Retail Revolution in the Digital Era: Examining the Changes in the Retail Landscape of New York City

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ABSTRACT

Storefronts are home to the retail and food service, providing goods and services to the city's residents, fostering local economy, and defining the neighborhood's characters. New York City as the main gateway city in United States has the most complicated retail system, ranging from local bodega, retail corridors, department stores to high street fashion stores. In the current decade, storefronts in New York City have been pockmarked with vacancies due to increasing rents, e-commerce and consumer's behavioral shifts. As important as it is to urban life, retail diversity is now threatened in many New York City's neighborhood. This research aims to analyze data from County Business Patterns and U.S. Census Bureau to study current retail network system and changes of retail activities over time in New York City. The goal of this research is to call for further investigation and innovative uses of the City's zoning, land use, and planning tools to improve retail diversity and preserve neighborhood characters.

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1. INTRODUCTION

Jane Jacobs suggested that if a city aims to foster sustainable growth, it should have a critical residential density with great diversity (Jacobs, 2016). Jacobs stated that:

> "Streets and their sidewalks, the main public places of a city, are its most vital organs. Think of a city and what comes to mind? Its streets. If a city's streets look interesting, the city looks interesting, if they look dull, the city looks dull. (Jacobs, 2016, page 107)"

A neighborhood is not only defined by its residential population but also characterized by the interactions of the commercial and community activity on the street. A critical residential density should also be fostered for mixed-use neighborhoods, encouraging walkability, multi-modal transportation, and diverse and active commercial uses. Brick-and-mortar stores are an important part of the urban experience. Retail development is closely connected to the local economy, and an integral element of neighborhood character, supporting local demand for goods and services.

Since the first online transaction was processed in 1994, online shopping has become a crucial component of the retail industry. Emerging technologies greatly influence the retail development in cities and push forward a retail revolution. Along with other challenges impacting on the future health of brick-and-mortar stores, emerging technologies become a key contributing factor to the changes in retail landscape in many aspects. The innovative concept of an urban warehouse that functions as a distribution center, retail, and customer services center strengthens the digital-physical connection and fosters changes in the urban built environment. The digital and marketing innovation in the form of new business model adapted by e-commerce giants have enabled them to monopolize the electronic commerce market and become competitors in physical retail

markets. Convenience and immediacy are the key drivers shaping the shopping behaviors of consumers.

Over the last decade, changes in retail development in New York City are due to a variety of factors including pressure from e-commerce platforms, local government policies, disproportional property value inflation and real estate tax burdens, leading to increasing vacancies of storefronts in downtowns, retail corridors and many neighborhoods. Zukin (2004) stated that retail corridors are democratic. Retail is a place for social interaction, daily experience and to welcome people to participate regardless age, gender, income and background. Reese and Ye (2011) argued that community changes arise from a shared social view among similar people living together who are closely connected to the local retail and community amenities.

A diversified retail composition in neighborhoods plays a vital role within the local community context to the larger urban sustainability context. Retail in New York City is a complex structure consisting of small local businesses, high-end fashion stores, department stores, big-box chains and shopping malls. Understanding the changes in retail development is a key measurement when establishing retail planning policy goals and implementing zoning incentives and regulations.

1.1. Background

From rural strip-malls to Manhattan's high street, brick-and-mortar retail continues to decline nationwide. Numerous newspaper articles to broker's reports have shown that retail real estate industry seems to be on an accelerating disruption curve. Rapid changes in tenant dynamics, customer behavior, customer demographics and digital innovations have stimulated the shift in retail industry (*Commercial Real Estate Outlook 2018*, 2017). Increasing vacancies and turnover rates along with store

restructurings and closures, retail stores are experiencing a complete makeover. The typologies of retail stores are in need of adaptive change to cater the movements in the market.

A recent market research study found that a total of 50 US retailers filed for bankruptcy in 2017 and more are at risk of defaulting in 2018 (Peterson, 2017). E-commerce has rapidly expanded, and Amazon has been a major pushing factor to the retail revolution. Researchers have predicted that up to 20% of total retail sales will be attributed to E-commerce by 2019 (Carlson & Larco, 2017). E-retailers have started to take advantage of brick-and-mortar as a platform to experiment with a physical extension and stimulate online sales. Amazon has been gradually spreading its footprint in Manhattan with an urban warehouse in Herald Square and a book store in Columbus Circle. High street fashion and boutique stores are no long the trendiest places to go. Companies that are adaptive have changed their marketing and branding strategies to cater for the new consumer demands. Rather than spreading their businesses across the city, companies have started to monitor carefully at their retail footprint. The brick-and-mortar stores are no longer for sales revenue but act more like a show room for their products. The location of their flagship stores becomes extremely important. Consumer are longing for the flagship, so-called the experiential stores, in cities.

Besides the strong presence of e-commerce, the issue of the retail revolution is much more complicated. The long-standing debt of chain stores and the oversupply of American malls are all contributing factors in retail vacancies. American retail space per person is about 25 square feet compared to 15 square feet in Canada and 9 in Europe which has led to an increasing vacancy in cities (John H. Sokul, 2017). The land prices in New York City has skyrocketed since the last economic crisis. Investors and landlords have attempted to pass the burden onto tenants by charging unaffordable rental rates.

Following the rises in vacancy, the average retail lease has shrunk from ten years to a shorter period (i.e. option of 5-year lease with 5-year extension). Landlords have tried to fill in vacancies with pop-up stores and short-term leases (Gonzalez, 2017).

In New York City, retail vacancy has been moderately increasing from cycle lows, meanwhile asking rents continue to increase (*2018 Retail North American Investment Forecast*, 2018). However, new construction in the outer boroughs will be expected to stimulate retail growth in terms of inventory and employment. In Manhattan, the new development in Hudson Yard will become the largest delivery for retail with a million square feet of new space (*2018 Retail North American Investment Forecast*, 2018). Changes in the retail industry are not only the matter of typology. As a ripple effect, any changes in the retail affects employment, neighborhood characteristics, urban design and transportation. Retail planning is an important aspect of urban planning for sustainable growth, economic development and community development.

1.2. Research Questions

By investigating changes of retail composition in New York City since 1994, this thesis aims to develop a better understanding of the current retail landscape for future retail planning. Evaluating the annual changes in different sectors in the retail industry helps understand the impacts of online retailing on the physical retail landscape in the digital era. To observe current retail trends, monitor future health of brick-and-mortar stores, and recommend urban planning policies and strategies regarding future retail planning, statistical and spatial analyses were performed to answer following questions:

1. What is the current retail store network in New York City?
2. What are the impacts of e-commerce growth on the physical retail landscape in New York City?

3. How do the retail landscapes change over time?

2. LITERATURE REVIEW

2.1. The Development of the Retail Industry in America

Retailing is a competitive and market-driven industry in America. Development of the retail industry is heavily dependent on the changing nature of consumers and their responses (Weitz & Whitfield, 2006). The retail landscape in cities has been reshaped for decades and is continually changed. Urban retail structure has moved from downtown corridors through large-scale suburban retail outlets, big-box and chain stores, and retail parks to high street fashion and boutique stores. E-commerce, urban warehousing and experiential stores have slowly become the latest trends afterward.

Brick-and-mortar stores and retail outlets were first built to serve general needs of the population in the neighborhood. The underlying growth of retailing between 1870 to 1920 was primarily triggered by the electrification and expansion of streetcar systems. The role of retailing in downtown areas reached its zenith in the 1920s and gradually diminished until the 1950s. The large-scale decentralization of retail activity into suburbs occurred with the proliferation of the automobile and urban sprawl (Robertson, 1997). The improved access and increased demands were the key ingredients for the development of department stores and later the "big-box" retailers. Department stores such as Macys, Marshall Field, Bloomingdales and Barneys were able to growth and prosper in the late-nineteenth century (Robertson, 1997). The concentration of retail activity in downtown cores has led to agglomeration economies.

2.2. Retail Trade Area and Spatial Structure

Reilly's *Law of Retail Gravitation* stated that

> "Two cities attract retail trade from an intermediate city or town in the vicinity of the breaking point (the 50 percent point), approximately in direct proportion to the population of the two cities and in inverse proportion to the squares of the distance from these two cities to the intermediate town (Reilly, 1931)."

Reilly's law was an analogy between Newton's law of planetary motion, retailing geography and the spatial behavior of consumers. It is a generalized concept of retailing geography and the marketing area which has later been developed into conceptual frameworks of trade area estimation (Brown, 1992).

There is substantial research indicating that traditional retail was constituted by three main components: a geographic location, a specific industry, and accessibility to the store. Retailers relied heavily on the physical environment and constrained to a geographical boundary. They provided a theoretical framework for retail trading area and the significance of its spatiality (Dolega & Celińska-Janowicz, 2015; Erkip, Kızılgün, & Akinci, 2014; Ozuduru & Guldmann, 2013). One implication of this was that the size of retail market area varied by product type. The spatial structure of the retail sector depends on various factors such as buyer density, travel costs and fixed costs of the store, which translates into a hierarchy of retail networks (Meltzer & Schuetz, 2012). Berry (1967) stated that retail stores with a low fixed cost and sells goods that are frequently consumed and served locally, will typically have a denser distribution network in the city.

However, the importance of location has become uncertain at the present time. Boschma and Weltevreden (2004) stated that "from a traditional geographic perspective, one could expect that business-to-consumer e-commerce could make physical shopping redundant, leading to a 'death of distance'." Goods that were once sold to the customers within the immediate vicinity could now be shipped to home with one click on the website. The framework of trading area and the spatial structure of retailing was thus changed.

The retail network has altered in mix with a decline in product-based retail stores and a growth in service-based retail stores (Bakos, 2001). Product-based establishments are typically groceries, health and beauty products, and general household items that are sold at grocery stores, supermarkets, convenience stores, pharmacies, and general merchandise stores. Service-based establishments primarily serve the local neighborhood including laundry services, coffee shops, restaurants, and beauty salons.

2.3. Emerging Technologies and the Shift in Retail Industry

The development of the internet technology has opened up new avenue for retailing in the digital era. Technologies that affected the customer experience and influence consumer shopping behaviors have fostered a retail revolution. The digital innovations bring changes to the retail sector including the rise of online shopping, showrooming and warehousing, the use of social media for price comparison, advertisement and product reviews, and the integration of smartphones with all retail information and many more. Whether these are emerging opportunities or challenges to the local retailer is a debatable topic. The advance and innovation of technology has led to a major shift in urban retail logistics and further impacts the consumption of urban spaces.

E-commerce is growing at an astonishing rate and might lead to an assumption that brick-and-mortar stores must be dying. Worzala, McCarthy, Dixon, and Marston (2002) studied retailing in the UK and USA covering key topics including internet strategies, perceptions of the internet, barriers to e-commerce growth and real estate requirements in the early 21st century. The research found that most retailers were not too concerned about the potential threats imposed by e-commerce in the physical retail industry. Most retailers were concerned about fulfilment and delivery problem while maintaining foot

traffic in shopping centers. Online channels were indeed commonly viewed as a complementary service to the physical channels and would not cause decline in the demand for space in retail industry (Worzala et al., 2002).

The constant media references to the "retail apocalypse" are lacking in nuance. It is true that storefront vacancies are increasingly visible in downtowns and many neighborhoods. Major traditional retailers like The Limited American Apparel, Wet Seal and Aerospostale have announced bankruptcies and closures officially. However, retail real estate still maintains its stance in the city proven by the openings of Amazon Books, Amazon Go and many other omnichanneling retails in cities. The retail industry is restructuring and experiencing changes in size, scope and structure.

The growing demands of consumers and competition for providing the most convenient and immediate services have been the key driving forces for the evolution in the e-commerce platform. Consumers have higher expectations about the quality and immediacy of services. In response to that, retailers and suppliers are competing against each other offering more flexible and immediate shopping options. This has led to creation of multichannel and omnichannel marketing models in the recent decades (Dawson & Matthews, 2014). The evolution of e-commerce is shown in Figure 1.

Figure 1. Timeline of Electronic Commerce Evolution (Dawson & Matthews, 2014)

E-commerce exists in various forms, business-to-business (b2b), business-to-consumers (b2c) and consumer-to-consumer (c2c). The U.K. Cabinet Office defines e-commerce as "the exchange of information across electronic networks, at any stage in the supply chain, whether within an organization, between businesses, between businesses and consumers, or between the public and private sector" (Dixon & Marston, 2002). Under the rapid growth of digital technology and the innovation in networking, conventional retail logistics have been disrupted. In 2014, there were estimated $750 billion of transactions on the global e-commerce market (Pettersson, Winselett, & Koglin, 2016). There has been a growth of 14.6 percent in the e-commerce market from 2015 to 2016 in the United States, with annual sales totaling more than $300 billion. The growth of b2c e-commerce has contributed to the growing demand for warehouses in suburban areas.

Boschma and Weltevreden (2004) have stated that geography has become less and less important because of the expansion of e-commerce market. "From a traditional geographical perspective, one could expect that business-to-consumer (b2c) e-commerce could make physical shopping redundant, leading to a 'death of distance'"(Boschma & Weltevreden, 2004). This statement to an extent undervalues the purpose of physical shopping and exaggerates the prevalence of online shopping. Online shops are considered to be a complementary service to retail in the physical world and provide more options for consumers. Department stores, boutiques and retail can be condemned as a type of recreational activity and public spaces for social interaction. However, it is evidenced that the rapid growth of the e-commerce industry has impacted on the urban environment.

Under the concept of the multichannel model, the construction of fulfillment centers warehouses, and chain stores have been located towards the periphery of metropolitan

and suburban areas. The location of fulfilment centers and warehouses remains a crucial factor for businesses. However, the importance of the physical location has shifted from the demand of consumers to account for supply-chain reliability and logistical efficiency. Proximity to seaports, airports, and inland ports are the key factors to ensure the efficient delivery of goods (Pettersson et al., 2016).

Moving forward to the omnichannel model, the digital-physical connection has been re-emphasized. The distinction between online and brick-and-mortar shopping is blurred. There is a growing phenomenon that consumers shop online from a much broader stock then pick up the ordered goods from a specific point. Many retailers have started to adopt this omnichannel concept. Amazon, the e-commerce giant, has also caught up on this new type of ideology. The omnichannel marketing model is essentially to incorporate all shopping activity under one roof to shorten the process involved in stocking, dispatching and marketing.

Bakos' research predicted that various e-commerce categories would behave differently over time. Leisure travel had the highest percent of online sales followed by books, music, videos and software, computers and electronics, and apparel in 2000. Bakos further stated that consumables including food, beverages, supplies, health and beauty aids, and pet supplies were projected to have higher growth of online retail sales, followed by apparel, computers and electronics, while online retail sales of books, music, videos and the software sector was projected to fall. These trends highlight the differentiating effects of e-commerce on varying retail industries. The distribution of information goods such as newspapers, music, and videos is likely to be transformed from physical distribution systems to digital forms through the Internet (Bakos, 2001). The distribution of service retail such as restaurants, nail salons and grocery stores, is unlikely to be replaced because of the physical requirements.

2.4. Building a New Role for Retailing in Cities

Retail is a crucial component in sustainable growth of cities' built environment and urban economy. Retail is defined as a neighborhood's "third place", with homes representing the first and places of work as second (Oldenburg, 1999). Oldenburg believed a quality life requires balance in three realms of experience: the home, the workplace, and the third place. The third place is an informal public place offers a neutral ground for social connections, conversations with regular participants, and community life. Despite their importance, Oldenburg asserts that third places are steadily disappearing in American landscape because of suburbanization, urban renewal, and the mass media.

Ozuduru and Guldmann (2013) recognized and acknowledged the importance of retail planning in the context of the edgeless city[1]. They stated that retail development is essential in cities because it has provided goods and services; fostered employment and job growth; contributed to the local economy; generated income for local governments in the form of sales tax; and supported the livability and vitality of neighborhoods. Retail development certainly requires attentions from both public and private sectors.

Retail activity is an important part of daily life in cities and neighborhoods, and the spatial organization of contemporary urban spaces (Erkip, Kızılgün, & Mugan, 2013). Their research described retail spaces as at the core of the urban experience. The development of the retail industry caused much debates about the role of new retail forms in the viability of city centers. In metropolitan areas, retail structures are often

[1] The edgeless city is a sprawling form of development that accounts for the bulk of office space found outside of downtowns.

much more complex than in smaller city centers and have challenged the urban sustainability.

Following the changes in the size of the baby boomer and millennial demographics, it is expected to see a consumer behavioral shift in the current decade. A consumer behavioral shift in other words symbolizes a transformation in the functions of retails. Millennials will gradually overtake Baby Boomers as the largest America's generation in the late 2020s. As millennials will soon become the major purchasing power, demand for types of goods and services is different due to the different lifestyles millennials enjoy. Millennials value convenience and cost-efficiency, thus the conventional retail stores can no longer satisfy their needs. More and more consumers prefer online shopping because it is easy, convenient and cost-effective.

In the recent decade, there is an increasing formation of internet-based companies such as Amazon, Expedia, and Auto-by-Tel. The internet has allowed these new businesses to deliver products from manufacturers to consumers without going through wholesalers (Bakos, 2001). It greatly shortens the time and cost of production. On the other hand, the role of FedEx and UPS has become increasingly important to the e-retailers because of their expertise in delivery.

The Internet has created a wider platform for consumers to learn more about the products they buy and compare prices from different sources. More than 40% of consumers collect information from the Internet before they make purchases at the stores (Weitz & Whitfield, 2006). The role of brick-and-mortar stores has already changed since the development of e-commerce platform. Consumers will visit a physical store for the experience but may not necessary purchase from a store. Traditional retailers still play a vital role in the current retail market though, their existence become less significant to consumers.

2.5. Neighborhood Changes and Vitality

Monroe Sullivan and Shaw (2011) stated that changes in retail landscape may refashion neighborhoods and cities that would in a way gentrify the neighborhoods. They have analyzed the impacts of "commercial gentrification" on local retail logistics using Alberta Street, Portland as a case study. Their result highlighted that urban revitalization intervention, so-called "creative class" interventions, in the city had reshaped the ethnic nature and characters of the neighborhood. They urged city agencies to take notice of the changes in ethnic character of the neighborhoods when they introduced the concept of "creative class" into cities that could revitalize the industry.

Zukin (2004) further emphasized the changes of retail structure had significant impacts on the social class and ethnic character of the neighborhood. Residents were generally less comfortable with the changing ownership of retail stores in their neighborhood and to an extent felt pressured as their fears of displacement grew. Williamsburg and Harlem were used as case studies to explore the role of these new types of stores and services, namely boutiques, on the changing composition of retail and services as agents of change. The analysis highlighted the dramatic increases in small local chains and large chain stores, while the share of traditional local stores and services continued to decline. The media, state, private developers and quasi-public organizations believed that the influx of boutiques was a sign of urban revitalization.

A changing retail landscape had negative effects in some cases particularly in African American neighborhoods. The low-income residents identified the upscaling in urban space consumption with "white" interests as the changing landscape was perceived as a vivid image of commercial gentrification. Local communities called for attention to displacement of local retail stores and services which created the main

income sources for the lower-class residents in the neighborhood. The increasing value of commercial properties for boutiques subsequently drove the surrounding land and property prices up. As a result of these new shops, these gentrifying neighborhood experienced displacements of independent stores that had traditionally served the neighborhood's lower-income residents (Zukin, 2004).

The implications of business displacement extended beyond the storefront and might be a greater indication of gentrification (Patch, 2008). The emergence of new public character was vital and challenged the existing character of the affected neighborhoods. Storefronts as the "face of the street" provided surveillance and stability as well as the relationship between residents and strangers. Patch (2008) defined the concept of street gentrification as the visible manifestation of neighborhood transformation. The street now contained new types of businesses, hours of business operation, posters on the storefront, music playing out of windows, sidewalk occupancy and many other tangible features of street life that residents register as part of their daily lives experience. These experiences of place, concepts of space and attachment affected the relationships which residents establish, maintain, and nurture with the neighborhood. Changed to these geographic characteristics that were associated with the ethnic and social environment of the neighborhood highlighted the importance of retail.

2.6. Retail Resilience and Urban Policy

Resilience is a concept often used to describe how various systems respond to shocks which is established in three main contexts, physical, engineering and ecology (Dolega & Celińska-Janowicz, 2015). Much of the planning literature applies the concept of reliance to the retail sector and discusses its specificity in the town center context. Salgueiro and Erkip (2014) emphasized that retail district resilience was critical in

sustainability growth of cities and understood how it might contribute to a community's image, identity, satisfaction and cohesion. Shopping behaviors of individual were changed such that shopping had become a 'leisure experience' other than a basic activity to satisfy consumer needs, which led to increasing competitiveness in the retail market and changes in physical structures. Salgueiro and Erkip (2014) highlighted that the retail development and service supply at neighborhoods was closely tied with the neighborhood livability. Ozuduru and Guldmann (2013) stated that issues in retail planning and development had altered urban dynamics and highlighted the importance of retails in city revitalization. The decline of local retailers and the change of retail landscape in inner-city neighborhoods had a huge impact on retail employment and drove it to the urban fringe.

It is important to understand the impacts of retail development on community development and neighborhood change so that suggestions for stakeholders and city planners to maintain and improve retail district could be made. From an economic or social and urban perspective, the adaptive approach of understanding and measuring resilience was more appropriate as cities change restlessly. The purpose of analyzing the meaning of 'resilience' was to apply it to the understanding of the evolution of urban retail systems, and further modified and developed urban policies to reduce vulnerabilities and improve sustainability of city growth. Sustainable urban development would be enhanced with a collaborative approach between public sector policy-makers and private sector (Ozuduru & Guldmann, 2013).

3. METHODOLOGY

3.1. Study Area and Temporal Bounds

The research study area is New York City, covering all five boroughs, Manhattan (New York County), Queens (Queens County), Brooklyn (Kings County), Bronx (Bronx County), and Staten Island (Richmond County) as shown in Figure 2. Data used for analysis is aggregated to the ZIP code level.

Figure 2. New York City Zip Code Tabulation Areas

While the period of mid-nineteenth century saw a decentralization of retail activity to suburbs and the advent of "big-box" retailers, the retail industry experienced a turning point around 1994 when the first online transaction was processed. The most recent

data produced by U.S. Census Bureau for businesses and establishments is the County Business Patterns in 2015. The analysis will look at the changes of retail activity distribution from 1994 to 2015.

3.2. Data

Table 4 is the list of datasets used throughout the analysis of this study was to explore the changes of retail landscape in New York City over time. The complete ZIP Code Industry Detail File, known as ZIP Business Patterns (ZBP), is the primary source of data on retail and commercial activity used in this analysis. ZBP is the main dataset collected in the series of County Business Patterns (CBP) by U.S. Census Bureau. This series includes the number of establishment by industry, employment, and payroll that are useful for studying economic activity and analyzing economic changes over time. These datasets are publicly available online since early 1980s. Using public data ensures the consistency and coverage throughout the city with limited biases or focuses on particular areas. Most commercial and retail information and datasets are collected by private agencies for sale, as a type of information product. Private data is not free for use mostly and do not guarantee coverage throughout city or consistency over time. Therefore, most private datasets are not applicable for this study even if they provide more detail at a more granular level than public data. The other source of data used for analyzing the current retail store network is from Reference USA.

CBP provides subnational economic data by industry which are publicly available from 1986 to 2015, the most recent year. The availability and consistency is the primary reason using CBP for analysis. However, the detail of such data is less granular compared to private data. Such data are mostly aggregated to a point where no personal identifiers are available. CBP is aggregated to the ZIP code level which no data is linked nor traceable

to a particular store or street. This is a significant limitation of public data, though, it should still be sufficient to answer the research question at a general level.

CBP provides a record for each known establishment that is located in the United States, Puerto Rico and Island Areas. The definition of an establishment stated by U.S. Census Bureau is the following.

> "An establishment is a single physical location at which business is conducted or services or industrial operations are performed. An establishment is not necessarily equivalent to a company or enterprise, which may consist of one or more establishments. ("Business Dynamics Statistics Definitions," 2017)"

The dataset covers nearly 1,200 industries classified by the North American Industry Classification System (NAICS) from 1997, and the Standard Industrial Classification (SIC) prior to 1997. The primary source of industry classification is derived from Economic Census, or other Census surveys.

NAICS is the standard used by Federal statistical agencies in classifying establishments in nearly 1,200 industries. This system categorizes establishments by 2- to 6-digit codes at different levels of precision. Because this research focuses on retail activity, Retail Trade (NAICS 44-45), and restaurants (NAICS 722) are chosen as shown in Table 2.

SIC has been used for business establishment classification prior to 1997 and replaced by NAICS in most capacities. Different from NAICS, SIC categorizes establishments in 10 divisions and 99 major groups. Division G: Retail Trade (Major Group 52 – 59) of CBP from 1994 to 1997 from SIC is chosen for analysis to explore retail changes. Group 52-59 is cross-referenced with the NAICS 44-45 and NAICS 722 group to maintain data consistency for analysis.

Bakos' research predicted that different e-commerce categories have performed significantly different over time. As e-commerce has different sales penetration and is

expected to have different impacts on various industries, different sectors will be compared to look at the actual impacts in New York City. Restaurants, hardware stores and bookstores are chosen to compare the changes over time. This research begins with an analysis of current retail store network in 2017 and studies the correlations between retail and neighborhood characteristics.

As the most recent ZBP published by U.S. Census Bureau is up to 2015, the retail data in 2017 is collected from Reference USA for the purpose of analysis. As the retail sector has experienced tremendous changes in the recent years, using data in 2017 will provide a better understanding of current retail store network. Reference USA follows both the SIC and NAICS classification system and aggregates data to the ZIP code level. Thus, retail data can be viewed and used for analysis.

The next section is an analysis of New York City's retail change since 1994. Changes to the retail landscape are measured by the differences in retail trade and three specific industries: restaurants, hardware stores and bookstores. The subcategories within each sector are shown in Table 3 in NAICS group and its corresponding SIC group. Each NAICS code is cross-referenced through NAICS Association to match with the corresponding SIC code.

DIVISIONS	MAJOR GROUPS	SECTORS
A	01 – 09	Agriculture, Forestry, and Fishing
B	10 – 14	Mining
C	15 – 17	Construction
D	20 – 39	Manufacturing
E	40 – 49	Transportation, Communications, Electric, Gas, and Sanitary Services
F	50 – 51	Wholesale Trade
G	52 – 59	Retail Trade
H	60 – 67	Finance, Insurance, and Real Estate
I	70 – 89	Services
J	91 – 99	Public Administration

Table 1. SIC System

CODE	SECTORS
44	Retail
441	Motor vehicle and parts dealers
442	Furniture and home furnishings stores
443	Electronics and appliance stores
444	Building material, garden equipment
445	Food and beverage stores
446	Health and personal care stores
447	Gasoline stations
448	Clothing and clothing accessories stores
451	Sporting goods, hobby, book, and music stores
452	General merchandise stores
453	Miscellaneous store retailers
454	Nonstore retailers
722	Food service
7221	Full-service restaurants
7222	Limited-service eating place
7223	Special food services
7224	Drinking places (alcoholic beverages)

Table 2. NAICS System

CODE	SECTORS
	Bookstores
NAICS 451211	Book Stores
SIC 5192	Books, Periodicals, and Newspapers
	Hardware Stores
NAICS 444130	Hardware Stores
SIC 5072	Hardware
SIC 5251	Hardware Stores
SIC 7699	Repair Shops and Related Services, not elsewhere classified
	Restaurants
NAICS 722	Food Service
SIC 5812	Eating Places

Table 3. Subcategories for NAICS and SIC

Variable	Dataset	Geography	Source
Retail Stores	Complete ZIP Code Industry Detail File	ZIP Code	U.S. Census Bureau (1994 – 2015)
Retail Stores		ZIP Code	Reference USA (2018)
Hardware Stores	Complete ZIP Code Industry Detail File	ZIP Code	U.S. Census Bureau (1994 – 2015)
Hardware Stores		ZIP Code	Reference USA (2018)
Book Stores	Complete ZIP Code Industry Detail File	ZIP Code	U.S. Census Bureau (1994 – 2015)
Book Stores		ZIP Code	Reference USA (2018)
Restaurants	Complete ZIP Code Industry Detail File	ZIP Code	U.S. Census Bureau (1994 – 2015)
Restaurants		ZIP Code	U.S. Census Bureau (1994 – 2015)
Total Population	2016 American Community Survey 5-year Estimate	Census Tracts	U.S. Census Bureau
Millennial Population	2016 American Community Survey 5-year Estimate	Census Tracts	U.S. Census Bureau
Household Incomes	2016 American Community Survey 5-year Estimate	Census Tracts	U.S. Census Bureau
Foreign-born Population	2016 American Community Survey 5-year Estimate	Census Tracts	U.S. Census Bureau
Land Use	MapPLUTO	Tax Lot	NYC Department of City Planning
New York City ZIP Code	NYC ZIP Code Boundaries	ZIP Code	NYC Department of City Planning
Census Tracts		Census Tract	NYC Department of City Planning

Table 4. Summary of data used

3.3. Analyzing Retail Store Networks in New York City

To answer the first research question, "what is the current retail store network in New York City?", summary statistics for each measured sector is calculated to

compare them. For each industrial group, retail density (establishments per acre) is calculated and mapped using geographic information system (GIS). ZIP Code is designed by U.S. Postal Service (USPS) for delivery efficiency to represent groups of delivery points. In fact, the USPS does not define boundaries for ZIP Codes.

As defined by U.S. Census Bureau, "ZIP Code Tabulation Areas (ZCTAs) are generalized area representation of U.S. Postal Services (USPS) ZIP Code service areas. Simply put, each one is built by aggregating the Census 2000 blocks, whose addresses use a given ZIP Code, into a ZCTA which gets that ZIP Code assigned as its ZCTA code("ZIP Code™ Tabulation Areas (ZCTAs™)," 2017)." As the land area of each ZCTA varies widely, comparing the count of establishments in each category may be misleading. Hotspot analysis of establishments is performed to identify areas of retail cluster in the city for each sector. Because in hotspot analysis, the land area of each ZCTA does not matter as the absolute count of establishment will be used.

As described in "Chapter 2. Literature Review", retail activity across neighborhoods in New York City is expected to have different patterns. The amount and type of retail activity will vary by types of consumers, purchasing power, and store costs. The changing consumer behavior of millennials may show impacts on the retail landscape of the neighborhood. Meltzer and Schuetz (2012) found that low-income neighborhoods had lower densities of establishments, while ethnically diverse neighborhoods to the contrary had a more diverse retail landscape. To identify patterns between neighborhood characteristics and retail activity, millennial population, foreign-born population, and land use will be mapped and overlay with establishment network.

Millennial population will soon replace the Baby Boomers as the largest age group in the current decade. The influx of millennial population into a neighborhood may lead to shift in the retail diversity as they have a different consumer behaviors.

Thus, it is chosen to compare with the retail density to observe the correlation between these two variables. In addition, foreign-born population is observed to show if ethnically diverse neighborhoods will have a different retail network in comparison.

Millennial population, and foreign-born population data are aggregated to the census tract level by U.S. Census Bureau. To get a better understanding of neighborhood characteristics and retail activity, data will be aggregated to the neighborhood level. They are defined as neighborhood tabulation areas.

3.4. Measuring Retail Change Over Time

To understand how the retail landscape has changed over time, the changes in retail activity will be measured by the difference between total number of retail establishment in 1994 and 2015, rather than measuring annual changes. Annual changes tend to be relatively small and somewhat messy to observe major differences. As such, annual changes in retail presence will be plotted in a line chart to observe the general trend of its growth. The growth rate of retail establishment will be calculated using a standard measure:

$$\%\ \boldsymbol{change} = \frac{(\boldsymbol{Retail_{i,15}} - \boldsymbol{Retail_{i,94}})}{\boldsymbol{0.5} * (\boldsymbol{Retail_{i,15}} + \boldsymbol{Retail_{i,94}})} * \boldsymbol{100}$$

$Retail_{i,15}$ is the retail metric in industry *i* in 2015 and $Retail_{i,94\ is}$ the retail metric in industry *i* in 1994. As Meltzer and Schuetz (2012) have discussed in their research methodology, using a standard measure can reduce potential measurement error associated with large deviations. This growth rate provides a symmetric growth rate over time. Using data that have been collected and aggregated 20 years ago, it is likely that there will be some level of discrepancy.

Using GIS, the establishment data will be mapped to the ZIP-code level for retail trade, restaurants (eating places), hardware stores and bookstores. Hardware stores and bookstores are product-based establishments, while restaurants are service-based establishment. Many news reports stated that the product-based establishments are affected by e-commerce more severely than service-based establishment because they are easily replaced by e-retailers. Therefore, these three retail categories are chosen for analysis. In each ZCTA, the growth rate calculation will be performed to observe area with greater growth or loss over time.

4. RESULTS

In this section, summary statistics of the various retail sectors, spatial representation of retail activity over time and neighborhood characteristics are presented to describe the amount, types and changes of retail store network in New York City. Neighborhoods with greatest change over time are further analyzed.

4.1. Retail Store Network in New York City

The following tables and figures are the representation of retail store network in New York City in association with neighborhood characteristics in 2017. Figure 3 is a spatial representation of the number of retail establishment in each ZCTA in New York City. It shows that all New York City's neighborhoods have some amounts of retail activity in 2017. As all neighborhoods are mixed-use, with some have more residential coverage, there are no entirely residential neighborhoods in New York City as shown in **Error! Reference source not found.**. Most retail stores cluster at high-density r esidential and commercial neighborhoods.

Table 5 further breaks down the number of establishment in each sector that are covered in the retail trade and restaurants. As one business may have more than one NAICS code assigned, the sum of establishment number in each sector is larger than the total number of establishment in retail trade. As shown, the most active retail sector is clothing and clothing accessories stores, and the following is miscellaneous store retailers including florists, office supplies, stationery and gift stores, used merchandise stores and new specialty store merchandise. Overall, there is a good mix of retail activity across sectors.

However, there are considerable variations in the quantity of retail activity across the city as shown in Figure 4. Retail density in 2017, measured by retail density, establishment count over land area in acreage. It is because neighborhoods across the city have different types of land use, demographics and socio-economic status of households. Figure 5 shows the hotspot analysis of retail establishment across the city to determine area of retail clusters. The most active neighborhoods commercially are all in Midtown and Lower Manhattan. Brooklyn has signs of a growing retail store network, particularly in waterfront neighborhoods like Williamsburg, Brooklyn Height and Dumbo. Similar to Brooklyn, waterfront neighborhoods in Queens like Long Island City has relatively higher retail density than neighborhoods further away from the waterfront and Manhattan. Midtown Manhattan has the strongest retail network and serves as a commercial core, while the retail density gradually decreases from Midtown.

Figure 6 and Figure 7 are comparisons of retail density to foreign-born population and millennial population respectively. In general, the population of millennials are fairly widespread throughout the city. Midtown, West Harlem, Williamsburg, Greenpoint and Long Island City has higher population of millennials. As shown in Figure 6, millennial population is seemingly higher in neighborhoods with

higher retail density. On the other hand, there are clustering neighborhoods with high percentage of foreign-born population and low retail density in Queens and Brooklyn as shown in Figure 7. Neighborhoods with highest retail density have the lowest percentage of foreign-born population. These patterns are mostly shown in Manhattan, Brooklyn and Queens.

Staten Island and Bronx do not show relevant patterns between retail density, millennial population and foreign-born population. These two boroughs have low retail density overall. However, the existence of Manhattan commercial core might largely swamp the analyzed result for outer boroughs. The analyses look at a smaller geographic scale to testify the correlation between retail density, millennial population and foreign-born population. Figure 9, Figure 10, Figure 11 and Figure 12 are comparisons of retail density to the two chosen demographic variables in Staten Island, Brooklyn, Bronx and Queens respectively. Results presented in each borough are similar to the conclusion from the city as a whole. Staten Island and Bronx has no clear relationship between the chosen variables.

Code	Sector	Number of Est
44-45	Retail Trade	39,954
441	Motor vehicle and parts dealers	2,327
442	Furniture and home furnishings stores	3,537
443	Electronics and appliance stores	3,762
444	Building material, garden equipment	3,169
445	Food and beverage stores	9,364
446	Health and personal care stores	6,060
447	Gasoline stations	1,135
448	Clothing and clothing accessories stores	12,066
451	Sporting goods, hobby, book, and music stores	3,157
452	General merchandise stores	2,130
453	Miscellaneous store retailers	11,417
454	Nonstore retailers	7,575
722	Food service	29,405
7225	Restaurants and Other Eating Places	25,577

Table 5. Establishment count for each retail sector

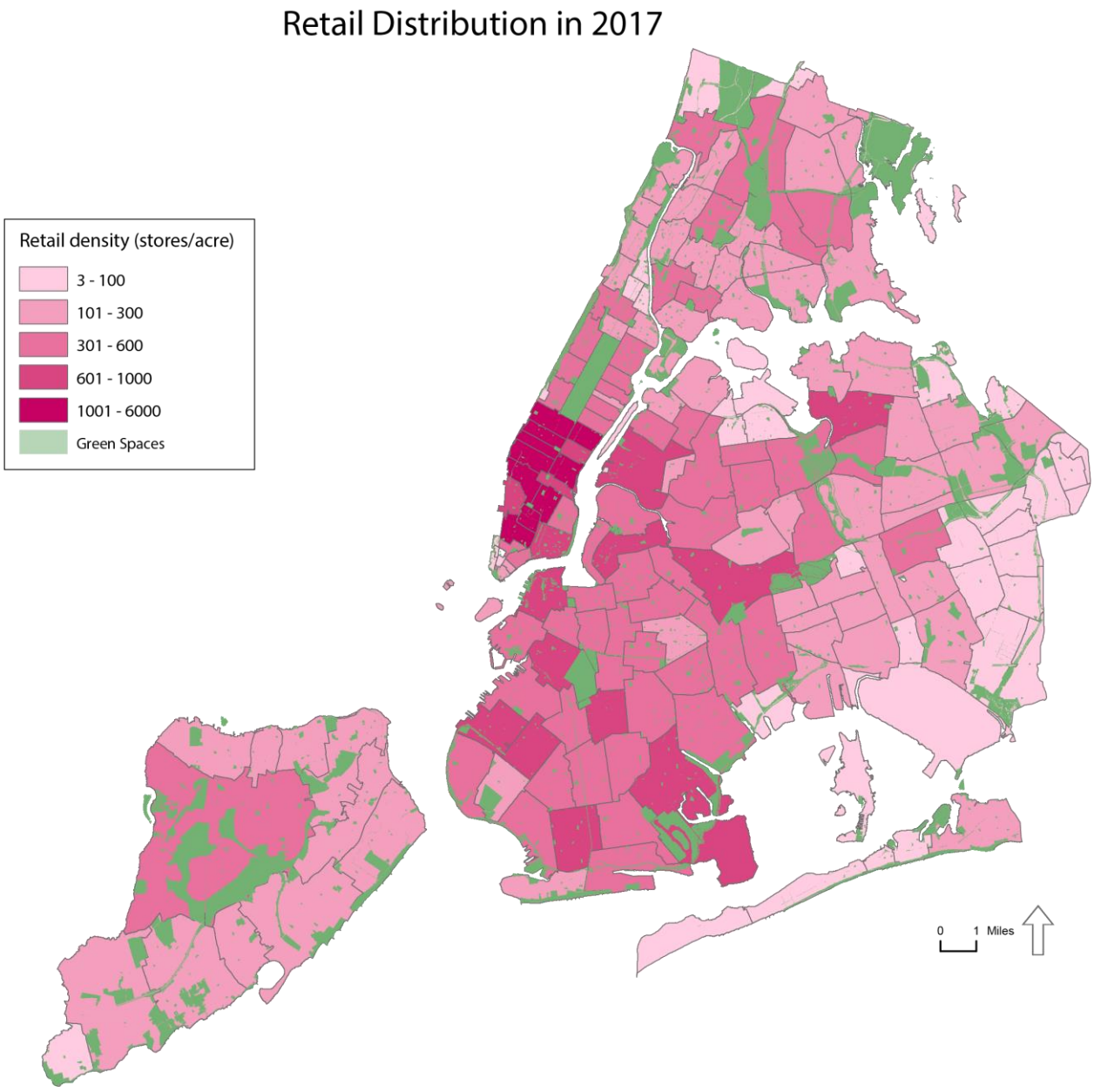

Figure 3. Retail distribution in 2017

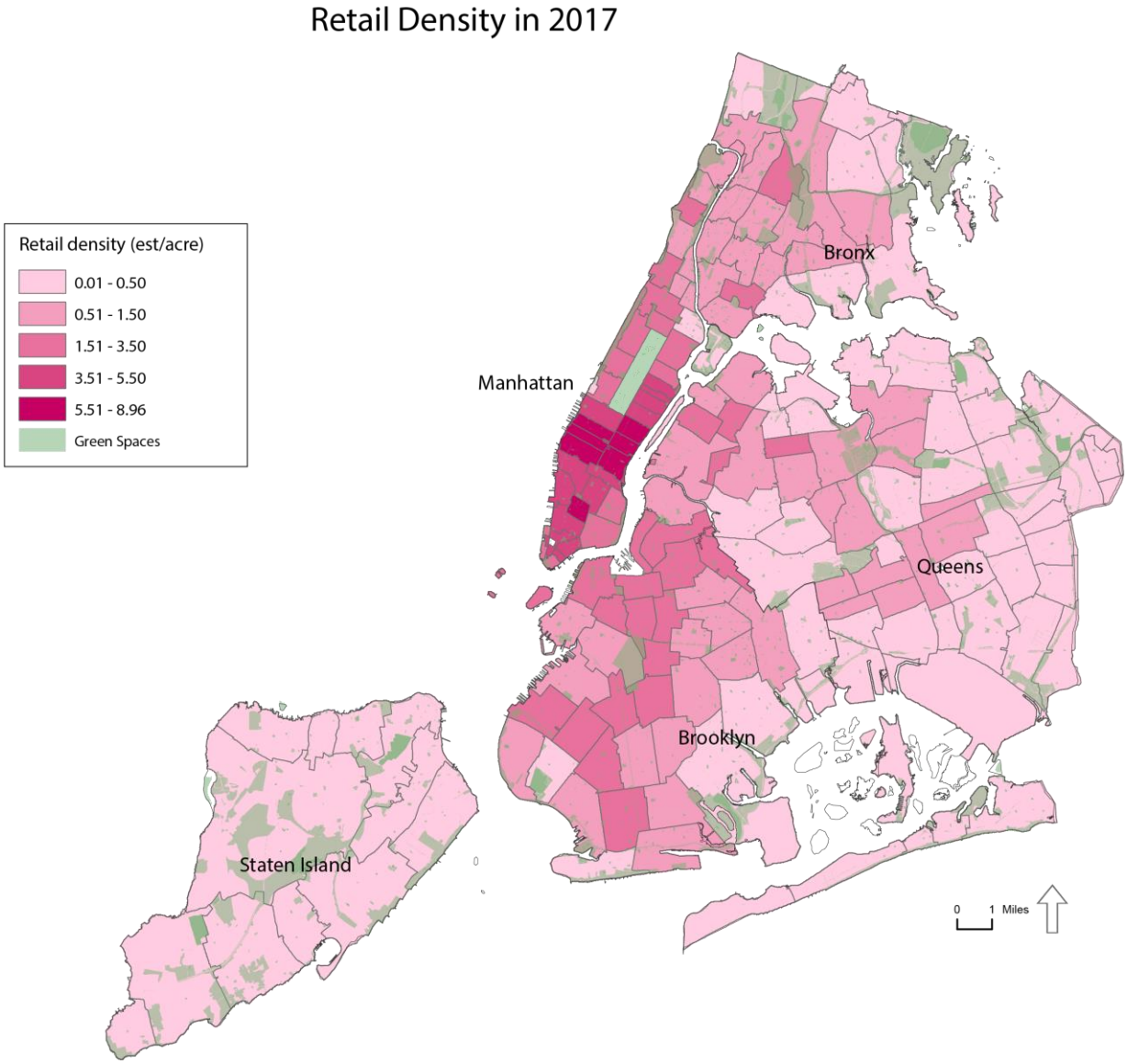

Figure 4. Retail density in 2017

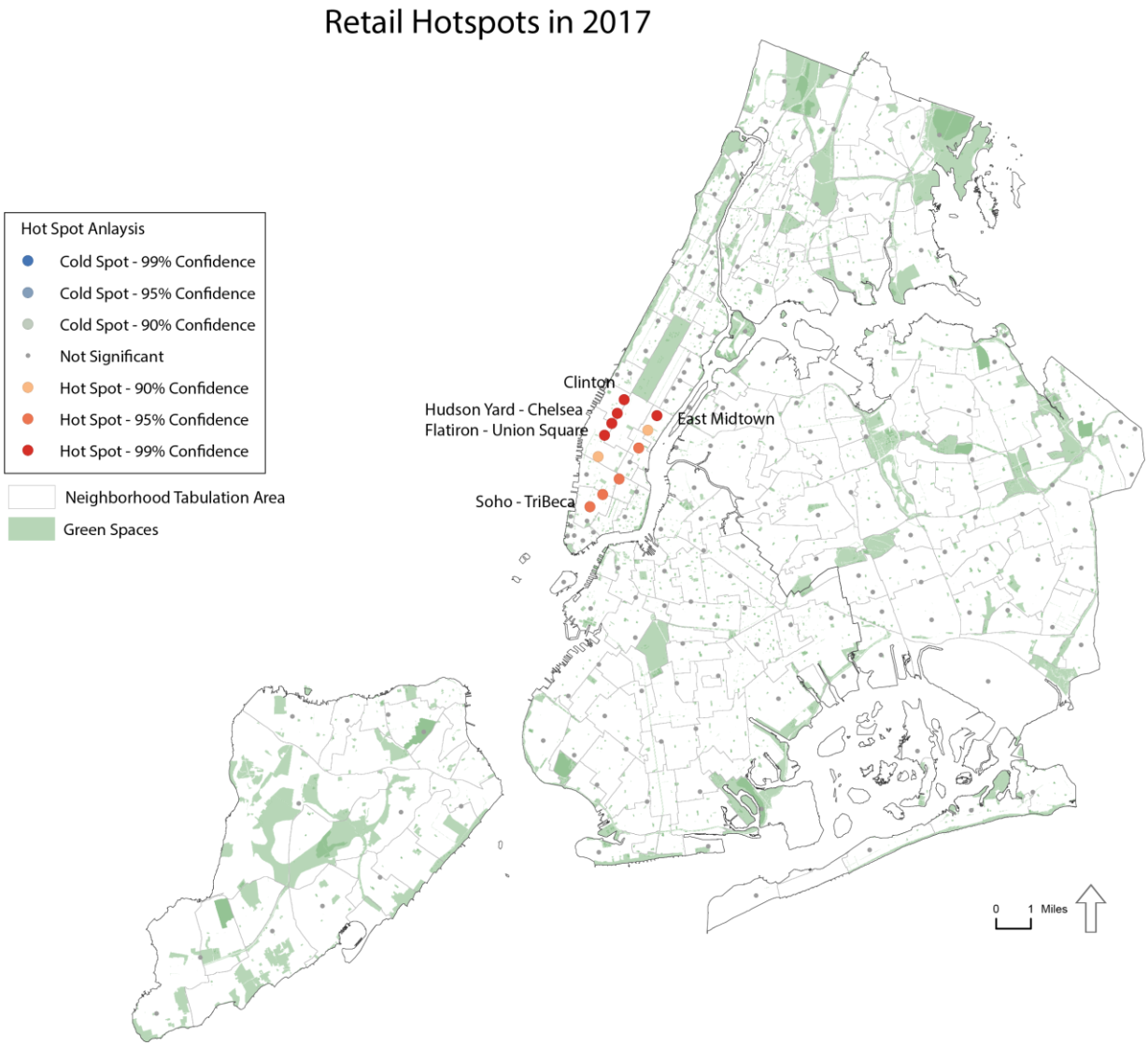

Figure 5. Retail hotspots in 2017

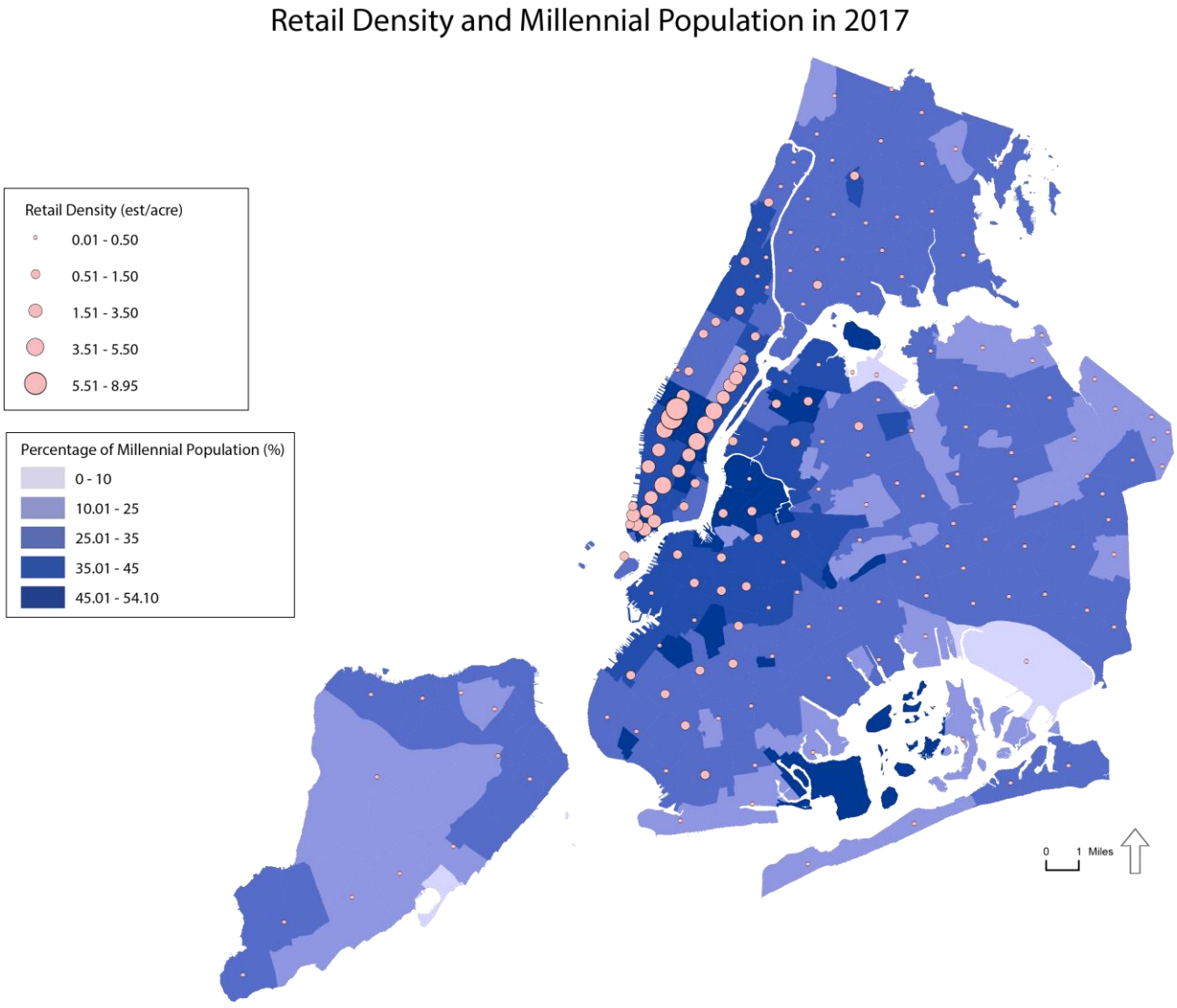

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Figure 6. Retail density and millennial population in 2017

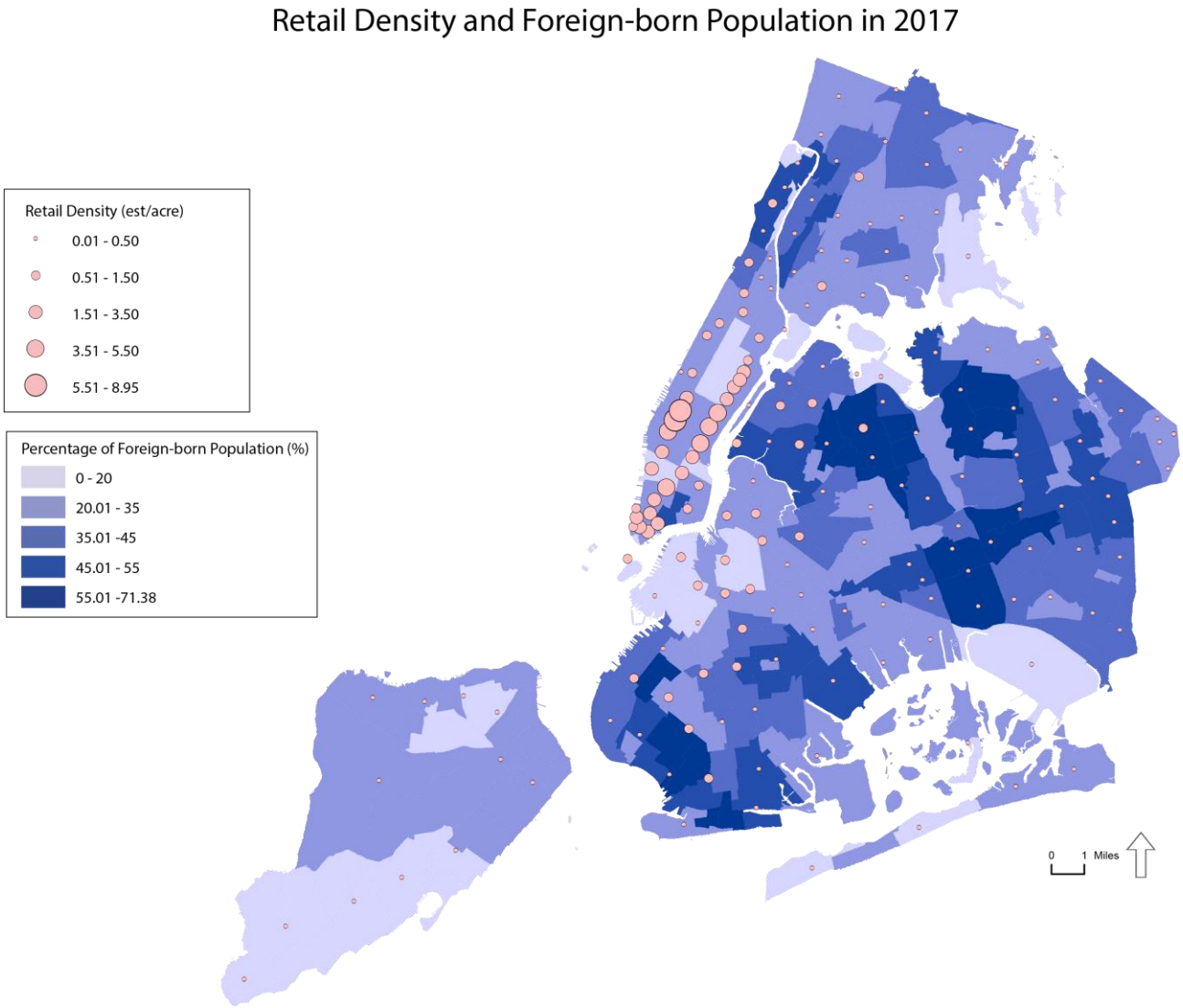

Figure 7. Retail density and foreign-born population in 2017

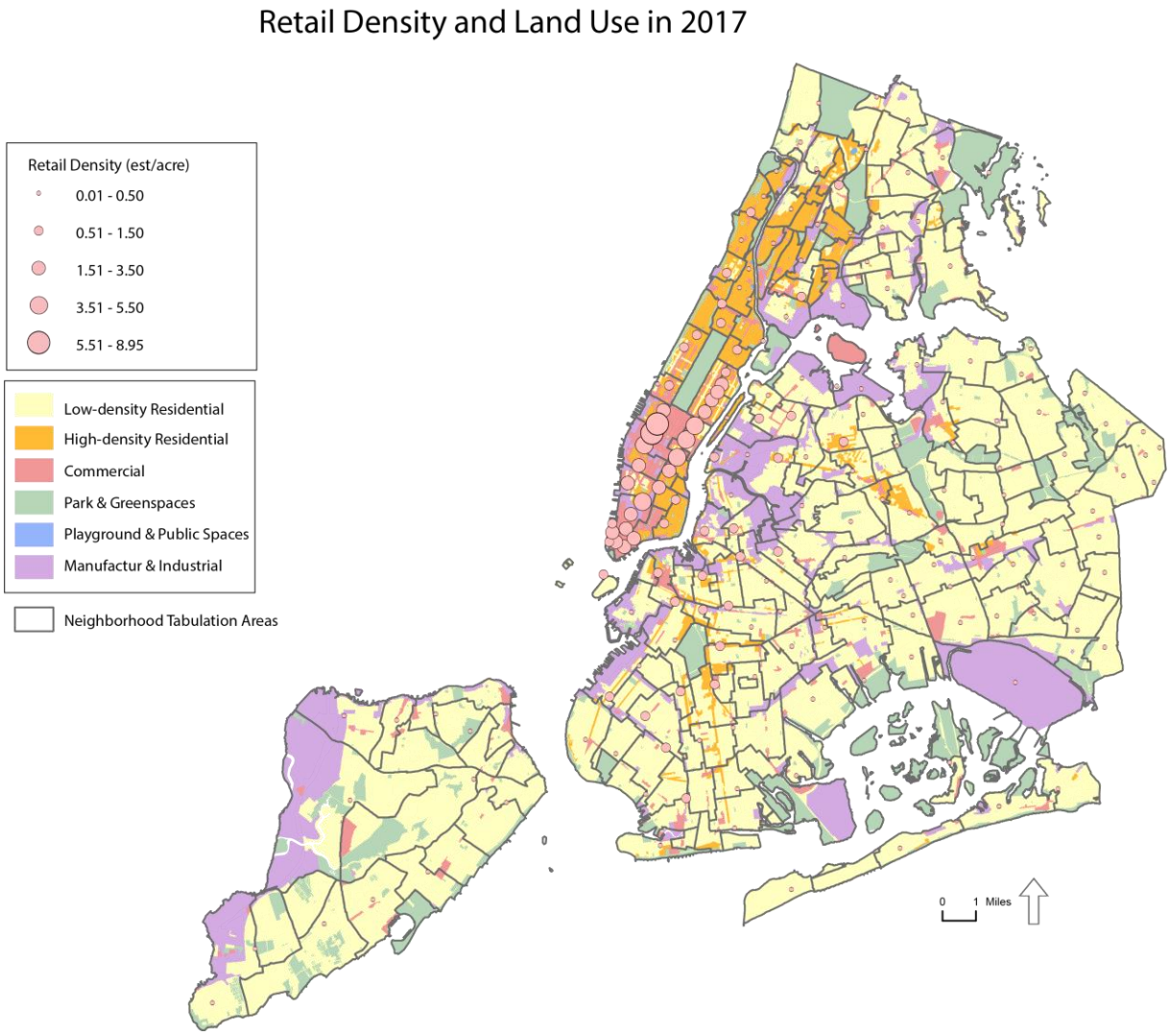

Figure 8. Retail density and land use in 2017

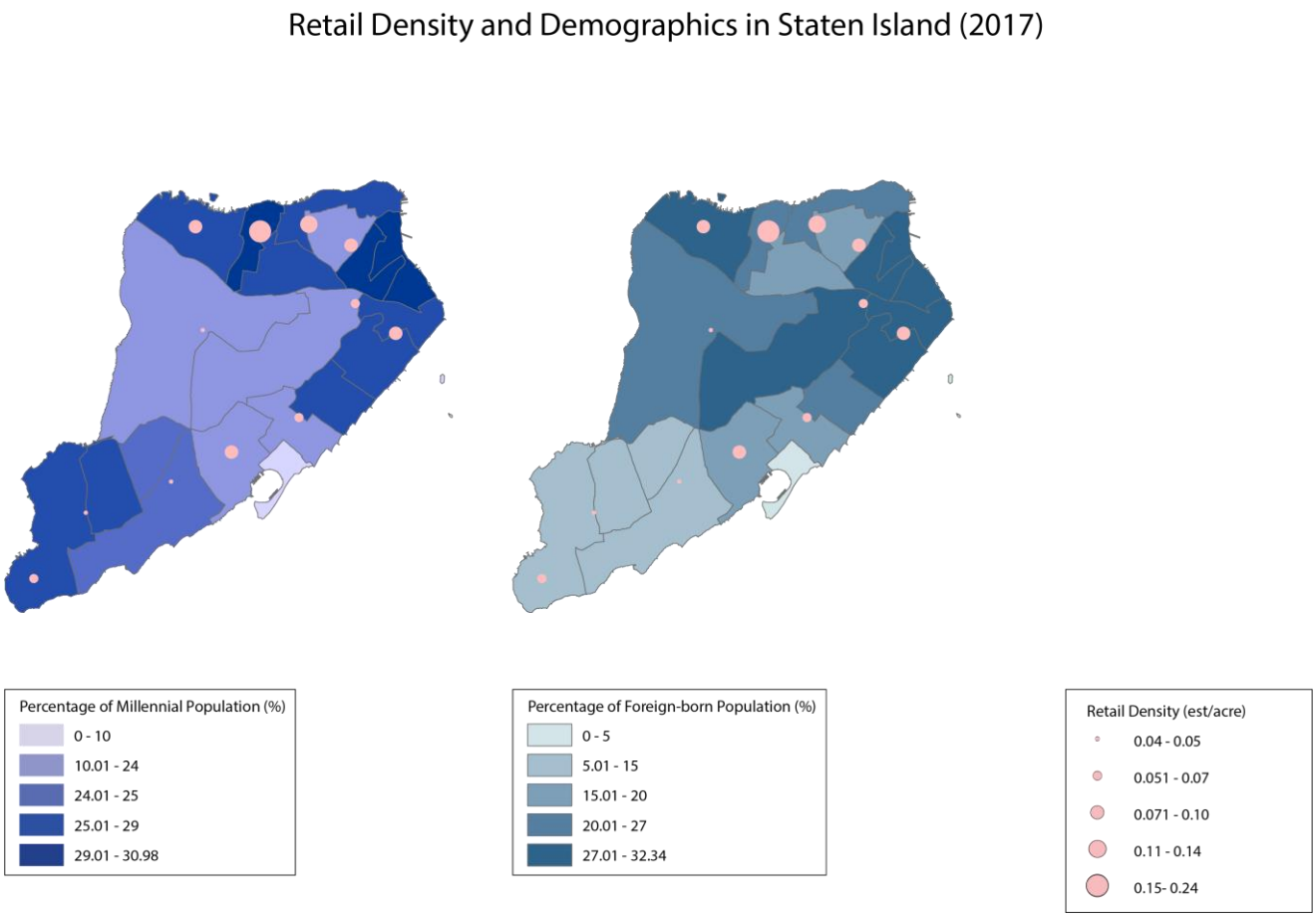

Figure 9. Retail density and demographics in Staten Island

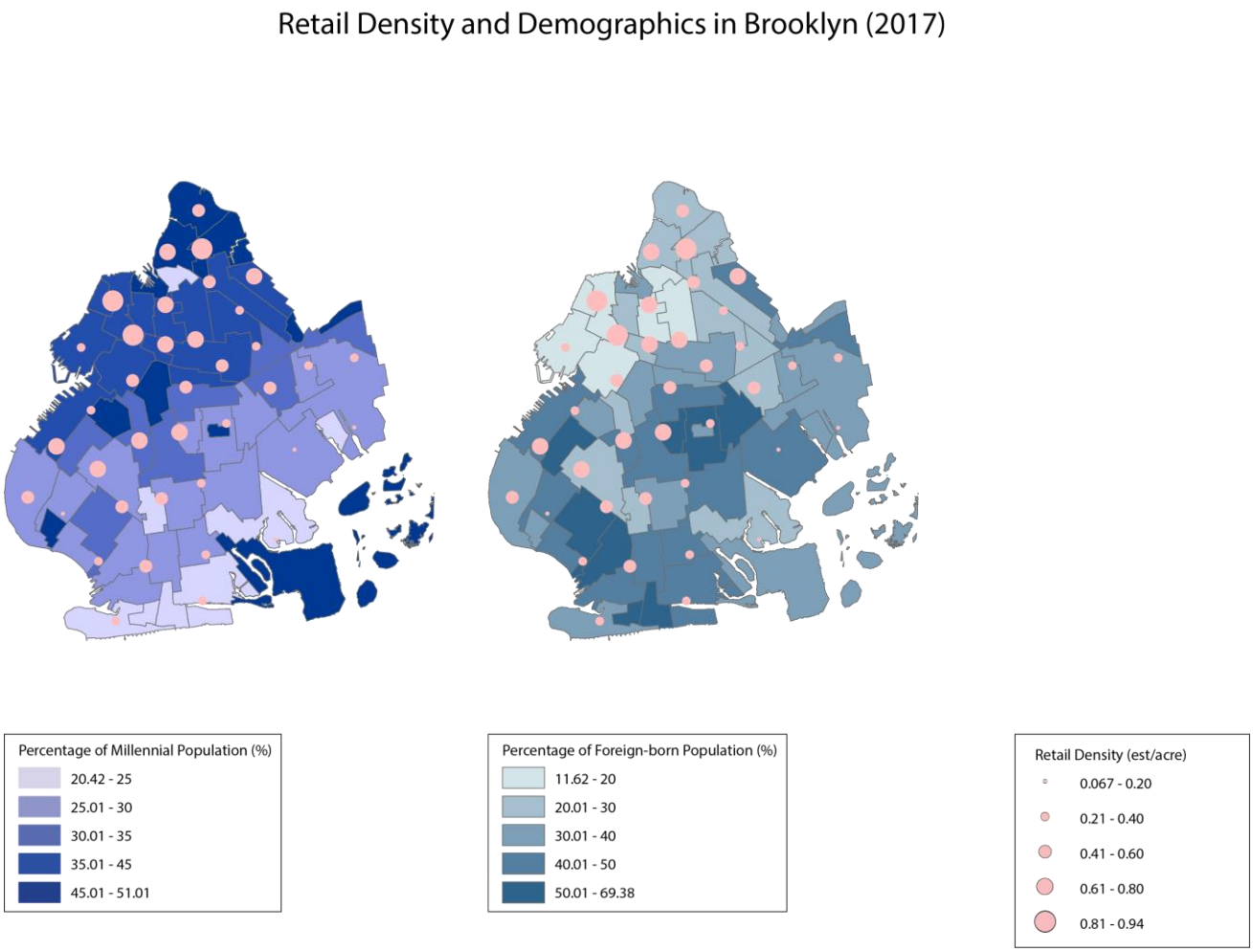

Figure 10. Retail density and demographics in Brooklyn

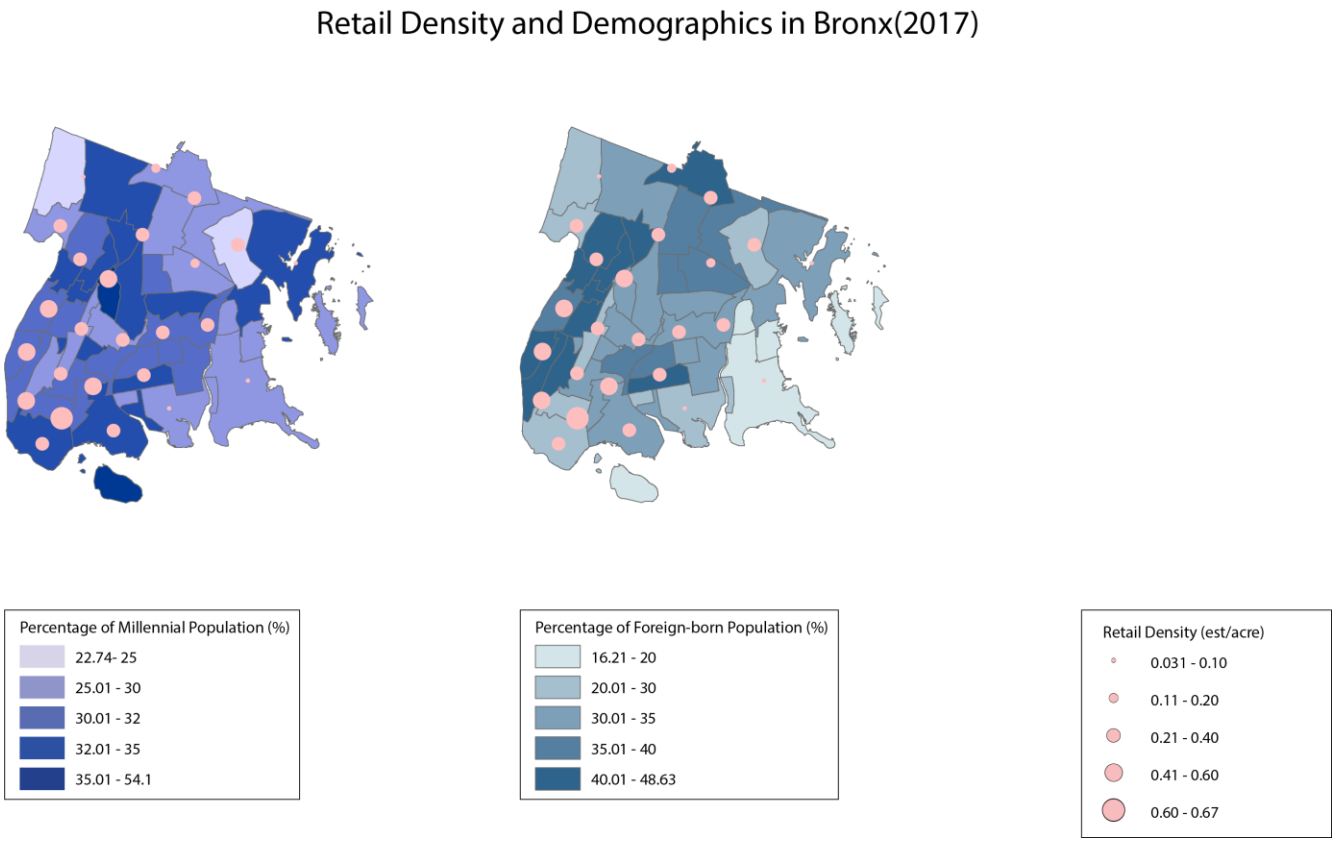

Figure 11. Retail density and demographics in Bronx

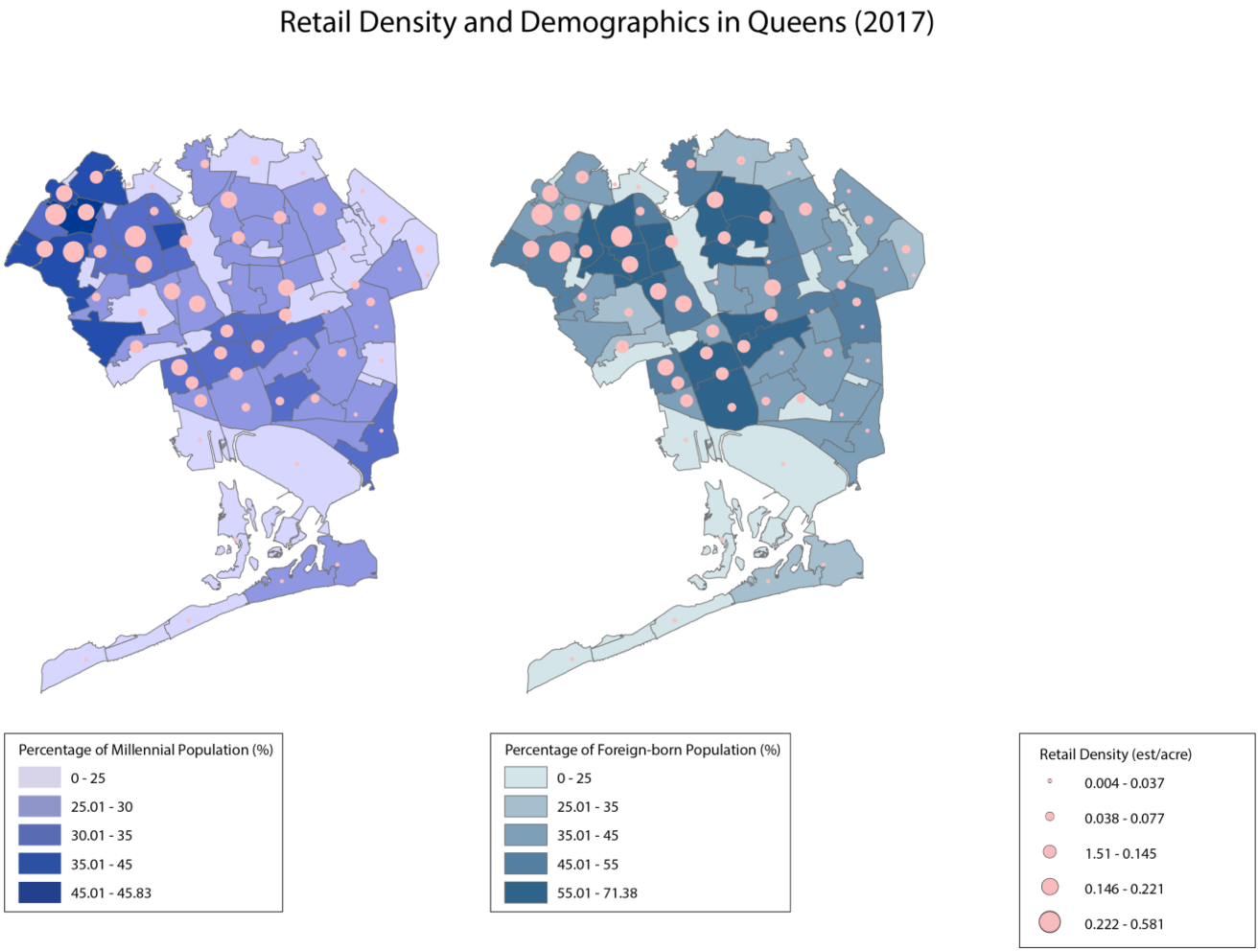

Figure 12. Retail density and demographics in Queens

4.2. Changes in Retail Activity Over Time

The following tables and figures are the results of changes in retail from 1994 to 2015 for the entire New York City. Three subcategories in the retail trade, restaurants (food services), hardware stores and bookstores are chosen for comparison. As mentioned in the "Literature Review" section, e-commerce has a various degree of impacts on different retail sectors in terms of service-based sectors and product-based sectors. Consumer demands have shifted from buying goods to dining out. Hardware stores and bookstores are seemingly the most impacted sectors.

Table 6, Table 7, Table 8 & Table 9 present the growing trends of retail trade, restaurants, bookstores and hardware stores from 1994 to 2015 respectively. The results

are presented in absolute values of each year's establishment counts, rather than the percentage differences. As mentioned in the "Methodology" section, the most updated ZBP dataset is 2015, and the most recent retail is provided by Reference USA. To ensure data consistency, only datasets from the same source are used for comparison. Data up to 2015 are used for observing patterns in retail change over time.

Even though using the same dataset from the same source, there are issues with data consistency due to the variations in retail classification. As shown in Table 9, there is a significant drop in hardware stores from 1998 to 1999. One reason could be the possibility of some major events regarding hardware store development in the year of 1998. However, the issue in this case is most likely due to the change of SID system to NAICS system in 1997. The change from SID code to NAICS code may result in different definitions and classifications of hardware establishment. Therefore, the result of hardware store growth is unreliable in this case.

Overall retail trade has experienced a significant increase of 18,000 in total number of establishment in the whole city since 1994 as shown in Table 6. Food service sector, (restaurants) has experienced a significant growth over time. The total number of restaurant establishment has doubled, whilst bookstores have been gradually decreasing since 1994. By calculating the standardized percentage change, retail trade has steady increases over time across the city as shown in **Error! Reference source not found.**. B rooklyn overall has more significant increase in retail trade compared to the other boroughs. Neighborhoods including Hudson Yard, Long Island City, Williamsburg and Sunset Park have experienced substantial increases over time. The contributing factor is most likely the rezoning/upzoning of these neighborhoods to allow a greater mix of uses and foster developments. Neighborhoods including Lower East, Upper East, East Harlem, North Riverdale, Eastchester, and Oakland have undergone retail declines over time.

Neighborhoods surrounding World Trade Center such as Chinatown are impacted by 911 and rapid growth of SoHo. While neighborhoods of SoHo and World Trade Center have both attracted retail developments from nearby neighborhoods. Considering the rezoning efforts in East Harlem, it is interesting to see that East Harlem has experienced a retail decline over time which would require a finer analysis on the neighborhood to examine the driving forces behind it.

In terms of food service industry, the entire city has experienced significant increases of 75% over time. Half of the neighborhoods in New York City have more than 100% growth since 1994, in particular Brooklyn and Bronx. The result emphasizes the expansion of service-based industry. To the contrary, bookstores have an overall decline of 78% over time. There is a significant number of neighborhoods have no bookstores at all. However, the number of bookstores in most neighborhoods is very small to begin with, when there is a slight addition or closure, the percentage change becomes extremely significant. For example, there are various neighborhoods have a 200% decrease. These neighborhoods mostly have one bookstore existed in 1994 and closed over time. Long Island City is one of the few neighborhoods that is considered to experience a significant decrease in bookstores, while the number of retail stores and restaurants has increased substantially over time.

Figure 16, Figure 17 & Figure 18 examines the relationship between retail density and restaurants, hardware stores and bookstores in 2017 respectively. As the 2017 data is collected by reference USA, to avoid data inconsistency the comparison between chosen retail subcategories is performed for the year of 2017 only. The change of retail from 2015 to 2017 is unable to be executed for the same reason. In general, neighborhoods with higher retail density also have high restaurants, hardware stores and bookstores density. In general sense, it indicates that in majority of neighborhoods

with retail activity, there is a seemingly good mix of retail types. However, this statement will require a more detailed analysis of each retail sub-sector to support. Because the number of restaurants is substantially greater than the other two sectors, the clustering of restaurants tends to be more spread out. These three chosen subcategories of retail trade show a similar pattern of clustering. Outer boroughs except Brooklyn are generally much weaker in retail performance with lower density and possess no retail clustering.

In sum, retail trade establishments in New York City have been growing and expanding across the city over time, particularly the food service industry. It is true that under the impact of e-commerce and various other factors, product-based establishments such as bookstores and hardware stores are shrinking quantitatively and spatially. Overall retail activity has not showed signs of slowing down in future development.

Table 6. Growth in retail trade from 1994 - 2015

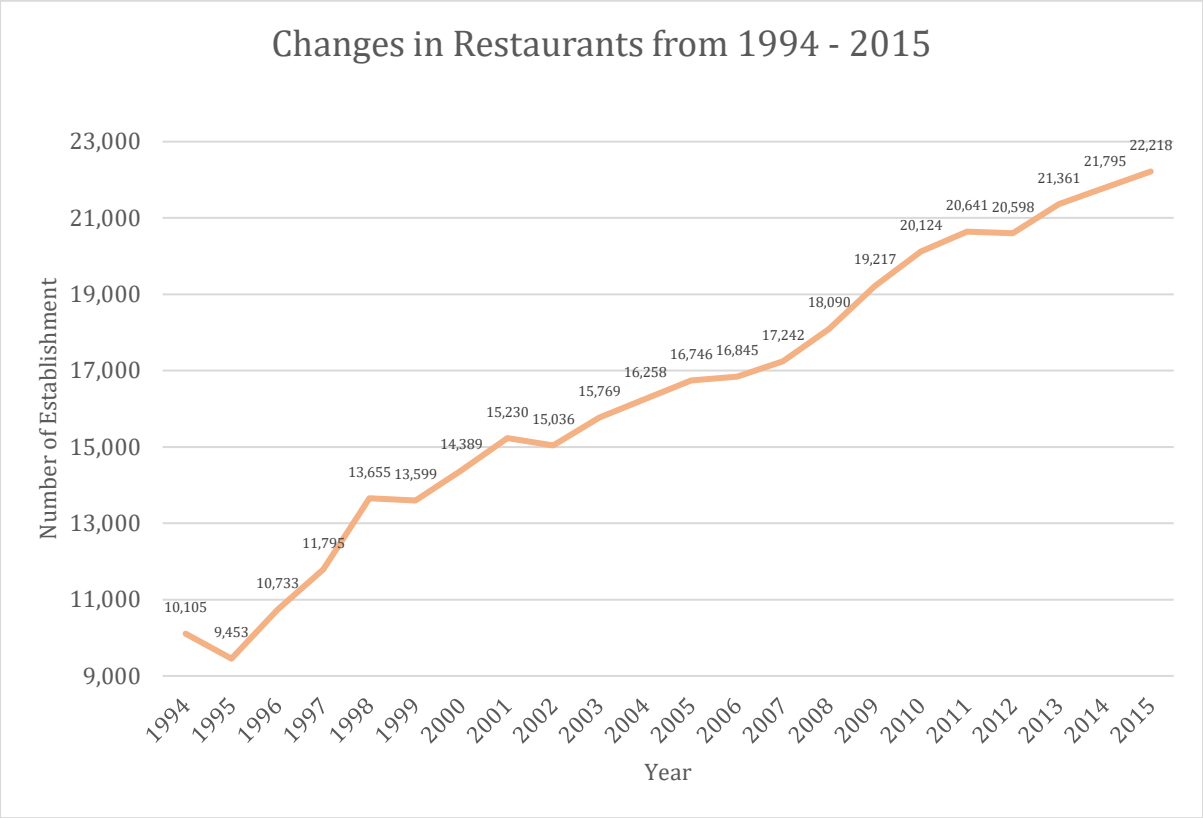

Table 7. Changes in restaurants from 1994 – 2015

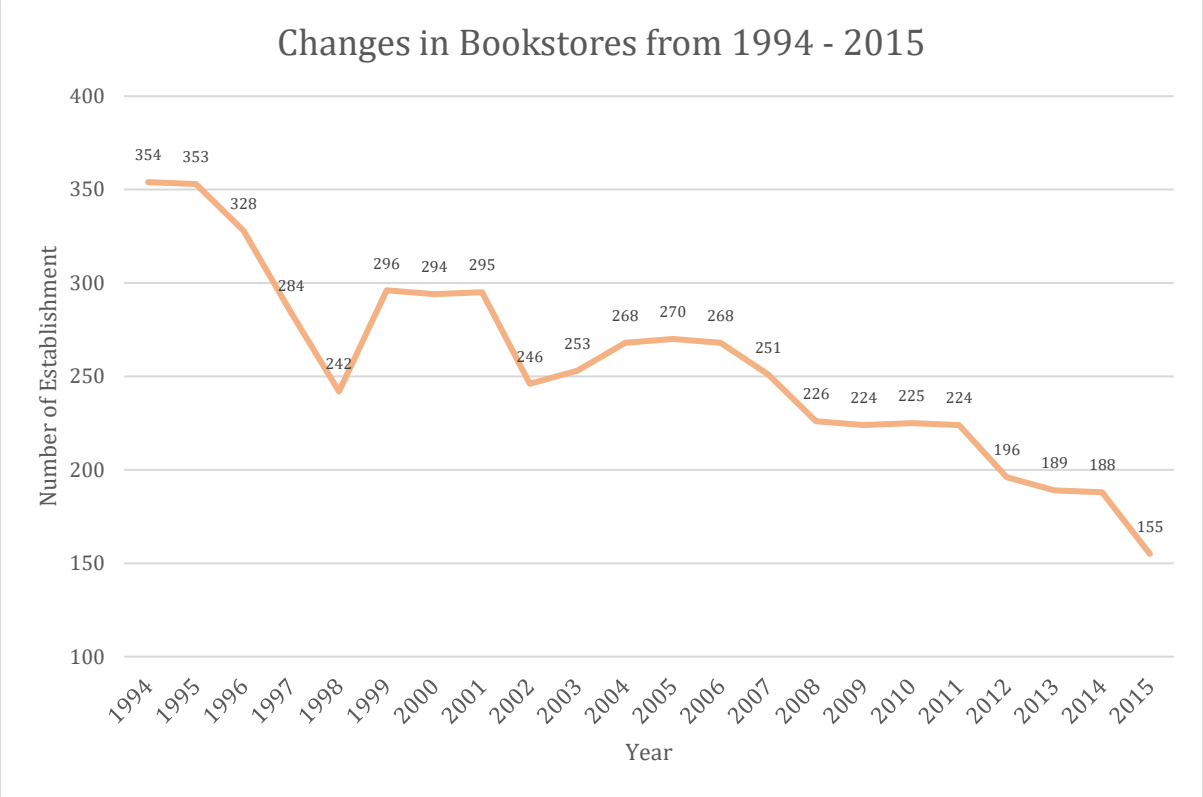

Table 8. Changes in bookstores from 1994 - 2015

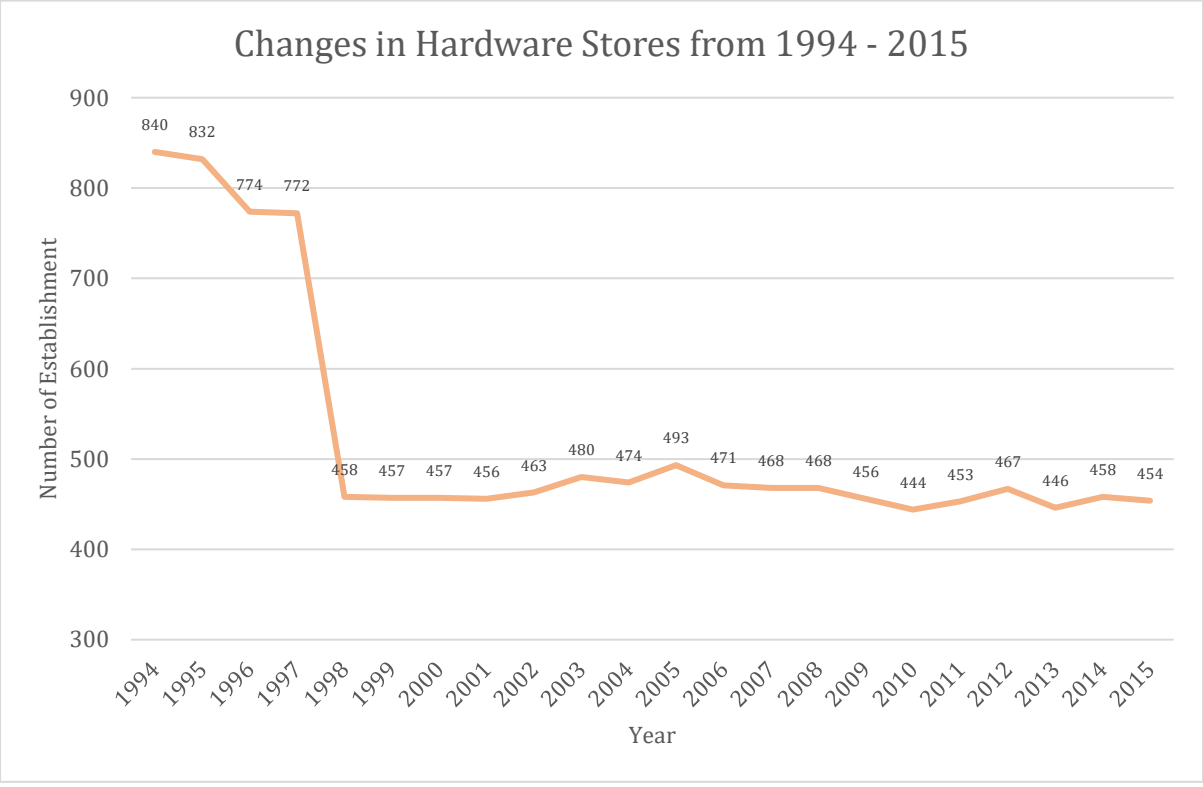

Table 9. Changes in hardware stores from 1994 - 2015

Standardized Percentage Change of Total Retail Establishment Count from 1994 to 2015

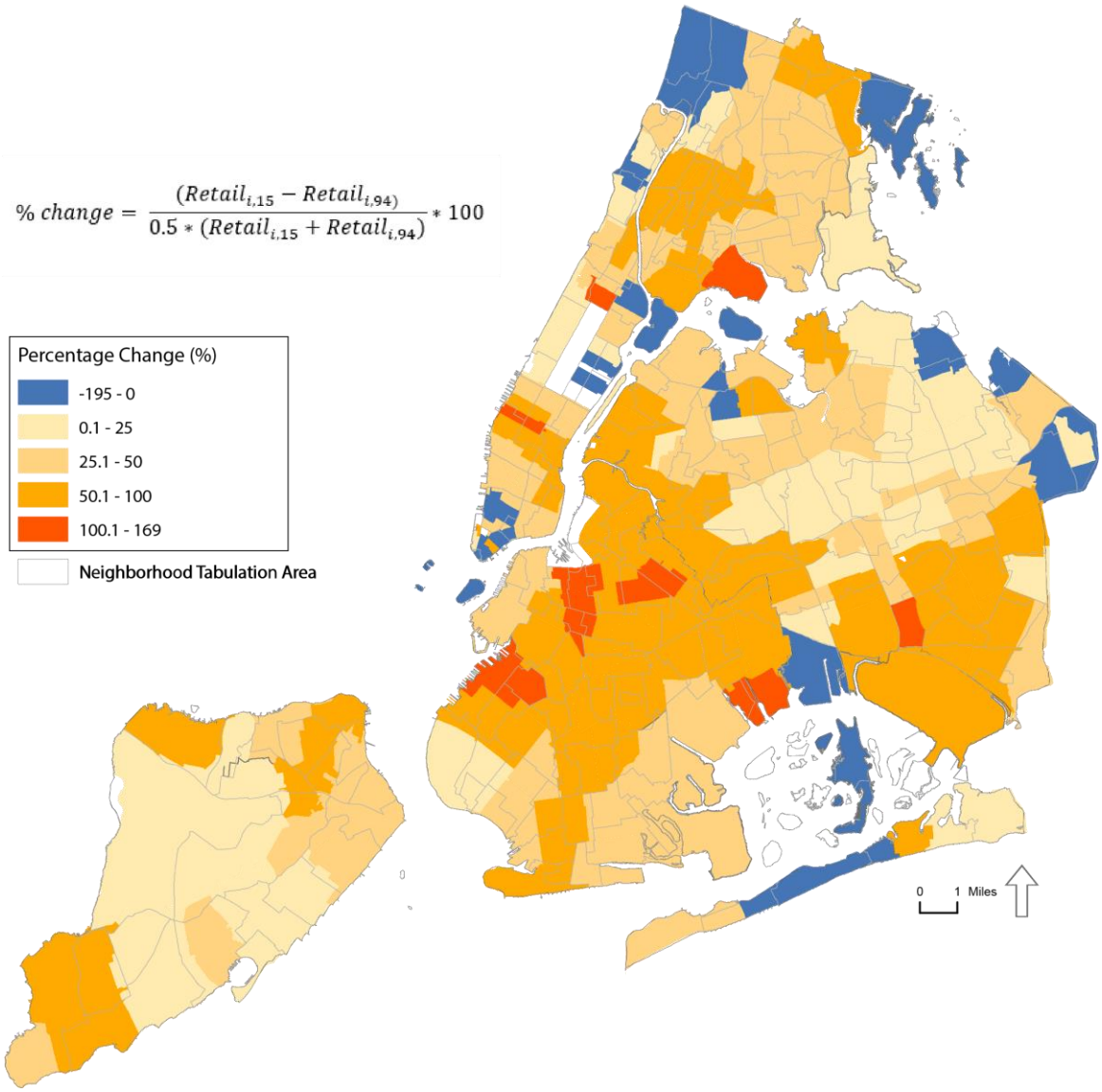

Figure 13. Percentage change of retail establishment from 1994 – 2015

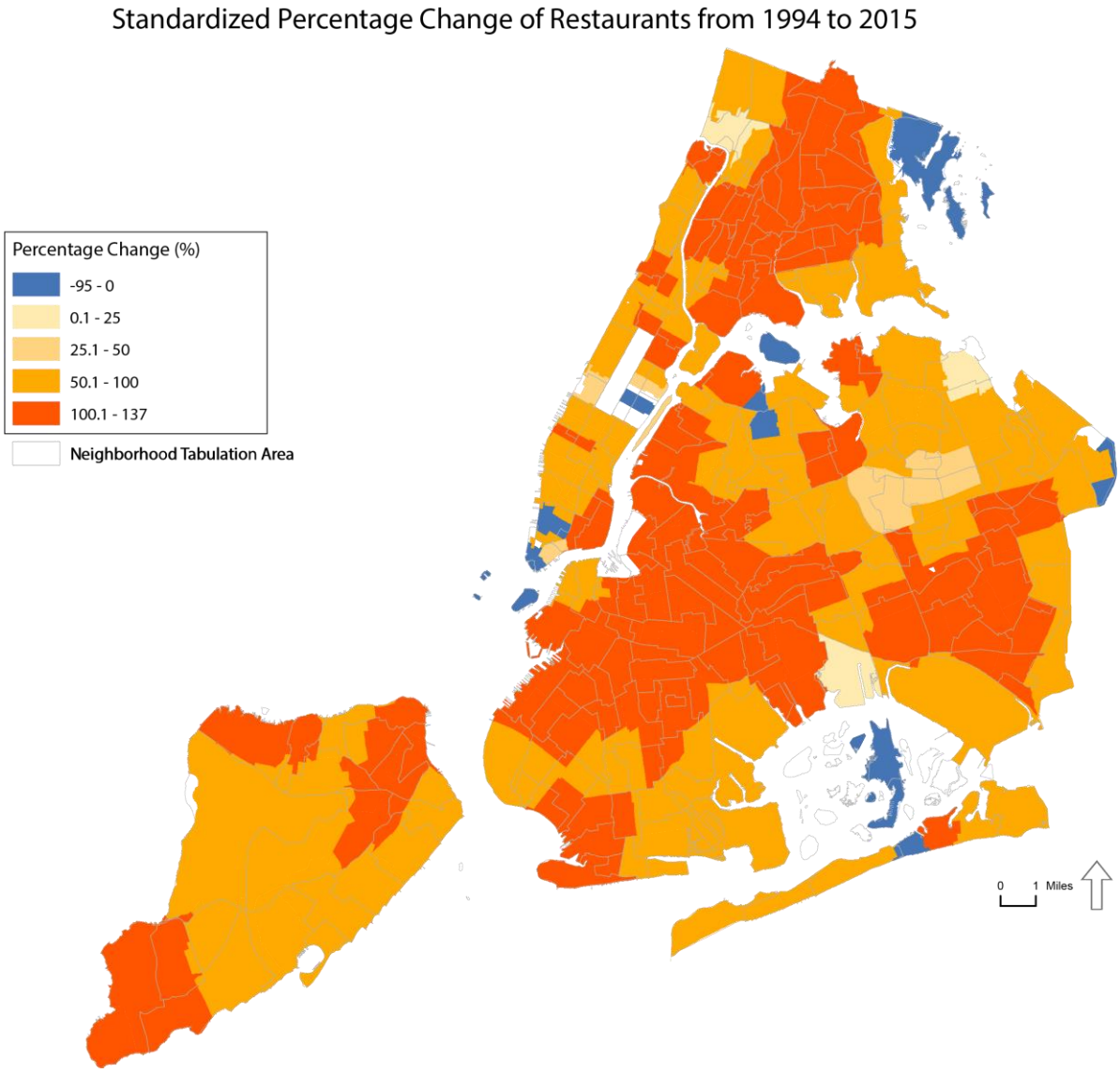

Figure 14. Percentage change of restaurants from 1994 – 2015

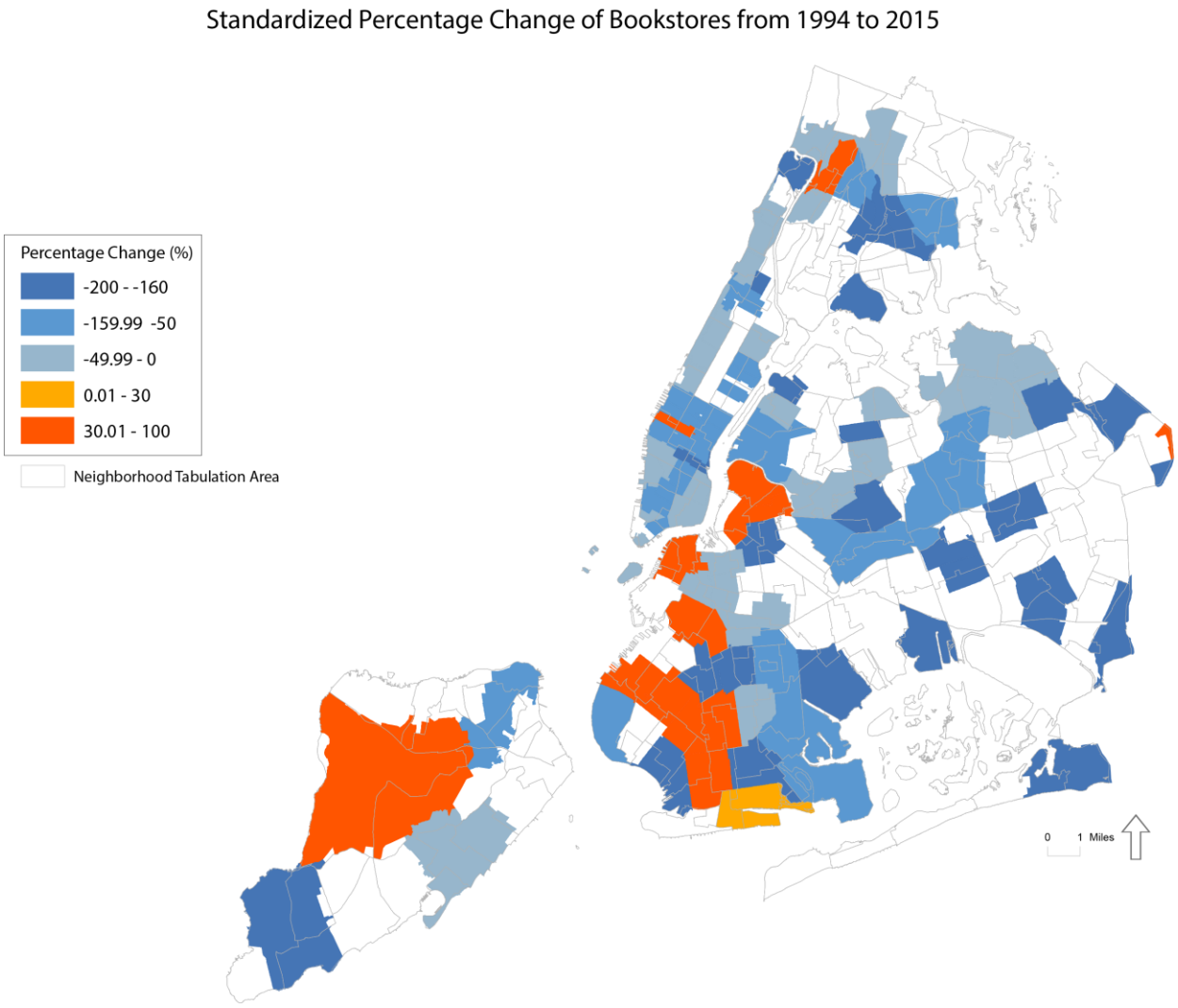

Figure 15. Percentage change of bookstores from 1994 – 2015

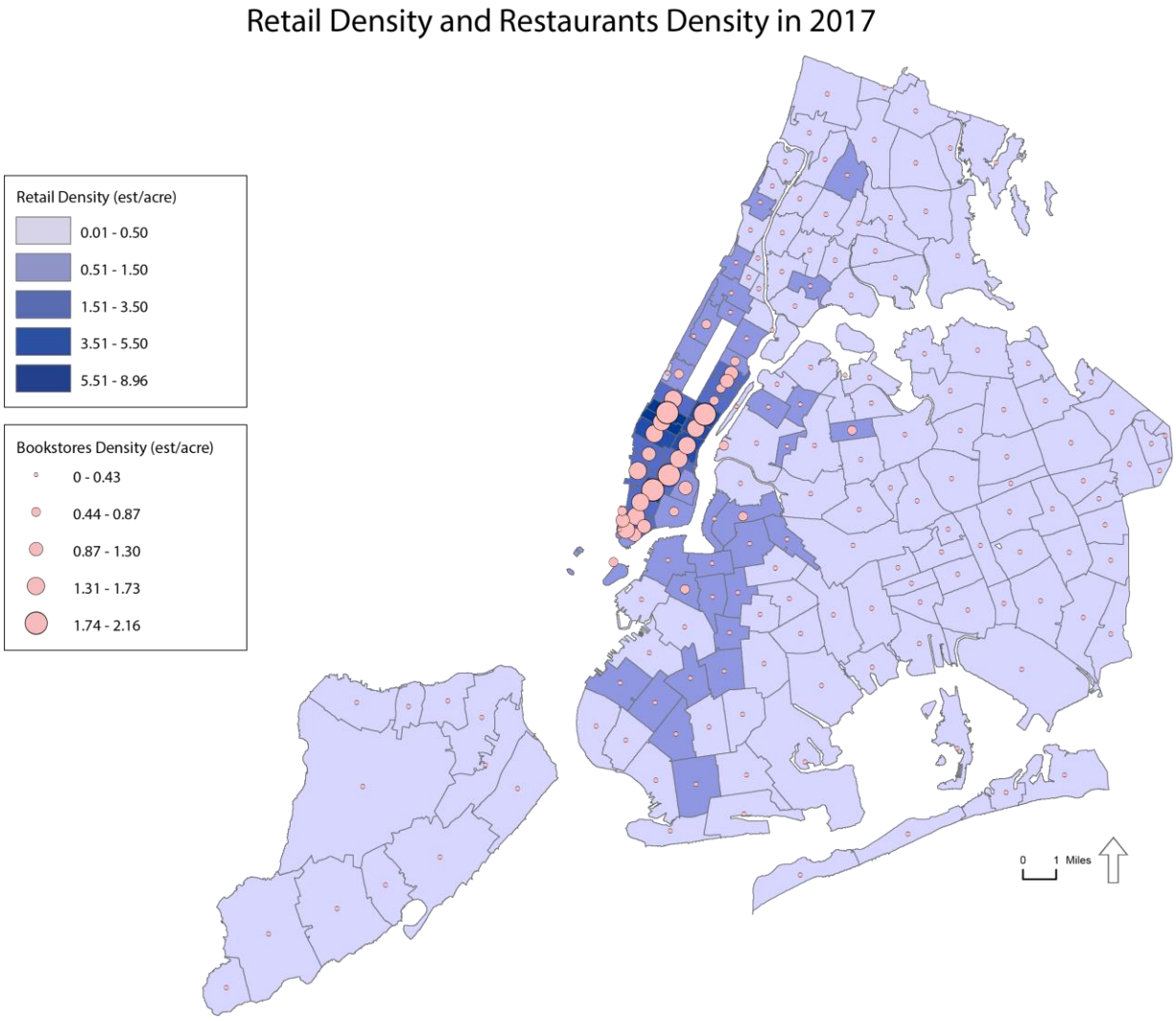

Figure 16. Retail density versus restaurants density in 2017

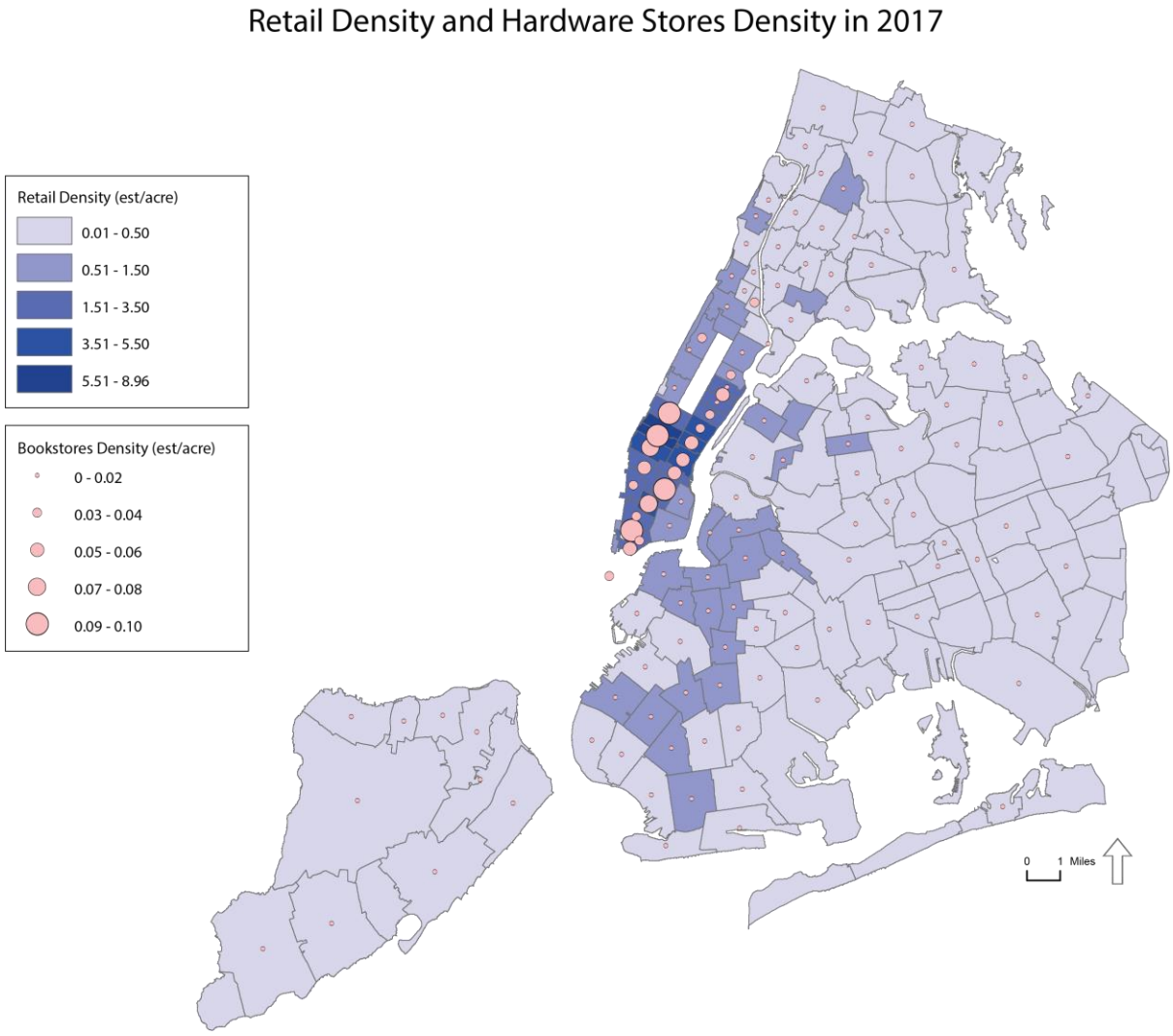

Figure 17. Retail density versus book stores density in 2017

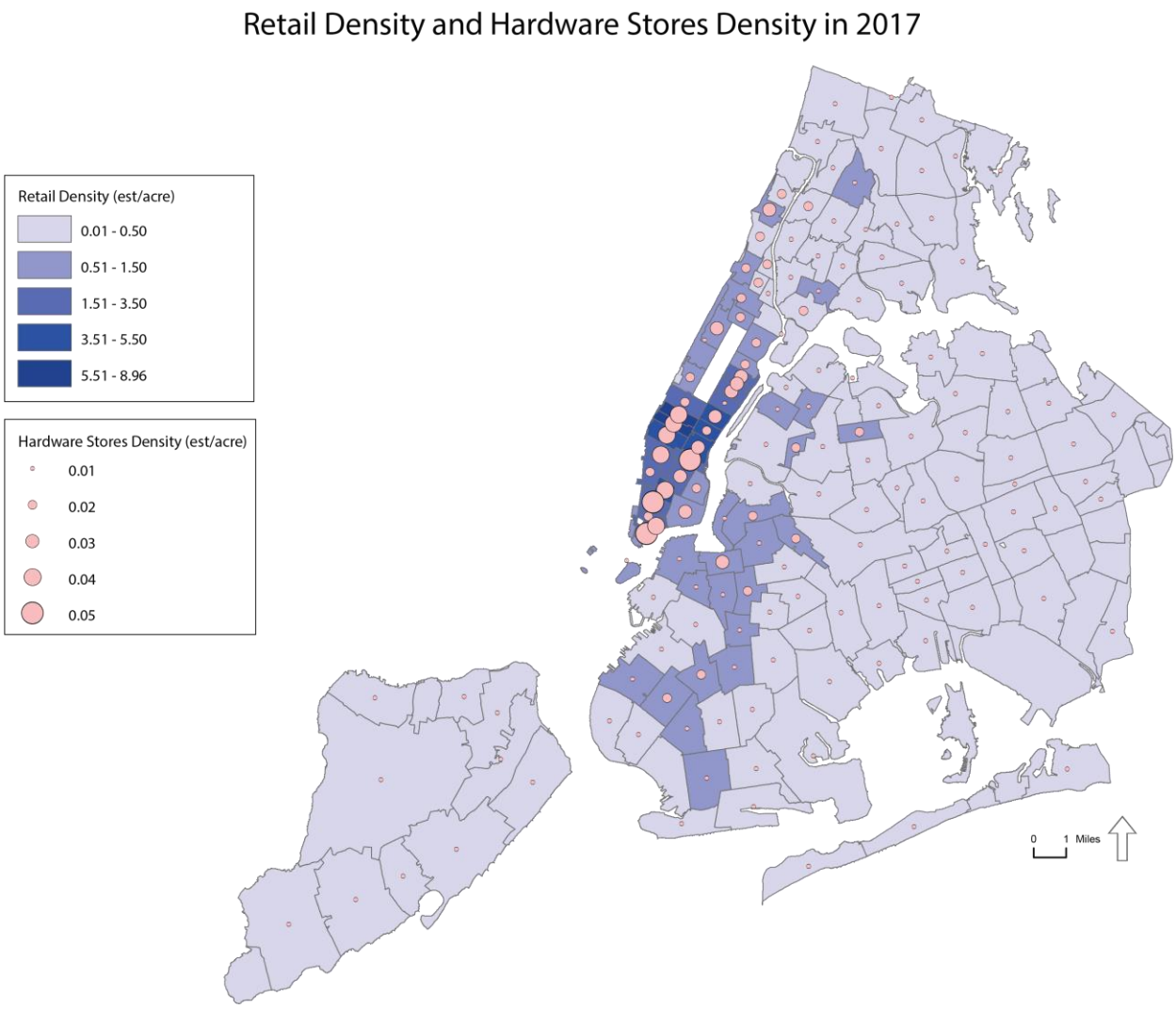

Figure 18. Retail density and hardware stores density in 2017

5. DISCUSSION

Following the findings from the previous section, the conclusion is that retail trade in New York City is not dying and will continue to grow. However, the growth of each retail sector is not synchronized and will require separate treatment to cater for the variety of demand for goods and services. As demand for various goods and services have shifted from product-based retailers to service-based retailers, there should be a modification in retail typology. In other words, the requirements of size, design and layout for retail spaces are different.

Each area in New York City forms a small neighborhood where residents will find a grocery store, a bodega, a liquor and other types of neighborhood stores within a block or two. The presence of essential goods and services improves the quality of life and secures the local employment. While some of these stores become obsolete due to online stores, neighborhoods are losing the retail diversity and critical neighborhood service retails. Changes in the retail typologies will lead to a shift in employment, accessibility, street safety and quality of life. It increases the travel time to get certain goods such as hardware and books if residents are in urgent needs. Because of the growing demands of click-and-mortar stores (e-retailers), warehouses and storages become significant and in need. The employment basis may shift from traditional retail and restaurant businesses to light industry and warehousing. However, there is not enough analysis performed in this research to show a more granular result in terms of retail changes in size, employment and types. The study of employment should be incorporated into research in the next step.

Another interesting observation from the result is the increasing number of establishment synchronized with increasing vacancies of storefronts across the city

over time. A report published by the Office of Manhattan Borough president has found that nearly 200 storefronts on Broadway were vacant in 2017. Borough President, Gale Brewer, claimed that these vacancies along major commercial corridors were due to high rent costs, competition from online retail and pressure from Borough's commercial-rent tax (Brewer, 2017). It is interesting that the number of establishment has increased while the demand for goods and services in the neighborhood has declined. It raises the concerns of increasing vacancies across the city and vitality of a neighborhood. Landlords might have a false belief of unrealistic high rents that can be collected.

While this study focus on issues and findings for the whole city of New York, a smaller scale and finer scope is required to gain a more meaningful conclusion as to how retail activity differs from borough to borough. This leads to the issue of data availability and consistency, and the geographical scale. In addition, a more granular assessment of local retail establishments and the neighborhoods they serve is needed to examine commercial changes to the neighborhood level. It ties back to the issue of Modifiable Areal Unit Problem (MAUP). It is a common problem in spatial analysis of aggregated data in which the results differ significantly.

As discussed in the "Research Limitations" section, the use of ZCTA is a typical MAUP which may lead to statistical bias. The boundary of ZCTA itself is problematic and using ZCTA to calculate retail density can also be somewhat misleading. ZCTA is a rough approximation of ZIP code boundary. Using ZCTA to calculate retail density will then result in some levels of discrepancies as the actual land area is not necessarily the precise representation of land area. The retail density will be a generalized representation spatially. In creating ZCTA, the Census Bureau took the most frequently occurring ZIP Code in an area for the ZCTA code which in most instances, the ZCTA code is the same as

the ZIP Code. On the other hand, there could be areas in which some ZIP codes do not fall into the right ZCTA. ZCTA can be different from time to time as the ZIP codes of establishment have been changed. Using the same ZCTA for both to calculate retail change over time will at times result in some degree of discrepancy.

Certain building or specific location in New York City have their own individual ZIP Code assigned which raises the problem of data aggregation and calculation. For example, Grand Central Station has two ZIP Codes, 10165 and 10168, assigned specifically for its buildings. Penn Station, Madison Square Garden and some other landmark locations all have their individual ZIP Code assigned. When ZCTA was created, these specific-location ZIP Code form small polygons within a large polygon. In other words, these buildings fall within a large ZCTA but they become their own ZCTA as shown in Figure 19. This causes misleading representation for retail density calculations. The land area of these small ZCTAs is very small while the count of establishment is relatively high, which results in area with high retail density. Researchers must be cautious when dealing with ZCTA for analysis. These small ZCTAs are merged into the corresponding large ZCTA in this analysis.

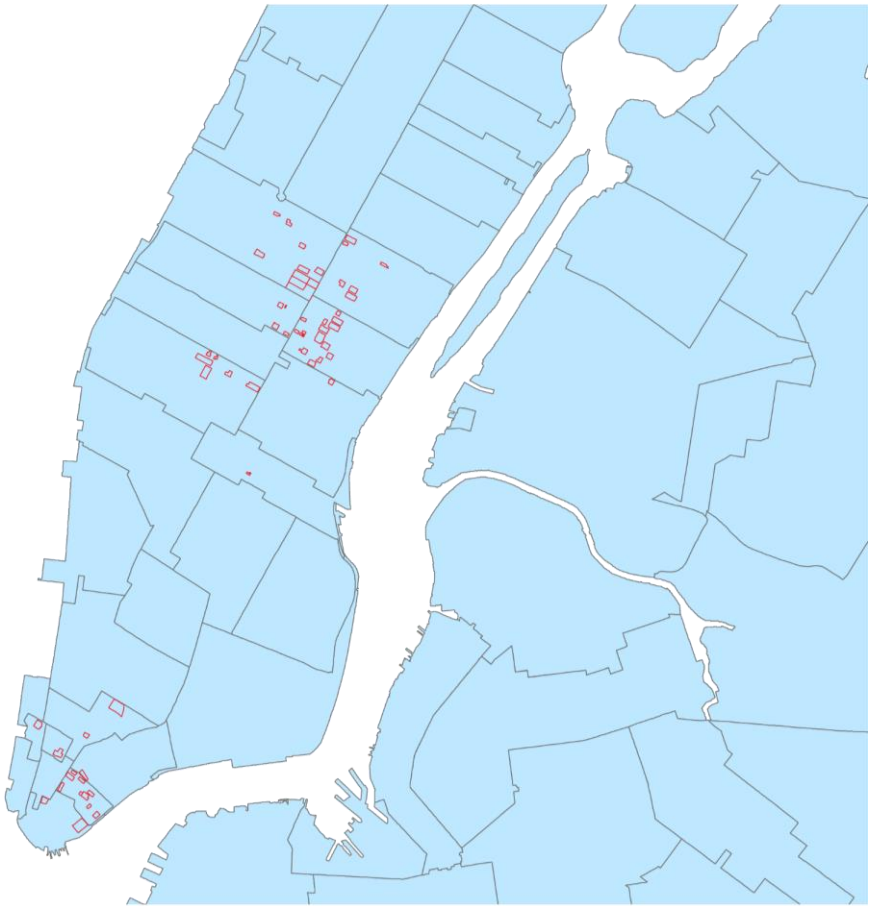

Figure 19. ZCTA documentation problem

The designation of ZIP Code to businesses is also another issue on top of ZCTA. As ZIP Code is assigned by USPS for delivery purpose, ZIP Code for establishment can be changed over times which is often the case. It is difficult to get accurate results over time when there is a degree of uncertainty in it. Coupled with the MAUP, it raises the possibility of errors in the result. As retail establishment is aggregated to the ZIP-Code level, there is no other method to measure the retail activity. The discrepancies in statistical result need to be taken into consideration. One of the ways to ameliorate the MAUP is to work with percentage change rather than absolute values. To calculate the percentage change over time, the same ZCTA boundary is used for both 1994 and 2015.

Furthermore, the percentage change calculated in this research is using the standardized equation to reduce the large deviations.

Besides the issue of MAUP and ZIP code, data availability and consistency is also another major challenge in this research. As mentioned in the "Methodology" section, the analysis of retail activity uses data from 1994 and a couple of other sources. Because retail data are mostly private and require subscription, there is limited data available for a more granular research.

A major concern of this research analysis is the consistency of ZBP data due to their industrial classification system. Prior to 1997, ZBP is classified based on the SIC system and changed to the NAICS system after 1997. This potentially leads to a mismatch in establishment classification. For example, in the SIC system, restaurants are categorized under the group of retail trade. While, in the NAICS system, the entire section of restaurants is taken out of the group of retail trade and classified under food services. In addition, the NAICS code is modified once every five years. It raises the possibility of different classifications for similar types of establishments.

Though the SIC and NAICS codes for each sector are cross-checked, there may still be potential discrepancies in the total counts of establishments. As seen throughout the findings, the NAICS code for hardware stores is cross-referenced with the SIC code through the NASIC Association. Even though the codes are cross-referenced through authoritative organizations, the definitions of hardware establishments are probably changed which results in a huge difference from 1998 to 1999.

Another data issue is the use of Reference USA. It is a private infogroup company that aggregated U.S. businesses data serving the library communities. The data collection method is disclosed, but the source of data is unknown. Because it is a private company, it is not possible to cross-reference the classification used in Reference USA with Census

Bureau data. This may lead to some levels of discrepancy in industry classification. In addition, Reference USA only allows a maximum 250 records for download each day. It also shows aggregated data in charts online which requires the analyst to compute that into a spreadsheet manually. Using data from Reference USA must take into consideration the time input. Therefore, in this research, the retail changes over time are compared from 1994 to 2015 instead of 2017 to avoid the variations in establishment classifications from different data sources.

In sum, working with a large dataset over 20-year period for the entire city is tedious and time-consuming, and often can be problematic and biased statistically. A smaller scale of analysis is much needed to get a better understanding of retail changes to the neighborhood level. The study of retail trends in New York City is only the first step to grasp a general understanding of shifts in retail store network. A more detailed analysis is required to further examine this issue for future urban growth and development.

6. PLANNING IMPLICATIONS

There is a handful of rigorous and thoughtful research looking at residential neighborhood changes. Quantitative research on commercial changes to the neighborhood scale is rarely focused. This study aims to provide an understanding of what kinds of changes are brought by e-commerce and how the retail store network has changed over time in New York City. Many studies have focused on the impacts of e-commerce growth on urban transportation, namely the freight program, and urban warehousing. There are limited studies concentrated on the relationships between e-commerce and neighborhood development.

To fully understand the issues in retail planning and propose policies for future health and growth of retail development, a more detailed analysis is required. Variables including employment and measure of size, access and diversity should be analyzed next to further associate the relationships between e-commerce and its impacts on the retail structure. Frequency of ownership change, vacancy rates, rental rates and pricing of goods and services are some other retail metrics must be investigated to gain a more thorough and meaningful conclusion.

More granular data are required to examine how retail patterns have changed in neighborhoods that are undergoing economic and demographic shifts. The influx of new businesses into different neighborhoods across the city has preserved the supply for goods and services to local residents and protected the employment base in retail. The more important question is whether the disparities in new businesses compared to traditional mom-and-pop stores in the neighborhoods will lead to commercial gentrification and displacement. Do the new businesses offer the same value in terms of neighborhood character as the traditional local businesses that have defined the

neighborhood? It is important to consider how to ensure the poor do not suffer from the changes.

While this study focused on commercial development and changes, a key takeaway from this study is the importance of data collection, management and organization in the planning field. At a more general level, in this case is New York City as a whole, there is available data for analysis to see the general correlations between different variables. However, the issue of retail planning is far more complex and involves various other non-studied factors to gain a better understanding in depth. As seen throughout the findings, the data consistency of retail data has been an issue and extremely time-consuming to analyze. The documentation and organization of such data should be more refined and systematic.

This study provides an example of how methodologies and techniques used in the planning profession can shed light on topics that are often talked about. The method to treat, collect and analyze data is critical to effectively communicate findings and results. For example, the decision to use standardized percentage change versus absolute values is a comparative strategy over time to reduce large deviation. It also highlights the importance of data in exploring urban issues. In the big data era, there is a variety of data sources available for use. Meanwhile, planners should learn to choose the right dataset for use and deal with data carefully with the appropriate method.

The decision to look at certain issues at what scope and scale is an important point to consider. There are advantages and disadvantages to explore an issue at the city scale. The amount of time required for analyzing an issue at the city scale because of the dataset should be kept in mind. The levels of precision when performing studies at the city scale versus a city block are substantially different. Planning policy tends to be set at the city scale so it may be better to start at a more general level then refine the issue

to a smaller geographical scale. For example, looking at variations in price per square foot (PSF) of retail space among neighborhoods, whether the percentage change in PSF is homogenous across the city will be an important aspect to explore. If the market pressure on the retail rental rates are different across the city, the question will be whether the retail policies be implemented at the city level or the neighborhood level. Another question will be whether the impacts of retail changes are the same across neighborhoods. It is important to analyze these issues at a smaller scale to ensure that the vulnerable population and neighborhoods are covered under policy.

7. CONCLUSIONS

Scholars have dedicated number of studies to understand the nature of the retail revolution in the digital era. Many are associated with the urban transportation policies to reduce congestion caused by deliver patterns. There are limited studies focused on the retail transformation and neighborhood changes. Local commercial amenities along with the residential population will impact on neighborhood change. This study aims to examine the retail changes currently and over time in New York City and explore the patterns associated with neighborhood characteristics. While this study focuses exclusively on New York City, the issues presenting themselves in this rapidly changing urban environment are not unique to New York. The changes in the retail sector are leading to demographic and economic shifts in neighborhoods, their residents, and their businesses all over the country.

Through analyzing statistics and mapping using GIS, the current retail store network in New York City is analyzed and retail changes over time are explored across the city. This study concludes that the physical retail sector is still active across the city and continues to grow over time. Retail growth is not synchronized across various retail sectors and requires a finer study. Other variables including measures of sizes, employment, diversity, rental rates and vacancy rates should also be investigated to gain a better understanding of retail changes.

One key takeaway from this study is the importance of data. The method of data collection, management and organization is extremely important and needs to be considered when planners are collecting their data in the future. The method of dealing with large dataset is critical to provide reliable and valid conclusions. The implications of this study may help planners better understand how to use and interpret data. This

suggests how future studies should be carried out that incorporate a variety of variables to investigate, and be cautious with the large datasets. Another important aspect is the geographical scale of investigation, analysis and policy implementation. Policy makers should consider whether the policy should be imposed at the city level or the neighborhood level.

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