THE GEOGRAPHY OF PARTIAL-MARKET EXITS: APPLYING GEOSPATIAL AND ECONOMETRIC METHODS TO ANALYZE 2017 DEPARTMENT STORE CLOSURES IN THE UNITED STATES

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Thesis Prepared for the Degree of

MASTER OF SCIENCE

UNIVERSITY OF NORTH TEXAS

May 2019

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Reed, Connor. *The Geography of Partial-Market Exits: Applying Geospatial and Econometric Methods to Analyze 2017 Department Store Closures in the United States*. Master of Science (Applied Geography), May 2019, 59 pp., 5 tables, 4 figures, 1 appendix, bibliography, 90 titles.

Many factors have prompted the adoption of partial-market exit strategies in retail as a means of reducing cost and minimizing risk. These mass closures have become more frequent in recent years. Marketers and economists have offered explanations for these closures linked to the rise of e-commerce, the real estate cycle and general changes in consumer taste. The research here marks an attempt to apply geospatial and econometric methods to better understand what factors explain the spatial variation of these closures across the United States. Specifically, the analysis examines the store networks of Sears, J.C. Penney and Macy's- large, established department stores that, collectively, announced over 100 closures at the beginning of 2017. By treating each store as a unit of observation, and a closure as a limited dependent variable, this analysis will attempt to quantify the relationship between place-specific factors and retail closures using Probit modeling. This application of modeling marks a deviation from traditional analyses in retail geography which, up until the early 2000s, have focused almost entirely on store development and growth. The results reveal patterns of spatial clustering of closures in and around the Rust Belt and demonstrate the strong negative effect of competitive agglomeration on the probability of closure.

ACKNOWLEDGEMENTS

I would like to thank all of the scholars, mentors, friends, and family who supported me throughout the research process. Thank you to Dr. Tammy Leonard, Dr. Chetan Tiwari, and Dr. Murray Rice for their guidance, investment and advocacy over the past two years. Thank you to Dr. R. Andrew Butters for helping me lay the foundations for this project when I was still an undergraduate student. The time we spent discussing basic ideas and models became a great launch pad for the study as it exists now.

Many thanks to my undergraduate research intern, Jonathan Croker. Your assistance with data cleaning, store profiling and GIS processing was invaluable. Your efforts are appreciated. I must thank Tami Deaton, Keshia Wilkins and all of the faculty in the Department of Geography for giving me a great community to be in while studying here for two years very far from home. Finally, to the family and friends who have supported me through each challenge and triumph- thank you, always.

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CHAPTER 1

INTRODUCTION

In the early months of 2017, a wave of closure announcements came from some of the largest and most recognizable brick-and-mortar retailers in the United States- including Macy's, J.C. Penney, Sears, Payless, RadioShack, Kmart, Staples, CVS, and others. Retail firms closed large portions of their store networks as a means of cutting costs and maintaining profitability. This cost reduction strategy of rolling back operations in key markets is termed, *partial-market exit* (Syam & Bhatnagar 2010). The 2017 closure announcements marked a step in a broader retail trend that some marketers, journalists, and economists have dubbed *the retail apocalypse*. This title remains somewhat hyperbolic. Many retailers in the United States are still finding success and expanding store networks (Peterson 2018). However, the many closures from these retailers certainly warrant the attention of both researchers and practitioners in retail geography.

Retail geography is a sub-field of business geography. It draws from methods and theories in economic and urban geography, planning, economics and data science. Thrall (2002) defines business geography as an aggregation of geographic thought, analysis and technologies to solve business problems. Studies in retail geography aim to capture value for business, and also contribute to the development of cities, and our understanding of consumer behaviors (Dawson 1980). The sheer volume of closures, and the variety of retail industries and formats that have been affected mark an unprecedented change in the retail landscape of the United States. These store closures are inherently spatial, and the methods and theories of retail geography can be applied to here to better understand this critical time of transition in the retail economy.

Intuitively, the retailers themselves (including their employees, senior leaders and

shareholders) are all explicit stakeholders in any study of retail closures. Shareholders and executives may be primarily concerned with minimizing network costs, and eliminating unprofitable stores. Employees and managers of closed stores, more often than not, may lose their jobs or be transferred elsewhere. The effects of these closures stretch up and down the supply chain beyond the retailer.

There are also other stakeholders. Suppliers may have to adjust their shipping routes and distribution plans with fewer stores receiving shipments. Customers, of course, must adjust shopping plans and either find another proximal store from the same chain, or shop at a competitor. Markets will become less competitive with the exit of players, redistributing market power to surviving retailers. Customers may also redirect their spending to online offerings from the same or other retailers if no suitable locations are close by. Though ecommerce offerings can help to continue satisfying demand in markets where stores are closed, retailers may still find their geographic reach diminished through partial-market exit strategies, especially if these retailers rely heavily on brick-and-mortar retail for revenue streams. The implications of these closures continue to stretch even beyond the supply chain, and can carry consequences for local urban economies in which stores have historically served as anchors for economic activity.

While the case is clear for the business stakes in this study, the research here will focus on the perspectives of communities and cities where these stores are located. Cities have a vested interest in the health and profitability of their retail centers. Large-scale, middle-market department stores like Macy's, J.C. Penney, and Sears may act as significant economic anchors-especially for smaller communities (Cohen 1996; Konishi & Sandfort 2003; Kruger 2010; Contrera 2018). Their position in smaller communities also serves to keep cash flows contained within the local economy, preventing revenue leakage into nearby larger cities (Thrall 2002).

Closures of these stores at a macro-geographic scale may have serious consequences for retail markets and urban economies. Dramatic shifts in market power as a result of firm exits can propel competing businesses to the top of industries, as in the case of Arbitron's market exit in 1993, which served as a launch pad for Nielsen in the market for media rating and analytics (Batra et al. 2006). Generally, these shifts in market power may create monopolistic market structures which see lower quality products with less variety (Karakaya 2000; Dickinson & Rice 2010).

In addition to shifts in market structure, chain store closures can also change urban development. Mitchell (2000) discusses how newly built chain stores and malls may pull businesses to the periphery of small cities and towns, away from the central business district. Once these stores close, small cities and towns may be left with a downtown that fails to thrive, and no other successful retailers to satisfy demand. Cavan (2016) notes the increased potential for urban decline and decay if closed stores sit unused, without effort to redevelop or repurpose properties. Meltzer and Capperis (2016) briefly discuss retail stores as generators of social and communal capital- contributing to a sense of place or identify for communities. Retail failure may disrupt this sense of place, or destroy it completely (Contrera 2018). Though the consequences are well-documented, because mass closures from many retailers are only a recent development in retail landscapes, geographers have not given proper focus to the patterns that are associated with these closed locations.

To that end, the purpose of this paper is to build a model that will assist in conceptualizing trends and patterns in retail closures related to market- and site-specific factors. This study will focus specifically on the previously mentioned department stores: Macy's, J.C. Penney, and Sears because of their unique position as anchors, distinct economic challenges, and

their visible role as symbols of retail change. This study makes a contribution by linking demographic and place-specific factors that have been empirically defended to be related to retail closures back to a narrative of economic development- a discussion that is largely absent from existing literature (Shields & Kures 2007, Nikolic & Weiss 2013). The thesis seeks to better inform policy and regulatory decisions related to shopping development and localized competition for the benefit of the communities where these chains are located.

There is a gap in knowledge related to these recent mass closures. For many years, retail geographers and analysts have focused their research efforts on store network expansion rather than reduction (Shields & Kures 2007). However, as ecommerce rises, consumer tastes change and the economic trajectory of retail continues to transform, a more formal study of partial-market exists is warranted, and a general call for more studies of retail closures has been clear in academia, already (Johnson 2000; Karakaya 2000). Though debate remains about the reality of any retail apocalypse these mass closures across retail sub-industries remain an unprecedented transformation in the retail environment of the United States (Peterson 2018). Efforts to understand this phase of the retail industry may better inform future analyses of whatever form brick-and-mortar retail takes in the future. Regardless of where retail researchers and practitioners believe brick-and-mortar retail will be in the future, partial-market exits mark a stepping stone that must be better defined and characterized.

Before detailing the analytical methods and results, it is important to acknowledge the contributions of geographers and researchers in other fields that have made some contributions to a larger investigation of retail closures. The following literature review explores important scholastic contributions in retail geography and retail practice dating back to the 19th century, and catalogues key works on retail failure and store closures from economists, geographers and

business scholars. After inventorying these works, I will discuss methodological and structural gaps in the existing literature that this thesis aims to address.

CHAPTER 2

LITERATURE REVIEW

This literature review traces the narrative of retail closure studies from the theoretical and historical foundations laid in the early 20th century through to contemporary geospatial and econometric studies being performed today. To gain better perspective on the contributions of contemporary studies in retail closures, it is important to understand the research foundations of the discipline, beginning with a brief survey of the fundaments of location theory and quantitative economic geography, followed by a discussion of current research in retail geography. From there, I focus the discussion on market exit and retail closures, specifically-beginning with the first regional studies in retail closures in the early 20th century. The discussion then turns to the quantitative revolution, and the use of regression modeling and other methods in retail applications. Here, I will offer some comments on aspatial closures studies beyond the field of geography. I will end the review with an examination of contemporary retail closure studies using econometric methods.

Research Foundations: Location Theory

Almost any study in retail geography warrants some discussion of the fundaments of quantitative economic geography. These are core concepts in business geography that were developed by location theorists with an interest in the location patterns and processes associated with urban and industrial development in the late 1800s and early 1900s. Appropriately, this sub-field is often called *industrial geography* or *industrial location theory*. Though, over time, the works here expanded to include more detailed studies of competitive markets and retailers. Today, the research is usually referred to as *location theory* or *spatial economic theory.* This body of research informs much of the intuition behind optimal retail locations and market

definition. Though these concepts are often used in geography, many contributors to location theory identified themselves as economists who worked on spatial problems (Smith 1981).

The construction of a research foundation for business geography begins, for all practical purposes, with von Thünen (1821), whose greatest contribution to the field involved a theorization about the supply and demand for space. He proposed that the value that may be captured from a landowner in a market is a function of revenue, input costs and opportunity costs. It asserts that identical products will carry an identical price in a market, assuming productivity is equal across space for all producers. Though von Thünen's research was intended to be applied to the agricultural sector, it presents some fundamental intuition behind the impact of transportation costs on revenue, which remains a key consideration for all retailers today (Thrall 2002).

In addition to von Thünen, Weber's (1929) research in locating manufacturing facilities informs much of the site selection literature of the 20th century. Weber worked to develop a deductive theory of location determinants for industrial sites at a time when factories were expanding across Europe. His findings demonstrate the influence of labor costs, agglomeration benefits and transport costs on the location decision of the firm. This marks one of the first formal studies of industrial location.

Until 1930s, von Thünen, Weber, and their peers had approached the location decision of the firm explicitly and exclusively from the cost side of the production function. Their least-cost approaches dominated literature and practice until Hotelling's (1929) intervention. Hotelling placed greater emphasis on the location of demand and spatial competition (Greenhut 1951). Least-cost approaches weakly assume uniform demand and limited market interaction between competitors across space. Once the demand assumption is relaxed, the optimal location is no

longer as simple as minimizing costs. Hotelling's locational-interdependence approach assumes a spatially spread market with relatively uniform production costs for firms. This model is more consistent with the monopolistically competitive markets retailers operate in today. Hotelling's classic illustration of duopolistic equilibrium in a linear market demonstrates that competitive firms will maximize their market share. However, the model is inherently limited in its assumption of duopoly, uniform price, and a linear organization of markets (Smith 1981). Soon after Hotelling, geographers took steps to more precisely define polygonal market areas.

Reilly (1931) famously married mathematical models of physical forces in gravitation and repulsion to consumer choices in urban location. Reilly's law describes the extent to which two cities may attract business from some intermediate location as a function of population proportions, and the mathematical inverse of the squared distances from each city or store to the intermediary location. His retail gravity law was one of the first spatial interaction methods developed specifically for urban geography. Gravity modeling has yielded a range of applications and tools in the social sciences well-beyond urban studies (Davies 1976). While Reilly's work does not form the methodological foundation of this study, it is a grounding theory for the relationship between distances between competitors and profitability, and inspired one of the most visible and applicable models to come out of retail geography from the 1960s. Huff (1963) made a significant contribution to the field by re-adopting and re-purposing Reilly's law of retail gravitation to apply not only to urban centers, but to specific retailers. Huff mathematically derived a probabilistic consumer choice model which could gauge the attractiveness of competing retail locations using metrics for distance and site-specific factors. Though Reilly is the formal founder of the principle, the Huff model is what is most commonly cited in practice.

Almost all of the previously mentioned scholars were explicitly economists focused on inherently spatial problems, or trying to incorporate a spatial dimension into traditional theorizations of production and industrialization. Christaller (1933) is often credited with the first significant geographical contribution to location theory *from a geographer*. His *central place theory* transcribes a geometric organization of urban centers based on economic assumptions and a hierarchy around the metropolis. The result of his theorizations is a network of service centers with defined market boundaries. Though central place theory presents some empirical challenges, it serves as a foundational work in studying the spatial arrangement of markets and cities. Lösch (1954) added another level to the work of Christaller by constructing unique market areas depending on the commodity or industry being studied. Unlike Christaller, who drew market areas out from larger urban centers, Lösch began with smaller market areas for multiple product skews. The areas where most of these markets shared a common area became the geometric centers of market activity (Böventer 1962). Lösch's extension of central place theory is more reflective of modern retail market analysis, in which trade areas are drawn according to specific store locations, and may also take different geometries for different product skews.

In aggregate, the works outlined in this section form the foundation of contemporary retail geography. They are the theoretical backbone of the empirical methods introduced during the quantitative revolution in geography, and are also, by extension, informing modern research in retail geography being conducted today.

Contemporary Retail Geography

Retail geography has a rich history as a sub-field of business and urban geography. Its development rests largely on some foundational methodologies and models produced during the quantitative revolution in geography. Many of the site selection and sales determinant studies

performed during the second half of the 20th century are still used or replicated today in retail market analytics and scholastic research (Reynolds & Wood 2010). These models and methods will be inventoried in detail in a later section of this review.

In today's retail geography community, geospatial technologies and other data analytics software are mainstays in the arsenal of scholars and practitioners, and drive new studies in retail geography that go beyond traditional investigations of store sales determinants or site selection scenarios. It is unfortunate that there are no texts reviewing and recording all of these new developments in the field as of yet. The most recent, holistic review of retail geography comes from Birkin et al. (2002), who discuss some timeless concepts in retail location strategy such as growth approaches, relevant demography and distribution. These remain key considerations in spatial studies of retail landscapes. However, Birkin et al. only scratch the surface of e-commerce development, which was still in its infancy at the time of publication. As I will discuss, this is a key new development in retail geography, and as the field matures, Birkin *et al.*'s text will not keep pace with the discipline without an update.

To better understand the current landscape of retail geography research, it is helpful to break down the field into different research themes. One body of work in contemporary retail geography is focused specifically on the *spatial structures* of new and/or important retail development. Rice et al. (2016) focus on the growth of Wal-Mart- arguably one of the most powerful and important retailers in the United States. They study the spatial patterns of growth for Wal-Mart, finding that although growth at the national level appears organic and radial for all stores, a regional examination reveals targeted and careful planning of the store network that is not necessarily dependent on existing distribution infrastructures, but more dependent on demography. This is a counter-intuitive observation about one of the biggest cost-cutters in the

retail marketplace, and a spatial lens was critical in understanding this growth strategy. Rice et al. is just one example of a study of the spatial patterns in a market or store network. Hernandez et al. (2004) used similar analytical methods in a comparative study of Toronto and Dallas, with a particular focus on power retailing- a novel development at the time of publication. Ó hUallacháin and Leslie (2013) perform a similar study of spatial market structures in Phoenix, finding significant and intuitive competitive agglomeration among auto-dealers and clothing retailers.

Some studies in this research theme examine how major disruptors or externalities may alter the spatial characteristics of retail markets. There are many examples of this research. Yarbrough and Rice (2013) examine retail geographies relative to light rail transportation development. Nilsson and Smirnov (2015) take a game theoretic approach to retail competition relative to major road infrastructures- with a focus on quick service restaurants. Ceh et al. (2018) follow the development of a Wal-Mart's transition from medium-sized to super-sized in a Toronto market, the results of which were increased property values for the site and a wave of retail closures from stores in the surrounding area.

This research theme has an enduring relevance within retail geography. Urban environments and retail markets are constantly changing, and it is because of this change that there will always be a need to evaluate (and later re-evaluate) the spatial characteristics of retail markets as the nature of the industry, economy and cities continues to transform. Every major retail marketplace is due for an in-depth examination of the locational attributes of its stores to keep businesses, planners and scholars well-informed. There will always be an opportunity to study the geography of retail markets, and how retail geographies change when introduced to a disruptor or externality, or how they change more gradually with the passing of time. The present

study certainly falls within this structural theme with its examination of spatial and demographic patterns among partial-market exits for major department stores.

A second research theme in retail geography focuses specifically on *experimental methodologies and data resources*. As big data and social network data continue to become more sophisticated and accessible, the opportunities for new methods and models will grow for the retail geography community. Some scholars in the field have already addressed the opportunities and challenges presented by this growth. Lloyd and Cheshire (2016) are some of the first geographers to leverage geo-tagged social network data to approximate retail locations and market areas. This method, in effect, substitutes for a traditional customer spotting in which the exact locations of customers are known. This study, in and of itself, offers some exciting potential for the future of retail geography and location data. Retail geographers may begin to map sentiment, customer experience, and social media perceptions using this social network data in concert with textual analysis and GIS.

Graves and Gerney (2018) also examine data sources and their applications in retail geography. They study and compare the many vended sources of demographic data, an important resource in any retail location study. They find some concerning inconsistencies among the data sets provided by many vendors for a high price that should, theoretically, have very little variation between like observations. Their study illustrates that, in spite of all of the opportunities and potential that we may find in increased data availability, there also come issues of accuracy, consistency, and cost.

The final research theme in contemporary retail geography is, arguably, the fastest growing and most important. A large body of literature is focusing exclusively on the growth and development of *e-commerce and e-retail* (or e-tail). In many respects, e-commerce is also a

"disruptor" or "externality" in the spatial structure of retail markets. However, this particular development is massive, and has far-reaching consequences not just for retail space, but for the global economy as a whole. As such, retail geographers have been turning their attention to this phenomenon to better understand where it is going, and how it will impact existing geographies of consumption.

For example, Cao et al. (2013) examined sales in Minneapolis-St. Paul and found that consumers in urbanized areas with high access to retail are more likely to make ecommerce purchases than urban consumers with low access to retail options. Ren and Kwan (2009) add that areas with a higher white population tend to see more e-commerce sales. They also find that e-commerce sales are high in rural areas as a result of lower accessibility to retail options and spatial diffusion of trends and behaviors from urban cores. All of the trends and patterns in e-commerce sales from Cao et al. (2013) and Ren and Kwan (2009) are present in the United Kingdom as well. E-retail sales in the U.K. are higher in rural areas, but young and affluent urban consumers are also purchasing products online, often in spite of their easy access to a variety of proximal local retailers (Kirby-Hawkins *et al*., 2018; Clarke *et al*., 2015). Retail geographers continue to compile insights about the geographic footprint of e-commerce, and its consequences for existing retailers. Hernandez (2014) notes that omni-channel activities are driving e-commerce sales, and the numbers are exponentially increasing over time.

Though this development may hinder some brick-and-mortar formats (Cao et al. 2013), it by no means signals a decline in the importance of geography in retail planning. With e-commerce development comes a need for real estate infrastructures that are inherently spatial. What location can sustain a data center? A warehouse? A distribution center? These are the

questions e-commerce executives face, and retail geographers can investigate (Thompson 2011). In the midst of this e-commerce growth, a resounding truth remains: *location still matters*.

What is noticeably absent from this catalog of research themes in retail geography is any detailed discussion of partial-market exits, and retail failure in general. The remaining sections of the literature review trace the narrative of retail closure studies from the first mortality studies in the early 20th century, through to modern econometric studies being performed today.

Research Foundations: Retail Mortality Studies

As location theorists and spatial economists were beginning to lay the theoretical foundations of business geography, other scholars in marketing and business were conducting some of the first geographic studies of retail closures, specifically. During the 1930s and 1940s geographers were conducting highly regionalized studies of particular landscapes, places, and markets (Schaefer 1953). These micro-geographic studies were also conducted by researchers beyond the field of geography.

Early studies in retail failure were the product of scholars in marketing and entrepreneurship. These reports focused on retail closures in specific cities and industries. The language of these studies favors terms like business "mortality", rather than "closure" or "exit". This owes to one of the greatest determinants of retail failure at the time simply being that the store clerk or shop owner would die (McGeary 1930). I have dubbed this body of works *retail mortality studies*. These works began with McGeary's (1929) assessment of retail mortality in Buffalo markets. McGeary performed a basic descriptive analysis of the mortality rates of new retailers in a variety of industries via business survey data. He found that 60% of all grocers who entered the market between 1918 and 1928 had exited the market within a year. McGeary

concluded, simply, that the grocery industry was saturated with incoming, incompetent entrants and was hyper-competitive compared to other retail industries in Buffalo.

In his 1930 text, McGeary tried to more effectively explain these business failures. He associated retail mortality with three key factors. The first, and least applicable to the present study, was that retail stores may fail when the proprietor becomes ill or dies. Another factor related to retail mortality was economic change in the retail landscape of Buffalo. McGeary noted that the buying habits of Buffalo consumers had been changing over the course of his study. Consumers were becoming price conscious and were, generally, enjoying a higher standard of living. Also, customers of chain stores were more likely to shop multiple locations for any goods they needed. The final factor McGeary explored was population change. He observed that retail chains were more likely to co-locate, creating market centers, where the mortality rate was lower than for more isolated stores. This insight crucially informs the current study, and supports more general literature about the geographic phenomenon of agglomeration- where firms co-locate to remain competitive. While McGeary's work was not quantitatively rigorous, it marked the first true exploration of the patterns and associated causes of retail closures in the United States. It also took steps to examine the phenomenon through a geographic lens, featuring some hand drawn maps and market segmentations of Buffalo by ward. In this regard, McGeary's research is fundamental, and set the stage for other regional geographic studies of closures, and the more quantitatively rigorous closure studies to come. After McGeary's work in Buffalo, other researchers produced similar publications that were based on observations and summary statistics on retail mortality in specific regions or cities (Phillips 1934; Greer 1936; Burd 1941).

The researchers in the preceding mortality studies often examined retailers who entered and exited markets quickly, but it is important to note that none of these studies considered mass closings from chain retailers. In the era of these studies, chain retailing was a relatively novel marketing concept, and partial-market exit had not been furnished as a cost-reduction strategy (McGeary 1930). Regardless, research in mortality studies is certainly the empirical foundation of all retail closure research today. Though this body of regional studies carries historical significance and serves as a launch pad for future works on retail closures, the works in the sub-field never built any ongoing trajectory leading to more modern closure studies; the field became stagnant after the 1940s. This may be attributed to the end of the economic depression of the 1930s and 1940s, and may also have linked to greater changes in the entire field of geography. Mortality studies were plagued with the exceptionalist ideology that was prevalent in the early 20th century, and countered by Schaefer (1953) in a cutting call for geographers to pursue positivist approaches. Up until the 1950s, geographers had been too concerned with place-specific studies that did not allow for strong comparisons or any discussion of broader spatial patterns across landscapes.

The Quantitative Revolution and Retail Geography

Out of Schaefer's intervention came what many geographers call the quantitative revolution. This turn toward increased quantitative rigor in geographic studies especially prominent in economic geography. In the 1950s, 1960s, and 1970s retail geographers adopted sophisticated and complex modeling methods to quantify many aspects of retail site selection and market analysis. One of these rigorous methods was linear programming. Garrison (1959) adopted linear programming to analyze the spatial structures of markets, while Moses (1968) used a similar method to minimize transportation costs in supply chains in a general equilibrium

approach. Linear programming remains a common tool for optimization of retail supply lines today.

Another, more visible, quantitative method in retail geography came from Applebaum and Cohen (1961). Their work set a precedent to more accurately arrive at trade area geometries using the exact locations of customers for multiple store locations in a network. This dramatically increased the spatial resolution and accuracy of market research in retail because it no longer relied on political, postal, or polygonal boundaries. By overlaying these trade areas with customer purchasing data, Applebaum (1966) was able to derive a variety of store performance metrics that are still used in the retail industry today. Market penetration remains a consistent estimate of a firm's geographic and economic proportion of total business in a city or region. Methodologically, this study will rely to some extent on Applebaum's work relating trade area geometries to relevant performance indices and demographics that fall within them.

Bunge (1962) put forth work that laid the foundation for some of the most important concepts in geographic information science (GIS)- a common tool for the retail geographer. Bunge formally defined and related various geographic geometries (points, lines, polygons) as a kind of cartographic topology that could be better used to identify clear patterns across space. His conceptualization of geometric shapes is still used in almost all aspects of GIS analysis and planning today. This type of conceptualization is very representative of the greater turn toward geographic theories and broader themes that came out of positivist approaches in the quantitative revolution (Adams 2001).

In addition to the variety of models mentioned, the quantitative revolution's reorientation towards mathematical rigor also saw the first marriage of geographic studies to regression analysis in economic geography. Regression modeling is the methodological foundation of this

study, and it was first introduced in human geography via McCarty's (1954) work on the McCarthy vote in Wisconsin. McCarty took many steps to marry economic theory, statistical methods and geographic problems. After his initial work on voting trends, he applied regression and correlations methods to industrial and economic geography, arguing that it was never enough for geographers to simply observe cartographic trends. Rather, there was a fundamental need for rigorous modeling to more definitively assert patterns and trends across space.

Before McCarty, the only geographers turning to regression were concerned with physical systems of the environment (Barnes 1998). Soon after, retail geographers began using regression models to assess demographic and geographic factors as determinants of store performance. One of the first applications of regression modeling in retail geography came from Ferber (1958), who worked to develop a model to explain retail sales variation between cities in Illinois. The model examined variation across space using predefined geographic units (in this case, city boundaries). It pulled from key demographic and economic variables such as raw population, income, and distance to competing cities. Ferber's regression returned statistically significant association between population, income and distance and retail sales. Intuitively, cities with higher population and income, and increased distance to another major city saw higher apparel retail expenditures. Ferber's adoption of regression analysis sparked a wave of studies using the same methodology with different combinations of variables. This trajectory went on well-beyond the quantitative revolution through the 1970s.

Regression Analysis in Retail Research

From Ferber, other retail geographers adopted linear regression modeling as a means of exploring the determinants of retail sales. Some models incorporated some place-specific metrics related to economic development initiatives and public works (Liu, 1970). Some variables were

adjusted to be per-capita metrics, and attempts were made to incorporate a broader range of segment-specific variables in models to make them more explanatory (Vitaska 1971). Other studies incorporated transportation metrics as a predictor of retail sales (Clements 1978). Over time, many geographers released various iterations and augmentations of retail regression models, incorporating and adding various spatial and non-spatial variables. To catalogue these many determinants of retail sales in all their forms and fashions from various geographic and economic researchers requires an exhaustive survey of past literature. Fortunately, the vast majority of these iterations- the researchers, the variables included, and their contributions- were catalogued by Mejia and Benjamin (2002). Their log of the many determinants of shopping center sales yielded some umbrella categories for variables that have been, and continue to be, included in regression models in retail geography: income, population, demography (age, gender, race), competition/agglomeration, and distance/accessibility. These variables working in concert have been empirically defended as determinants of retail sales, and all of these dimensions will be included in this study.

This rich history of research concerned with the determinants of retail performance provides much of the intuition behind this study and some of the variables included. However, all of these studies only gave attention to questions concerned with the expansion of store networks. The time between the 1950s and 2000s generally saw macro-economic growth in the United States, and a dramatic expansion of retail footprints and store networks. As a result, very little attention was given to analyzing and understanding retail closures (Shields & Kures 2007). It was not until the early 2000s that a few geographic studies of closures were released, and some researchers in marketing and business pushed for more research concerned with retail closures.

Spatial and Aspatial Closure Studies

It is notable that researchers in business, marketing, and geography began to turn their attention back to closures in the early 2000s- in retail, and in other industries. This is a pivotal point in which malls and some retail chains began to decline as e-commerce began to rise, and the looming Great Recession was poised to strike a severe blow to the real estate economy (Sanburn 2017). Several aspatial studies of retail closures pointedly address the need for more examination of market exits in the United States. Johnson (2000) used content analysis- an approach from psychology and communication studies- to compound the key phrases and words mentioned in a large sample of closure announcements from various retailers in major metropolitan areas from 1990-1996. He found that firm-specific financial burdens were the main catalyst of closures. However, a portion of the cause was attributed to various market- and site-specific factors, too. In the same journal, Karakaya (2000) also took steps to research closures. His research offered a more qualitative and theoretical discussion of the determinants and consequences of whole-market exits, and nested his discussion within economic industrial organization theory.

Syam and Bhatnagar (2010) examined partial-market exits, specifically. They discussed some of the consequences of these closures in terms of distribution and logistics. By employing a series of functions related to consumer satisfaction, minimizing distribution costs and maximizing proximal store sales, Syam and Bhatnagar were able to use linear programming to find optimal stores to close for a chain retailer. Though these aspatial studies are from different sub-fields of business research, and seemingly disparate in context and methodology, they all begin with a fundamental cry for increased research into the causes, consequences, and patterns of retail closures in the United States.

Geographers have also played a small role in answering the call for store closure studies from the business research community. Various spatial and descriptive analyses of closures from retail, health and medicine, and urban regions have been completed leveraging GIS and statistical methods. Xu and Liu (2004) used gravity modeling to analyze the sudden opening and closing of a new Office Depot store in Cincinnati. The model revealed the interactions between the new Office Depot location and proximal stores within the Office Depot network to be cannibalistic. Office Depot had mistakenly saturated the Cincinnati market with locations and actually lost sales as a result. This prompted the closure decision. Feng et al. (2011) catalogued and mapped all nursing home closures in the United States from 1999-2008. They used Gini coefficients and cluster analysis to develop a risk exposure metric that quantifies the risk of a nursing home closing as a function of the minority population and poverty levels in a given zip code. They also estimated potential profit losses by recording the number of beds available in each home. Kavroudakis et al. (2013) developed a program to geocode the locations of businesses closing in the Athens city center after the downturn of Greece's economy in the early 2010s. While this analysis was largely descriptive, and absent of any quantitative rigor, it marks one of the most recent closure studies that spatially and statistically summarized not only retail closures, but all business failures in a single metropolitan area.

While all of these geographic studies took steps to more closely examine market exits from businesses, many were either micro-geographic in scale, or too reliant on simple descriptive statistics to offer any insight into broader spatial patterns in any underlying geographic variables. In this regard, a greater intervention in the field of closure studies was required- and it came via financial and spatial econometricians.

Econometric Closure Studies

Econometric methods are worthy of attention here because of their previous adoption in retail geography research. One variety of econometric models, *discrete choice models*, allows for analysts to examine factors associated with binary decisions such as brand selection and pricing (Birkin et al. 2002). The two most familiar discrete choice models are Logit and Probit. Both of these models regress a binary dependent variable on a set of regressors. The Logit model is based on a logistic distribution and uses an odds ratio interpretation, while the Probit model is based on a normal distribution and is easier to use in accounting for spatial dependencies in the model. These models will be contrasted in finer detail in the methodology section. This particular set of econometric models forms the methodological foundation of this study, and directly informs much of the research process throughout.

Well before being applied to retail closures specifically, econometrics methods had already been used in analyzing business bankruptcy. Ohlson (1980) used a Logit model to identify some of the variables significantly associated with bankruptcy for U.S. firms from 1970-1976. Ohlson found that, generally, the size of the firms, total liabilities, total assets, and net income all yielded significant associative effects from the model. This analysis set a precedent for financial econometricians examining business failure. However, it did not include any kind of spatial dimension.

Ohlson's introduction of discrete choice modeling in the analysis of closure decisions was pivotal in the larger narrative of closure studies, and in the years following the call for greater research into retail closures, spatial econometricians adopted this framework to study partial-market exits. Shields and Kures (2007) worked through the most powerful and informative discrete choice model of retail closures to date. Their work informs much of this

study, and frames many of the central research questions. Logit regression modeling is used to measure marginal effects of various demographic and spatial factors associated with 2002-2003 Kmart closures in the United States. Their findings revealed that Kmart closures followed a pattern of areas with fewer households, more proximal competitors, and less poverty. This is consistent with the location strategy of Kmart being a discount store. Catering to large low-income households with less spending power and flexibility in choice was a key to store sustainability.

Their finding related to competition will be a particularly important finding in this study of closures. The structure of competition in retail markets can be directly influenced by policymakers and developers, and there are past studies that examine the relationship between policy-drive agglomeration and retail success. Kickert and vom Hofe (2017) study the impacts of agglomeration on retail survival in Detroit and The Hague, Netherlands. These cities were picked as cases in a comparative study, with Detroit having high vacancy and retail decline and The Hague enjoying a thriving retail economy. The results are “remarkably similar” for both markets. Retailers are less likely to close with increased competitive agglomeration. Mohanty and Mishra (2014) link the argument for retail agglomeration to lessons in public policy. They argue that the interaction of externalities produced from agglomeration (knowledge spillovers, consumer choice, labor proximities, etc.) fuel economic growth and mark the importance of cities in contributing policy that allows for this growth. Shoag and Veuger (2014) defend that public policy incentivizing clustered retail development yields positive spillovers for local governments and economies whose policies are designed to keep positive economic externalities contained within the geographic boundaries of the city.

More recently, Nikolic and Weiss (2013) constructed a similar discrete choice model similar to Shields and Kures (2007) for retail gasoline closures in Austria from 2003-2011. Their Probit model used a range of variables related to demography, location, and competitive landscapes to gauge which market factors were contributing to closures. Intuitively, Nikolic and Weiss's analysis returned that gas stations were more likely to close if they were more proximal to a dense concentration of competing gas stations.

The work of Shields and Kures, and Nikolic and Weiss provide ample precedent for further analyses of retail closure decisions. Not only did spatial econometricians account for the variation in demography, income, and population size across the retail landscape, but they also added some key geographic and site-specific variables such as proximity to competitors (Nikolic & Weiss 2013) and distance from distribution centers (Shields & Kures 2007). These variables are just as relevant for large department stores as they are for gasoline or discount retailers. The past findings of spatial econometricians reinforce the methodology used here, and also shape the targeted questions outlined in this research.

Most recently, a study of the subject retailers from this thesis was conducted by Tokosh (2018). Tokosh used a logistic regression to measure predicted probabilities of closures for J.C. Penney, Macy's and Sears using a substantial set of regressors. He finds that larger stores are less likely to close, and also finds store- and place-specific trends. In the western part of the United States: Macy's and Sears are more sustainable in large malls than freestanding sites and J.C. Penney stores are less likely to close in general, but those located in larger malls are more likely to close than freestanding sites. Impressively, Tokosh is able to capture more data on the observed stores themselves than any other closure study to date. While the scale and scope of Tokosh's modeling efforts is encouraging, Tokosh fails to situate his study effectively in the

existing body of work in econometrics. There is no comparison of Tokosh's findings to past studies (Shield & Kures 2007, Nikolic & Weiss 2013, Zhou & Clapp 2016).

Another recent study from Zhou and Clapp (2016) vantages a time-series fixed-effect Probit model to measure the relationship between mall anchor closures of stratified store types by price-point with closures and openings of similar and different stores. Interestingly, Zhou and Clapp find that the addition of a store in high-price point and low-price point markets increases competition and the likelihood for a given store at the same price-point to close. The only time agglomeration effects produce healthy competition with no closures is when price-points are varied among anchors.

Econometric studies of retail closures effectively combined the regression methodologies adopted during the quantitative revolution with some of the more fundamental causes of retail closures identified by store mortality scholars and asaptial closure studies from business researchers. Treating these factors as regressors against a discrete choice (whether or not a store closes) allows for greater insight into the associated effects from different factors across space. These contributions begin to address a greater gap in knowledge that has already been clearly identified by Shields and Kures (2007). Crucially, Shields and Kures recognize that retail geographers have been predominantly focused on the expansion of store networks, consistent with the continued development of retail markets throughout the 20th century and well-into the 2000s. The period between the retail mortality studies of the 1930s and the closure studies of the early 2000s was saturated with retail growth in the United States, and studies of store closures was consequently small.

This study contributes to the existing universe of retail closure studies, and retail geography more broadly. Its geographic scope and methodology are more robust than previous

spatial and aspatial studies, some of which have only focused on single store locations, or lacked the modeling methods necessary to identify more substantial demographic or place-specific trends (Kavroudakis et al. 2013; Xu & Liu 2004). This study also aims to capitalize on opportunities left open by Shields and Kures (2007). In their research, Shield and Kures only examined an isolated case. They used econometric and geospatial methods to study the partial-market exit of a single retailer- but changes in the retail landscape since the time of their research have prompted an unprecedented wave of closures that calls for a study of greater scope and scale, with more substantial implications for retail markets in the United States, and the communities in which these retailers were once economic anchors. This is one gap that future research needs to fill- a more holistic investigation of partial-market exits in the United States using national networks for some of the largest department stores in the country.

This study will also build off the important contribution from Tokosh (2018) by including some of the demographic variables that have been tested in previous empirical research, and by more appropriately situating the study in an existing body of work on partial-market exits. It will contribute the spatial lens absent from some of the earliest closure studies (Johnson 2000; Karakaya 2000) by testing for spatial dependencies in store closures and measuring geographic clustering in closed locations.

Most crucially, the present time is a critical moment of transition in the narrative of the retail economy. This time of brick-and-mortar decline and e-commerce growth is a stepping stone to a future of consumption that will place greater emphasis on the digital marketplace, experiential shopping, and convenience and immediacy. There is a need to understand this change, and its spatial characteristics- not only for the firms in the marketplace, but for the cities and communities whose futures are tied to the outcome of this change. This, perhaps, is one of

the greatest interventions of this study. None of the works inventoried in this literature review offered a thoughtful discussion of how their findings on partial-market exits or retail failures may be linked to economic development in communities. It is important for urban administrators to understand what characteristics of their community may be trending with retail failure or economic sustainability, and if there is anything that can be done through changes to policy, land use or competitive regulation to reduce the probability that stores will close. The consequences and warrants of this study go well beyond the bottom-line for a single retailer, and immediately raise questions about what demographic and place-specific factors are consistent with the partial-market exits seen in 2017. These questions are more formally outlined in the following section.

CHAPTER 3

RESEARCH DESIGN

Research Questions

The gaps outlined in the literature review leave questions raised about the spatial characteristics of the recent mass closures taking place in the United States. Three overarching research questions guided the methodology in this thesis, with each question feeding into the next. Each question has deliberate and direct consequences not only for the department store chains being studied, but for urban planners and local economies.

1. Was there statistically significant spatial clustering among department store closures in the United States in 2017?

The first research question motivated a preliminary analysis of closed store locations using spatial statistics. Feng et al. (2011) already revealed clear clustering patterns in nursing home closures by visualizing closed locations using GIS. However, the largely descriptive approach of the study, and the fundamental distinctions that exist between healthcare and retail industries demands a more thorough exploration of clustering patterns for department store closures, specifically. To identify statistically significant clusters of closures, this research analyzed spatial statistics for each chain's store closures, and the aggregate of all closures. Though literature explicitly addressing spatial patterns in closures is sparse, an aggregated discussion of the demographic and place-specific variables that have been empirically defended in association with closures identifies distributions of certain cities across the U.S. where closures may be clustered. Undoubtedly, Rust Belt cities fit these criteria, and have already been cast as "victims" of the retail apocalypse (Eide 2017; Kapner 2017). It follows that some spatial clustering of closures in the mid-west and eastern Great Lakes region was expected. This type of

preliminary analysis raised more targeted research questions about site-specific and demographic trends.

2. What demographic and place-specific factors account for the spatial distribution of department store closures in the United States in 2017?

This second research question dived deeper into the variation in total retail closures by targeting specific demographic and geographic variables that are characteristic of the stores themselves, or the markets in which they are located. It asserted a broader hypothesis that geography has some part to play in the closure decision for retailers. Multiple variables have been found to have a statistically significant relationship with closures in prior work: distance to distribution center and income (Shield & Kures 2007), distance to competitors (Nikolic & Weiss 2013), minority populations (Feng et al. 2011), among others. Table 3.1 lists these variables and, for econometric studies, also lists the marginal effect size.

Table 3.1: Past Empirical Variables

Variable	Literature	Effect Size
Demographic Variables		
% Hispanic	Feng et al. 2011	
% Black	Feng et al. 2011	
Population density	Nikolic & Weiss 2013	1.3% decrease in likelihood of closure for a unit increase
Income		
Site-Specific Variables		
Distance to distributor	Shields & Kures 2007	
Distance to like-store	Shields & Kures 2007	.1 % decrease in the likelihood of closure for a unit increase
Distance to competitors	Nikolic & Weiss 2013	.5% decrease in the likelihood of closure for a unit increase

By comparing the marginal effects of each variable in the model outputs, it was possible to determine which variables are present in any pattern with department store closures. In

examining the results of past econometric studies approaching similar research questions (Shield & Kures 2007; Feng et al. 2011; Nikolic & Weiss 2013), Hispanic and African-American population were expected to have a positive relationship with the probability of closure, agglomeration was expected to have a negative relationship with probability of closure, distance to distribution centers was expected to have a positive relationship with probability of closure, and income was expected to have a negative relationship with probability of closure.

3. To what extent did different demographic and place-specific factors account for store closures in 2017 for each chain: Macy's, Sears and J.C. Penney?

Building off of the answer to the second question, the analysis then focused on each retail chain as an isolated subset of the population. The effect sizes were then compared between the single chain and the aggregated set of all three retailers. Barring no substantial changes to standard error as a result of reduced sample size, we may make conclusions about how the demographic and place-specific variables are trending differently with each chain. This procedure is applied the same modeling methods and empirical foundation behind answering the second question with an added comparative discussion about how location factors may differ between chains. Based on knowledge of each chain's customer segmentation, income was expected to have a greater marginal effect on the closure decision for Macy's than for J.C. Penney or Sears. Macy's core demographic is typically wealthier than the other two department stores (Bailey 2015).

Data Inventory and Processing

Undoubtedly, the most important data for any geographic study of retail closures are the locations of the closures, themselves. These department store closures were all announced between January and March of 2017. Macy's and J.C. Penney closures were published through

Business Insider, while closures for Sears were made publicly available via a Sears Holdings press release. This thesis treated each store- both those remaining open and those closing- as a unit of observation, so it is necessary to have the entire store networks for these three department stores at the time of the closures. These store locations were sourced through ESRI Business Analyst 2016 store location data.

Another key dataset was distribution center locations for all stores. Macy's makes this data publicly available on their careers website (www.macysjobs.com). J.C. Penney released their distribution center locations in publicly available filings with the Securities & Exchange Commission (SEC 2016). Sears distribution center location data was generously donated from the Sears Holdings real estate department for this study.

In addition to data specific to each retailer being studied, the locations of major competitors for each firm were necessary to build a variable related to competition in local markets. This data was only used in the modeling piece of the methodology. The top competitors for each retailer were easily sourced from D&B Hoovers online. This database from Dunn & Bradstreet offers detailed profiles for almost all public companies in the United States, with listings of the top three competitors for major firms. The top competitors are provided in Table 3.2.

Table 3.2: Major Competitors (D&B Hoovers)

Macy's Top Competitors	J.C. Penney Top Competitors	Sears Top Competitors
Dillard's	Sears	Walmart
J.C. Penney	Kohl's	Macy's
Saks	Macy's	The Home Depot

The store networks of these competitors were also pulled from ESRI Business Analyst 2016. They were used in a geoprocessing workflow to calculate a proxy for competitive

agglomeration in each market.

The final datasets necessary for building econometric models come from the U.S. Census and are sourced from markets denoted by 3.5 mile drive time polygons around each store location. The network polygons accounted for variation in road networks, unlike a buffer. Arriving at a suitable trade geometry for disparate retail chains across the entire United States was challenging. In a regional or firm-specific analysis, trade geometries could be derived with much accuracy. However, to build trade areas specific for each retailer in each market is well-beyond the scope of this study. To maintain an equal and nationwide approach to trade geometries, the 2017 National Household Travel Survey data was used. This U.S. survey logs trip information on 923,000 survey participants based on travel times, distances and destinations. From this survey, the average distance a shopper travelled to a store in the U.S. in 2017 was 3.48 miles. From trade polygons, the following demographic variables were sourced in ESRI Business Analyst 2016: median household income, black population, Hispanic population, and population density.

Each store in the Macy's, J.C. Penney and Sears networks was assigned a binary variable representing the discrete choice of whether or not a store was slated for closure in the announcements from early 2017. If this binary variable value was equal to 1, the store was closed. If the store remained open, it was set equal to 0.

ESRI ArcGIS was used to calculate the number of competing stores within the 3.5 mile market area. I also calculated the number of same stores in the market. This is a control for any cannibalistic effects that may occur from two stores being located in the same market. In addition, the study measured the distance of each store from its nearest distribution center. ArcGIS has a built-in geocoder to assign latitude and longitude coordinates to all distribution

centers- which were previously only assigned an address. The analysis then calculated the Euclidean distance from each store location to its nearest distribution center.

Table 3.3: Data Inventory

Data	Data Type	Data Source
Macy's / JCP/ Sears Stores	Spatial- Point	ESRI Business Analyst 2015
Macy's / JCP / Sears Top Competitors	Categorical- Attribute	D&B Hoovers
Top Competitors Locations	Spatial- Point	ESRI Business Analyst 2015
Macy's / JCP Closures	Categorical- Attribute	Business Insider
Sears Closures	Categorical- Attribute	Sears Holdings
Macy's Distribution Centers	Spatial- Point	Macys.com
JCP Distribution Centers	Spatial- Point	SEC Filings
Sears Distribution Centers	Spatial- Point	Sears Holdings Real Estate
Hispanic population	Spatial- Polygon	U.S. Census 2010
Black population	Spatial- Polygon	U.S. Census 2010
Population Density	Spatial- Polygon	U.S. Census 2010
Median Household Income	Spatial- Polygon	U.S. Census 2010

Research Methods

Spatial Statistical Testing

Recall that the first research question from this thesis asks: *Is there spatial clustering among department store closures in the United States in 2017?* Answering this question required a measurement of spatial distributions based on the expectation that there is some degree of clustering. I expected to see some degree of statistically significant clustering in, or around, Rust Belt cities. This would be consistent with the narrative of economic decline that has been unfolding in the region (Eide 2017; Kapner 2017). I measured presence or absence of clustering among closures using the Local Moran's I. This spatial statistic identifies different types of significant clusters- high-high, high-low, low-high, low-low- based on some variable of interest.

In the case of this study, the variable of interest was the binary (0,1) field denoting whether or not a store closed. Calculated high-high clusters marked statistically significant clusters of closures, where the binary variable was equal to one. Similarly, low-low clusters marked statistically significant clusters of open stores, where the binary field was equal to zero. I created a simple heat map of closed locations and compared this density map to the locations of statistically significant clusters of closures. This test was not only performed at an aggregated level for closures across Macy's, J.C. Penney and Sears networks, but was also done separately for each firm. These firm-specific tests revealed clustering patterns that are part of an individual firm's location strategy, and unique to aggregated trends based on geography or demography.

Econometric Modeling

The key piece of the methodology was a discrete choice Probit model that assessed the association of the previously mentioned factors with the decision to close a store, given by the model:

$$Y^*_i = \sum \beta_k X_{ik} + u_i$$

where Y^* was the continuous latent variable indicating increased likelihood of a store closure, X denoted location-specific and socio-demographic factors and their corresponding coefficients (β) for k regressors, and u denoted unobserved error (Aldrich & Nelson 1984; Fox 2016).

Though, generally, Probit and Logit modeling are often related and very similar in output, the decision to choose Probit over Logit was not arbitrary or based on convention. It was possible that some significant spatially correlated error may be present in initial runs of the aspatial Probit model that would require more sophisticated models to account for spatial error. Many statistical software packages already have tools in place to handle spatial variants of Probit models (LeSage & Pace 2009). However, less work has been done on spatial variants of Logit

models. In the interest of accounting for the possibility of spatial error, this study used the Probit model.

In running iterations of the Probit model, the study gave particular attention to the marginal effect size associated with each variable to answer the second research question. In addition, the research applied the model to subsets of the closure data set specific to each retail chain to see how the effect sizes and statistical significances changed depending on the retailer- effectively answering Question 3.

CHAPTER 4

RESULTS

Answering Question 1: Local Moran's I

Figure 4.1 displays a density heat map of store closures for Macy's, Sears and J.C. Penney locations, with an overlay of blue nodes marking statistically significant clusters of closures calculated using Moran's I. Typically, the heat density raster will only show hotspots where there are more people, and resultantly, more stores to close to begin with. To improve on this, the local Moran's I controlled for existing store networks, and revealed significant clusters of closures relative to *all* stores that could have closed.

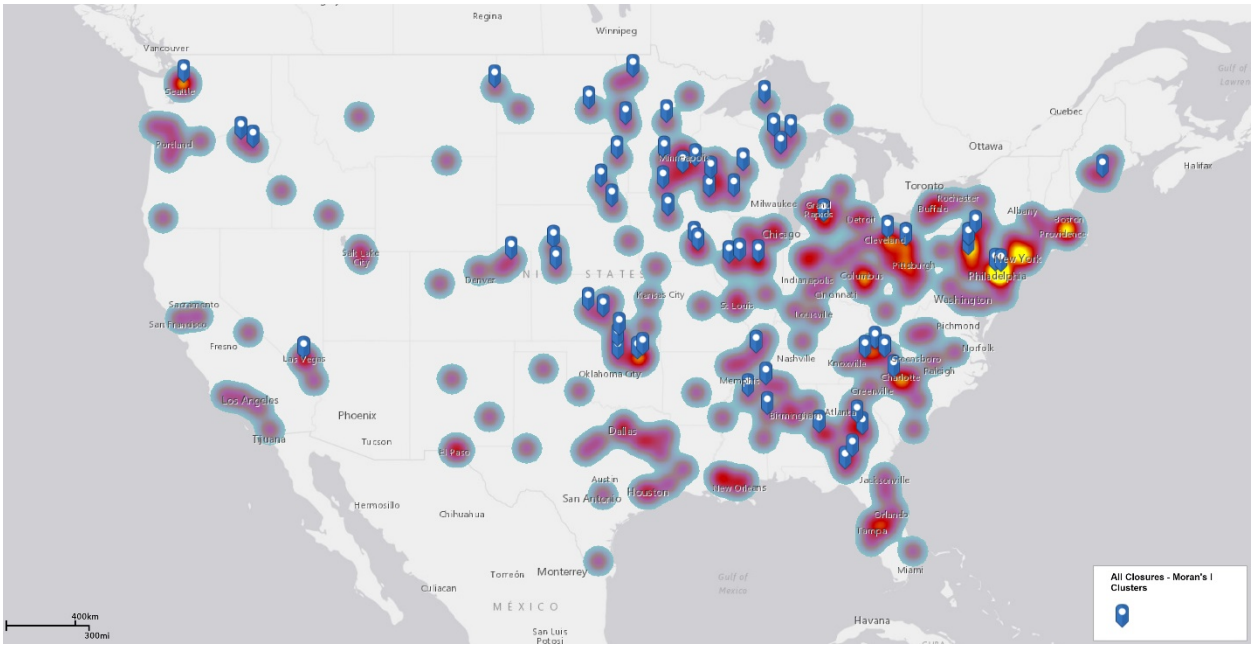


Figure 4.1: Local Moran's I (All Closures)

Notice the heat density layer captured areas with high numbers of closures in the southern part of the United States that, when compared with the clustered points marked in the Moran's I layer, are not statistically significant. Simply, this means that although there were many closures in this area, given the number of stores that are located there, the number of closures that

occurred is to be expected. This trend also appeared in Tampa, New York City and Boston. The methodology applied this same cartographic approach to subsets of the aggregated closure data for subsets of each chain. The results of this mapping procedure for each chain separately are given in Figures 4.2 - 4.4.

Macy's closures shown in Figure 4.2 were concentrated around Philadelphia and New York City, with some substantial presence in and around Rust Belt cities such as Pittsburgh and Cleveland. Further, a local Moran's I calculation revealed statistically significant clusters of closures in and around the Rust Belt, consistent with the general trend of economic decline these regions have seen in the past few decades.

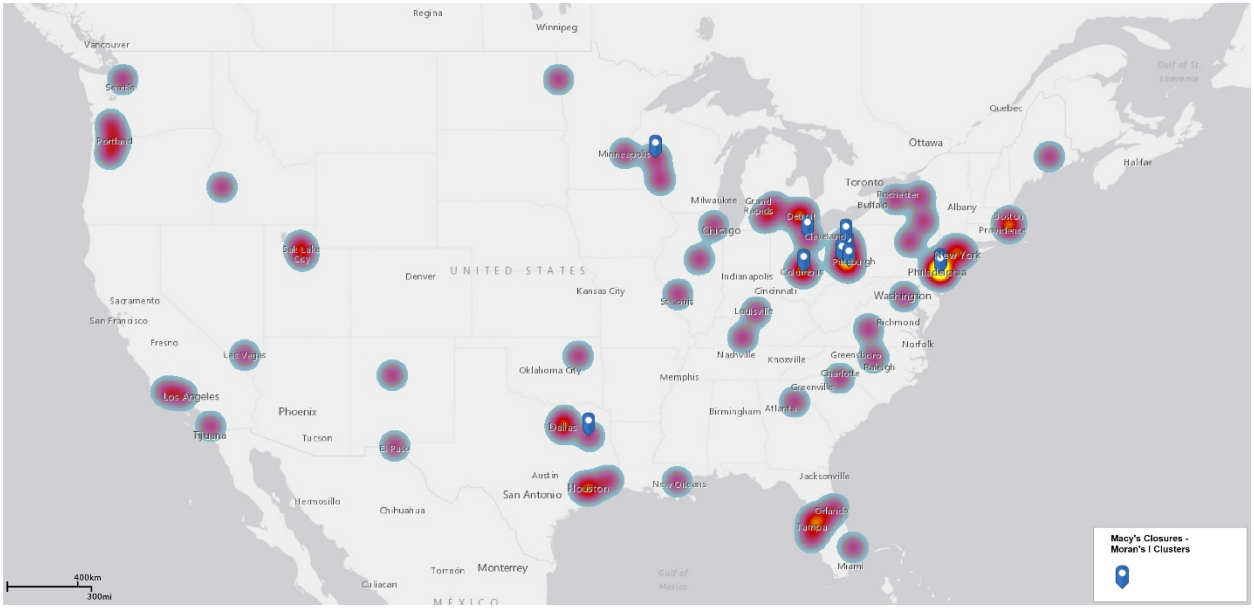


Figure 4.2: Local Moran's I (Macy's Closures)

J.C. Penney's closed locations in Figure 5 followed a very different pattern. There was no evidence of statistically significant clusters of closures around the Rust Belt, but a great number of clusters are present in Minnesota, Wisconsin and Illinois. There was also evidence of closure clustering in the Southeast part of the country.

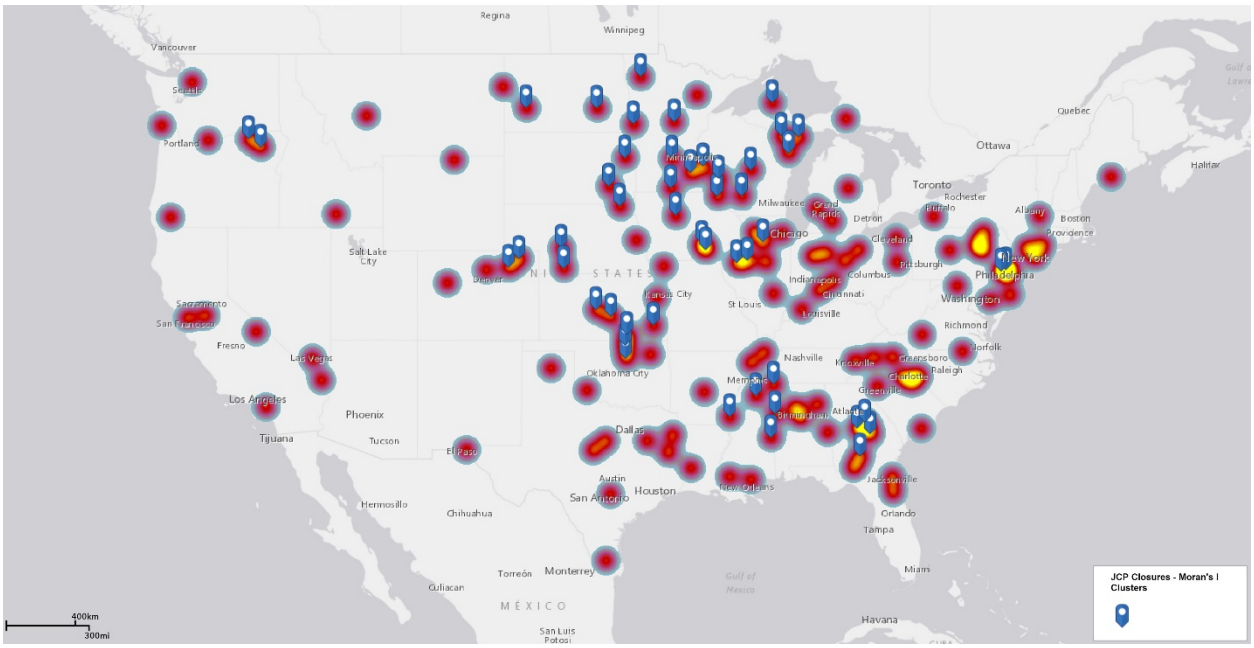


Figure 4.3: Local Moran's I (J.C. Penney Closures)

The final subset of Sears closures in Figure 6 aligned more closely with the clustering patterns found in Macy's store network, with some statistically significant clusters of closures in the Rust Belt: Cleveland, Pittsburg and Buffalo. These clusters extended down through Ohio and into Tennessee.

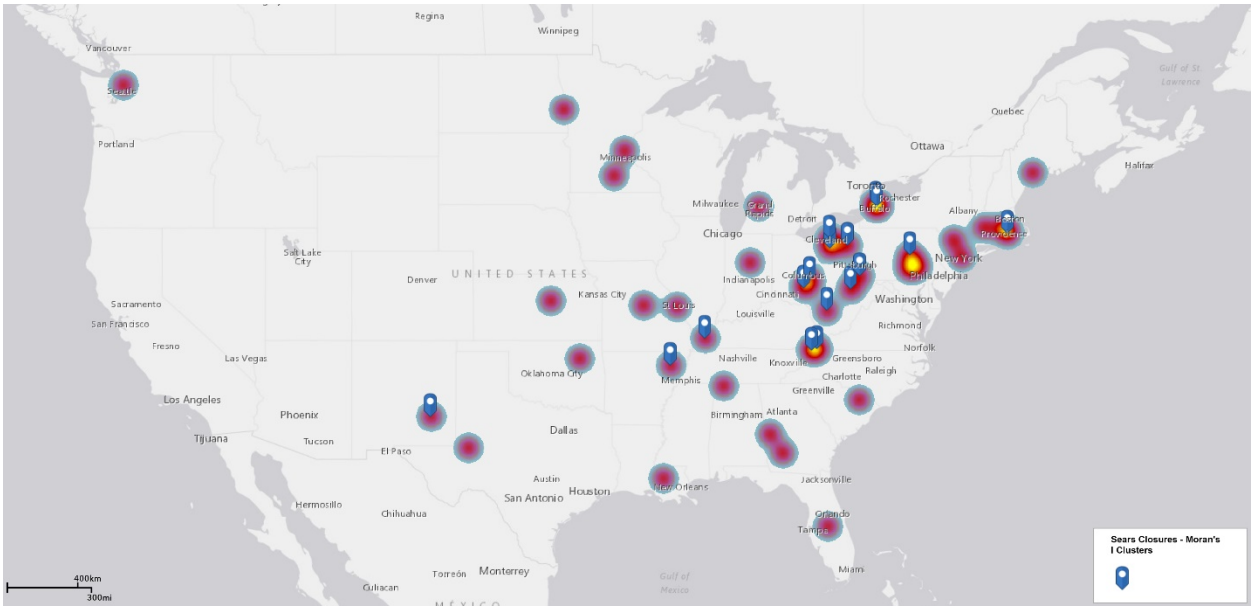


Figure 4.4: Local Moran's I (Sears Closures)

Applying a local Moran's I statistical test definitively answered the first research question. There was clear evidence of statistically significant clustering among department store closures in 2017. This clustering manifested in the Rust Belt for Macy's and Sears chains, consistent with the narrative of economic decline that has been prevalent in the region for decades.

Answering Question 2: Aggregate Probit Model

The first modeling results are given in Table 4.1. The left column of the table lists each covariate from the study. The second column, "All Closures," marks marginal effects (with standard error in parentheses below) for each standardized covariate for the aggregated model. The third, fourth and fifth columns apply this same model to each separate chain. The bottom two rows of the table provide the sample size and Akaike's information criterion for each model. The investigation used marginal effects here rather than the raw coefficient outputs from the model for ease of interpretation. Marginal effects provided the change in the probability of closure relative to a change in each covariate by one standard deviation.

Table 4.1: Marginal Effects of Demographic and Place-specific Factors on Store Closures (State-control)

	All Closures	Macy's	Sears	J.C. Penney
Median Household Income (Sq.)	-1.6178% *** (0.03852)	-2.0262% * (0.07927)	-2.4047% ** (0.1534)	-0.6212% (0.04063)
Population Density	-0.2247% (0.0573)	-2.8249% (0.1898)	0.6446% (0.08861)	0.06074% (0.10425)
Percent Black	-0.30004% (0.04656)	1.6334% (0.09261)	-1.0154% (0.128)	-0.3246% (0.0724)
Percent Hispanic	-0.9171% (0.06001)	-1.9766% (0.1234)	-1.2416% (0.1797)	0.2113% (0.0897)
Number of Competitors	-4.8057% *** (0.04549)	-4.6256% *** (0.09827)	-0.0174% (0.09815)	-10.02925% *** (0.07712)
Number of Same Stores	-1.818% ** (0.06455)	-0.3047% (0.1247)	-1.666% (0.1612)	-2.5944% (0.1049)

	All Closures	Macy's	Sears	J.C. Penney
Distance to Distribution Center (miles)	-0.004152% (0.00032)	3.8636% * (0.1533)	-2.8239% (0.2573)	0.1038% (0.1087)
Observations	2661	696	894	1071
AIC	1508.5	451.1	367.85	743.7

The dependent variable in all models is the binary closure choice (0 or 1); all covariates are standardized.

The "All Closures" model controls for each chain, in addition to state. Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

The aggregate Probit model directly answered Question 2 by identifying median household income, number of competitors in the market and number of same stores in the market as statistically significant factors underlying the entire sample of 2017 department store closures. Median household income has an economically and empirically defended negative trend with store closures. It is intuitive that markets that have a higher median household income are less likely to see department stores close. The interpretation of the marginal effect here was that as the median household income in the market increases by one standard deviation, the probability that a department store in that market may close decreased by 1.6178%.

Recall that the number of same stores variable simply counted the number stores in the market that were part of the same chain as the observed store. The interpretation of the marginal effect was that as the number of same stores in a market increases by one standard deviation, the probability that a department store in that market may close decreased by 1.818%.

The most important statistically significant regressor was number of competitors. Recall that this variable was calculated uniquely for each chain (see previous Table 3.2). This analysis counted the number of these competitors in each market. As the number of competitors in the market increased by one standard deviation, the probability that a department store in that market may close decreased by 4.8057%. This marginal effect demonstrated that increased

agglomeration and localized competition among stores reduced the probability of closure. While there is some debate about the balance between blows from competition and the benefits of knowledge spillover and consumer convenience- empirical research related to store closures has previously found competition to be statistically significant and negatively related to closures (Nikolic & Weiss 2013; Kickert & vom Hofe 2017).

Answering Question 3: Firm-specific Probit Models

To answer Question 3, the aggregate model was applied to sub-sets of the total sample specific to each store. The results for each chain are given in the third, fourth and fifth columns of Table 4.1. Because each firm has a unique location strategy, market segment and economic trajectory- the study expectation was that the marginal effects for each covariate may change when the aggregate model is applied to each retailer separately.

Median household income remained a statistically significant factor for Macy's and Sears, but not for J.C. Penney. Number of competitors also maintained statistical significance and a relatively high effect size for Macy's and J.C. Penney's models, but not for Sears. In particular, the effect size on J.C. Penney was large. As the number of competitors in a market increased by one standard deviation, the probability that the J.C. Penney location in that market will close decreased by 10.02925%. An additional covariate that was revealed to be statistically significant for Macy's was distance to distribution center- with a positive relationship. The interpretation here was that, for every one standard deviation increase in the distance in miles from a Macy's distribution center, the probability that an observed Macy's store will close increased by 3.8636%. Summarily, the break out of models for each chain effectively answered the third research question. The statistically significant factors underlying Macy's closures included median household income, number of competitors and distance to distribution centers.

The statistically significant factor underlying Sears closures were median household income, and the statistically significant factor underlying J.C. Penney, with a substantial effect size on closure decisions, was number of competitors.

The results displayed in Table 4.1 failed to account for local economic trends that may jointly influence the likelihood of having more competing stores in the market, and the likelihood that the observed store will be healthy and not close. Thus, the results in Table 4.1 may be biased. To test this, I ran one more model on each chain subset that controlled for metropolitan areas rather than states. The results are given in Table 4.2.

Table 4.2: Marginal Effects of Demographic and Place-specific Factors on Store Closures (MSA-control)

	Macy's	Sears	J.C. Penney
Median Household Income (Sq.)	-2.1853% ** (0.01016)	-1.4109% ** (0.00667)	-1.6899% ** (0.00792)
Population Density	0.1347% (0.01186)	0.08697% (0.00766)	0.1042% (0.009177)
Percent Black	1.6966% (0.01408)	1.0954% (0.00918)	1.312% (0.01094)
Percent Hispanic	-0.3533% (0.0196)	-0.2281% (0.0126)	-0.2732% (0.0151)
Number of Competitors	-4.803% *** (0.0118)	-3.1011% *** (0.00969)	-3.7143% *** (0.01074)
Number of Same Stores	-2.6993% * (0.01392)	-1.7428% * (0.00899)	-2.0874% * (0.010702)
Distance to Distribution Center (miles)	0.00757% (0.0001)	.00489% * (0.00007)	0.00586% (0.00008)

The dependent variable in all models is the binary closure choice (0 or 1); all covariates are standardized. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

These results in Table 4.2 demonstrated that controlling for MSA does reduce the effect size of competition, particularly for J.C. Penney, but it also returned a statistically significant covariate for competition with Sears stores that was not present in the results of Table 4.1. From this second iteration of models, it is shown that controlling for MSA rather than state returns a

statistically significant negative relationship between income and closures, and number of same stores and closures. The models controlling for MSA defend that the statistical significance and substantial effect size of number of competitors was not just a function of the economic health of communities, but has a true underlying trend with department store closures.

CHAPTER 5

DISCUSSION AND CONCLUSION

This thesis took steps to understand patterns of clustering and geographic distribution in department store closures in 2017 from J.C. Penney, Macy's and Sears. These steps directly addressed the first research question asked in the study. The use of local Moran's I extends on existing geographic studies of closures with added rigor and greater insight (Feng et al. 2011; Kavroudakis et al. 2013). It measures clusters of closures relative to networks of existing stores, rather than measuring the raw density of closed locations. These clusters were present in and around the Rust Belt, and the northern parts of the mid-west, and the Deep South for an aggregate analysis of all closures. Applying Moran's I to each chain individually reveals clustering in the Rust Belt for Macy's and Sears This is consistent with the narrative of economic decline seen in this region of the United States. In addition, the analysis revealed statistically significant closure clusters in the northern mid-west and Deep South for J.C. Penney.

The thesis also applied Probit modeling to assess demographic and place-specific factors that underlie partial-market exits for an aggregated sample of all three department stores, directly answering the second research question. Number of competitors had a negative relationship with the probability of closure with a relatively large effect size, suggesting that closures tend to be located in areas without a larger number of competitors in the market- and without any potential positive externalities that may result from such agglomerations. Median household income also had a negative relationship with the probability of closure, reaffirming past empirical and theoretical work that has defended the relationship between household income and store performance (Ferber 1958; Vitaska 1971). Interestingly, number of same stores also had a negative relationship with the probability of closure. This finding counters some past research on

the negative effects of cannibalization on store performance (Xu & Liu 2004), but may suggest a trend in which store closures are less likely to occur where a retailer has already established a market presence with more existing stores.

Finally, the thesis research addressed a third research question concerned with replicating the same aggregate modeling procedure for each individual chain- Macy's, Sears, and J.C. Penney. Distance to distribution center was revealed to have a statistically significant positive relationship with the probability of closure for Macy's. Income continued to have a negative relationship with the probability of closure for Macy's and J.C. Penney. The most important place-specific factor, number of competitors, not only had the greatest statistical significance and effect size for almost all iterations of modeling, it also is one of the most easily influenced by public policy. Urban planners and economic developers can play an active role in shaping the retail landscapes of their communities through careful retail planning and development policies. The contributions of this study are specifically designed to better inform planners and developers about what aspects of space planning they should focus on to ensure the longevity of department stores, and reduce the risk of retail closures in their towns. The city remains just as much a stakeholder in this study as the firm.

Discussion

While the cluster patterns identified under the first research question provide useful insight, they are not the most striking product of the analysis. What is most interesting about the results of answering the first research question is what is *not* on the maps. The study returned a surprising result with the absence of any statistically significant clusters of open stores, demonstrating that no urban market is explicitly safe from the wave of retail closures that has swept across the country.

Recall that local Moran's I is designed to measure variants of localized clustering: high-high, low-high, high-low and low-low. In the context of this study, statistically significant high-high clusters mark areas or regions where stores' binary variable is equal to 1, indicating closure. Most crucially, local Moran's I returns no evidence of low-low clusters in any iteration of the analysis- for Macy's, Sears, J.C. Penney or the aggregate of all chains. In the context of this study, low-low clusters would mark statistically significant clusters in regions or areas where stores are remaining open. There are none. Simply, this indicates that no urban area is safe from the wave of closures that came in 2017. This key finding should demonstrate to urban planners and economic developers the importance of proactive and impactful policies that may contribute to the longevity of department stores in their communities.

In order to know where policies and regulations should be focused to secure the future of department stores in local economies, we turn to the modeling results from answering the second and third research questions. The results of these models, in conjunction with insights from the preliminary local Moran's I calculations reveal some key insights to urban planners and administrators about factors that underlie department store closures, and may inform what policy or regulatory measures may be taken to ensure the sustainability of department stores in local markets. Income was found to have a statistically significant, negative relationship with the probability of closure. This inverse relationship between income and store performance is consistent with some of the foundational studies regressing income on sales and/or volume (Ferber 1958; Liu 1970; Mejia & Benjamin 2002).

Number of same stores had a negative relationship with closures, which may seem counterintuitive given what retail geographers know about the effects of cannibalization in markets (Xu & Liu 2004). However, the negative relationship is consistent with Shields and

Kures (2007). In this case, this signals more about the positive effects of brand presence and market penetration, rather than negative impacts from cannibalization.

As discussed in the methodology, the most important independent variable from the modeling procedure is number of competitors. This is not only due to the substantial effect size, but also because the competitive retail landscape of local economies can be influenced by changes to policy and regulation from economic developers and planners. There is a body of literature defending competitive agglomeration in retail as a catalyst for economic growth, and an argument that this catalyst can be controlled and supported with economic development policies and careful retail planning (Kickert & vom Hofe 2017; Mohanty & Mishra 2014; Shoag & Veuger 2014).

Considering the empirical results of this thesis and the body of existing literature supporting positive growth and externalities associated with retail clustering and agglomeration, a case can be made for producing economic policies that support department store agglomeration in an effort to reduce the probability of a closure. However, it should be acknowledged that this study does not control for local factors that may simply make areas with greater numbers of co-located stores more amenable to all stores in the market. The results found in this study are only associative, and it is possible that either process- effective policy or organic retail growth- may be fueling the results seen here. Recognizing this limitation also raises new opportunities for future research. While the findings here are important on their own, they also set up a foundation for further research.

Future Research Opportunities

The most important opportunity left open by this thesis for future investigation is in the data and controls present in the Probit models. The sophistication and rigor of the model are

constrained by what data are available. In a scenario in which individual store performance data were available, the model could more effectively control for the relationship between low sales numbers and the closure decision for a store location. There is potential for omitted variable bias here: an excluded variable that has statistically significant association with the variation in closures, and is correlated with regressors already included in the model. Replicating the modeling procedures in this thesis with a more complete data set of store characteristics will introduce store-specific control variables that may improve the accuracy of the models. These could include annual sales, square footage, or store age. Store age, could be correlated with distance to distribution center or numbers of competitors and like stores in markets. It is also correlated with the closure decision. Store real estate that reaches the end of a mortgage or lease, or that begins to depreciate in quality and value may be cycled out of the store network. Failing to account for this may create bias in the models.

There is also an opportunity for a more rigorous empirical investigations that consider other retailers, or a larger set of retailers. It is important to assess whether the findings of this study remain valid for closed stores in other sub-industries (ie. pharmacy, footwear, etc.) or for a more concentrated geographic study (ie. the Rust Belt). Because mass partial-market exits from multiple retailers remain a recent phenomenon, the gap in literature and the need to characterize this change in the retail landscape remains strong. Applying the methods used in this thesis to other retail markets of interest can only serve to provide more insights into the factors that underlie the mass closures.

Another future project, one that supports one of the most important research themes in retail geography today, could examine the relationship between retail closures and the development of e-commerce real estate formats- seeking patterns or trends in the growing spatial

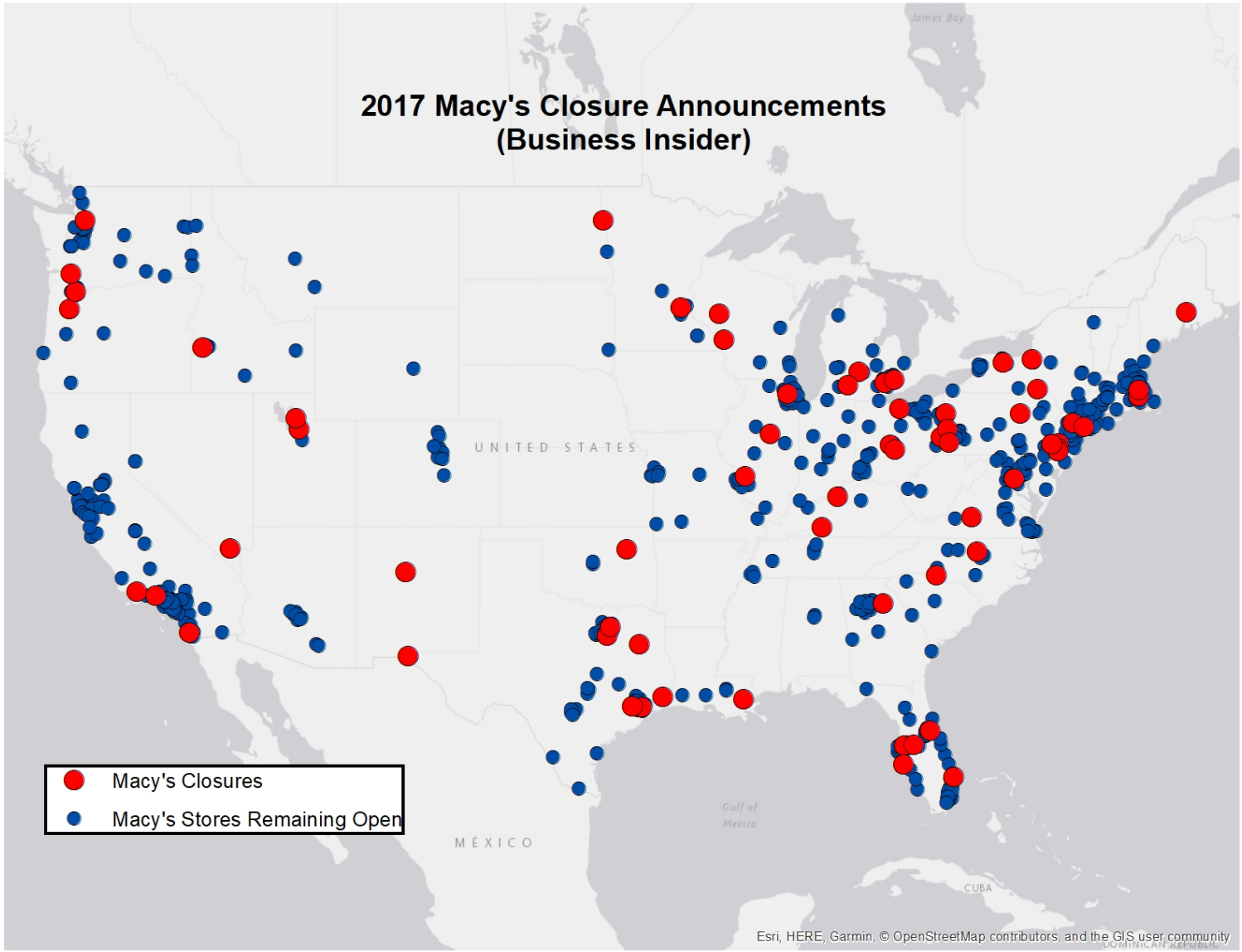
extent of e-commerce infrastructures and the continuing decline of brick-and-mortar locations. This temporal study could incorporate multiple years of growth and decline for e-commerce and brick-and-mortar. E-commerce development is not a dimension explored in this thesis, and there remains an opportunity to accurately measure the strength of the relationship between e-commerce expansion and retail failures across space and time.

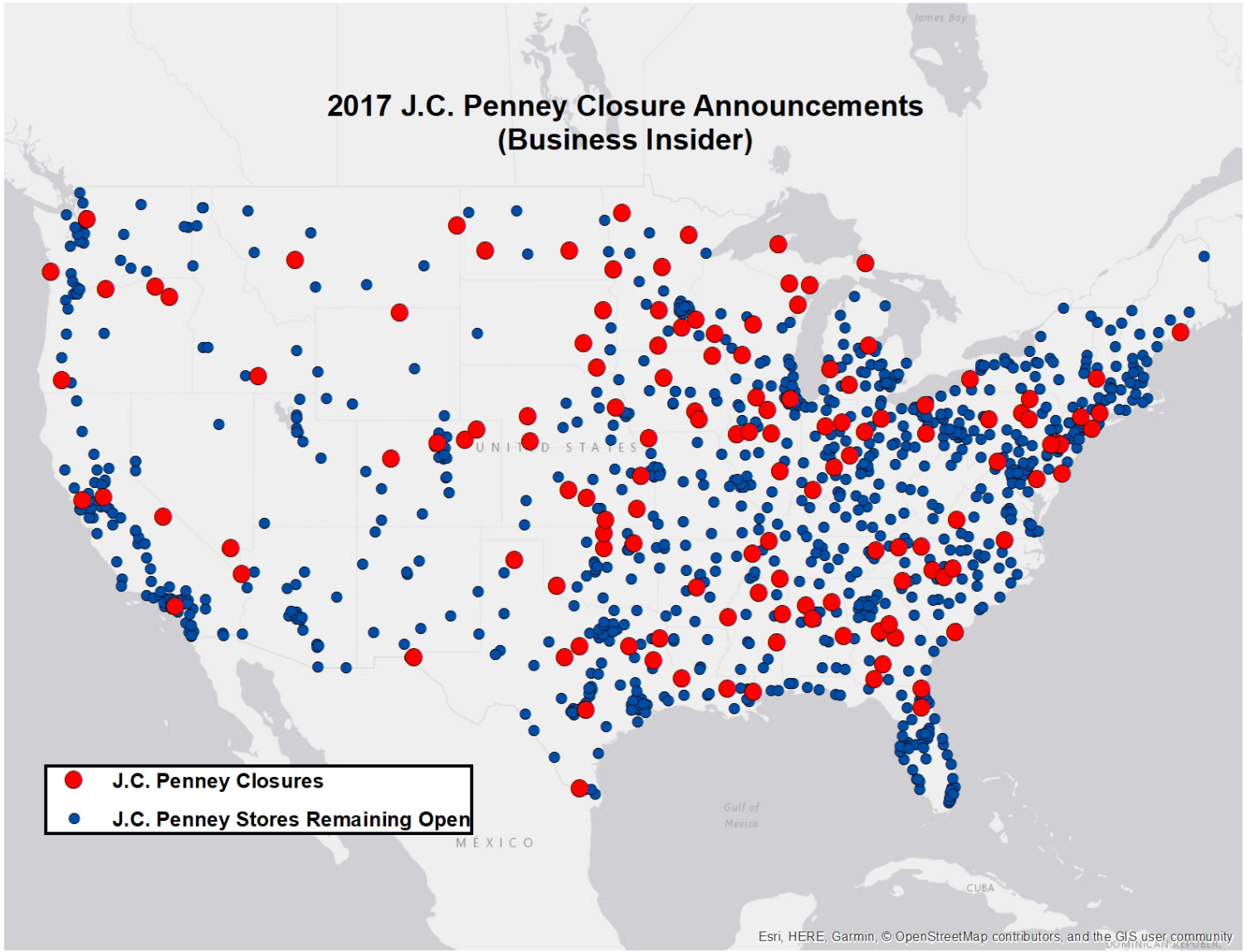
Conclusion

The emphasis this study has placed on economic development and applications of spatial statistics makes a substantial contribution to existing literature which has either only described and summarized spatial distribution (Feng et al. 2011; Kavroudakis et al. 2013), or has taken a less-holistic and more firm-oriented approach to modeling closures (Shields & Kures 2007; Nikolic & Weiss 2013). This study investigated the spatial characteristics of retail market exit during a period of change and transition in the retail landscape. This change is leading the retail economy to a future that focuses on digital and physical retail channels working together, with increased emphasis on convenience, immediacy and ever-changing consumer tastes. The change in retail closures in the United States from isolated incidents specific to select firms or markets to mass partial-market exits from multiple high-profile retailers continues to warrant rigorous investigation from retail geographers. This thesis marks the first of many efforts to that end.

APPENDIX

CLOSURE LOCATIONS


2017 Macy's Closure Announcements
(Business Insider)
UNITED STATES
MÉXICO
Gulf of Mexico
CUBA
Macy's Closures
Macy's Stores Remaining Open
Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community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(Business Insider)
J.C. Penney Closures
J.C. Penney Stores Remaining Open
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MEXICO
Gulf of Mexico
CUBA
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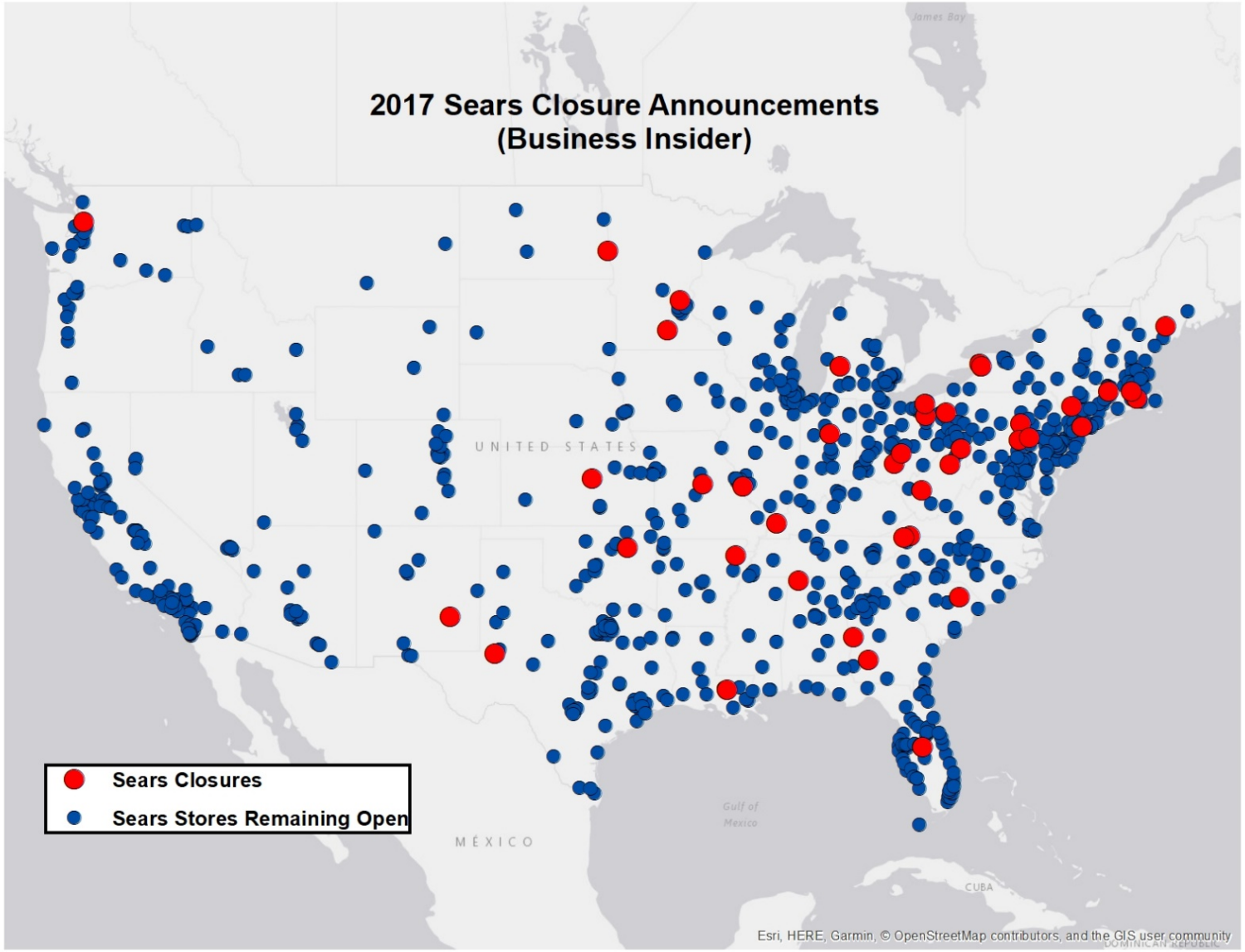
2017 Sears Closure Announcements
(Business Insider)
UNITED STATES
MÉXICO
Gulf of Mexico
CUBA
Sears Closures
Sears Stores Remaining Open
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