods are pictured on page 26 through 29.

The first subject that is going to be covered is the net change in firm establishments. The neighborhoods where the biggest dynamics in business are present are in the city centers and in neighborhoods that are next to the city center. These neighborhoods are predominantly in the Randstad area and in Tilburg and Eindhoven, as can be seen in figure 4. Neighborhoods with the highest numbers of business dynamics are the city centers of Almere, The Hague and Rotterdam. Neighborhoods that have the biggest business dynamics are also often neighborhoods that had high amounts of business establishment to begin with, as figure 4 has a lot of similarities with figure 3 that depicts the amount of firms per neighborhood in 2008. Expressed in percentages, the biggest dynamics are in the Randstad area and the Northeast of the country, with the highest numbers being in Rotterdam, Alphen aan den Rijn and Zwolle, as can be seen in figure 5. The neighborhoods that had enormous relative net business growth, the outliers mentioned in section 3.3.2., are all new neighborhoods with an average real estate age of about 5 year. Other neighborhoods that have the highest business dynamics in percentages are also newer neighborhoods but these are slightly older as indicated by their higher average real estate age. Because these neighborhoods are new, in a short time a lot of business settles in the area to cater to the residents. What could also be the case is that people with home-based businesses have moved to these new neighborhoods. Another example of this link between new neighborhoods and high relative net business growth is that a difference with the absolute growth is that most of the high ranking neighborhoods in that variable are the innercities and the surrounding neighborhoods, while in relative terms the neighborhoods that surround the inner city and the neighborhoods at the edge of the cities have the highest numbers and new neighborhoods tend to be located at the edge of the city. This can be illustrated by looking at the average age of the real estate per neighborhood in Zwolle, this is one of the municipalities with neighborhoods that show the highest relative net business growth and Zwolle as a whole is also very close to the average relative net business growth per neighborhood. Figure 2 shows that the oldest buildings are in the inner city, followed by the neighborhoods that surround the inner city, and that the youngest neighborhoods are at the edge of the city. An exception to this is the southern most neighborhood, called Soestweteringlanden, this could be because of old farm buildings in this neighborhood. The youngest neighborhood 'Stadhagen', located in the north-west of the city, is a suburb designed according the Vinex-model.

[1] All maps depict 503 neighborhoods while the rest of the analysis is about 502 neighborhoods. Amstel III/Bullewijk, the only neighborhood that was left to not have housing vacancy data after the process of checking all other exclusion criteria was done, is included in the maps.

Comparing the business dynamics of all municipalities in the dataset with only the 15 most populated municipalities, it can be seen that these bigger municipalities show more business dynamics as the means in these bigger municipalities are higher. The mean of the net change of establishments for the biggest 31 municipalities was 1930, or 66,71%, and the mean for the top 15 municipalities was 2442, or 76,34%.

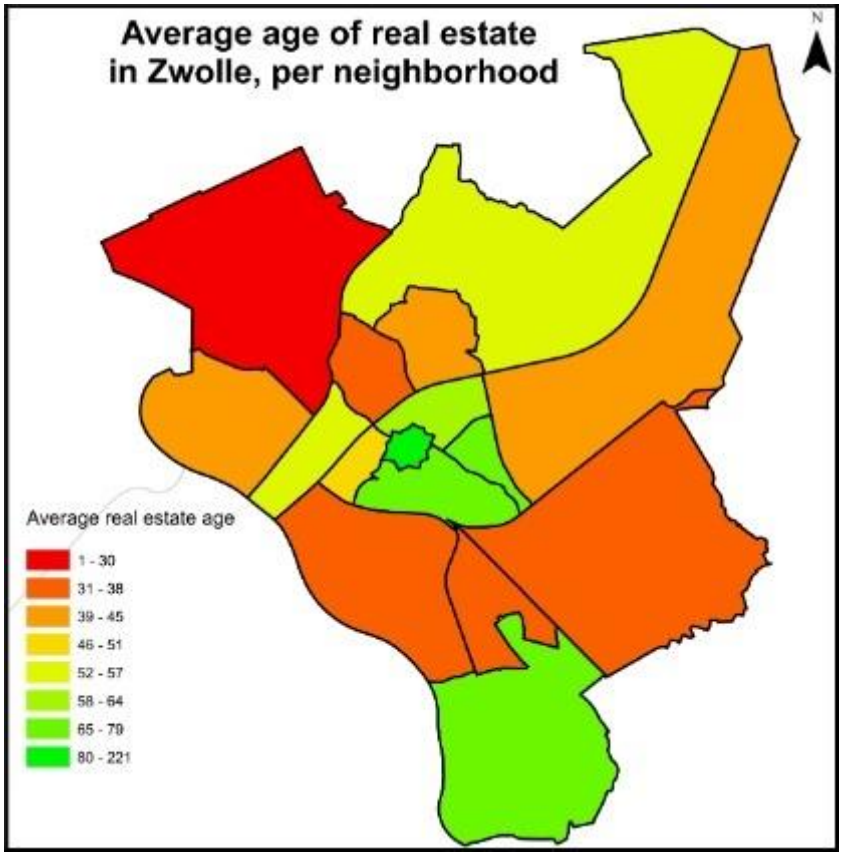

Figure 2: the average real estate age per neighborhood in Zwolle (data source: Kadaster).

When looking at the diversity of functions of real estate it shows that the neighborhoods that score the lowest on the Herfindahl-Hirschman index, meaning they are the most diversified, are spread around the country. Interestingly, the most diversified neighborhoods are generally located on the edge of the municipalities as can be seen in figure 6. In these neighborhoods the functions are more mixed than in the more central parts of the city. It is imagineable that the central parts of the cities are focused on retail and housing while in the outer neighborhoods more functions are present. When looking at the index scores overall, it is striking that most of the neighborhoods are actually not that diversified, with an average of 0,77. The best 12,5% of the neighborhoods score between 0 and 0,63 on the index, meaning that more than 87,5% of the neighborhoods are not that diversified or not diversified at all. Figure 7 depicts the diversity of the real estate ages and the similarity with the distribution of the functional diversity really stands out. This could tell that real estate from certain time periods tends to house certain functions. In general, neighborhoods with a diversity of real estate ages are the areas surrounding the inner city and some suburbs. On the other hand, neighborhoods that do not have diverse real estate are of course newer suburbs and neighborhoods in newer cities as these areas cannot contain older builidngs. Almere sticks out in figure 7 as it is the newest city in the dataset.

Intersection density is the highest in the inner cities of most municipalities, and in the Randstad area also in areas surrounding the inner cities. This is probably because these neighborhoods are the oldest and so primarily grew organicly. An example of a suburb with high intersection density is the

Vinex neighborhood that was mentioned earlier, Stadhagen in Zwolle. This could be designed with Jacobs' principles in mind, however this high intersection density could also be because of the high proportion of roundabouts in this neighborhood as mentioned in the methodology. Resident density is highest in almost the whole of Amsterdam, The Hague and Rotterdam, as well as the inner cities of some other municipalities. The Randstad area is the most populous area in the country and this explains the high density. The high population density in the inner cities of the other municipalities could be because these areas are compactly built as the intersection density high as well. The distribution of employment density shows generally the same picture as the resident density but is a bit more spread out around the country; it is less concentrated in the Randstad area.

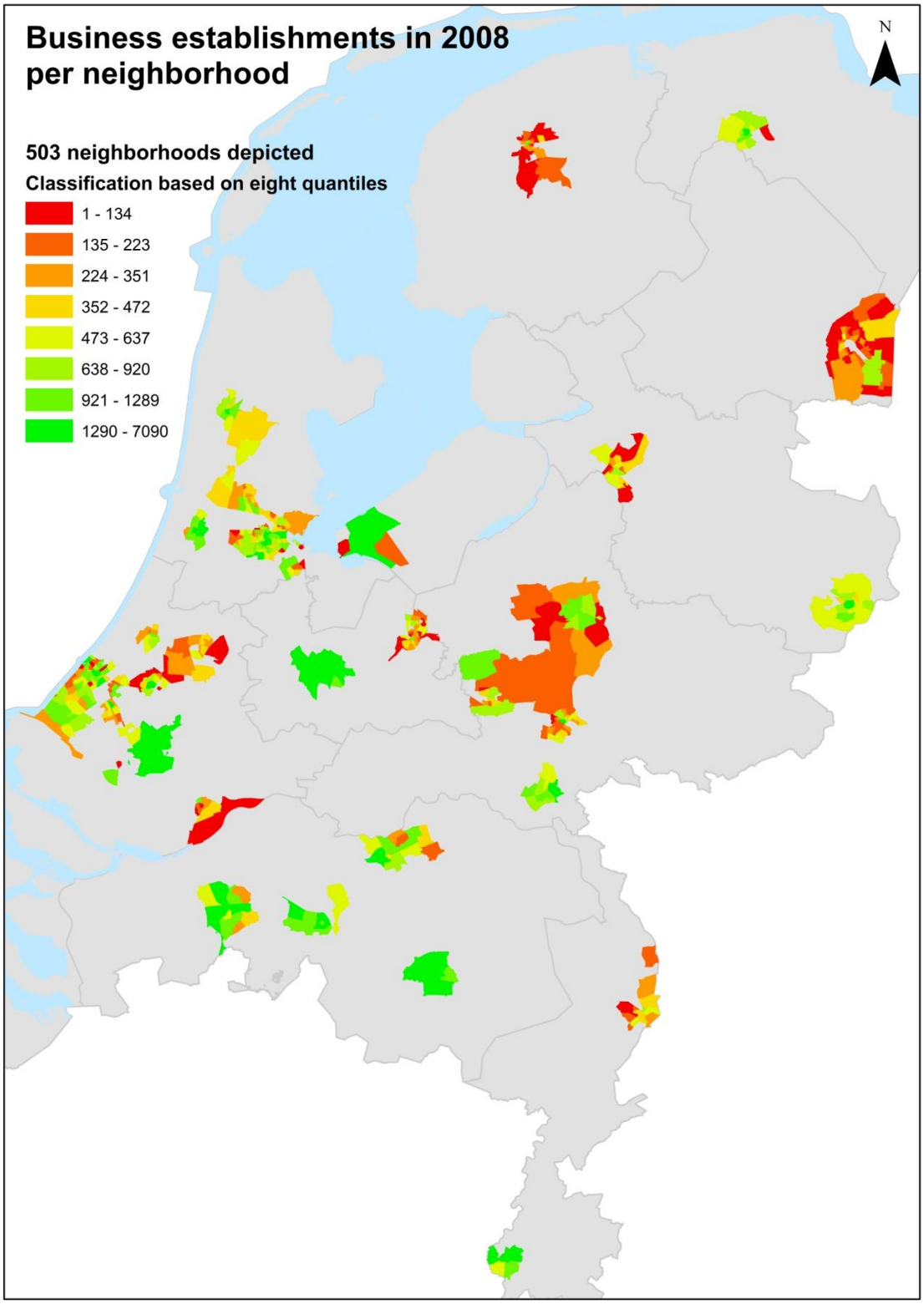

Figure 3: Business establishments per neighborhood in 2008 (data source: LISA)

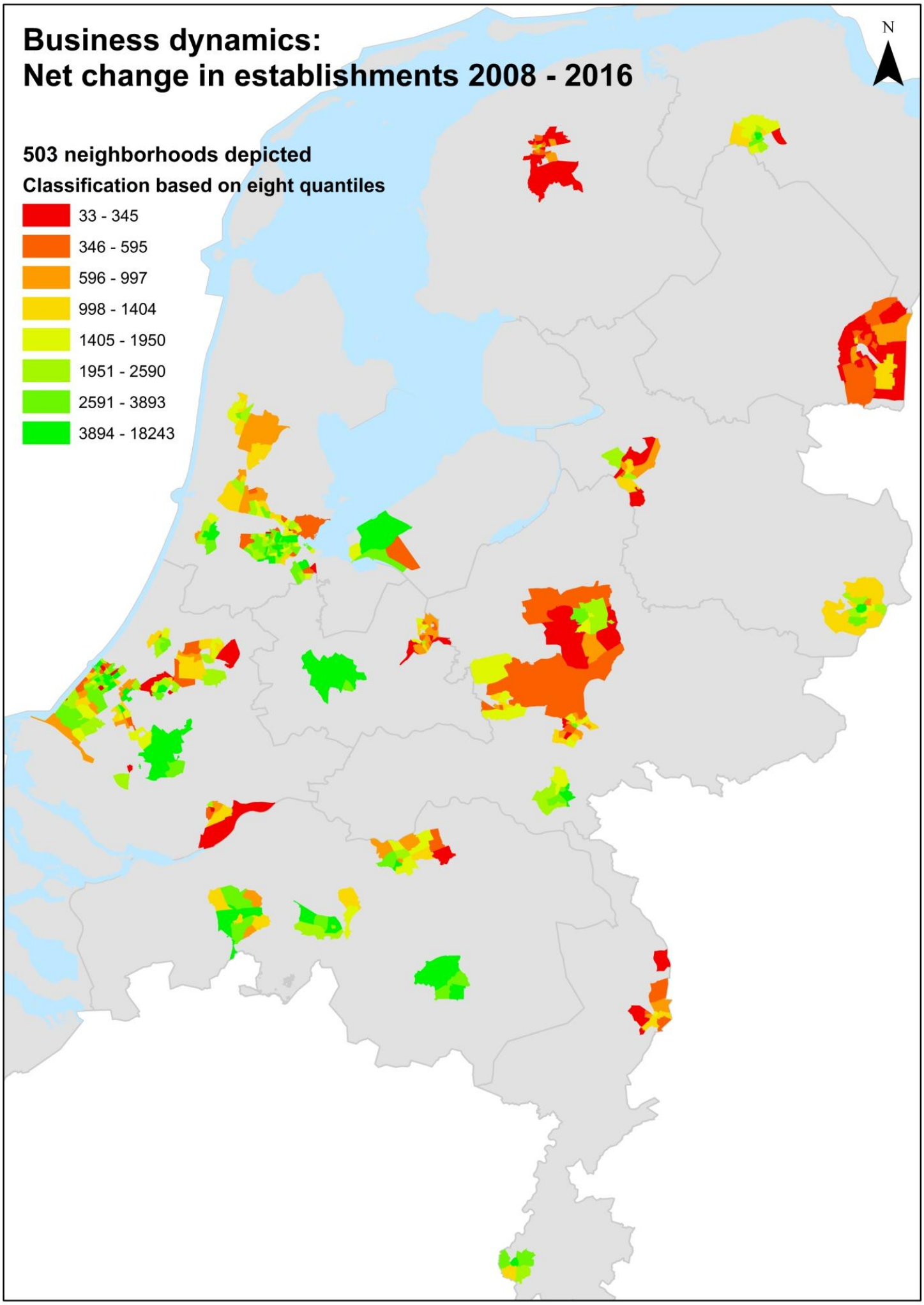

Figure 4: Net change of business establishments per neighborhood from 2008 up to and including 2016 (data source: LISA)

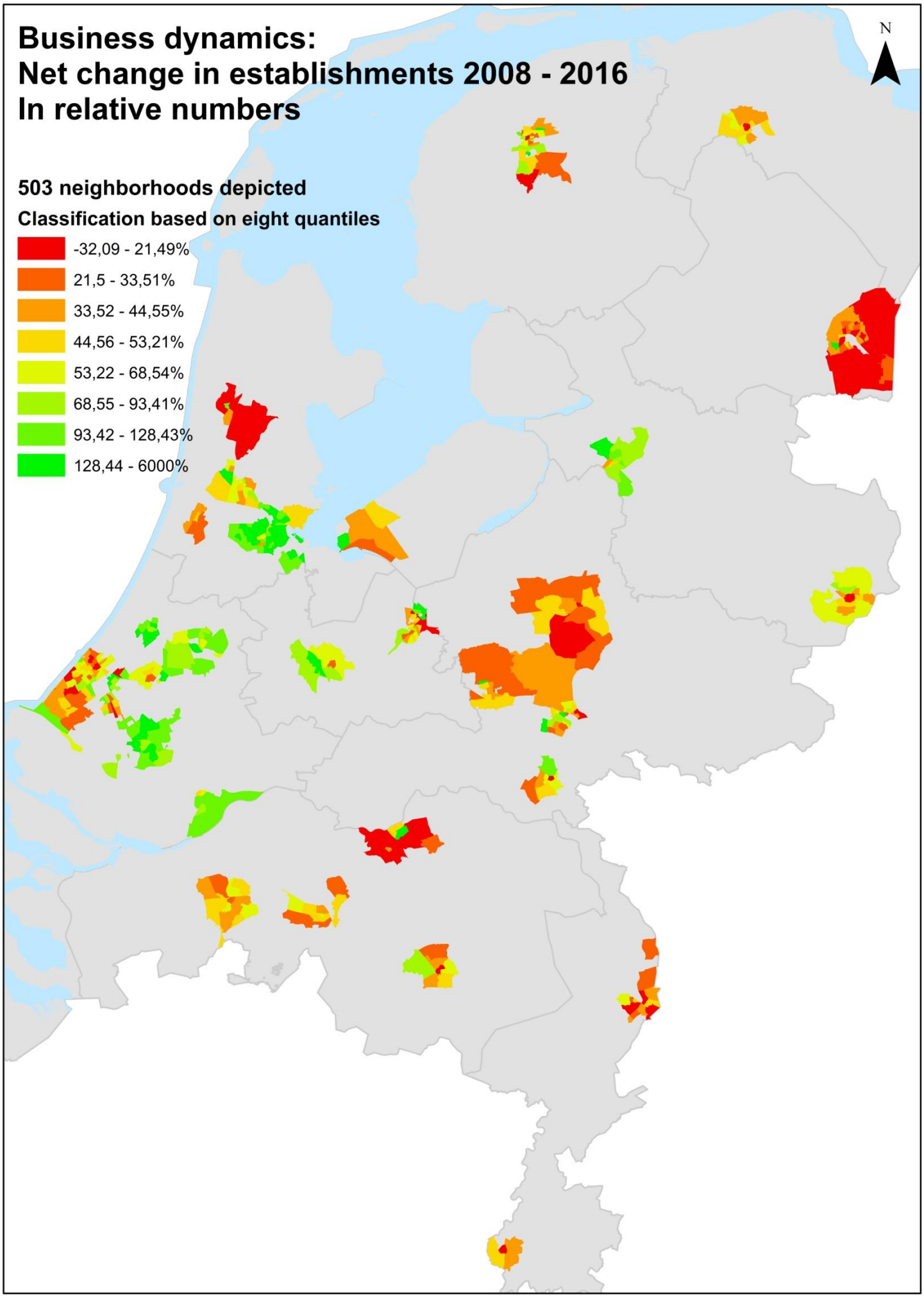

Figure 5: Relative net change of business establishments per neighborhood from 2008 up to and including 2016 (data source: LISA)

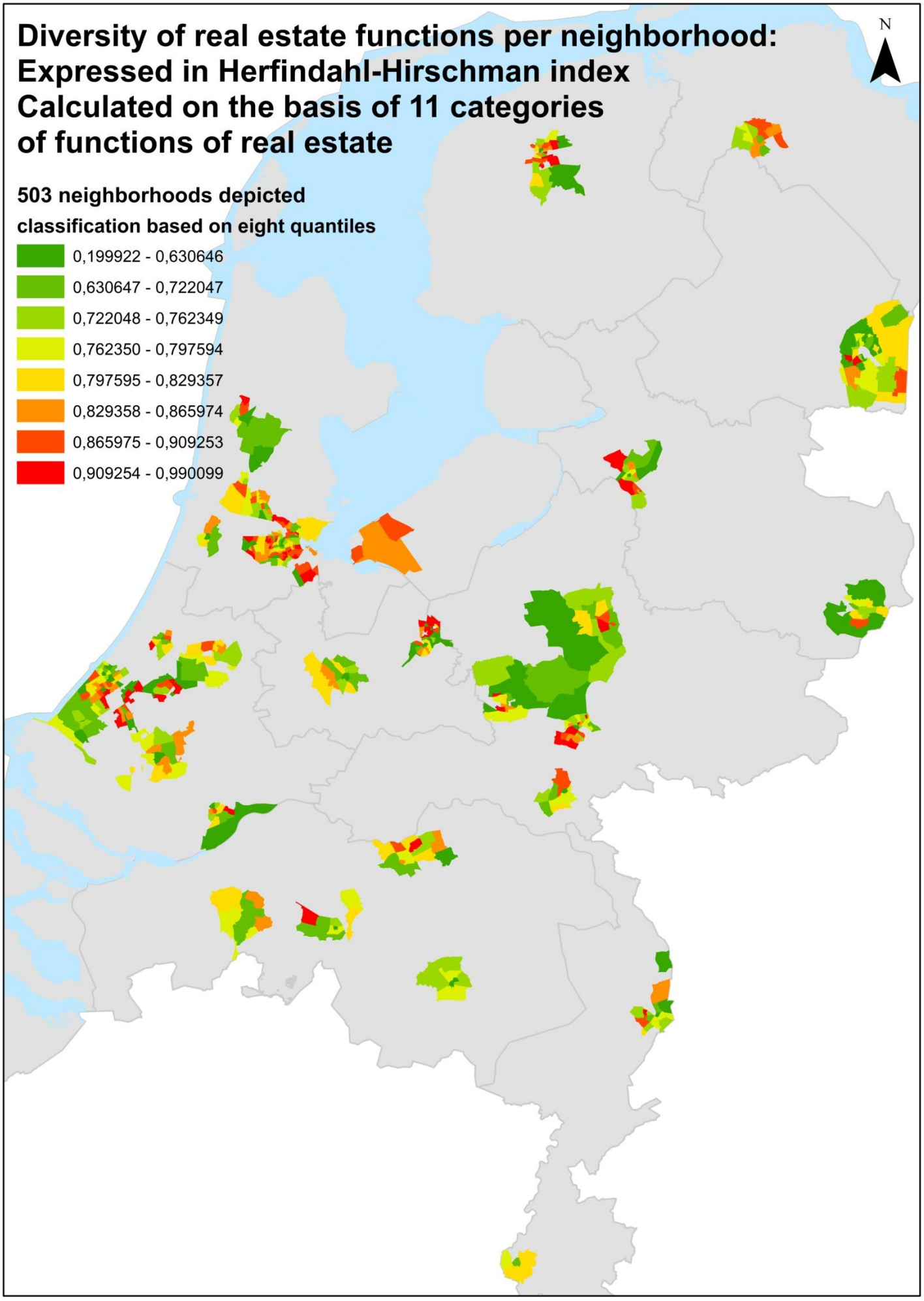

Figure 6: diversity of functions of real estate per neighborhood in 2018 (data adapted from Kadaster)

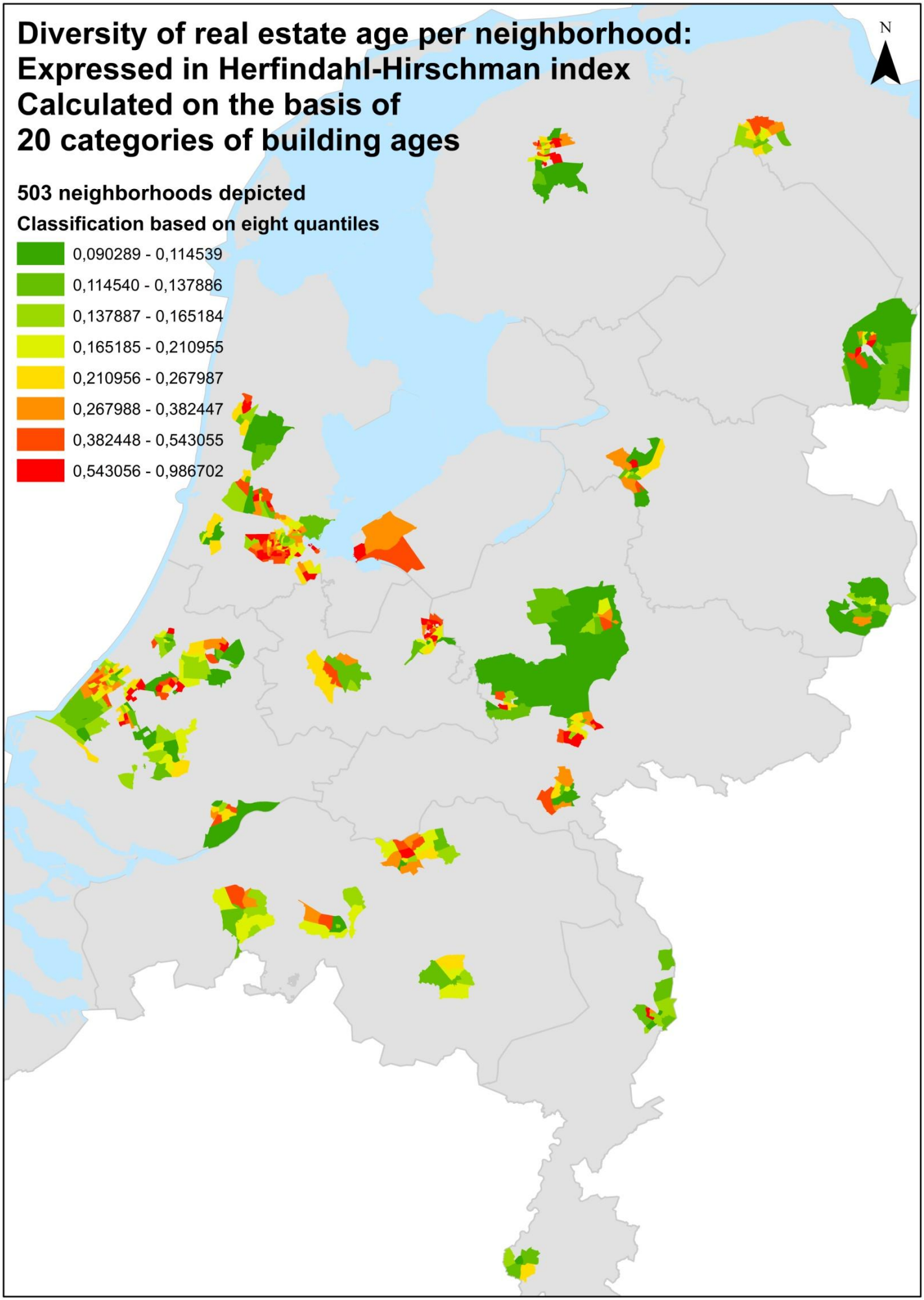

Figure 7: diversity of real estate age per neighborhood in 2018 (data adapted from Kadaster)

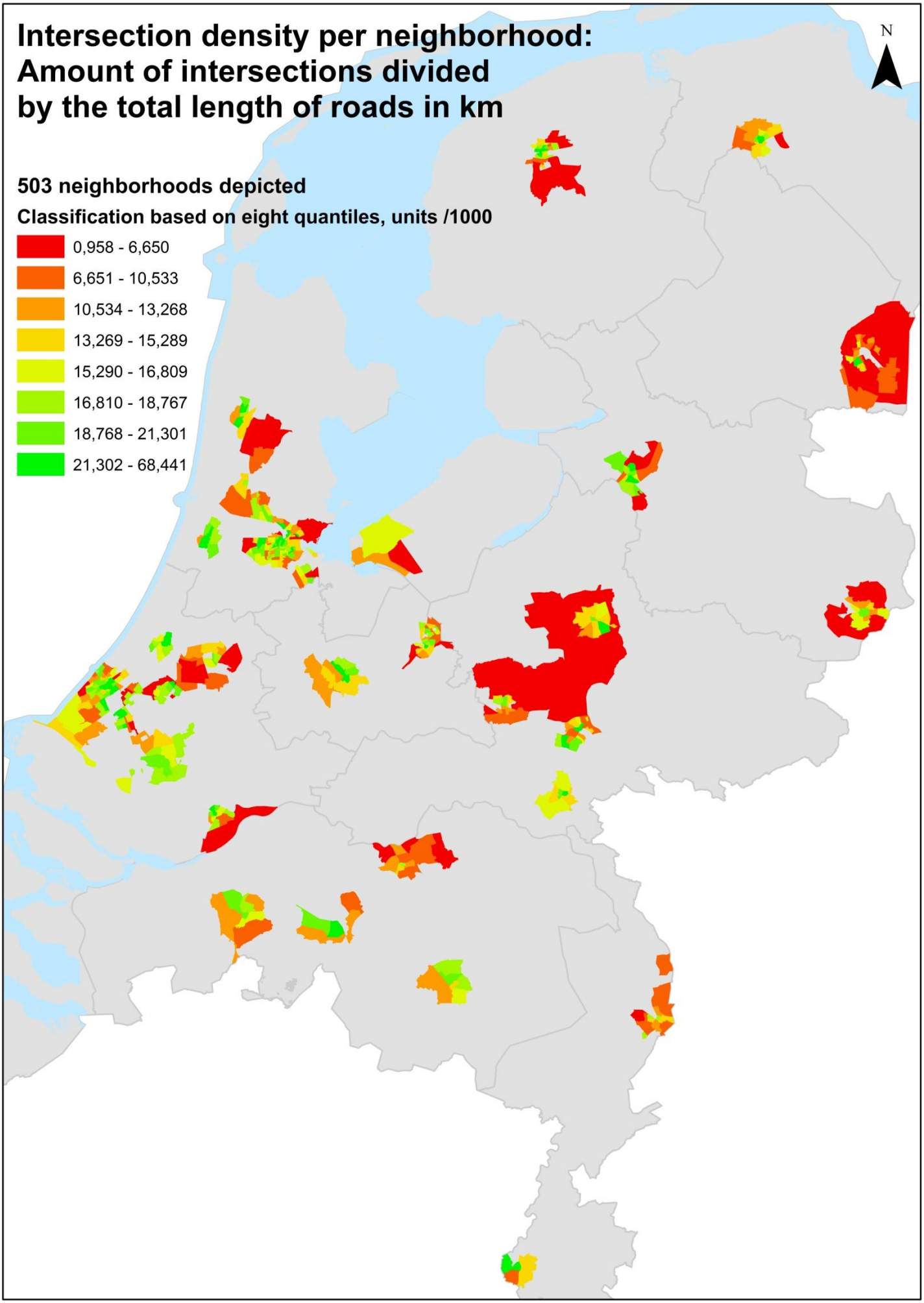

Figure 8: intersection density per neighborhood (data adapted from NWB)

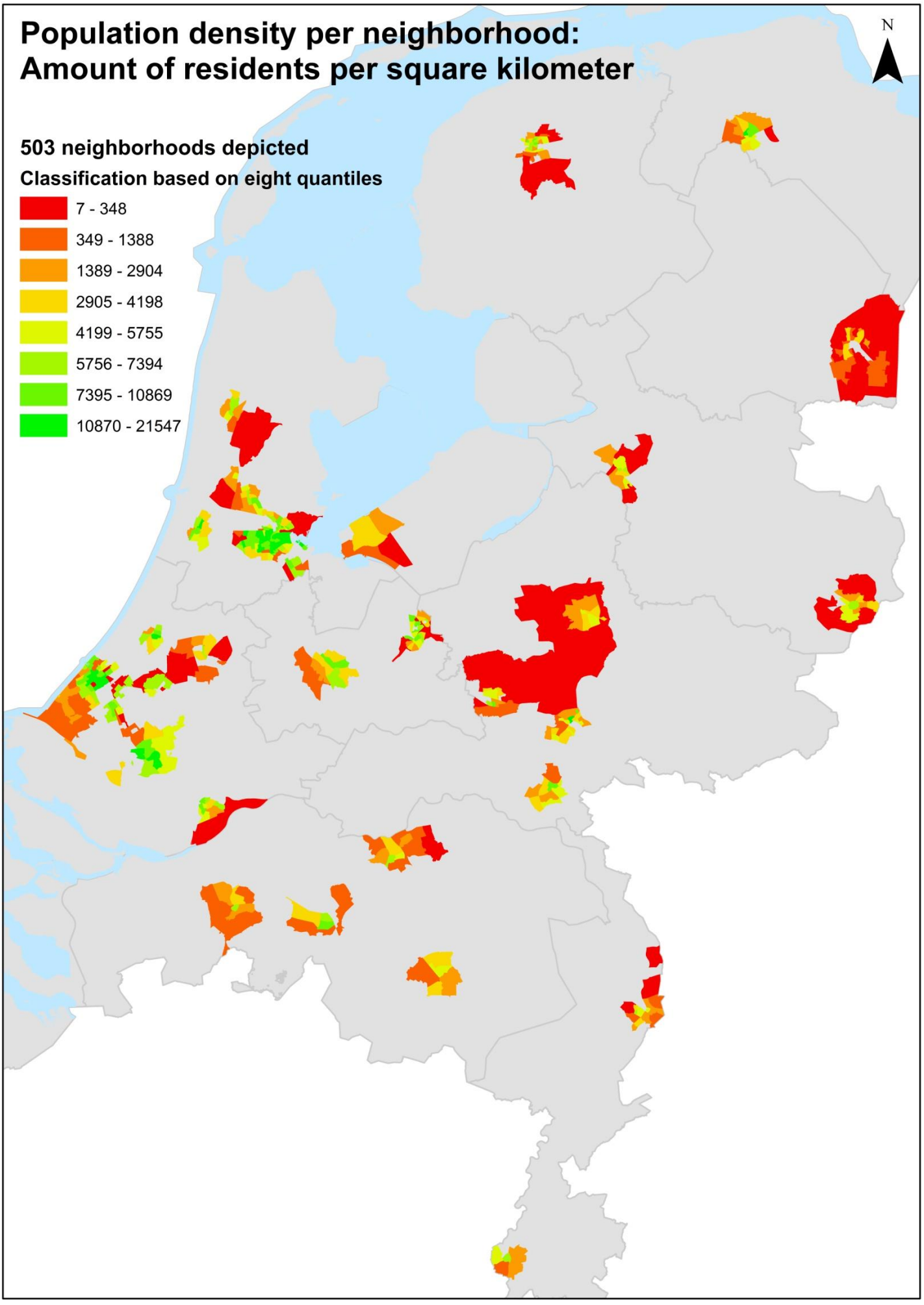

Figure 3: population density per neighborhood (data source: CBS/Kadaster)

4.2. Model results

4.2.1. Introduction

This section will cover the results from the regression models. This introduction will describe the regression models and will explain some choices that were made.

As described in the previous paragraph of this chapter, the general picture regarding the business dynamics expressed in absolute and relative numbers is different. The neighborhoods with the highest net change in business establishments are mainly located in the Randstad area and in the south of the country. In addition to this, it seems like a high net change in business establishments is linked to high initial business establishments. The neighborhoods with the highest relative net change in business establishments are mainly located in the Randstad area and in the northeast of the country. In addition to this, it seems like a high relative net change in business establishments is linked to newer neighborhoods. Because of these differences in the pattern of the two expressions of business dynamics, two regression models will be described. The model for the net change in establishments in absolute terms will be named model 1 and the model for the relative change will be named model 2. Another thing that became clear in the previous paragraph is that it seems that the age of the neighborhoods plays an important role in the business dynamics, especially when expressed in relative terms. This is why the age of the neighborhoods, expressed in the average age of real estate per neighborhood, will added as an extra control variable. This variable was obtained with spatial joins of the BAG data on buildings by using the merge rule 'mean' in the join operation. With the addition of this variable the R square of both models increased, albeit very slightly in the case of model 1. With the addition the R square of model 1 changed from 0,953 to 0,956 and the R square of model 2 changed from 0,306 to 0,327. This alone indicates a link between the relative net change of business establishments and the age of the neighborhoods.

In the maps in the previous paragraph six municipalities with a substantially higher surface area can be seen. These municipalities are Almere, Apeldoorn, Arnhem, Ede, Emmen and Leeuwarden. This bigger surface could influence the business dynamics in these cities and this is why a variation of the models will be discussed in which these bigger municipalities were excluded. A third variation of the models was already mentioned in the methodology chapter, namely a model variation in which only the 15 most populous municipalities are included. The variable names used in the models are described in table 3. The variables are not scaled and because of this the beta values will greatly vary. In all models the variance inflation factor was checked for potential multicollinearity issues and the results were that there was no multicollinearity among the variables. Table 4 presents the results of the initial models.

Variable name	Variable description
Diversity of functions	The Herfindahl-Hirschman index for the 11 functions of real estate in the neighborhood, calculated from BAG data
Diversity of real estate age	The Herfindahl-Hirschman index for the 20 categories of real estate ages in the neighborhood, calculated from BAG data
Resident density	The population density as expressed in residents per square kilometer, from the CBS wijk- en buurtkaart
Employment density	The population density as expressed in employmnent density per hectare, calculated with data from LISA and CBS
Intersection density	The amount of intersections divided by the total length of roads in kilometer, calculated from NWB data
Establishments in 2008	Amount of business establishments in 2008, obtained from LISA data
Average income	Average income per resident, from CBS wijk- en buurtkaart
% non-western immigrants	Percentage of non-western immigrants, from CBS wijk- en buurtkaart
% occupied houses	Percentage of occupied houses, from CBS wijk- en buurtkaart
Diversity of economy	The Herfindahl-Hirschman index for the neighborhood economy, on the basis of 22 categories of business sectors, calculated from LISA data
Average age of real estate	Average age of buildings in the neighborhood, calculated from BAG data

Table 3: variable descriptions

4.2.2. Results initial models

	Model 1: absolute change	Model 2: relative change
Diversity of functions	429,610**	76,223***
	(178,576)	(18,424)
Diversity of real estate age	-284,007***	-18,295*
	(103,213	(10,415)
Resident density	,050***	,002***
	(0,006)	(,001)
Employment density	,524	,182**
	(0,711)	(,071)
Intersection density	-6583,353**	216,625
	(3292,118)	(331,615)
Establishments in 2008	2,548***	-,014***
	(0,030)	(,003)
Average income	16,627***	1,635***
	(3,638)	(,374)
% non-western immigrants	14,181***	,927***
	(1,613)	(,163)
% occupied houses	-3,080	,087
	(3,273)	(,329)
Diversity of economy	-91,849	-65,414
	(302,874)	(71,949)
Average real estage age	-4,957***	-,400***
	(1,003)	(,101)
(Constant)	-287,841	-30,324
	(338,317)	(35,711)
R square	0,956	0,327
N	502	498

Coefficients: unstandardized Beta, Standard error in brackets
*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level

Table 4: results initial models

The diversity variables are expressed in the Herfindahl-Hirschman index and a lower score on this index signifies that a neighborhood is more diverse so this means that the beta values for the diversity indicators are expected to be negative as an increase in the regressor decreases the estimated mean of the dependent variable. The variable diversity of functions variable was significant but the coeffient had a positive value. This indicates that neighborhoods with a higher degree of diversity of functions of real estate will not generate more positive business. In fact, because it was found to significantly influence the dependent variables, it could be that less diverse neighborhoods could have more positive business dynamics. To verify this, because the diversity of functions is after all one of the most important variables to test, the models were estimated again but this time with a stepwise entering method of the independent variables. In these variations the variable was insignificant in model 1 but was significant at a 1% level in model 2, however again with a positive beta value (122,158). This leads to the rejection of hypotheses 1 'neighborhoods with a higher degree of diversity of primary functions of real estate will generate more positive business dynamics'.

The diversity of real estate age was significant at a 1% level in model 1 and significant at a 10% level in model 2, both with a negative coefficient value. This leads to the acceptance of hypotheses 2: neighborhoods with a higher degree of diversity of real estate age will generate more positive business dynamics. The resident density was significant at a 1% level in both models, but the employment density was only significant in model 2 and was insignificant in model 1. This leads to the acceptance of hypothesis 3 but in an altered form; neighborhoods with a higher population

density in the form of residents will generate more positive business dynamics and neighborhoods with a higher population density, in the form of resident as well as jobs, will generate more positive business dynamics when there are not much business establishments to begin with. The intersection density was found to be insignificant in model 2 but was significant in model 1 but however with a negative coefficient. In the stepwise variations of model 1 this variable did have a positive coefficient in the models with only the variables for the four generators of diversity included but the coefficient changed to negative again when the control variable 'establishments in 2008' was included. Hypothesis 4 'neighborhoods with shorter housing blocks will generate more positive business dynamics' will be rejected.

4.2.2. Results model variations and other results

In this section the results of the two variations of the models will be described, these variations did not present major changes to the models so these changes will only be described here and the results of the models will not be presented. Furthermore, two other relevant results will be described.

What changed in the model variation without the biggest municipalities in surface area for model 1 was that the intersection density was no longer significant. However, as the coefficient for this variable was negative this change is not really relevant. What changed in model 2 in this variation is that the diversity of real estate age was no longer significant. What changed for both models in the model variation with only the fifteen most populous municipalities included was that the diversity of real estate age was no longer significant. What only changed for model 1 in this variation was that the percentage of occupied houses was significant at a 5% level, but this relation was negative. What only changed for model 2 in the model variation with only the fifteen most populous municipalities included, was that average income per inhabitant was no longer found to be significant. These results lead to the rejection of hypotheses 5 'neighborhoods in bigger cities will for benefit more from the generators of diversity in generating more positive business dynamics'.

A variable that was tested was the percentage of non-western immigrants. Immigrants tend to be more self-employed than non-immigrants (Lee et al., 2004) and in this thesis the percentage of non-western immigrants in the neighborhoods was found to significantly influence business dynamics in every regression model. This proves that immigrants are not only more self-employed but also that neighborhoods with a higher degree of non-western immigrants, and so a higher diversity of ethnicities, attract more business. Another additional variable that was tested, the diversity of the neighborhood economy, was not found to be significant in any regression model. This could be explained by the fact that this research was about business dynamics overall and not about the generation of new business, as new products and new innovations are generally a product of a diverse economy.

4.3. Discussion

The most surprising result, that the diversity a functions was not significant, primarily needs explanation. This result could first of all be because of the different application or measurement in comparison to how Jacobs described it. Instead of a mix of functions, Jacobs proposed a need for mixed *primary* uses. The primary uses, are those which, in themselves, bring people to a specific place because they are anchorages; reasons for them to be there. In contrast, secondary diversity is a name for the enterprises that grow in response to the presence of primary uses, to serve the people the primary uses draw. Offices, factories and houses are primary uses. Certain types of entertainment and recreation can however be primary uses but in other instances these will be secondary uses. Exactly for this difficulty of classification of the uses of functions in cities, and in combination with the method of data analysis among a big set of municipalities and neighborhoods,

it was chosen to simply measure the mix of functions and to forego the division of primary and secondary uses. This could however explain why the results for this generator of diversity were not relevant. Another explanation could be, assuming that the type of measurement of the diversity of uses was correct, is that producers of a certain service or product locate themselves next to each other because of the consumers 'love of variety'. If consumers enjoy greater variety of choice, implying that more brand options are available at a certain location, the utility of the consumer will be higher. So if the consumers know that in an area a higher variety of products is available, this will encourage them to consume more in that particular area (Pike et al., 2017). This will drive firms to locate next to or close to each other and so in these smaller areas where the firms are located one function will predominate. This explanation can be supported by the regression models as they imply that areas with a lesser degree of diversity of functions have more positive business dynamics.

A higher degree of diversity of real estate age was found to signifiantly influence business dynamics as expected. This means that Jacobs' proposition 'new firms need old buildings' holds. This is strengthened by the fact the diversity of real estate age was not found to significantly influence business dynamics in the models that only include the top 15 most populous municipalities. As there is more business in these cities in general, the business dynamics could include a higher degree of existing firm movement instead of new firm formation. The significance of neighborhoods with a higher degree of diversity of real estate age could however also imply other things than only the economic convenience of older buildings for new firms. It could be that these kinds of neighborhoods are simply found to be be attractive because of the presence of older buildings mixed with newer buildings. It could also be that a high degree of diversity of real estate age in neighborhoods correlate with locational factors. These could be good accessibility at the edge of some municipalities or a preference to be located in a neighborhood that surrounds the inner city as this provides good connectivity with the inner city while at the same time providing more parking space.

That population density significanly influenced the business dynamics was also expected as the potential customers base for firms will be higher in more densely populated areas. The difference in the models regarding this variable can also be understood as, in addition to the Randstad area, in general less densely populated areas in the northeast of the country showed the most business dynamics in relative terms. Especially in these less densely populated cities firms will need to be located in areas that show higher employment density as inputs for their labour pool.

The outcome for the variable intersection density tells us that short blocks of buildings, and therefore a higher probability for people choosing to walk, are not interesting for most firms. In fact, a lesser degree of intersection density, and so longer blocks, was found to significanly influence business dynamics in model 1. Neighborhoods with longer blocks are in general more easily accessible, meaning people could find their way with greater ease in these kinds of neighborhoods. However in these kinds of neighborhoods there is a lower chance of people choosing to walk (Sung et al., 2015; De Nadai et al, 2016). In this day and age with easy and fast access to information and high mobility because of many transportation options it can be better to settle business in an area with a high accessibility than in an area where there is a higher probability of pedestrians, or maybe even cyclists for that matter.

5. Conclusion

This thesis quantified the Jacobs' generators of diversity and related them to business dynamics on the neighborhood level in 30 of the most populated municipalities in The Netherlands. This added to research on the generators of diversity as well as business dynamics. While generators of diversity have been related to business dynamics, this has never been done with all the four of the drivers of diversity at the same time. There has been extensive work on business dynamics and diversity but this was however with regards to the diversity of the economy and not the diversity of the environment and the uses of the environment.

The main research question for this thesis was: what influence does the degree of diversity, in terms of Jacobs' generators of diversity, have on the business dynamics in residential neighborhoods? This was researched using data from multiple sources in linear regression models. The outcomes were that the diversity of real estate age and the population density in the neighborhoods were found to significantly influence business dynamics. The diversity of functions and short building blocks were not found to be of significant influence in the models. These results, especially with regards to the diversity of functions, have to be interpreted with caution however because of limitations of the data that was used. To express the diversity of functions the diversity mix of functions at the time of spring 2018 was used while the dependent variable was the net change in business establishments from 2008 up to and including 2016. This diversity mix of functions should have ideally been from 2008, if this had been the case there is a chance the results would have been different.

The two generators of diversity that were found to be of influence to the business dynamics could be correlated to other effects than those described by Jacobs (1961). In particular the diversity of real estate age could be related to locational factors, this could be elaborated upon in further research.

6. References

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Appendix I: Neighborhoods excluded in the analysis

Keys for reason for exclusion:

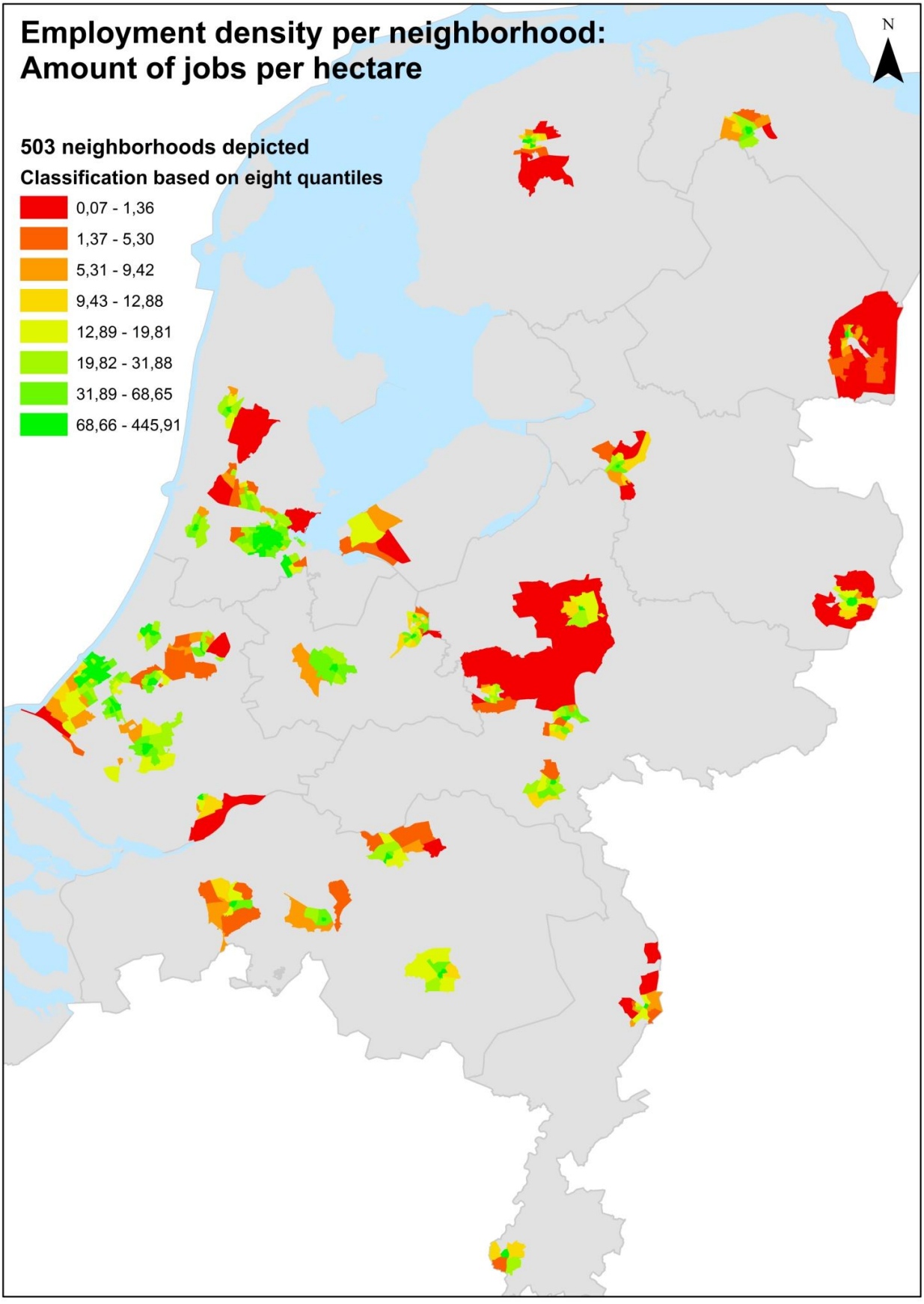
A	Air(port)
B	Name signifies industrial area
C	Too much agriculture, mineral extraction and manufacturing
D	No income data
E	No housing vacancy data
F	No business establishment data

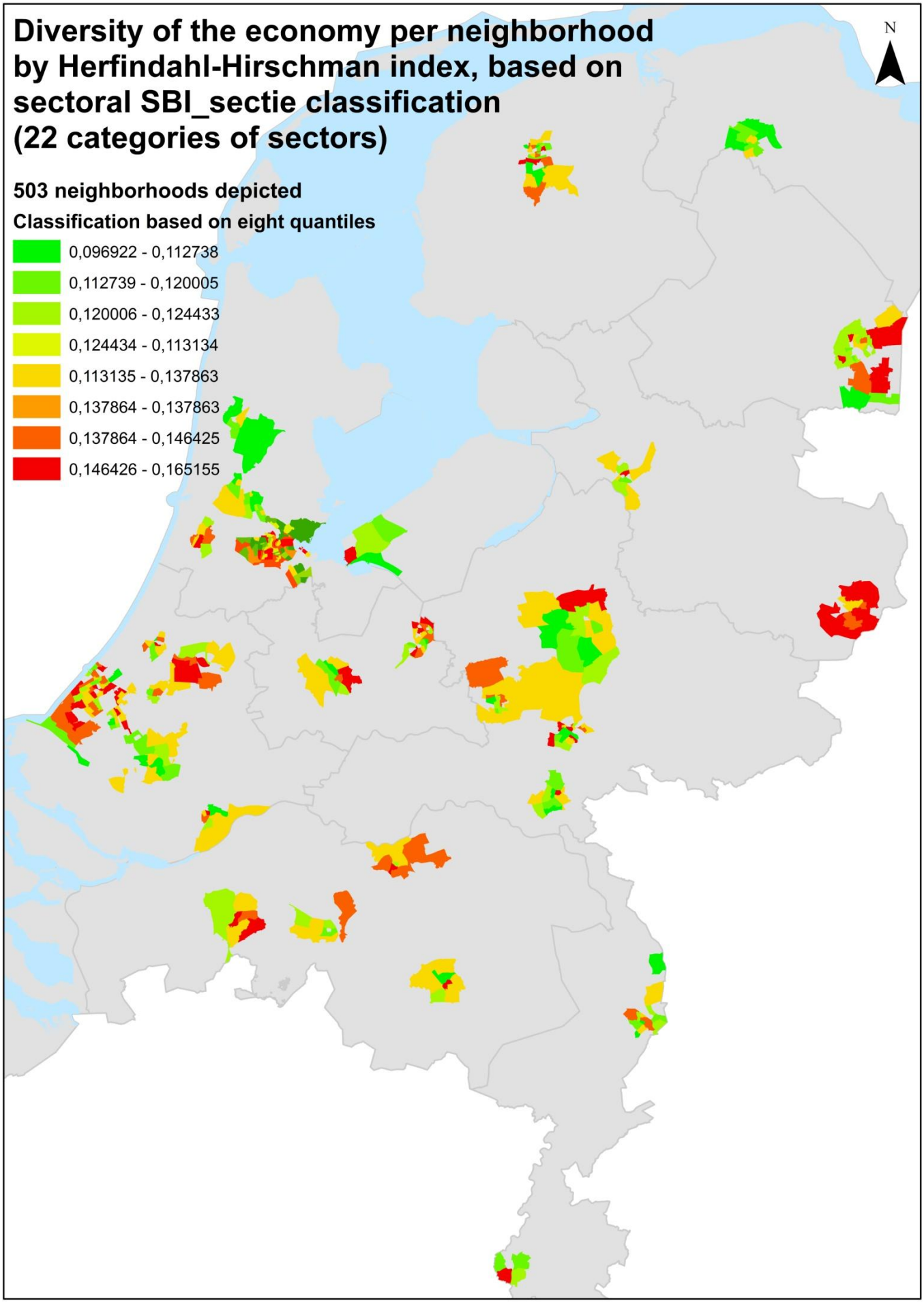
Neighborhood	BU_CODE	WK_CODE	Municipality	Reason for exclusion					
				A	B	C	D	E	F
Wijk 08 Industriegebied	nvt	WK063708	Zoetermeer		1	1			
Wijk 07 Bedrijfsterreinen Enschede-West	nvt	WK015307	Enschede		1	1			
Wijk 53 Kern Emmen Industrieterreinen	nvt	WK011453	Emmen		1	1	1		
Wijk 38 Bedrijventerreinen-Oost	nvt	WK008038	Leeuwarden		1	1	1		
Bedrijventerrein	nvt	WK022813	Ede		1	1			
Wijk 19 Industriegebied West	nvt	WK050519	Dordrecht		1	1			
Wijk 05 Buitenwijk Noordoost	nvt	WK093505	Maastricht			1			
Wijk 28 Trade-Port	nvt	WK098328	Venlo			1			
Wijk 21 Nieuw-Schoonebeek	nvt	WK011421	Emmen			1			
Botlek-Europoort-Maasvlakte	nvt	WK059923	Rotterdam	1		1	1	1	
Wijk 60 De Zwette	nvt	WK008060	Leeuwarden			1	1		
De Klomp	nvt	WK022860	Ede			1			
Wijk 42 Wielenpôlle	nvt	WK008042	Leeuwarden			1			
Wijk 04 Noord	nvt	WK085504	Tilburg			1			
Wijk 03 Buitenwijk Noordwest	nvt	WK093503	Maastricht			1			
Wijk 73 Jirnsum e.o.	nvt	WK008073	Leeuwarden			1			
Wijk 41 Marsweteringlanden	nvt	WK019341	Zwolle			1			
Wijk 72 Grou e.o.	nvt	WK008072	Leeuwarden			1			
Harskamp	nvt	WK022870	Ede			1			
Waalhaven-Eemhaven	nvt	WK059921	Rotterdam			1	1		
Wijk 51 Belfeld	nvt	WK098351	Venlo			1			
Wijk 32 Op de Hei	nvt	WK098332	Venlo			1			
Ederveen	nvt	WK022850	Ede			1			
Spieringhorn	BU03630375	WK036303	Amsterdam			1	1	1	
Spaanse Polder	nvt	WK059918	Rotterdam			1			
Zuidoost	nvt	WK001405	Groningen			1			
Wijk 04 Isselt	nvt	WK030704	Amersfoort			1			
Wijk 51 Wormerveer	nvt	WK047951	Zaanstad			1			
Wijk 43 Lomm	nvt	WK098343	Venlo			1			
Arnhemse broek	nvt	WK020203	Arnhem			1			
Wijk 41 Schepenbuurt	nvt	WK008041	Leeuwarden			1			
Vondelingenplaat	nvt	WK059922	Rotterdam			1	1	1	
Wijk 04 Hoorn	nvt	WK048404	Alphen aan den Rijn			1			
Wijk 06 Staart	nvt	WK050506	Dordrecht			1			

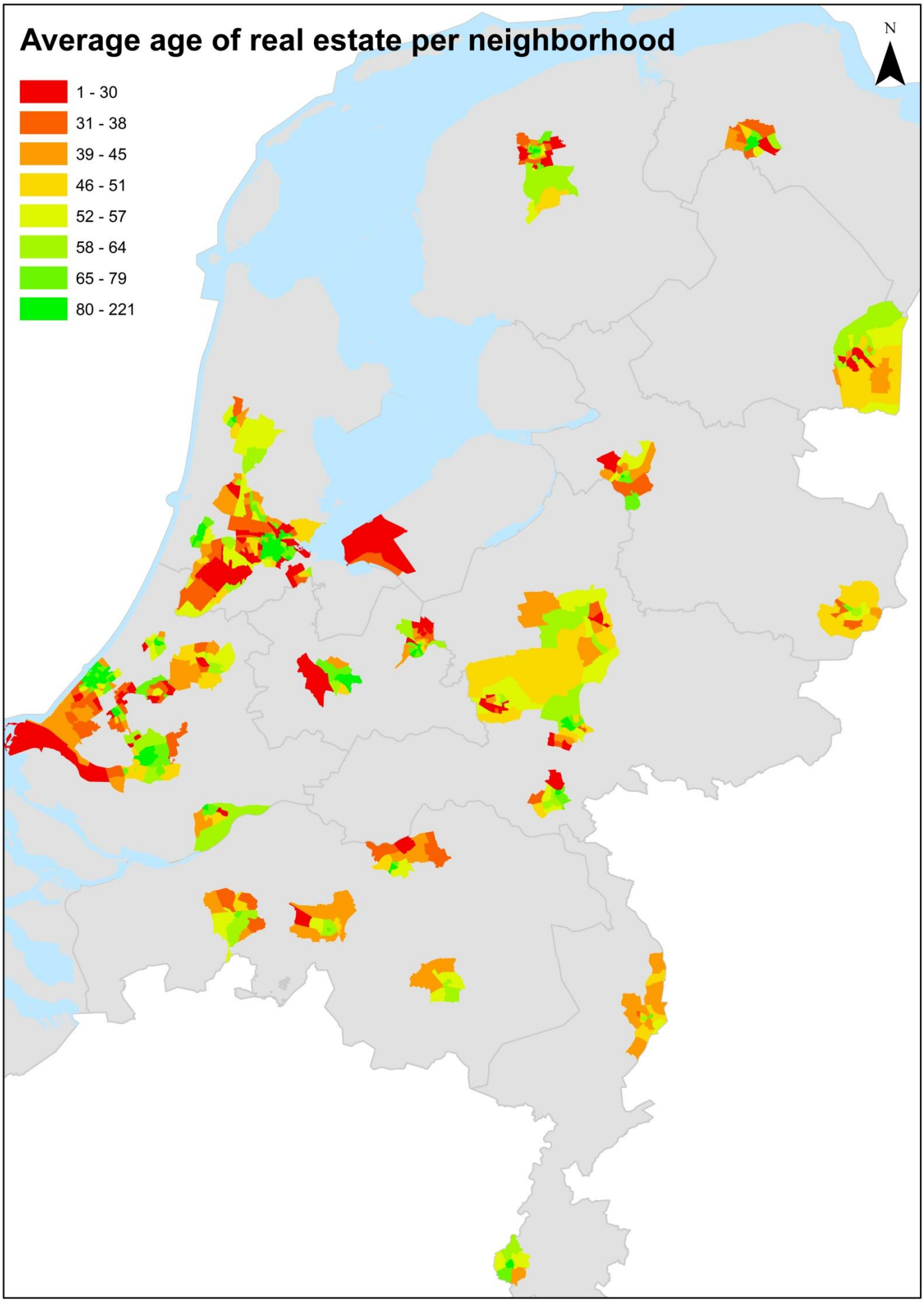
Wijk 21 Westenholte	nvt	WK019321	Zwolle			1			
Wijk 07 Steekterpolder	nvt	WK048407	Alphen aan den Rijn			1			
Westelijk Havengebied	BU03630110	WK036301	Amsterdam	1		1			
Nieuw Mathenesse	nvt	WK059919	Rotterdam			1	1	1	
Wijk 27 Buitengebied West	nvt	WK030727	Amersfoort			1			
Buiksloterham	BU03630671	WK036306	Amsterdam			1			
Zeeburgereiland/Nieuwe Diep	BU03630534	WK036305	Amsterdam			1			
Wijk 05 Oost	nvt	WK085505	Tilburg			1			
Bedrijventerrein Sloterdijk	BU03630111	WK036301	Amsterdam		1				
Bedrijventerrein Schieveen	nvt	WK059926	Rotterdam		1		1	1	1
Wijk 58 De Werp	nvt	WK008058	Leeuwarden				1	1	
Wijk 69 "De Zuidlanden"	nvt	WK008069	Leeuwarden				1	1	
Wijk 01 Oostduinen	nvt	WK051801	's-Gravenhage				1	1	
Wijk 65 Buitengebied Noordwest	nvt	WK008065	Leeuwarden				1	1	
Wijk 06 Almere Pampus	nvt	WK003406	Almere				1	1	
Wijk 23 Park Schothorst	nvt	WK030723	Amersfoort				1		
Wijk 16 Delftse Hout	nvt	WK050316	Delft				1		
Rotterdam-Noord-West	nvt	WK059924	Rotterdam				1	1	
Wijk 26 Abtswoude	nvt	WK050326	Delft				1	1	
Amstel III/Bullewijk	BU03630792	WK036307	Amsterdam					1	
Wijk 09 Rietveld	nvt	WK048409	Alphen aan den Rijn				1	1	
Rivium	nvt	WK059925	Rotterdam				1	1	
Veluwse Poort	nvt	WK022805	Ede				1		
Vijfhuizen	nvt	WK039415	Haarlemmermeer						1
Schiphol	nvt	WK039416	Haarlemmermeer	1			1	1	1
Wijk 56 Wiarda	nvt	WK008056	Leeuwarden				1	1	1
IJburg Oost	BU03630574	WK036305	Amsterdam				1	1	1
Aalsmeerderbrug/ Oude Meer/ Rozenburg / Schiphol Rijk	nvt	WK039406	Haarlemmermeer						1
Lijnden / Boesingheliede	nvt	WK039404	Haarlemmermeer						1
Abbenes / Buitenkaag	nvt	WK039409	Haarlemmermeer						1
Burgerveen / Leimuiderbrug / Weteringbrug	nvt	WK039408	Haarlemmermeer						1
Cruquius	nvt	WK039413	Haarlemmermeer						1
Rijsenhout	nvt	WK039407	Haarlemmermeer						1
Badhoevedorp	nvt	WK039405	Haarlemmermeer						1
Zwanenburg	nvt	WK039403	Haarlemmermeer						1
Wijk 30 Vathorst-De Bron	nvt	WK030730	Amersfoort						1
Beinsdorp	nvt	WK039411	Haarlemmermeer						1
Zwaanshoek	nvt	WK039412	Haarlemmermeer						1
Lisserbroek	nvt	WK039410	Haarlemmermeer						1
Nieuw-Vennep	nvt	WK039402	Haarlemmermeer						1
Hoofddorp	nvt	WK039401	Haarlemmermeer						1

Appendix II: Additional maps

This appendix depicts maps that were not depicted in chapter 4, these are maps on the employment density, the diversity of the economy and the average real estate age per neighborhood.




Diversity of the economy per neighborhood by Herfindahl-Hirschman index, based on sectoral SBI_sectie classification (22 categories of sectors)
503 neighborhoods depicted
Classification based on eight quantiles
0,096922 - 0,112738
0,112739 - 0,120005
0,120006 - 0,124433
0,124434 - 0,113134
0,113135 - 0,137863
0,137864 - 0,137863
0,137864 - 0,146425
0,146426 - 0,165155
N


Average age of real estate per neighborhood
N
1 - 30
31 - 38
39 - 45
46 - 51
52 - 57
58 - 64
65 - 79
80 - 221