DECODING THE FORMATION OF A RETAIL GIANT:

THE EVOLVING GEOGRAPHY OF COSTCO'S STORE NETWORK

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Although Costco operates over 580 warehouse stores throughout North America, their location strategy remains relatively unexamined in the economic geography literature. A cursory examination of Costco's network makes it clear that the firm chooses to locate primarily in the suburbs of major cities, where income levels are somewhat higher than the national average. However, what is not clear is the extent to which other demographic and geographic factors adequately account for Costco's store locations, and what strategy underlies the geography of the firm's warehouse stores, especially in relation to its distribution network.

This research studies Costco in order to decode the location strategies that have guided the company's North American and international expansions. The investigation attempts to identify key elements of Costco's multinational retail network, including this network's evolution over time. This paper seeks to benefit both retail business and public policymakers by highlighting elements of Costco's location strategy that have contributed to the firm's success.

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CHAPTER 1. INTRODUCTION

The retail environment in the United States has sustained many transformations over the past 50 years. Retailers have adjusted their operations in response to continually changing urban dynamics that have produced new challenges for retail development. As the urban population continues to rise and spread farther from the central business district (Millward 2008), new regional retail opportunities continue to form (Rice, Ostrander, and Tiwari, forthcoming). New shopping behaviors and infrastructure such as cars, parking and bulk purchases have caused a shift from small scale shopping communities to large, big-box stores and power centers such as Wal-Mart and Target, (Buliung et al 2007; Cotton and Cachon 2007; Simmons 2012), new urban developments like mixed use construction (Lorch and Hernandez 2008), category "clusters" such as Home Depot and Lowes, (Jensen et al 2005), and to the influx of e-commerce (Lai et al 2014). Increased consumer mobility has led to more congestion within metropolitan areas (Louf and Barthelemy 2014), causing retailers to strategize their location efforts accordingly (Delisle 2005). Globalization and economic change have also contributed to foreign direct investment in retail overseas. Such investment is one of the most rapidly growing ventures for large corporations, including Costco (Park and Byung Il 2014). Other important economic changes have contributed to the failure of large retailers such as Circuit City (in 2006) and Blockbuster (in 2013). A large portion of the changes within the retail environment can be attributed to technological changes that have influenced spatial decision-making behavior. Innovations in geographic information systems (GIS), coupled with easily accessible and extensive demographic, psychographic, and economic data have enabled retailers to implement targeted

expansion strategies. Although retail geographers focus more on stores and consumers than business geographers, both approaches are paramount to sound practices within the field of retail geography. The development of effective ideas is a central business strategy for adapting to the highly dynamic retail industry. One such idea is one of the most transformative to affect the industry, and is responsible for the majority of the retail structure today.

One of the most effective and profitable concepts conceived in the retail sector occurred when Sol Price invented the warehouse store format in 1954 by opening FedMart in San Diego, California. In 1971, the Great Atlantic and Pacific Tea Company opened a Warehouse Economy Outlet (WEO) in Pennsauken, New Jersey, although it would close only a few years later. Price altered his original warehouse store concept in 1976 by opening Price Club in San Diego, California and charging his customers an annual fee, allowing them the ability to shop in the store. In 1983, Jim Sinegal and Jeffrey H. Brotman in Seattle, Washington would copy his warehouse club concept by opening the first Costco warehouse. Costco has since grown to become a multi-billion dollar international retailer with 648 locations worldwide as of January 1st, 2015. That same year, Sam's Club opened their first warehouse club in Midwest City, Oklahoma and has since grown to 621 stores within the U.S and Puerto Rico. A year later in 1984, BJ's opened their first warehouse club in Massachusetts, and today operates 206 stores in the eastern United States (Gelbtuch 1990). From 2000-2010, warehouse club industry sales grew 7.8% compared to 3.5% for the entire retail sector (Warehouse Club Intelligence Center 2015). Today, warehouse club retailing is a $198 billion industry

(Warehouse Club Intelligence Center 2014). Despite the industry's rise from relative obscurity in the early 1970's, few scholarly studies (Gelbtuch 1990, Bates 1977) have focused their attention on the development and expansion of major warehouse clubs like Costco, Sam's Club and BJ's.

As of 2014, these three firms are the only competitors within the warehouse club industry in the United States. The clear leader of this group is Costco (see Figure 1).

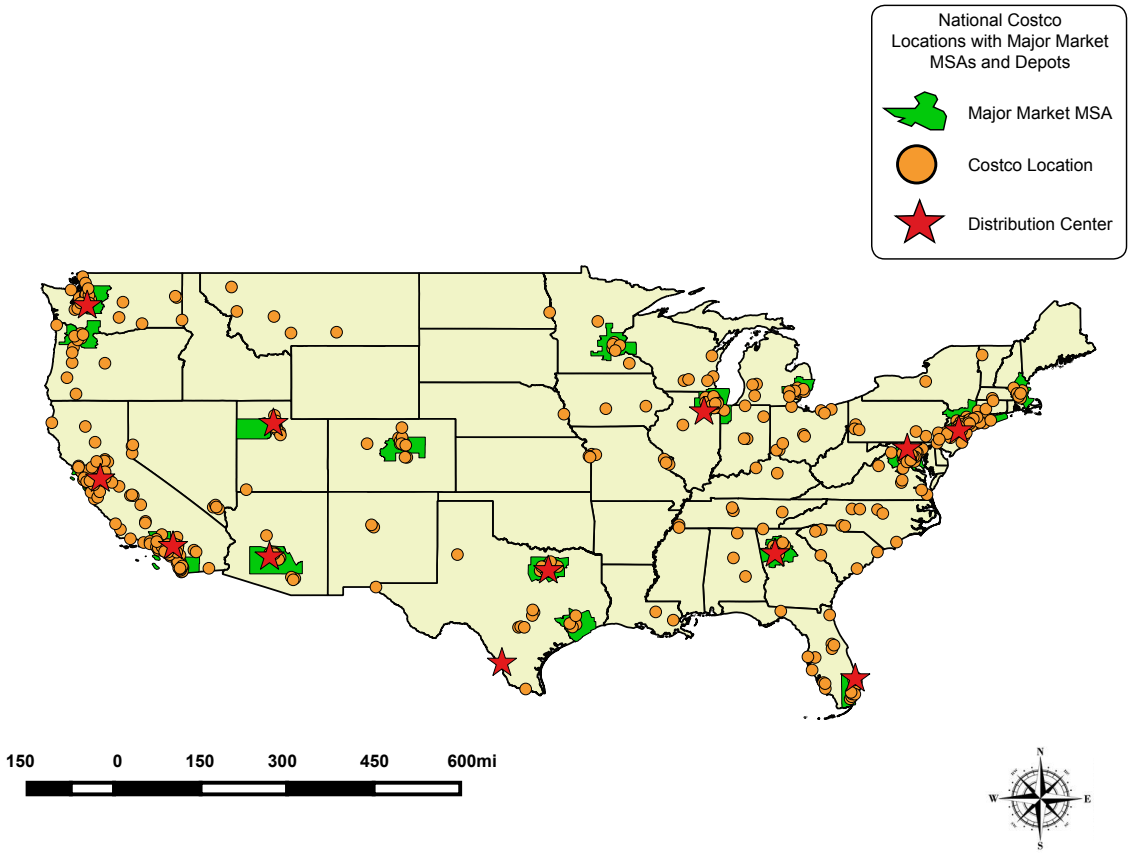

Figure 1: National Costco Locations with Major Market MSA's and Depots

accounting for roughly 60% of total net sales (Warehouse Club Intelligence Center, 2014). Figure 1 shows Costco's national store network with distribution center locations and major market metropolitan statistical areas. What is interesting about Costco's

expansion from a retail perspective is its ability to grow so rapidly with almost no formal advertising and low amounts of product mark up. As of 2014, Wal-Mart is the only retailer that Costco has yet to overtake for worldwide annual sales. Despite the fact Costco operates one-fifteenth the amount of stores of Wal-Mart, their total sales are about one fourth that of world's largest retailer (Costco 2014). In order to fully understand Costco's expansion from a geographical perspective, it is important to position this study within the context of retail geography.

Retail geography is the study of placing retail stores in profitable locations based upon the location and characteristics of customers and competitors. Retail geographers assess the infrastructural needs of a potential site and perform analysis on the population they believe can be captured. The discipline has becoming increasingly popular in recent years as geographic information systems (GIS) allow for more detailed spatial information to be analyzed in a simpler and more efficient manner. Early studies in retail geography focused on population patterns in retail buying (Rolph 1932), excessive competition (Ford 1935), neighborhood retail outlets (Green 1936), studying retail trade areas (Whiteley 1936; Converse 1937; Bratcher 1939; Doherty 1936), retailers adjustment to current conditions (Applebaum 1941), consumer behavior in retail stores (Applebaum 1951), shopping center dynamics (Schapker 1956), and the effects of income on retail sales (Russell 1957). By the late 1950's, retail geographers began re-evaluating their location strategy by incorporating a more scientific approach in response to evolving growth from downtown trade areas to suburban shopping centers (Hindersman 1960). Retail geography began its emergence in the late 1950's

following the publications of *The Selection of Retail Units* (Nelson 1958), *The Structure of a Retail Market and the Market Behavior of Retail Units (*Holdren 1959*), Restraints upon Retail Competition (*Hollander 1965*),* and *Geography of Market Centers and Retail Distribution (*Berry 1969*.* These works highlighted the importance of site selection, marketing strategies, and retail form and function, but struggled to address the emerging dynamics of consumer behavior. In the 1980's, *Retail Geography (*Dawson 1980), and *Retail Location and Retail Planning* (Guy 1980) concentrated on more contemporary issues within the retail environment by studying the spatial behavior of consumers. These works showcased the spatial variations amongst consumers, developers, and retail stores, and helped establish a new approach to market location strategy. Today, research and discussion continues to be conducted concerning the nature of retail geography in an effort to develop its importance as an interdisciplinary field that has far-reaching implications and research avenues to pursue (Leyshon and Thrift, 1997; Willis et al, 2001).

Nevertheless, retail and consumer pattern behavior remains difficult to understand across different landscapes due to constantly changing consumer attitudes. Research in retail geography aims to understand the spending patterns of consumers and how retailers formulate strategies that serve those consumers (Lowe and Wrigley 2010; Poole et al 2006). In the past 50 years, the retail structure in America has moved away from a large number of small stores to a lower number of large stores, and online shopping. These large stores rely on distribution centers to fulfill their high demand for orders. A distribution center is a large building that stores products to be redistributed to retailers, wholesalers, or consumers. Rice, Ostrander, and Tiwari (forthcoming) and

Holmes (2011) examine the geography of distribution centers and their function for Wal-Mart's store network, however similar studies for Costco have yet to be accomplished. Although the number of retailers has gone down, sales have gone up steadily since that time. It appears that concentrating sales into several larger stores has benefited profitability considerably (Hahn 2000). Beginning in the early 1960's, the eventual large-scale, big-box retailers Wal-Mart, Target, and K-Mart began opening discount stores and expanding across the United States. While K-Mart no longer generates the sales volume of a top tier retail chain, Wal-Mart and Target have expanded rapidly over the last 50 years to become the world's first and eighth largest retailers (National Retail Federation 2014). The success of major retailers such as Home Depot, IKEA, Barnes and Noble, Best Buy, and others demonstrate the benefit of the big box format.

Research focus

This research examines the locational selection process for Costco stores from its inception in 1978 to 2014. The thesis explores the strategies which Costco uses to expand its store network within the United States and aims to conceptualize this process through an examination of the local, regional, and national development strategies of the retail chain in order to forecast future development and understand which markets are close to maturity and which markets have potential for considerable growth. The results of this study aim to produce empirical evidence for understanding the decision-making process that Costco uses for the construction of new warehouse locations. It will uncover how geography impacts Costco's network expansion by

highlighting the interaction between the urban environment and warehouse locations and by uncovering the structure of their consumers through an analysis of demographic data. The study also attempts to explain what geographic role Costco's distribution centers serve in the existing and future warehouse network. The final goal of this study was to understand the contribution to "place" that Costco stores make, and what, if any, relationship exists between housing trends, competition from other warehouse clubs, and urban development and urban sprawl and Costco stores. This was done by assessing the general expansion pattern of Costco's store and distribution network, and utilizing a case study approach to showcase the demography and geography of one of Costco's major markets. This thesis asks the following questions: 1. What was the general expansion pattern and sequence of Costco's expansion? 2. How is geography important to Costco's network of distribution centers and what role does this network serve for Costco's current and future warehouse network? 3. What type of contribution to "place" does a Costco store make, specifically, how does the opening of a new Costco store affect the surrounding area in terms of business activity? What is the market makeup of the surrounding areas of Costco stores in terms of demographics?

The thesis also utilizes a point pattern analysis using a Bivariate K methodology. The subsequent chapters of this thesis are as follows: Chapter 2 will provide a detailed analysis of the relevant literature, Chapter 3 will outline the data and methodology, and Chapter 4 will summarize the results, and also have an extended discussion and conclusion section.

CHAPTER 2. LITERATURE REVIEW

The following literature review provides a general overview of retail geography and its connection to business geography. The review follows this with a survey of early contributions to retail and business geography beginning with the 1950s and ending in the late 1970s. This literature review will also examine the warehouse club industry from its inception to its current state, and attempt to position it appropriately within the current retail geography literature by identifying potential reasons as to why it has not received the attention it perhaps warrants. Finally, this literature review will narrow its focus by examining the research on chain expansion and identifying what specific contributions have been made in regards to Costco.

Business geography

It is important to understand retail geography in the appropriate context by positioning it accordingly within its parent field of business geography. Business geography uses geographic reasoning and advanced technologies to decipher and evaluate data in support of better business decisions. It differs from economic and urban geography by applying its concepts to solve problems within the business environment, rather than attempting to explain its arrangement (Thrall 2002). Business geographers use geographic information systems (GIS) software to analyze a vast array of geographic data. GIS connects information on economies, real estate, and competitors with consumer lifestyles, demographics, and psychology. Business

geography draws on ideas and insight from economic geography by applying its findings to improve the functionality of business. The implementation of reliable and successful best practices has proved challenging for business geographers since the 1990's as the landscape of capitalism has evolved and corporations have altered their structure in response to complex information based networks organized across space (Scott 1998). Indeed, the economic geography environment has proven to be highly dynamic, especially since the inception of modern technology (Truffer 2005). The incorporation of economic and business geography provides the framework for study in retail geography.

Business geography and real estate market analysis have been described as being synonymous (Thrall 2002). However, this premise is not a consensus within the business geography community (Berry 2003). According to Thrall (2002), business geographers perform real estate market analysis by establishing trade areas, assessing the competition, and estimating demand. This analysis is conducted at the appropriate geographic scale, and is specific to the potential site. Business geographers compile their findings into a report that is prepared for clients. While real estate market analysis is a key component of study in business geography, it does not comprise the entirety of the subject area. There are many instances in which business geography principles can lead to improved business decisions, regardless of whether it involves real estate, such as marketing strategies, transportation logistics, and existing infrastructure evaluation. Regardless of the application, business geography and real estate market analysis supply investors, buyers, sellers, developers, and planners with the information they

need to make geographically informed business decisions (Brueggeman and Fisher 1996). The majority of the data business geographers use is obtained from commercial data vendors, or various level governments (Thrall 2001).

Retail geography

Essentially, retail geography uses business geography principles, practices, and techniques and applies them to retail development, marketing, and infrastructural needs (Plummer and Sheppard 2006). Retail geographers can use GIS to analyze and interpret data in order to maximize efficiency throughout store networks and make calculated assessments regarding site selection (Novak and Gilliland 2011). Retail site location accounts for a substantial portion of study in retail geography and relies on ideas from business geography and real estate market analysis.

A considerable amount of literature in the retail sector has been on the shift in landscape from predominantly traditional shopping centers and retailers to an influx of big box retailers and power centers (Hahn 2000). This transformation has made it difficult for smaller, independently owned retail stores to compete with larger retailers like Wal-Mart (Dean & Sobel 2008), Target, and K-Mart (Graff 1998). The overall theme of most of these articles is to evaluate the relationship between retailers and the surrounding population, as well as evaluating the effect those retailers have on the economy at the local, regional, and national level. Although many of these articles use statistical methods to quantify these affects, their research often lacks the geographical

focus that this paper will attempt to capture. Despite a divide that exists between the literature and the goals of this study, understanding said literature provides a foundational understanding that is essential for such an undertaking.

Retail Geography combines the business component of retailing and the locational component of geography to form a fundamental approach to deciding where to place retail stores, and how to maximize profitability with existing stores (Ferguson, 2013). Despite retail geography once being labeled a boring field (Blomley 1996), it has become an integral component of social-scientific research (Novak and Gilliland 2011), as well as a key ingredient for the expansion strategies of major retail chains. Retail geography has been described as a combination of economic and urban geography (Wrigley 1998). The literature in retail geography finds its roots with central place theory and Walter Christaller's publication of *Central Places in Southern Germany* (1933), and has been an established practice for business research and application (Rice, Ostrander, and Tiwari, forthcoming). The theory attempts to organize space into a manner that maximizes efficiency for consumers, given a certain array of needs, or, maximizes their satisfaction given certain budget restrictions (Laulajainen 1988). The result is a formally arranged, or strategically planned commercial network of central places or 'centers' at differing and definite 'levels'. This hierarchical classification of centers is determined by the amount of goods and services offered. High-level centers will offer everything available at low-level centers, and more.

Within this network of high and low level centers, consumers are expected to

minimize travel costs by visiting the closest appropriate level center. Despite its longstanding application for understanding urban environment dynamics, central place theory often struggles to account for the intricacies of present-day urban networks (Taylor et al 2010). The theory loses a considerable amount of its contemporary analytical capability by equating travel costs to purchase price, despite the fact that travel costs have decreased significantly more than purchase price since the inception of the theory (West et al 1985). Nevertheless, central place theory serves as an adequate framework for studying retail expansion and urban agglomerations.

Retail geography uses an applied point of view that combines marketing and planning with spatial thinking for store location decisions (Jones and Simmons 1987). Consumers are the essence of the retail industry. Their habits, choices, and behaviors are paramount for decision makers to grasp because they fundamentally affect the manner in which the retail structure develops (Birkin et al 2002). Consumers have evolved to become increasingly astute, requiring better standards of quality and service (Palmer and Beddall 1997). Retailers must develop adaptive strategies in response to rapidly shifting consumer attitudes. This evolution is a result of greater resources available to the consumer, such as better mobility, and access to e-commerce, in addition to others.

There has been a transformation of the retail landscape towards larger, big-box retailers, which has led to changes in both business strategy and consumer behavior (Hernandez and Simmons 2006). This shift in consumer behavior has been attributed to

many factors, such as the claim that shopping is second most important leisure activity, behind watching television, in North America (Goss 1993). Most of the retail growth in the last twenty years has occurred in the big-box store format (Buliung et al 2007). The popularity of shopping has been observed closely by retailers, resulting in changes to store formats to make shopping easier. These changes include the creation of "destination" retailers, where consumers can shop within several categories all under the same roof (Bodkin and Lord 1997). These retailers, such as Costco and Wal-Mart, have been described as "category killers", because they offer a wider selection at lower prices than their smaller, specialty store competitors (Hahn 2000). What is lacking in the literature is investigation into how these big-box stores and destination retailers interact with the urban environment. There is also an absence in explanation of the specific decision-making process that occurs for the expansion of a major retail chain. This study will attempt to mitigate these deficiencies by addressing the interaction between the urban environment and a retail chain network and identifying specific expansion strategies used by decision makers.

The basic goal for retail geographers is to identify locations where stores will be the most successful. Thus, their focus is to find a match between retailer and location. Of course, certain locations that work well for one retailer may not be best for another. Retail geographers pay attention to ongoing changes in consumer preferences, attitudes, and spending patterns in order to provide retailers with the information they need to remain profitable in the highly competitive retail market.

Early contributions

The influential works of Walter Christaller (1933) and August Lösch (1940) to the central place literature provided the groundwork for early contributions in retail literature. Central Place Theory identifies the correlation between central functions and population centers, providing a framework to understand the retail structure (Forbes 1972). The theory attempts to organize “central places” or agglomerations of people into a network of high and low order places. These central places are what are more commonly known as towns and cities. Lösch and Christaller focused their attention on different aspects of central places, or service centers. The emphasis on service location enhancement from Lösch, contrasted with Christaller’s attention to explaining current service location arrangements, produced a pair of priorities that persist to distinguish ample research in the field (Rice, Ostrander, and Tiwari, forthcoming). The earliest efforts to use research in assessing and selecting store sites dates back about a century ago.

As retail development began its ascent in the early 1960’s, store-location strategy began receiving more attention in the United States and abroad (Applebaum 1966). Within the retail literature, contemporary terms like retail trade area, and outdated terms like chain store control zone, appear as early as the 1930’s. By the late 1950’s and 1960’s, retail geographers began adapting to the rapidly changing retail climate by creating models depicting consumer space preferences (Huff 1959), and statistically theorizing spatial distribution models (Wilson 1967). However, this emphasis on quantitative modeling restricted retail geographers from incorporating the multitude of

components that comprised the modern day retail system, such as regulation, expansion, capital, and investment. By the early 1980's, research in retail geography had responded to these limitations by extending its concentration to align with advancements in economic geography more widely (Bagchi-Sen and Lawton Smith 2006). Thus, the attention to retail location was soundly recognized in the literature as an important practice, giving credibility to retailing from urban and economic geographers (Birkin et al 2002). Today, theoretical and empirical research in retail and business geography has transformed to reflect the evolution of urban development that shapes the framework for contemporary retail activity.

Chain expansion

Although there is ample available research on retail geography, and expansion studies have been conducted for other retailers like Wal-Mart (Graff 1998), there is little mention of the warehouse club industry and its related locational issues. Growth and expansion strategies of retail establishments invariably brings query in geography. Perhaps the most commonly used method of growth employed by retailers is organic growth, where a retailer simply opens additional stores (Guy 1994). When doing this, if the retailer decides to target only the major markets, the growth is referred to as hierarchical diffusion. Conversely, when retailers open new stores in nearby markets, rather than targeting only the most populated towns and cities, the growth is categorized as contagious diffusion (Shaw 1992). This method of expansion has proven to be highly coherent and effective for successful development of retail networks. Observation of

contagious diffusion by Brown (1981), Jones (1981), and Jones (1988) in regards to Friendly's, Asda, and Misslebrook and Western and 7-Eleven, respectively, illustrates its effectiveness as a legitimate growth strategy. Meyer and Brown (1979) also examined the diffusion of the Friendly Ice Cream chain and found that availability of financial capital can influence nearly every aspect of a retail firm's expansion. Other factors, such as an efficient distribution network, were found to be a crucial piece of a successful expansion campaign (Graff and Ashton 1994).

Another mechanism for expansionary firms is selectively acquiring existing retail stores belonging to another entity and converting them into their own. This can by simply acquiring one store at a time, or a collection of stores at once. There are two main spatial implications with acquisitions (Laulajainen 1987). The first is that the company may not be acquiring locations that fit optimally into their expansion strategy. The second is that large acquisitions can involve considerable pieces of national area.

The increasing interest in the geography of expansion strategies of retailers demonstrates the connections between economic geography studies and work originating in business and management (Coe and Wrigley 2007). Research that focuses on elements of expansionary retail firms has been conducted from a wide range of viewpoints, including financing of expansion (Okeahalam and Wood 2009), business ethics and sourcing methods (Coe and Hess 2005; Vranceanu 2014), and the implementation of local adaptation for enhanced market growth (Aoyama 2007).

It is apparent that geographical and management literature regarding retail site

selection planning has settled on endorsing progressively sophisticated techniques for accurate assessments of market capability (Birkin et al 2002). The early literature on diffusion methods amongst retailers focused broadly on summarizing the observed changes within regional and national markets, but lacked in pinpointing the best practices that decision makers used to formulate their strategies. Today, there is still a need for more concrete, pertinent literature regarding the fundamental processes used by decision makers for retail chain expansion in a highly complex and dynamic retail environment.

The warehouse club industry

There is no denying the growing importance of warehouse clubs. However, it is challenging to find relevant literature when looking for material related to the industry. Perhaps the biggest reason for this is warehouse clubs rapid, and somewhat overlooked rise to an almost $200 billion per year industry. Beginning in the early 1970's, warehouse-retailing concepts such as the furniture warehouse showroom used by Levitz and Best Products started receiving critical acclaim, prompting major firms to explore the warehouse method (Bates 1977). By 1988, warehouse clubs had become a "significant form of mass merchandising" (Gelbtuch 1990, p 153). However, retail geography as a broad literature has yet to engage the warehouse club component of retail in any detail. Warehouse club retailers differ in concept from traditional retailers like Wal-Mart and Target. They operate in bland looking facilities that frequently generate two to three times the sales volume of other traditional style retail chains

(Gelbtuch 1990). While the exterior of these warehouse clubs may look no different from a Target or Wal-Mart, their interiors are usually particularly basic, with concrete floors, few product labels and signs, and wooden pallets stacked high with merchandise. They rely on annual membership fees for a large portion of their revenues, and pass savings they acquire from distributors onto their customers by forcing them to purchase items in bulk quantities. Warehouse clubs have built upon the existing 'value pricing' model, with membership fees, and less through product mark ups.

Sol Price pioneered the warehouse store concept in 1954 with his creation of FedMart. Price would later collaborate on the creation of Price Club in 1976, which would later merge with Costco in 1993. The industry has seen rapid growth since 1983, when 21 warehouses existed and sales were under $1 Billion. By 1988, those numbers increased to 306 warehouses and $14 Billion in annual sales (Mandel Jr. 1988). Today, the number of total warehouses in North America is around 1,550 accounting for $462 Billion in sales. The catalyst for this rapid growth is a combination of little to no advertising, few credit card usages, low rent and construction costs, and minimal staffing (Gelbtuch 1990). Because the chain from distributor to consumer is relatively short, warehouse clubs are able to remain profitable while keeping price markups in the 8-15% range. This number is much less than the 25-30% markup commonly used by the traditional discount retailers. Warehouses usually turn over their inventory every three weeks while discount stores do so every three months. Another difference with warehouse style retailers is the manner in which they acquire their merchandise. In traditional retail stores like Wal-Mart or Target, a sizeable portion of their inventory

comes from wholesale manufacturers. However, often times these manufactures aren't able to capitalize on the growing retail sector.

There is recognizable market potential for these warehouse style retailers, but the actual product manufacturers seem to have some trouble getting involved with the retail structure. Many of these manufacturers don't take warehouse style retailers into account when planning production or marketing (Courtemanche and Carden 2014). If they do business with a bulk sell, warehouse style corporation, it is carried out as an afterthought. Another issue for these manufacturers is remaining competitive with the actual brands produced by the Warehouse retailer. Kirkland brand at Costco puts out products that are similar in quality but priced considerably lower than the mainstream brands that would usually fill that product space. This makes it difficult to bring in big names, but also drives them to be more competitive with their pricing. This approach to sales is different than the norm for many retailers. Current retailers believe that inventory should be low so that the store can deal with the actual sales of the item, instead of managing excess product (Tan and Karabati 2013). Sometimes this even results in a lack of product availability on shelves, and ultimately results in a higher cost to both the retailer and the consumer, because of the need for constant reordering and restocking (Courtemanche and Carden 2014). Warehouse Style Retailers bear the upfront cost and effort in keeping a large inventory, but in the end profit and help their customers to profit from their large inventories available. Re-ordering is necessary, but product availability is not dependent on that ordering for day-to-day operations.

Costco

Costco Wholesale Corporation is a retail warehouse style store chain that sells common households items at discounted prices, usually in large quantities and to families or businesses. They are the largest warehouse club retailer in the world, the second largest retailer in the world, and the nineteenth largest company in the world, based on revenue (Fortune Magazine 2014). Their aggressive expansion strategy has enabled them to locate over 671 stores in seven countries, on four continents (Costco Wholesale Corporation 2014B). Members pay an annual fee of $55 allowing them the right to shop at any one of Costco's 663 stores located throughout the United States, Canada, and nine other countries (Costco 2014).

Costco began in California in 1976 under the name Price Club, in what is known to be a converted airplane hangar. Founders Sol and Robert Price raised $2.5 million and opened the first warehouse store for club members only, thus pioneering the concept. Three years later, Price Club would open a second location, and by 1980, offered its first public stock. In 1982, Jeff Brotman and Jim Sinegal began collaborations on what would become known as Costco, opening a warehouse in Seattle, Washington in 1983. In 1993, Price Club and Costco merged to form PriceCostco, and in 1999, PriceCostco became Costco Wholesale Corporation (Costco Wholesale Corporation 2014B).

Costco's business model differs significantly from its three major competitors, Wal-Mart, Target, and Sears. Costco's key strategies are low prices, limited selection, and a shopping strategy called "treasure hunting" that intrigues customers and introduces an element of surprise (Corona and Altamirano 2010). According to a survey by consumerreports.org in which 6,903 subscribers were polled, Costco received a score of 85 out of 100, the highest among all retailers (Consumer Reports 2014). Costco offers savings to members by marking up prices by no more than 14 percent, and 15 percent for non-Kirkland brand merchandise, compared to a 25 percent mark up by supermarkets, and 50 percent from department stores (Greenhouse 2005). Of the 4,000 items that Costco offers in its stores, roughly 1,000 are specialty or seasonal products that consistently change. Additionally, Costco is the world's leading seller of fine wine (Thompson 2009). Costco's members shop an average of 22 times per year, and more than a third live in households with an income of $75,000 per year (Boyle et al 2006). This level of income is comparatively higher than Costco's main competitors, and explains how Costco is able to generate such high levels of sales inside their stores. As of 2010, Costco had 82 fewer stores than its main competitor Sam's Club, yet generated $20 billion more in sales. Costco warehouses average $918 per square foot on average per year, while Wal-Mart and Sam's Club average $438 and $552, respectively (Corona and Altamirano 2010).

Costco's core customers are people looking to save money without suffering the drawbacks from discounters like long checkout lines and crowded, undersized aisles (Goldberg 2008). Its customer's place confidence in Costco's rigorous product

evaluation practice and trust that the products they purchase are of the highest quality (Gue 2009). Costco is able to purchase more merchandise from its distributors because they only carry about 4,000 items in stock, compared to 40,000 from some of their competitors and nearly 100,000 rom Wal-Mart (McArdle 2013). This inventory focus allows Costco to keep its shelves stocked while their competitors often have several products that are out of stock. Furthermore, because Costco has fewer offerings, if a product does go out of stock, the consumer is notified in a timelier manner, and often, the product is no longer advertised until its inventory can be replenished. Costco relies on relatively no advertising other than word of mouth.

Costco's nearly 55 million members pay an annual membership fee of about $55 per on year. These fees account for over $2 billion in annual revenue, allowing Costco to compensate for their lower profit margins on items (Costco 2014). What differentiates Costco from other retailers is their focus on making products cheaper where others look to find the maximum amount somebody is willing to pay. Costco's products are often offered at prices that competitors are unable to match, and cause consumers to purchase them even if they did not originally intend to. Part of the Costco shopping experience is their use of "treasure hunting", which is when shoppers purchase items they did not originally plan to because they do not want to pass up a bargain (Corona and Altamirano 2010). Costco strategically places all of the food items at the back of the store in order to force its customers to navigate the entire store first. They also elect to not include signs or any sort of directory in their stores in order to increase the likelihood that a customer will stumble upon an unknown item and purchase it Costco indeed has

become a master of “impulse purchasing” (CNBC 2012). Brian Wansink, Professor of Marketing at Cornell University, says, “shopping at a warehouse club gives us license to spend like we otherwise wouldn’t if we were in a normal store” (CNBC 2012). An important component of warehouse club shopping is the feeling of being part of a special group, as opposed to just a regular customer. This psychological difference causes customers to get excited about shopping in ways that non- club retailers cannot match, and has been labeled the “Costco Addiction” (Boyle et al 2006).

Although the daily operations of Costco have been well documented and examined, the geography of their current store and distribution center network have not. However, other retailers like Wal-Mart and Target have indeed been the subjects of scholarly work in retail geography. The goal of this thesis is to investigate the methodologies utilized for studying the geography of other major retailers and apply select ones to assessing the geography of Costco. The following subsection of this literature review briefly surveys the methodologies that have been used for this kind of analysis.

Relevant analytical techniques

There have been a myriad of methodologies used to study spatial distributions and geographic patterns in the field of retail geography. Often, these methodologies employ some type of point pattern analysis to analyze how a retail network is arranged in space. It seems, however, that the retail geography literature is more focused on

observing the manner in which retailers are conducting business, rather than how they have built their network of store locations.

One of the methodologies used for analyses in retail geography is a nearest neighbor analysis (NNA). NNA is a point pattern analysis that compares an observed point pattern distribution to a theoretical distribution (Mehta and Kastner 2011). Its three goals are to determine if a point pattern is nonrandom, significantly nonrandom, and if it is significantly clustered or dispersed (Mehta, Hauenstein and Kastner 2012). It focuses on the process of understanding pattern change and pattern comparison. The product of a NNA is its R ratio index (see Figure 2).

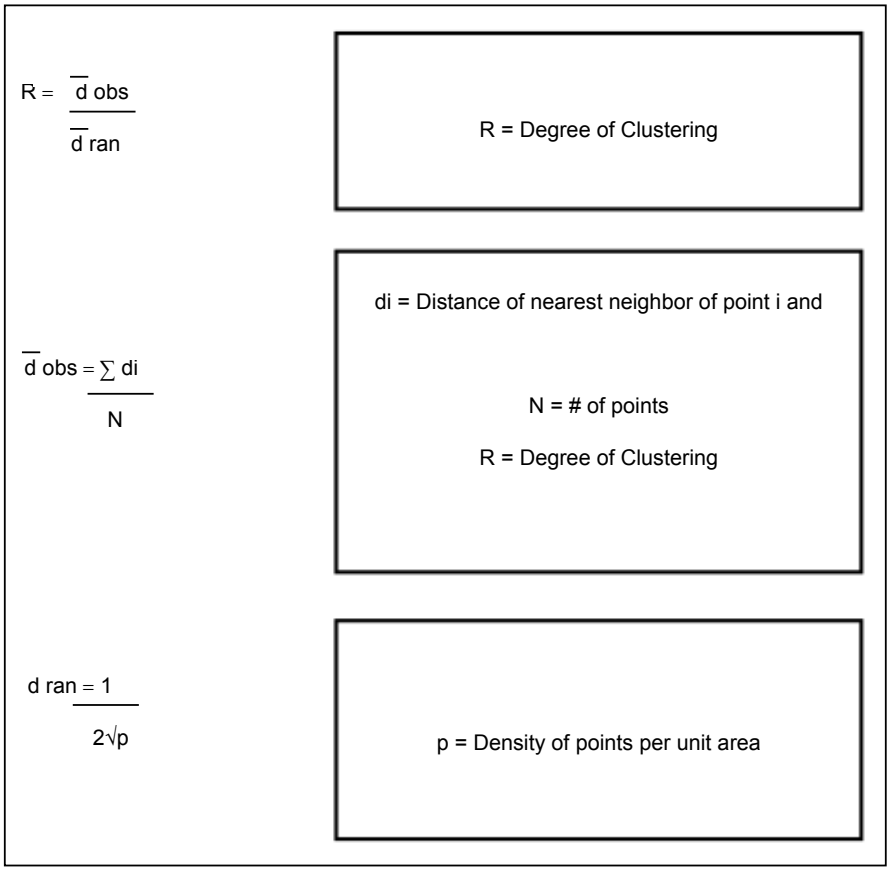

Figure 2: Explanation of NNA details

The interpretation is that an R ratio of 1 means the point pattern is significantly random. An R ratio of 0 means it is significantly clustered, and an R ratio of 2.1491, the maximum possible value, indicates a significantly dispersed (uniform) point pattern. NNA can be used for determining spatial patterns of archaeological sites, disease spread, plant and animal dispersions, and more (Stark and Young 1981). In geography, NNA is useful for studying almost any point pattern. Initially, this thesis would use a NNA to assess what type of dispersion existed throughout Costco's store network. However, other methods were also considered, such as Geary's C, a test of normality about a distribution of a population.

Geary's C test of normality calculates the ratio of the sample mean deviation to the sample standard deviation (D'Agostino 1970). Geary's C is a popular choice for studying point patterns because it does not require any re-ordering of the data, knowledge of the population mean, or even a large sample size.

Ultimately, a NNA was determined to not be the most suitable method for producing the intended findings of this thesis. It struggled to explain how two point patterns differed from another, which was also a shortcoming of Geary's C. The goal from the beginning was to compare two observed point patterns to an expected or completely random point pattern, in this case, the initial Costco store in each major market, all of the stores within those markets and regions, and an expected uniform point pattern. The most suitable method for achieving these objectives was determined to be another analytical method available for point pattern analysis, Ripley's K.

Ripley's K, like NNA and Geary's C, is a tool for analyzing mapped point process data. It can also fit models, test hypotheses about a pattern, and estimate parameters (Dixon 2002, Sayer and Wienhold 2013). It can perform its function over different distance scales, something NNA cannot (da Silva et al 2008). The Ripley's K (t) function summarizes a point pattern in two dimensional space, and focuses on one aspect of an event, its location (Kiskowski, Hancock and Kenworthy 2009). It will tell you whether the observed pattern of events is consistent with an expected one, usually a Poisson process, also known as complete spatial randomness (CSR) (Dixon 2002).

The theoretical Ripley's K (t) function is:

$$K(t) = \lambda^{-1} E \text{ [number of extra events within distance t of a randomly chosen event]}$$

where λ is the density (number per unit area) of events (Dixon 2002).

It is commonly used to study the point patterns of trees, disease, plants, birds, fauna, and other point pattern data. A form of Ripley's K (t) function called Bivariate K was determined to be most suitable for achieving the goals of this thesis. The Bivariate K function describes characteristics and relationships between two point patterns. The Bivariate K version will provide a unique literary contribution because of its subject, Costco Wholesale, and approach, comparing two point patterns. It essentially describes how the two point patterns relate over space. In the case of the Bivariate K, it compares two point patterns to an expected Poisson process for CSR.

A Poisson process is a stochastic process that records the frequency of events in a specified time interval (Orsingher and Polito 2012). It essentially is a uniformly distributed point pattern, one that can be compared to observed patterns to compare clustering, dispersion and randomness (Tse 2014). For the Bivariate K analysis, two point layers of Costco stores were compared to a Poisson process for CSR. This type of analysis for Costco will be the first of its kind in the field of retail geography.

Literature conclusion

The reality is that the overwhelming majority of literature in retail geography will either focus on spatial aspects of how retailers are conducting business, or what type of patterns can be discovered throughout their expansion. Furthermore, most papers in the current literature omit Costco from their discussion altogether.

When assessing the current retail geography literature, it is important to understand the main themes that continue to arise. Consumers are becoming more astute and informed every day, and retailers spend large amounts of money and effort to adapt to these constantly changing attitudes. E-commerce has enabled consumers to compare prices and value quickly and easily, and avoid shopping at stores altogether (Palmer and Beddall 1997). The retail structure is also changing. Today, big-box stores dominate the retail landscape, and in many places, large big-box retail corporations are driving family-owned retailers out of business (Hahn 2000). Consumer mobility has

improved to the point that retailers can capture consumers from drive times of over 20 minutes. Consumers have little issue with traveling if it means they can buy the products they want at attractive prices (Lowe and Wrigley 2010; Poole et al 2006). Retailers have adapted to suburban population sprawl by focusing their location efforts on areas where consumers prefer to be. Costco has positioned itself well for these concepts by locating primarily in suburban areas and offering a large selection of products at unbeatable prices. Their store network, however, is still yet to be analyzed within the retail geography literature.

Despite the existence of separate literatures related to chain store expansion (Laulajainen 1987,1988; Graff and Ashton 1994; Graff 1998, 2006), and the warehouse club industry (Gelbtuch 1990; Richardson 1993; Kim and Choi 2007), gaps still remain. The literature that relates directly to Costco focuses on business strategies including merchandise pricing (Courtemanche and Carden 2014), customer service and consumer loyalty (Cascio 2006), branding strategies and manufacturing practices (Hu and Chuang 2009), marketing efficiency and the ability to create shareholder value (Corona 2014), effects of in-store sampling on retail sales (Wu 2010), “treasure hunting” and customer attraction (Corona and Altamirano 2010), and international market entry (Minahan et al 2012). Store and distribution center location, interaction with the urban environment, contributions to place and adjacent retail development, and correlation with housing and economic trends all play a minor role in the application of retail geography. It is true that Teo and Shu (2004) examine the distribution network design of warehouse retailers, but their work makes no specific mention of Costco, the biggest player in the warehouse club industry. Therefore, major gaps exist in the overall body of

store location research related to warehouse clubs generally, and Costco more specifically. Focused research is needed to deal with the unique dynamics associated with warehouse club network development.

Thus, although there has been ample research done on many aspects of how retailers operate in space, little addresses the cumulative developmental trajectory and strategies that characterize the emergence of retail giants. In particular, the lack of research related to Costco provides an opening that research needs to fill. The following chapter outlines the details of the case study approach this thesis uses to fill these important gaps in the retail geography literature.

CHAPTER 3. CASE STUDY

The preceding has outlined the general issue of retail expansion and the specific case of Costco as being worthy subjects for further research by retail geographers. This chapter outlines the specifics of the research plan this thesis follows to provide insight into Costco's network development trajectory. It will use several different methodologies to answer three important research questions.

Research questions

Question 1: What was the general expansion pattern and sequence of Costco's expansion?

This question will be answered in two separate ways, one descriptive and the other based on spatial statistics. In order to adequately answer this question using advanced spatial methodology, I will first provide a comprehensive overview of Costco's store network from a purely geographical perspective. There have been published papers compiling data on Costco's earnings and store locations, but a detailed geographic overview does not exist in the retail geography literature. This thesis will attempt to provide the detailed overview that exists in the retail geography literature for other retailers like Wal-Mart (Graff 1998, Ostrander and Rice 2011).

This thesis will provide this detailed overview by compiling data on several aspects of the geography of Costco's store network, such as a census region breakdown of store locations, compilation of major markets, demographic profile of major markets, and a decade by decade and yearly analysis on network expansion. This approach will provide the reader with information on Costco's store network that currently cannot be found anywhere else. It will take their store network locations and expand in detail their geographic context in order to provide a comprehensive detailed overview. This new information will allow the reader to know how Costco's store network is distributed regionally, at the state level, temporally, in terms of land area, and more. It will provide a detailed summation of Costco's store network from a purely geographic perspective. The goal of this data compilation is to provide a thorough overview of the current geographical context of Costco's store network in order to provide a framework for the remainder of the thesis.

The second part of the answer to this research question will be done with a Bivariate K methodology, a form of Ripley's K. The goal will be to quantify, in terms of clustering, how Costco has saturated their major markets following initial entry. A "major market" will be any city containing five or more Costco stores. Stores may be located outside of the city limits, but all major markets will have at least five locations within relatively close proximity to one another, and will form a noticeable cluster.

Essentially, this paper will analyze two point patterns and compare them to an expected or perfectly uniform pattern (CSR), to analyze the geographic distribution of

Costco's store network by each major market, in a designated census region. There will be four census regions used for this portion of the analysis, West, Midwest, South, and Northeast. What the Bivariate K will do is draw a circle around each initial store, at a pre-determined interval, in order to compare the observed distribution of stores to a Poisson process or CSR. These circles will create hundreds of separate sectors, each one-kilometer apart. R does this by counting the number of stores found in each sector extending from the initial point, and comparing them to an expected Poisson process. R will then combine the results into one simple graph, showing the level of clustering as distance from the initial store increases.

This analysis will provide a detailed account of how Costco's store network has evolved following their entry into their major markets. It will provide a valuable literary contribution because it will quantify the level of clustering that is present in each major market, and will allow for further studies to be conducted on the topic. These two approaches will analyze Costco's store network, and will not include any information on its distribution network.

Research Question 2: How is geography important to Costco's network of distribution centers and what role does this network serve for Costco's current and future warehouse network?

The lifeblood of Costco's store network is its distribution centers. These "depots" are streamlined for maximum operational efficiency. Costco's reputation for timeliness is

among the best in the delivery sector. The quantity of product that passes through these doors is almost too large to imagine, yet the amount of time before it is for sale in stores is among the shortest in the industry. Costco operates 12 distribution centers in the United States: 5 in the West, 1 in the Midwest, 5 in the South, and 1 in the Northeast.

To answer this second research question, I also will first provide the same sort of detailed overview for the distribution network that was previously done for the store network, in order to provide ample background to the reader. What is important about this detailed overview is that it will organize, compile, and package meaningful geographic data for the distribution network in a way that has not been done before. Each distribution center will be organized into a chart with opening date, city and state, census region, address, gps coordinates, distance to nearest store, distance to nearest distribution center, and more.

The second portion of the analysis will again utilize R and a Bivariate K methodology to assess how Costco stores are located among distribution centers. This approach will provide a spatial analysis on Costco's distribution center network to see how Costco has saturated its store network following the location of a distribution center. It will utilize the same point pattern approach that was done for the store network, but will combine the Northeast and Midwest regions into one (there is only one distribution center located in each). This analysis will show, spatially, which distribution centers are located near larger store clusters, and how regionally, the distribution

network supports the store network. The final research question will focus on nearby demographic and business data.

Research Question 3: What type of contribution to "place" does a Costco store make, specifically, how does the opening of a new Costco store affect the surrounding area in terms of business activity? What is the market makeup of the surrounding areas of Costco stores in terms of demographics?

The term "place" in this instance is used to categorize the kind of landscape around a Costco store, as well as how each store's surroundings are structured in terms of businesses, highways, roads, residential areas, etc. This definition of place used here will focus on business activity, specifically, how Costco has chosen its locations where conducting business is most suitable for their business model. This question will be answered at the regional level in North Texas. The answer to this question will contain two components, the first, a 1-mile diameter analysis on the surrounding businesses near Costco stores, the second, a 27-minute drive-time analysis on market characteristics, and demographics. The reason for the 27-minute drive time is based on independent research conducted at Costco headquarters in May of 2014 (Testa, 2014). Although somewhat arbitrary, a 27-minute drive time was ultimately the best decision for this thesis.

Initially, the answer to this question was intended to show a picture of the businesses within the surrounding 1-mile diameter of a Costco store before and after

construction, but the data acquisition proved to be too time consuming and difficult. In addition, there were accuracy concerns that ultimately led me to alter the analysis to show a current picture of the business activity within a 1-mile diameter of all Costco locations within the North Texas region. I chose the 1-mile diameter because I did not want the area contain too much information that may easily be unattributed to the presence of a Costco store. Thus, for this analysis, the smaller the area was, the better. This size was also good for including some of the housing communities that often exist within half a mile or less of areas where Costco stores are located.

The second component of this analysis will utilize a 27-minute drive time capture area to reflect Costco's ability to attract consumers from drive times of greater than 25 minutes. Although 30-minutes may have been a more obvious choice, it was not chosen because it was slightly too large for the goals of this study. Independent research showed that 27 minutes was about the average high for a Costco customer to travel.

Costco's large capture area is something that is unique in the industry, something they do perhaps better than any other retailer. Part of the reason for this is their ability to transform short order goods into long order goods. Products such as toilet paper, bottled water, deodorant, mouthwash, toothbrushes, and more can be purchased once or twice a year, rather than every few months or weeks like at traditional retailers. Costco not only offers larger quantities than most retailers, but their prices are basically unbeatable. A consumer can theoretically purchase enough non-perishable goods to last several years, at a great unit price.

The goal for this analysis will be to show what type of environment exists in the surrounding areas near Costco stores, particularly the trade areas where they attract customers. The aim will be to show what type of activity, at the regional level, Costco stores are located near. North Texas is one of Costco's largest markets in terms of metropolitan area population, and this analysis will show what the market characteristics are at a detailed level. Rice and Ostrander (2011) provided a similar market analysis for Wal-Mart in their paper that this thesis will replicate for Costco, albeit at the regional level, not the national one. The reason for the regional approach is to provide a case study analysis on one of Costco's major markets, and keep the scope of the analysis within reach for a master's thesis. Any type of analysis at a larger level would either prove to be too time constrictive or would require a reduction in the detail of the data. Such an analysis for Costco does not exist in the retail geography literature. In order to provide a meaningful analysis that produced quality results, identifying the most suitable methodologies was important for this thesis.

Methods

This thesis uses a variety of methodologies to analyze Costco's developmental trajectory. The detailed overview of Costco's store network was performed primarily in Microsoft Excel. However, the maps and figures that correspond with the calculations were done in Quantum GIS (QGIS), and Adobe InDesign. Pitney Bowes MapInfo was also used to map and geocode certain store locations. Beginning with the data from Aggdata.com, each Costco store was assigned a census region according to the United

States Census Bureau regions: West, Midwest, South, or Northeast. Following this, information on each region was provided to compare the number of stores in each region, to figures like population, land area, income, and more. In addition, breaking down yearly, and decade-by-decade expansion of Costco's store network provided a temporal expansion analysis. There was also additional information on Costco's store network that simply is too tedious to mention.

Ripley's K, specifically the Bivariate K version, was used for the spatial analysis portion of this research question. Ripley's K was chosen in favor of a nearest neighbor analysis. Ultimately, Ripley's K has an advantage over NNA because of the ability of Ripley's K to perform an analysis over pre-determined distance scales (Giuliani, Arbia and Espa 2014). This issue with the NNA meant that it could not quantify clustering over a certain distance, particularly a large geographic area such as a census region. Ripley's K on the other hand was not only able to quantify clustering, but could do so using several points as beginning points, and expanding and performing the analysis outward from there. This was especially useful for analyzing several major markets in a large geographic area. Ripley's K was also easier to use with R than NNA, and produced results that meant much more than simply which Costco store was closest to another. NNA in the end did not have the power and complexity of Ripley's K.

The Bivariate K was done using popular software among geographers; specifically a program called R. R is a programming language and software for statistical computing. It has immense capabilities, and is ideal for the type of analysis

that this thesis utilized. R makes point pattern analyses relatively easy to conduct because of its simple structure, and user-friendliness. Using R, this thesis utilized a Bivariate K methodology to analyze how Costco's network has expanded following their initial entry into major markets. For example, the first Costco store in Seattle opened in 1983. Today, there are over 20 locations in the greater Seattle metropolitan area, and over 200 in the West region alone. This number accounts for over 40% of Costco's North American network, making it the most saturated census region for Costco stores. The question became, how did this saturation occur, and what level of clustering do we see today? R can answer, and quantify this question fairly easily, but required data packaging from other programs.

R required QGIS to provide the point patterns and study area layers. QGIS worked in tandem with R to perform the Bivariate K analysis. QGIS is a cross-platform, open-source geographic information system application. It is not as powerful as ESRI ArcGIS, but is sometimes easier to use and less prone to failure. For this thesis, the essential requirement for the R analysis was good point pattern files, which QGIS is perfect for creating. Loading a CSV file (comma separated value) with latitude and longitude coordinates provided the points needed for the analysis. These shape files were then converted into metered distance and saved and uploaded into R, where the final analysis was computed. All point patterns were computed as straight-line distance.

Using QGIS and the data from Aggdata.com, all Costco locations were mapped and separated into the four census regions. Currently, of the 470 Costco locations

included in the study, 229 are located in the West, 75 in the Midwest, 110 in the South, and 56 in the Northeast. From there, a points layer was created for every census region showing only the first Costco location to open in each major market. Editing the attribute table and allocating initial Costco's to their census region created the points layer. Essentially, I created a layer for every census region with only the first Costco location of every major market. For example, the first Costco to open in San Diego (one of Costco's major markets in the West) was in 1976. Therefore, this location was the "initial store" for San Diego. There were seven other major markets in the West region and thus seven other "initial stores": Los Angeles, San Francisco, Portland, Seattle, Salt Lake City, Denver, and Phoenix. In the Midwest, there were three major markets: Minneapolis-St. Paul, Chicago, and Detroit. In the South: Dallas-Fort Worth, Houston, Atlanta, Miami-West Palm Beach (South Florida), and Washington D.C. area. In the Northeast: New York and Boston. A series of steps is required to perform the analysis in R.

Step 1: Load all Costco locations into QGIS as a points layer from a CSV file.

Step 2: Allocate all locations into their appropriate census region.

Step 3: Create a layer for each region.

Step 4: Identify all Costco "major markets" within each region.

Step 5: Identify the first Costco location to open in all of these major markets.

Step 6: Create a points layer for each region's "initial stores."

Once every major Costco market has its own initial points layer, the next step was to create polygons for each census region. This was done in QGIS by creating a new polygon layer, selecting “toggle editing”, and drawing the layer along their actual boundaries. The reason for this approach, rather than using the actual layers obtained from the census bureau, was to simplify the layers, and make the operation easier for R to perform. The boundaries may have some slight differences from the actual boundaries of the geographic region they represent, but did not render any differences in results of the Bivariate K because of the outward approach. This means that eventually, the chart showed no levels of clustering at all, once the Bivariate K had extended far enough away from the initial store. Minor differences in layer boundaries simply did not make any overall difference. As long as all of the Costco locations were included within the polygon, the difference in shape had no effect on the results.

The goal of this approach was to compare the distribution of Costco stores in each major market, following the initial store. It showed how Costco’s current store network has evolved following their entry into their major markets. The results quantified how the store network is organized spatially.

The first step of the process was to load all of the necessary packages to R in order to perform the Bivariate K correctly. These packages were spatstat, splancs, and PBSmapping. The next step was to set the parameters and functions for the Bivariate K. In order to do this correctly, the input was “l <- function(k,s) {sqrt(k/pi)-dist.s}”. This input told R that it was to perform a Ripley’s K analysis. The next step was to set the proper

parameters for the analysis. These parameters work best when they are done in meters, therefore they were set to “dist.s <- seq(0,500000,1000).” What this input meant is that R started the analysis at each initial store (0), and extended the range to 500,000 meters or 500 KM, at an interval of 1 KM. Again, this preparation required several key steps.

Step 1: Load spatstat, splancs, and PBS mapping into R.

Step 2: Set parameters and functions for Bivariate K.

Step 3: Set proper parameters for the analysis by changing increments to meters.

Step 4: Load the “initial stores” layer for the desired region.

Step 5: Load the “region stores” layer (the layer with all Costco stores in each region).

Step 6: Load the shape file for the desired region (created manually in order to simplify the operation in R).

Step 7: Run the Bivariate K operation.

Step 8: Create a chart of the results.

The charts were then slightly altered in Adobe InDesign in order to increase their aesthetic appeal. The second research question essentially utilized the same methodology that was used for the first one.

The methodology for providing the detailed overview of Costco’s Distribution network was also done primarily with Microsoft Excel, with mapping operations done in

QGIS and Adobe InDesign. The same approach that was utilized for the store network was applied to the distribution network.

The spatial statistics component to the analysis was also done using R and the Bivariate K tool to compare two point patterns, the depots and Costco locations. Using R, this paper ran the Bivariate K at the same pre-determined parameters used for the first question in order to compare Costco's distribution center network to their store network, and a Poisson process for CSR. This shows in graph form how the depots are arranged in space within the store network at the census regional level. It quantified how distribution centers serve their store network from a purely spatial perspective. For this analysis, the Midwest and Northeast depots were combined to meet the minimum of two points for R to successfully run the Bivariate K analysis.

The methodology needed to answer the final research question was a business summary for all Costco stores in North Texas, at a 1-mile diameter, and a population and demographic summary as well. These reports were gathered and compiled to highlight key information that was pertinent to how Costco operates in space, at both the immediate surrounding area (1-mile diameter), and their larger trade areas (27-minute drive time). All of this data was compiled and organized to highlight the makeup of Costco's trade areas and nearby business environment. This portion of the analysis relied on Esri Business Analyst for data acquisition.

Data

The primary data that was used for the point pattern analysis portions of this study were the complete list of Costco Wholesale stores in North America. This list was obtained from aggdata.com (aggdata.com 2014) and contains a plethora of information including opening date, address, and GPS coordinates current as of December 31st, 2014. Aggdata.com is a data provider that markets a variety of current and detailed business-specific location data sets. To further examine and establish the quality of the Costco database purchases for this research, I verified the location of all 544 Costco locations from the dataset, ensuring the locations encoded in the aggdata.com dataset match with actual Costco locations. This verification was done by geocoding the provided latitude and longitude coordinates with Google Maps and Google Earth Imagery.

Most of the information in the data-set is categorical and pertains to characteristics that vary among Costco stores; such as whether that particular Costco offers optical services, or stays open past 8:00 p.m. Information such as this was omitted from further use here because these fields are not relevant to this study. However, the store location and store opening date information in the dataset is highly relevant to the present study purposes.

Costco has opened additional stores from the time this thesis commenced, so the cutoff point for the data that was included in the study is December 31st, 2014.

During the analysis, there were no issues with the point pattern data. Additional information that was needed, such as store by region breakdown, comparison to population, and demographic information, was calculated and obtained with Microsoft Excel and Esri Business Analyst. In order to simplify the study and avoid cross-border issues, the Bivariate K component of the study only analyzed Costco stores located in the lower 48 United States (and omits stores listed in the dataset for Canada).

Esri Business Analyst was used for the data acquisition for the demographic, business, and market analysis portions of this thesis because of the detailed business and demographic database they possess, and because all of their data is current as of 2014. For the business analysis in North Texas, a 1-mile diameter business summary was conducted for all 10 North Texas Costco locations. As mentioned earlier, there was a concern with performing this business summary at a larger area than a 1-mile diameter because the data could potentially become diluted. The goal for this analysis was to attribute Costco with a substantial impact on the surrounding business environment, and a 1-mile diameter was determined to best be able to do that.

In addition to this analysis, the results section provided a detailed market analysis for all Costco stores located in North Texas. This analysis was a demographic and income comparison between all 10 North Texas Costco locations. This was done as a 27-minute drive time market analysis showing a number of demographic metrics such as median household income, average household income, number of households, number of families, median age, race and ethnicity, and more

CHAPTER 4. RESULTS

The following section summarizes the final results from calculations, analysis, and statistical methodologies used in this thesis. Interpretations, inferences, and perceptions based on these results are outlined in the discussion and conclusion section of this thesis. The goal of this thesis is to outline the location strategy that used by Costco for their store and distribution network expansion and identify how demographic factors may contribute to their current network arrangement. To address this subject matter, three research questions were investigated separately.

Question 1: Costco expansion

The first question for this thesis was to assess the general expansion pattern and sequence of Costco's expansion from their first store opening in 1976 to the last store opened in December of 2014. The analysis combined both descriptive and spatial statistics to form a two-part approach. The descriptive portion of this analysis yielded some interesting results in terms of how Costco has expanded their store network over time. Although Costco operated 470 stores in the 50 United States as of December 31st 2014, only 461 were included in this study, as locations in Alaska and Hawaii were omitted.

Regional approach

It was clear from the beginning that Costco has focused its location efforts on the coasts, in areas where population densities are high, and major, sprawled metropolitan areas allow for sizeable store clusters spread out over space. Tables 1 and 2 break down Costco's store network by United States census region.

Table 1: Stores Per Census Region

Region	Stores per Region	States in Region	Region Population	Percentage of Population	Percentage of U.S. Land Area
West	220	11	75,187,681	23.58%	24.2%
Midwest	75	12	67,745,108	21.24%	21.24%
South	110	16	119,771,934	37.56%	24.61%
Northeast	56	9	56,152,333	17.61%	4.58%
Aggregate	461	48	318,857,056	99.99%	74.63%

Table 2: Percentage of Stores Per Census Region

Region	% of Stores Per Region	% of States in Region	Region Population	Percentage of Population	Percentage of U.S. Land Area
West	47.8%	23%	75,187,681	23.58%	24.2%
Midwest	16.2%	25%	67,745,108	21.24%	21.24%
South	23.8%	33%	119,771,934	37.56%	24.61%
Northeast	12.2%	19%	56,152,333	17.61%	4.58%
Aggregate	100%	100%	318,857,056	99.99%	74.63%

Figure 3 shows the United States census regions that were used for the regional portion of this thesis analysis.

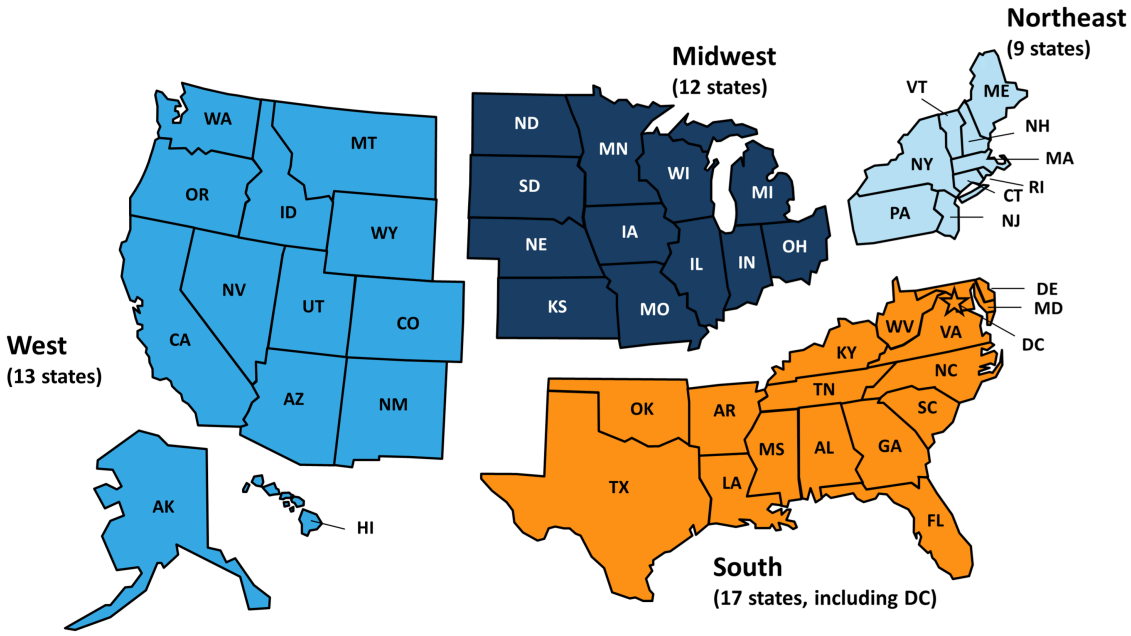

Figure 3: Census Regions of the United States

In total, there were 18 total markets used for this analysis. Tables 3 and 4 provide a summary of the geography of each major Costco market, as well as an income summary for all major Costco markets, respectively.

Table 3: Major Market Geographic Breakdown for all Costco Markets

Store Number	Market Reach (km)	Market Reach (miles)	Stores Per Market (SPM)	Population Per Store (PPS)	Percentage of Total Stores
Seattle-Tacoma-Bellevue	111 km	69 mi	15	244,765	3.19%
Portland-Vancouver-Hillsboro	53 km	33 mi	8	293,530	1.7%
San Francisco-Oakland-Hayward	93 km	58 mi	15	306,270	3.19%
Los Angeles-Long Beach-Anaheim	146 km	91 mi	36	368,395	7.65%
San Diego-Carlsbad	67 km	42 mi	13	251,033	2.76%
Phoenix-Mesa-Scottdale	69 km	43 mi	14	320,650	2.97%
Salt Lake City	20 km	12 mi	5	230,668	1.06%
Denver-Aurora-Lakewood	55 km	34 mi	7	393,465	1.48%
Minneapolis-St. Paul	50 km	34 mi	6	582,529	1.27%
Chicago-Naperville-Elgin	137 km	85 mi	19	502,873	4.04%
Detroit-Warren-Dearborn	88 km	55 mi	9	477,401	1.91%
Dallas-Fort Worth-Arlington	110 km	68 mi	10	695,433	2.12%
Houston-The Woodlands-Sugar	71 km	70 mi	6	1,081,696	1.27%
Atlanta-Sandy Springs-Roswell	75 km	47 mi	9	623,813	1.91%
Miami-Fort Lauderdale-West Palm	133 km	82 mi	11	539,074	2.34%
Washington-Arlington-Alexandria	124 km	77 mi	17	354,925	3.61%
New York-Newark-Jersey City	222 km	138 mi	31	648,157	6.59%
Boston-Cambridge-Newton	48 km	30 mi	5	946,432	1.06%

All Figures Based on 2014 U.S. Census

Table 4: Major Market Income Summary for all Costco Markets

Major Market	Stores per Market	Major Market (MSA) Population	Median Household Income	Population Per Store	Percentage of Total Stores
Seattle-Tacoma-Bellevue	15	3,554,760	$50,733	244,765	3.19%
Portland-Vancouver-Hillsboro	8	2,265,223	$46,090	293,530	1.7%
San Francisco-Oakland-Hayward	15	7,239,362	$63,024	306,270	3.19%
Los Angeles-Long Beach-Anaheim	36	16,373,645	$45,903	368,395	7.65%
San Diego-Carlsbad	13	2,813,833	$47,067	251,033	2.76%
Phoenix-Mesa-Scottsdale	14	3,251,876	$44,752	320,650	2.97%
Salt Lake City	5	1,333,914	$48,594	230,668	1.06%
Denver-Aurora-Lakewood	7	2,581,506	$51,088	393,465	1.48%
Minneapolis-St. Paul-	6	3,615,902	$54,304	582,529	1.27%
Chicago-Naperville-Elgin	19	9,157,540	$51,046	502,873	1.27%
Detroit-Warren-Dearborn	9	5,456,428	$49,160	477,401	1.91%
Dallas-Fort Worth-Arlington	10	5,221,801	$47,418	695,433	2.12%
Houston-The Woodlands-Sugar	6	4,669,571	$44,761	1,081,696	1.27%
Atlanta-Sandy Springs-Roswell	9	4,112,198	$51,948	623,813	1.91%
Miami-Fort Lauderdale-West Palm	11	3,876,380	$38,632	539,074	2.34%
Washington-Arlington-Alexandria	17	7,608,070	$57,291	354,925	3.61%
New York-Newark-Jersey City	31	21,199,865	$59,799	648,157	6.59%
Boston-Cambridge-Newton	5	5,819,101	$52,792	946,432	1.06%

All Figures Based on 2014 U.S. Census

West region

Costco's beginnings in California are one of the main reasons that 220 of their 461 total stores are located in this 11 state region. This accounts for almost 48% of their total store network in a census region with 23% of the lower 48 contiguous states. Table 5 provides a breakdown of stores and major markets located in this region.

Table 5: West Census Region Major Markets and Stores

Major Market	Stores per Market	Year of First Costco	Chronological Store Number	MSA Population	MSA Population Density
Seattle-Tacoma-Bellevue	15	1983	11	3,671,478	596/sq mi
Portland-Vancouver-Hillsboro	8	1983	13	2,348,247	333/sq mi
San Francisco-Oakland-Hayward	15	1983	9	4,594,060	1,825/sq mi
Los Angeles-Long Beach-Anaheim	36	1983	8	13,262,220	2,734/sq mi
San Diego-Carlsbad	13	1976 (Original)	1	3,263,431	776/sq mi
Phoenix-Mesa-Scottsdale	14	1978	2	4,489,109	308/sq mi
Salt Lake City	5	1984	15	1,153,340	140/sq mi
Denver-Aurora-Lakewood	7	1990	98	2,754,258	599/sq mi

All Figures Based on 2014 U.S. Census

The West census region saw its first Costco store open in 1976. Over the next 10 years, 32 of 36 Costco stores were opened in this region. This accounts for 89% of total stores opened during this period. From 1986-1995, the West region was again the leading census region for store openings, with 102 of 151 stores opened or 67.5% of total stores. From 2006-2014, location efforts were no longer heavily focused in the West, although 43 of 131 stores still were opened in the region. This accounted for 33% of store openings during that period. The most store openings to occur in the region in one year occurred in 1992, when 17 new stores were opened. This was the highest number of stores Costco has opened in one year in any census region. With 23.5% of the total U.S. population in the West, this region is home to the most saturated market of all four census regions. The West region is also home to the highest number of major markets of any census region (see Figure 4).

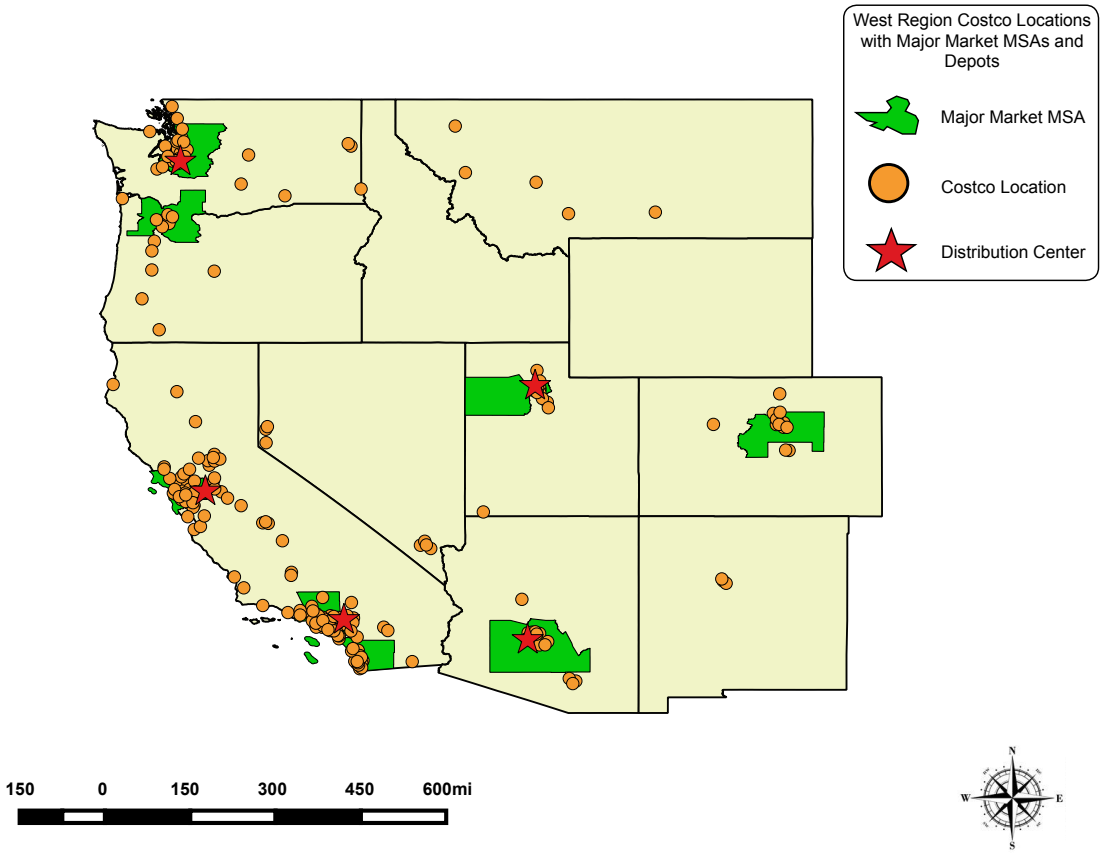

Figure 4: West Region Costco Locations with Major Market MSA's and Depots

Although not every group of five or more stores was included in this study, most were. In larger census regions like the West, it was important to include as many major markets as possible in order for the Bivariate K to have an adequate number of initial starting points. In census regions like the Northeast, it was not as imperative to utilize this technique. Consequently, certain markets, although meeting the requirement for consideration as a cluster, were not included in this study.

In the West, there are 8 major markets. The first, Seattle-Tacoma-Bellevue, saw it's first Costco store open in 1983, and today has 15 total stores, just over 3% of the

total store network, tied for second most in the West region. This was the 11th Costco to open for the retailer. With a MSA population of 3.6 million and an MSA population density of 596 people per square mile, this region is a fairly saturated market. Of course, Costco is headquartered in the Seattle Area, and has a strong presence in the region. The Seattle market has a market reach of 69 miles. For purposes of this study, market reach is the greatest distance between stores within the same market. This gives a general indication of the extent and geographic reach of each market. Another metric used for this portion of the analysis was the population per store. This number is calculated by dividing the MSA population by the number of stores. The population per store gives a general idea of how many people, on average, are living within a trade area within each major market. The population per store for the Seattle-Tacoma-Bellevue MSA is 244,765. The median household income for this MSA is $50,733 per year.

To the south, the Portland-Vancouver-Hillsboro market has 8 stores or 1.7% of the total store network, with their first store also opening in 1983. This was the 13th Costco store to open overall. The Portland-Vancouver-Hillsboro MSA is home to 2.3 million people and has an MSA population density of 333 people per square mile. The market reach for the Portland market is 33 miles, with a population per store of 293,530. The median household income for this MSA is $46,090 per year.

The next market, San Francisco-Oakland-Hayward, also saw its first Costco store open in 1983. This store was the 9th overall store to open. Today, Costco operates

15 stores in this market accounting for 3.2% of their store network. With an MSA population of 4.6 million and 1,825 people per square mile, this MSA is the second most densely populated in the West region. The San Francisco market has a market reach of 58 miles, and a PPS of 306,270. The median household income for this MSA is $63,024 per year, the highest of any market included in the analysis and the highest in the United States.

The largest store market in the West region is to no surprise, Los Angeles. With 13.2 million people in the Los Angeles-Long Beach-Anaheim MSA and a population density of 2,734 people per square mile, this MSA is the most populated both in terms of total population and population density. The Los Angeles MSA is home to 36 Costco stores or 7.65% of Costco's total store network, the most in the West and the most of any major market in Costco's national network. The first store to open here was in 1983, the 8th store to open up to that time. The Los Angeles MSA has a market reach of 91 miles, the largest in the West region, and a PPS of 368,395. The median household income for this MSA is $45,903 per year.

Bordering the Los Angeles MSA to the south is the San Diego-Carlsbad MSA. This market is home to 13 total Costco stores and also is the birthplace of Costco, with the first store opening in the area in 1976. These 13 stores represent 2.76% of Costco's store network. This MSA is home to 3.2 million people and has a population density of 776 people per square mile. The San Diego market has a market reach of 42 miles and a PPS of 251,033. The median household income for this MSA is $47,067 per year.

The second ever Costco store to open, somewhat surprisingly, was in the Phoenix-Mesa-Scottsdale MSA in 1978. This approach differs from most retailers who open second locations fairly close to the original store. Costco has shown a historical ability to employ hierarchical diffusion, targeting major suburban areas for network expansion, regardless of geographic proximity to the original store. For comparison, Wal-Mart expanded their network contagiously from their Arkansas base, expanding outward without stretching expansion farther than 10 or 20 miles. Target, like Costco, opened additional locations in other states relatively early in their expansion, but their first three stores were in Minnesota, with their fourth opening in St. Louis in 1968.

The Phoenix market is now home to 14 total Costco stores and has a population density of 308 people per square mile, with 4.5 million total inhabitants. Almost 3% of Costco's national network is located here. The Phoenix market has a market reach of 43 miles and a PPS of 320,650. The median household income for this MSA is $44,752 per year.

Moving north, the smallest major market included in the West region for this study is the Salt Lake City MSA. This market is home to 5 total Costco stores or just over 1% of their national network, with the first store opening in 1984. With 1.2 million people, this MSA is also the least populated in the region. It is also the least densely populated with only 140 people per square mile. The Salt Lake City MSA has a market reach of 12 miles, the lowest in the region and the lowest for any major market included

in the study. The PPS for the Salt Lake city MSA is 230,668, and the median household income for this MSA is $48,594 per year.

The final market included in the West region analysis was the Denver-Aurora-Lakewood MSA. This market currently has 7 total Costco stores, the first of which opened in 1990. This accounts for 1.5% of Costco's national network. This was the last major market that Costco penetrated in the West region, nearly 6 years after they entered the Salt Lake City area. The Denver MSA has a population of 2.8 million people and 599 people per square mile. Its market reach is 34 miles and its PPS is 393,465. The median household income for this MSA is $51,088 per year.

Midwest region

In the Midwest, a region that Costco did not penetrate until roughly midway through their expansion, they operate 75 total stores, accounting for just over 16% of their total store network. Two of Costco's bigger clusters are in this region, Chicago, and Detroit. The Midwest region comprises 12 of the lower 48 states and is home to a little over 21% the total U.S. population. The Midwest region has 3 major markets that were included in this study. Table 6 shows the breakdown of stores and major markets located in the Midwest region.

Table 6: Midwest Census Region Major Markets and Stores

Major Market	Stores per Market	Year of First Costco	Chronological Store Number	MSA Population	MSA Population Density
Minneapolis-St. Paul-	6	2000	244	3,615,902	515.4/sq m
Chicago-Naperville-Elgin	19	1998	212	9,157,540	1,318/sq m
Detroit-Warren-Dearborn	9	1998	205	5,456,428	1,104.8/sq mi

All Figures Based on 2014 U.S. Census

This region did not see an initial market store, or major market penetration, until 1998, the latest of any census region. However, 2 Costco stores were opened in the region between 1986 and 1995, accounting for only 1.3% of total stores opened during that time. From 1996-2005, Costco opened 40 of 152 stores in the Midwest region or 26.3% of total stores. From 2006-2014, 33 of 131 store openings were in the Midwest region, accounting for 24.6% of store openings during that time. The most store openings to occur in the region in one year occurred in 2001, when 10 new stores were opened. Figure 5 showcases the distribution of Costco's store network in the Midwest region.

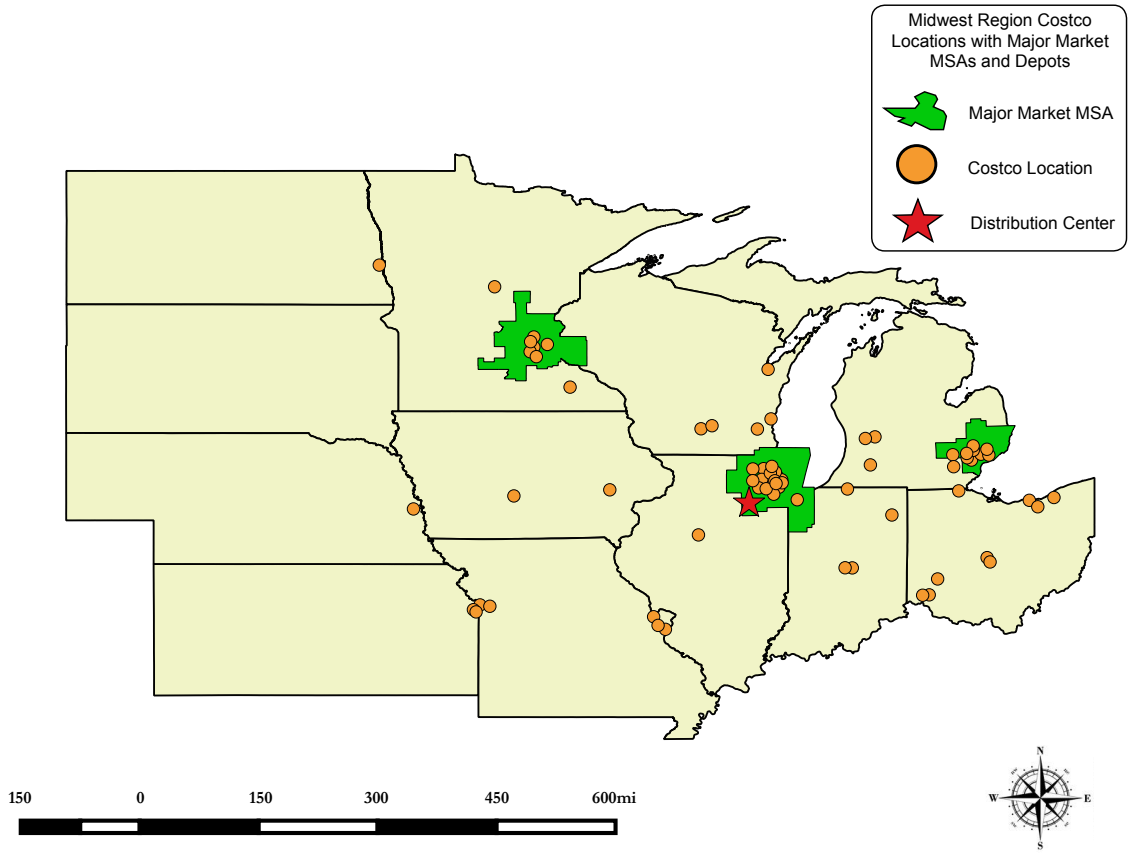

Figure 5: Midwest Region Costco Locations with Major Market MSAs and Depots

The smallest market in the region is the Minneapolis-St. Paul-Bloomington MSA with 6 Costco stores, the first of which opening in 2000. This store was the 244th Costco to open. This was the last major market Costco entered in the region. Costco operates 1.27% of their national network in this market. The Minneapolis MSA is home to 3.5 million people, and has a population density of 515 people per square mile. Its market reach is 34 miles and it has a PPS of 582,529. The median household income for this MSA is $54,304 per year.

The largest major market in the Midwest region is the Chicago-Naperville-Elgin market. With 19 total stores, it is one of the larger markets Costco operates in the United States. Over 4% of Costco's national network is located in the Chicago MSA. This market saw its first store open in 1998, the 212th Costco store to open. This MSA is also the most populated, with 9.5 million people and 1,318 people per square mile. Its market reach is 85 miles, by far the most in the Midwest region, and its PPS is 502,873. The median household income for this MSA is $51,046 per year.

The final market included in the Midwest region for this thesis was the Detroit-Warren-Dearborn MSA. This market is home to 9 total Costco stores or almost 2% of the national network, and saw its first store open in 1998. This store was the 205th Costco to open in the United States. The Detroit MSA is home to 4.3 million people and has a population density of 1,104 people per square mile. Its market reach is 55 miles and it has a PPS of 477,401. The median household income for this MSA is $49,160 per year.

South region

In the South region, Costco operates 110 total stores accounting for just fewer than 24% of their total store network. This 16-state region is home to the highest proportion of the U.S. population, 37.5%. There were five major markets from the south included in the analysis. Table 7 provides a breakdown of store and major markets for the south region.

Table 7: South Census Region Major Markets and Stores

Major Market	Stores per Market	Year of First Costco	Chronological Store Number	MSA Population	MSA Population Density
Dallas-Fort Worth-Arlington	10	2000	237	6,954,330	634/sq mi
Houston-The Woodlands-Sugar	6	2001	258	6,490,180	630/sq mi
Atlanta-Sandy Springs-Roswell	9	1996	193	5,614,323	630/sq mi
Miami-Fort Lauderdale-West Palm	11	1984	23	5,929,819	910/sq mi
Washington-Arlington-Alexan-	17	1986	47	6,033,737	962/sq mi

All Figures Based on 2014 U.S. Census

The South region was the only other region besides the West that Costco opened stores in from 1976-1985. Only 4 of the 36 stores opened during this time were in the South region, accounting for 11% of total store openings during this time. From 1986-1995 22 of 151 new stores opened in the South region, accounting for 14.5% of total store openings during that time. From 1996-2005, 41 of 152 new stores opened in the South, accounting for 27% of total store openings during that time. From 2006-2014, 43 of 131 stores opened occurred in this region, tied for the most with the West region. These 43 store openings represented 33% of total store openings during that time. The most store openings to occur in the region in one year occurred in 2001, when 13 new stores were opened. Figure 6 shows the geographic distribution of Costco's store network in the south region; along with the distribution centers and major market MSA's.

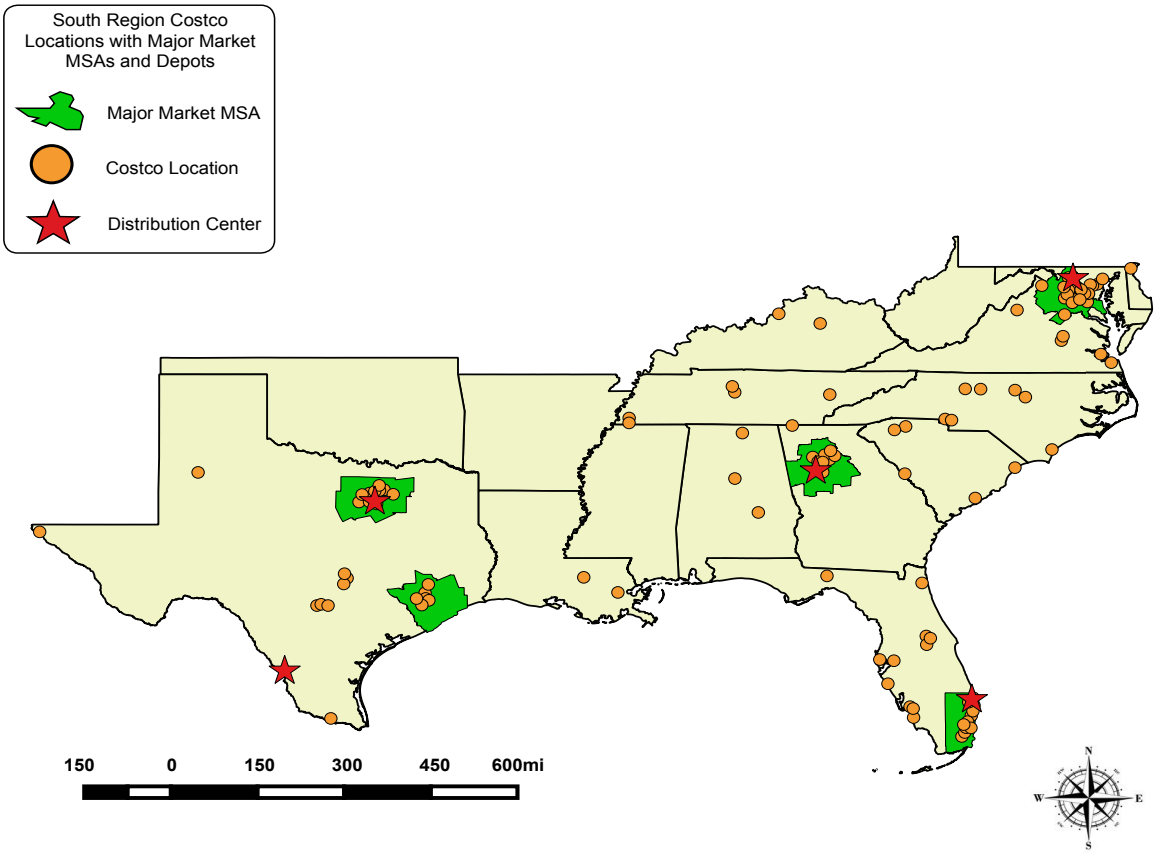

Figure 6: South Region Costco Locations with Major Market MSAs and Depots

The most populated market, Dallas-Fort Worth-Arlington, has 6.9 million people in the MSA and a population density of 634 people per square mile. With 10 stores in the MSA, this market has developed rather quickly from its first store opening in 2000. The initial store in this region was Costco's 237th store to open in the United States. Costco operates 2.12% of their national network in this MSA. This market has a reach of 68 miles and a PPS of 695,433. The median household income for this MSA is $47,418 per year.

The other major market located in Texas that was used for this thesis was the Houston-The Woodlands-Sugar Land MSA. This market, although highly populated with 6.5 million people, is home to only 6 Costco stores, accounting for 1.27% of Costco's national network. This market did not see its first Costco store until 2001, the 258th to open in the U.S. overall. The Houston MSA has a population density of 630 people per square mile. Its market reach is 70 miles and its PPS is 1,081,696. The Houston market is the only major market to have a PPS over 1 million people. The median household income for this MSA is $44,761 per year.

To the east, the next market included in the analysis was the Atlanta-Sandy Springs-Roswell MSA. Home to 9 Costco stores or 1.91% of total national stores, this market saw their first store open in 1996, the 193rd overall Costco store in the U.S. This market is also highly populated with an MSA population of 5.6 million and a population density of 630 people per square mile. Its market reach is 47 miles and its PPS is 623,813. The median household income for this MSA is $51,948 per year.

The oldest market in this region, the Miami-Fort Lauderdale-West Palm Beach MSA saw its first Costco store open in 1984 and today operates 11 stores overall, the second most in the region, accounting for 2.34% of Costco's national network. The initial store was just the 23rd store to open overall, showing how Costco extended its reach coast to coast in a relatively short amount of time. The Miami market has a population of 5.9 million and a population density of 910 people per square mile. Its market reach is 82 miles, the highest in the region, and its PPS is 539,074. The median

household income for this MSA is $38,632 per year, the lowest of any market included in the analysis.

The largest market in the south region is the Washington D.C.-Arlington-Alexandria MSA with 17 total Costco stores or 3.61% of Costco's national network. The first Costco to open in this region was in 1986 and was the 47th overall store. The Washington D.C. market is home to just over 6 million people and has a population density of 962 people per square mile. Its market reach is 77 miles and it has a PPS of 354,925. The median household income for this MSA is $57,799 per year.

Northeast region

Finally, in the Northeast region, Costco operates 56 of 461 stores, accounting for just over 12% of their total network within the lower 48 states. The Northeast region is comprised of 9 states and is home to 17.6% of the total U.S. population. Most of the stores in this region are concentrated in the Philadelphia, New York, and Boston metropolitan areas. The Northeast only has two major markets that were included for this analysis, New York and Boston. The Northeast region did not see its first Costco store until 1987. From 1986-1995, 25 of 151 new stores were opened in this region, accounting for 16.5% of new stores during this time. From 1996-2005, Costco opened 19 of 152 stores in the Northeast region, accounting for 12.5% of new stores during this time. From 2006-2014, 12 of 131 new store openings occurred in the Northeast, accounting for 9.4% of new stores during that time. The most stores to open in the

Northeast in one year occurred in 1993, when 7 new stores opened in the region. Table 8 provides a breakdown of store and major markets for the Northeast region.

Table 8: Northeast Census Region Major Markets and Stores

Major Market	Stores per Market	Year of First Costco	Chronological Store Number	MSA Population	MSA Population Density
New York-Newark-Jersey City	31	1987	58	20,092,883	1,576/sq m
Boston-Cambridge-Newton	5	1990	106	4,732,161	1,524/sq m

All Figures Based on 2014 U.S. Census

The New York-Newark-Jersey City MSA is the second largest Costco market in the country, with 31 total stores or 6.59% of their national network. This market saw their first store open in 1987, the 58th overall store. The New York MSA is also the most populated market in the study and the most populated market in the country, with a population of 20.1 million and 1,576 people per square mile. Its market reach is 138 miles, by far the highest of any market in the region and the entire analysis. This can partly be attributed to elongated geography of Long Island. The New York MSA has a PPS of 648,157. The median household income for this MSA is $59,799 per year. Figure 7 provides a geographic distribution of Costco's store network in the Northeast region; along with the distribution centers and major market MSA's.

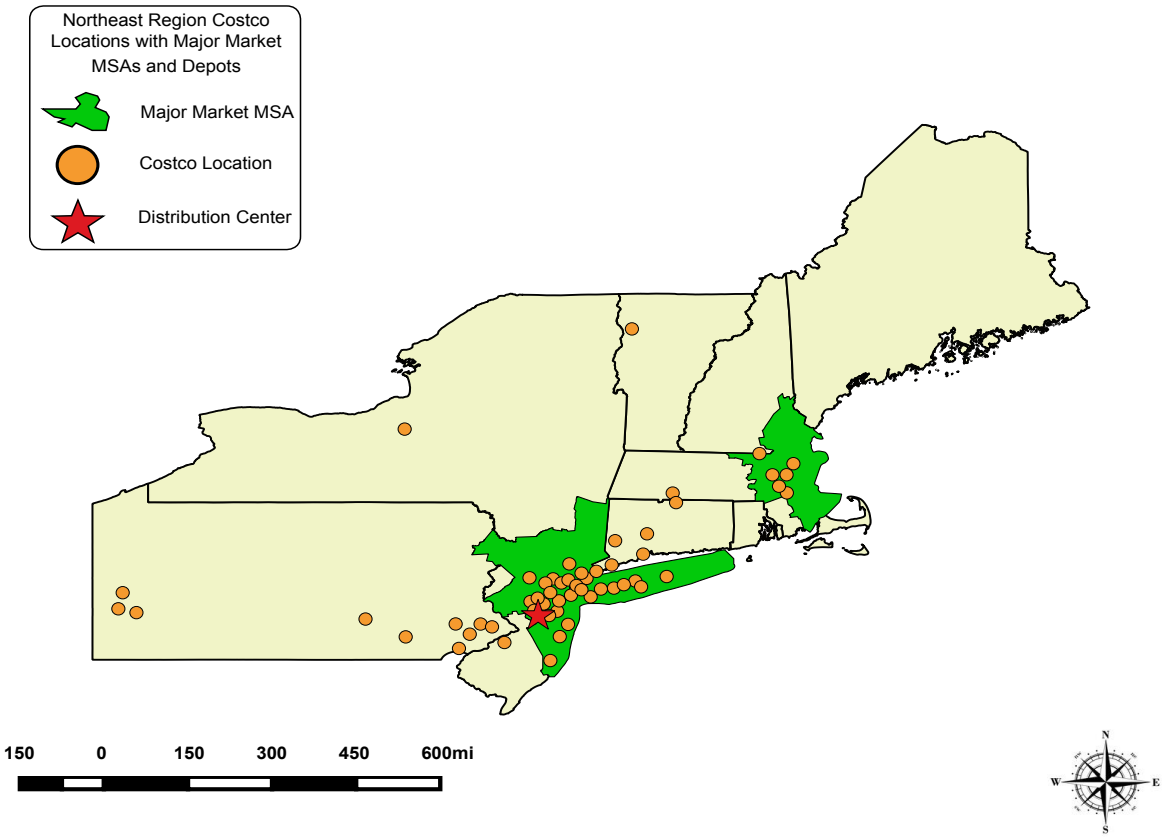

Figure 7: Northeast Region Costco Locations with Major Market MSAs and Depots

The other major market in the Northeast region is the Boston-Cambridge-Newton market. This market is small, with only 5 total stores, the first of which opening in 1990. This store was the 106th Costco store to open overall. Costco operates just over 1% of their national network in the Boston MSA. The Boston-Cambridge-Newton MSA has a population of 4.7 million and a population density of 1,524 people per square mile. Its market reach is 30 miles, the smallest in the region, and its PPS is 946,432, the second highest of any market included in the analysis. The median household income for this MSA is $52,792 per year.

Overall, Costco opened 36 stores from 1976-1985, 151 from 1986-1995, 152 from 1996-2005, and 131 from 2006-2014. Two thirds of Costco's national network opened from 1986-2005. Refer to tables 9 and 10 for a comprehensive summary of Costco's chronological store openings.

Table 9: Chronological Store Opening Summary for Costco Stores by Region

Census Region	Store Openings 1976-1985	Store Openings 1986-1995	Store Openings 1996-2005	Store Openings 2006-2014	Most Stores Opened in One Year
West	32	102	52	43	17 (1992)
Midwest	0	2	40	33	10 (2001)
South	4	22	41	43	13 (2001)
Northeast	0	25	19	12	7 (1993)
Aggregate	36	151	152	131	31 (2001)

All Figures Based on 2014 U.S. Census

Table 10: Chronological Store Opening Summary by Percentage for Costco Stores by Region

Census Region	Percentage of Store Openings 1976-1985	Percentage of Store Openings 1986-1995	Percentage of Store Openings 1996-2005	Percentage of Store Openings 2006-2014	Most Stores Opened in One Year by Percentage
West	89%	67.5%	34.2%	33%	17 (1992) (3.6%)
Midwest	0%	1.3%	26.3%	24.6%	10 (2001) (2.1%)
South	11%	14.5%	27%	33%	13 (2001) (2.76%)
Northeast	0%	16.5%	12.5%	9.4%	7 (1993) (1.5%)
Aggregate	7.8%	32.7%	32.9%	28.4%	31 (2001) (6.6%)

All Figures Based on 2014 U.S. Census

Bivariate K store analysis

The second portion of answering this research question was done using a form of Ripley's K called Bivariate K. The goal of this approach was to assess and quantify what level of clustering is present in Costco's major markets, and quantify how they expand their store network following initial entry. The analysis was done using a regional approach. Four separate Bivariate K analyses were performed using R, with each initial major market store serving as the starting point. The results were as follows:

The results from the West region show a high level of initial clustering following market entry. The analysis performed in R used eight initial Costco stores as starting points for the Bivariate K. Because the West region is so heavily saturated compared to the other census regions, the results were somewhat anticipated. Figure 8 is a graph of number of extra events versus distance. This graph shows us how the observed point pattern of Costco's store network relates to an expected point pattern or Poisson process for CSR. In the case of the Bivariate K, an extra event refers to and observed point (Costco store) within the distribution. However, these numbers are magnified by thousands of calculations performed by R. An observed event will be incorporated into these calculations, thus registering higher numbers of extra events. Essentially, if there are more Costco stores in a given area, there will be a higher number of extra events. This number varies throughout each census region based on distance, meaning that although some census regions may have similar numbers of extra events, the distance in which these events are observed may vary substantially.

Figure 8 shows a maximum number of extra events of just over 250,000, a highly clustered number. Immediately after the Bivariate K begins its calculations, there is a very small drop in clustering or market density, although the chart begins at around 60,000 extra events. This essentially means that the number of expected stores, based on a Poisson process for CSR, is fewer than the actual number of observed stores. Despite this brief initial decline in clustering, the results generated by R quickly show an extremely high level of clustering, and market density. This means that the observed number of stores is much greater than the expected number based on a Poisson process for CSR. The results indicate that observed number of extra events is higher than the observed number. This is undoubtedly attributed to very densely arranged markets in Los Angeles, San Francisco, San Diego, and Seattle. These multiple, highly dense markets are also the reason the chart begins at such a highly clustered mark of 60,000 extra events. Many of the stores outside of the MSA's in these areas are also located close to each other, making for even more clustering on the chart. Of course, it is important to understand how this clustering is being quantified over space. The chart indicates that the initial spike in market density begins to subside at a distance of about 28 miles. This represents one of the shortest distances of any initial clustering spike found in the analysis, and speaks to the density of Costco's west region market. Following this drop in clustering the chart still shows a higher than usual number of observed events, which continue to increase, albeit at a slower rate, to a distance of 103 miles. The chart in figure 8 then shows a steady decline in the level of market density and saturation, with a small upward trend at a distance around 290 miles. Compared to other graphs for the other census regions, this steady decline, with no

significant upward trend, is indicative of the large, wide-spread arrangement of major cities in the West region.

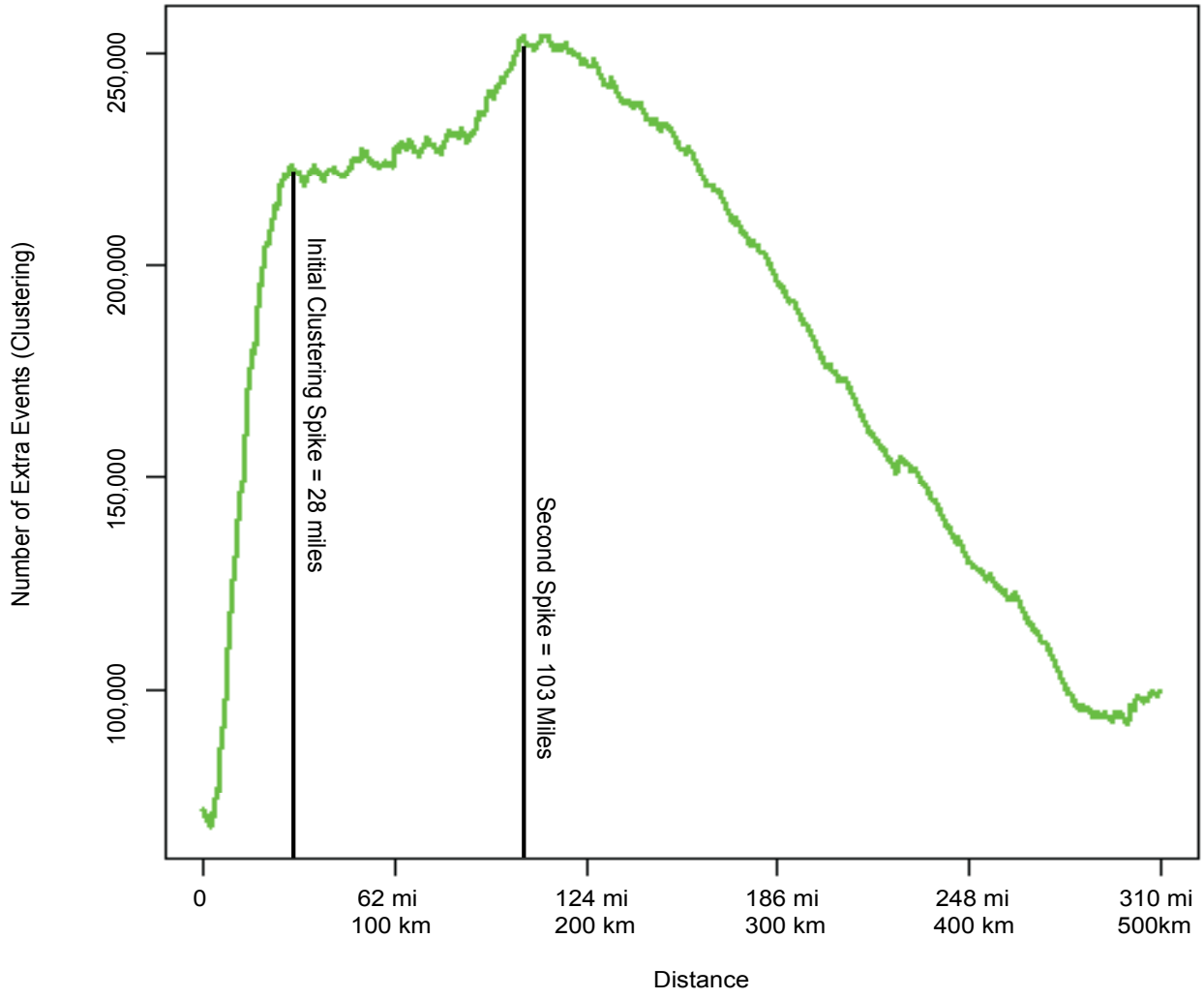

Figure 8: Bivariate K for West Region Stores

The Midwest region also, like the West, shows a clear drop in initial clustering following the start of the Bivariate K function (see Figure 9). This initial drop is about twice the size of that of the West, and can be attributed to less dense networks, and smaller market sizes in this region. Still, despite this drop, the number of extra events that the Bivariate K immediately yields is higher than that of the West, at around 100,000. It is important to note that this census region was the last for Costco to penetrate; yet still, their clusters are denser, overall, than the West region. Once the Bivariate K does begin to recognize observed stores or points, and runs its calculations against an expected pattern, the level of density increases substantially, and continues to do so to a distance of about 27 miles. Following this upward trend, a downward one begins, eventually yielding to another spike in clustering at a distance of 229 miles. Looking a the map of the Midwest region, it is clear to understand why this is, as most of the stores are located in major markets, with fewer stores in between. The clusters in this region have less reach, or sprawl, than the West region. The second upward trend in clustering is a result of the Bivariate K finding additional store clusters that did not have initial points used in the analysis. Therefore, because the calculation was run from Minneapolis, Chicago, and Detroit, it takes 229 miles of distance for a significant cluster, or mini-cluster, to register. Another reason this is the case is because all three previously mentioned locations are within generally the same latitudinal area. Overall, the Midwest region yields a maximum number of extra events of around 285,000 with an initial number of events at around 100,000.

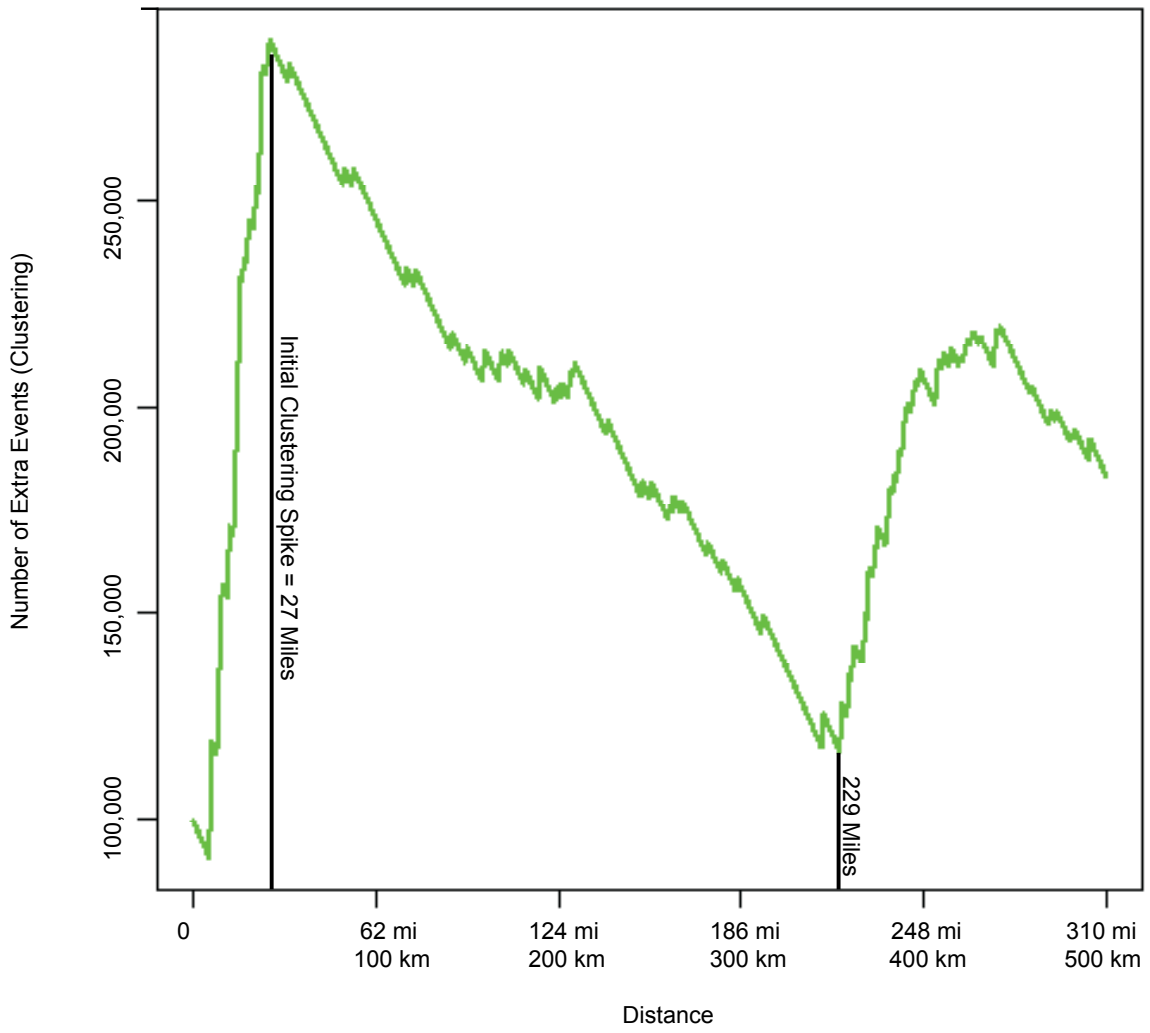

Figure 9: Bivariate K for Midwest Region Stores

The composition of the Costco's network in the South region, according to the Bivariate K analysis, shows a similar maximum level of clustering to the West and Midwest, but differs in terms of distance decay (see Figure 10). This region's Bivariate K analysis yielded an initial clustering level, or number of extra events, of around 90,000. This number quickly drops to around 70,000 extra events, then yielding to a steady increase in market density, eventually culminating with a maximum number of extra

event of 235,000. The South region's maximum clustering spike begins to subside at a distance of 61 miles, over twice the distance of the West and Midwest. This means that, although the South does indeed reach a high level of density, it is sustained for twice the distance as the West and the Midwest. It can be determined; therefore, that the South's network is more dispersed over space, but still has enough overall stores to register a high spike in market density. Following this upward trend, the graph indicates a decline in store frequency, followed by a second, smaller upward trend that begins to decline at a distance of about 167 miles. The South's network shows more pronounced fluctuations than any other regions, according to the graph, a result of a wide geographic area with major markets located in every corner, such as Miami, Washington D.C. and Houston.

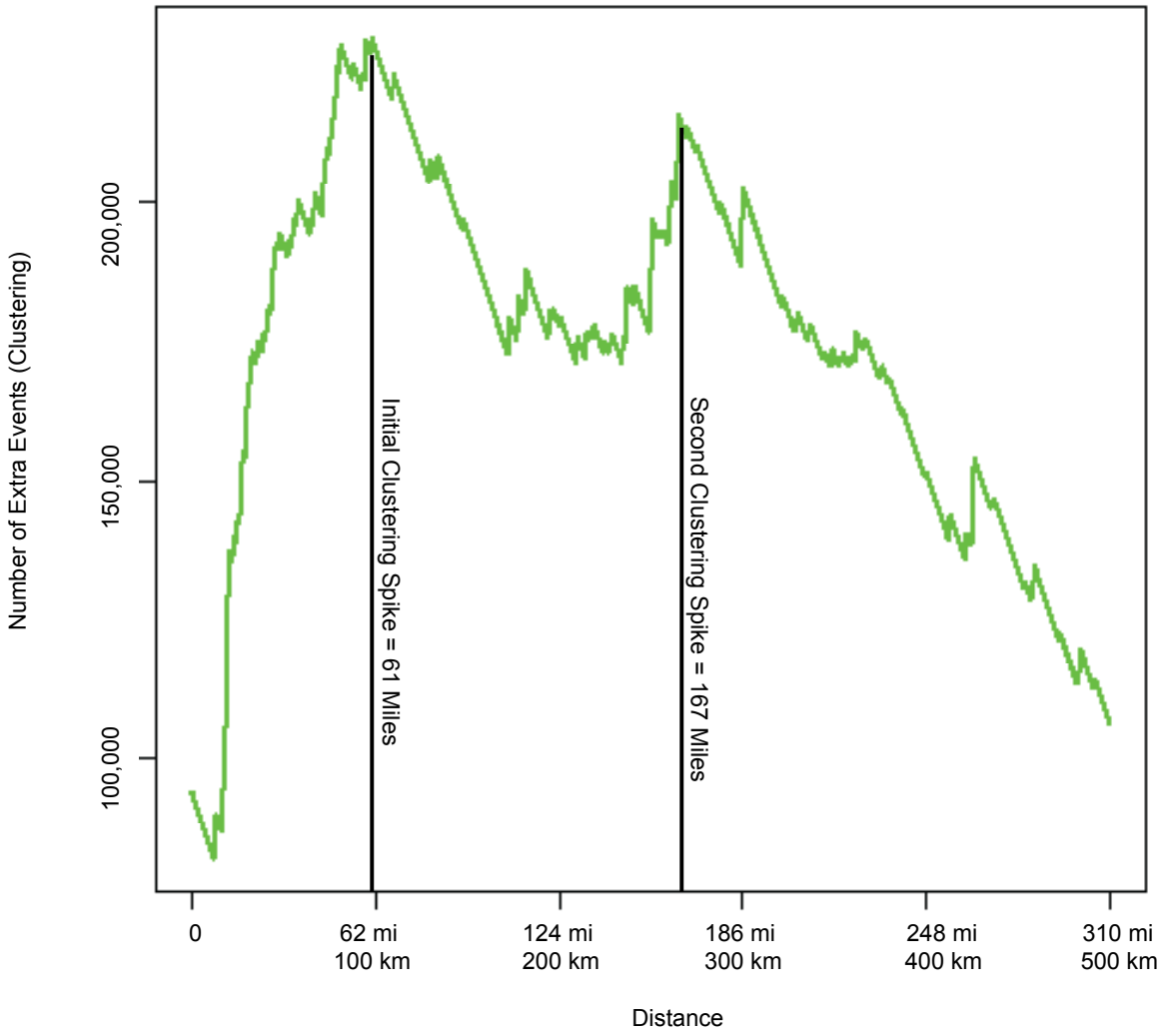

Figure 10: Bivariate K for South Region Stores

The Northeast region yielded the most unique chart of any of the census regions (see Figure 11). Its initial clustering was again much higher than expected, but was sustained for a distance of 80 miles, the highest of any region included in the study. The Northeast region had an initial clustering level of 80,000 extra events, culminating with a maximum number of extra events of 320,000, the highest of any region. This clustering did subside somewhat with increasing distance, but continued to show upward movement for distances of 150-200 miles, before a second, more pronounced decline

was observed. Unlike the other three census regions, the final number of extra events, based on the calculations, was much higher than expected. This means that the level of clustering throughout the region is higher, overall, than the other three census regions. It does not mean that the clustering in the Northeast is the highest within major markets, however, the graph tells us that it would be more difficult to find areas without Costco stores relatively nearby in this region than it would in the other census regions. This difference is the product of several factors: 1) A significantly smaller geographic area than the other three census regions. 2) A very large, very expansive cluster in New York. 3) Almost no areas where Costco stores are not within 100 miles. Stores in Colchester, Vermont and Syracuse, New York contributed to this significantly.

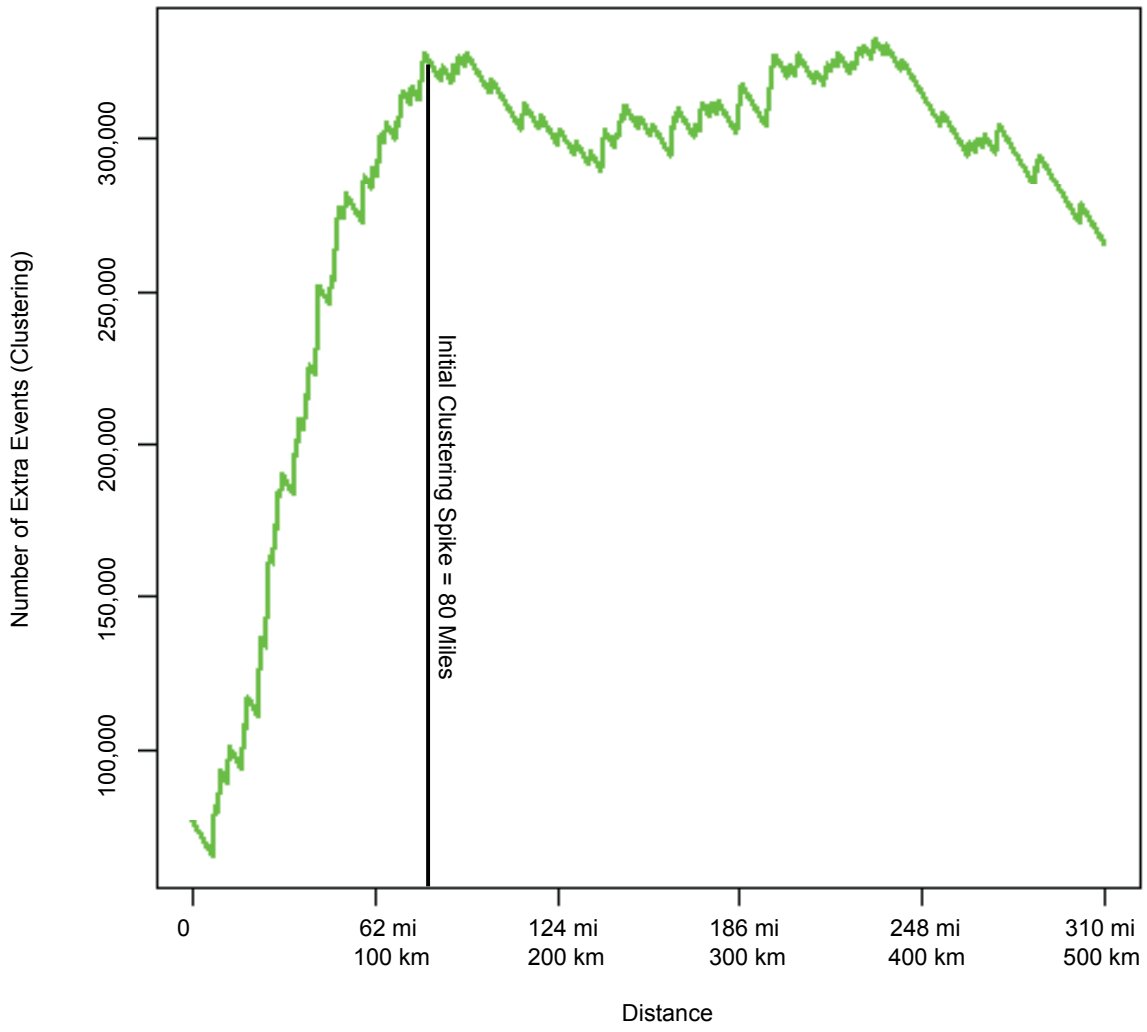

Figure 11: Bivariate K for Northeast Region Stores

Question 2: Distribution center expansion:

The second question for this thesis was to assess the general expansion pattern and sequence of Costco's expansion for their distribution center network. The analysis combined both descriptive and spatial statistics to form a two-part approach. The descriptive portion of this analysis yielded insightful results in terms of how Costco has expanded their distribution network over time. Costco's first distribution center opened

in 1992 in Tracy, California, following a need to store large quantities of products for re-distribution to area stores. It is no surprise that in 1993, Costco opened more locations than any other year on record. The addition of a distribution network is the catalyst for Costco's rapid level of growth. Today, Costco operates 12 distribution centers across the U.S. Tables 11 and 12 show the breakdown of distribution centers in all four United States Census Regions.

Table 11: Number of Distribution Centers Per Census Region

Region	Depots per Region	States per Region	Region Population	Percentage of Population	Percentage of U.S. Land Area
West	5	11	75,187,681	23.58%	24.2%
Midwest	1	12	67,745,108	21.24%	21.24%
South	5	16	119,771,934	37.56%	24.61%
Northeast	1	9	56,152,333	17.61%	4.58%
Aggregate	12	48	318,857,056	99.99%	74.63%

Table 12: Percentage of Distribution Centers Per Census Region

Region	% of Depots per Region	% of States per Region	Region Population	Percentage of Population	Percentage of U.S. Land Area
West	41.6%	22%	75,187,681	23.58%	24.2%
Midwest	8.3%	24%	67,745,108	21.24%	21.24%
South	41.6%	32%	119,771,934	37.56%	24.61%
Northeast	8.3%	18%	56,152,333	17.61%	4.58%
Aggregate	100%	96%	318,857,056	99.99%	74.63%

As with the store network, it is of no surprise that the majority of Costco's distribution center network is based in the Western United States. In the West region, Costco operates five total distribution centers, accounting for 41.6% of their total distribution center network in a census region with 23.5% of the population. Following the initial distribution center opening in 1992, Costco opened a second "depot" in Mira Loma, California in 1998. It is important to note that each distribution center has two separate departments, a "wet", and a "dry". The wet department is for food and drinks; the dry is for all other goods. Costco's third distribution center in the region was their fourth overall, a location in Tolleson, Arizona that opened in 2000. That same year, Costco opened a depot in Sumner, Washington, and finished their network, for now, with a location in Salt Lake City, Utah in 2006. This arrangement of five depots shows Costco's desire to spread their network over space throughout the region.

In the Midwest region, Costco operates 1 distribution center, accounting for 8.3% of their total distribution center network in a census region that is home to 37.56% of the total U.S. population. Costco's first and only depot to open in this region was in Morris, Illinois in 2001. There have been plans for additional distribution centers in the region, but nothing has been confirmed to this point. This region is home to the greatest untapped market of any other region for Costco in terms of geographic coverage, and it would not be surprising to see additional depot's opened in an effort to strengthen the regional network.

In the Northeast region, Costco operates one distribution center, accounting for 8.3% of their total distribution center network. The Northeast region is home to the lowest percentage of the United States population, 17.61%. Costco's only depot in this region opened in Morris, Illinois in 2001. This location is the main supplier for the New York and Boston markets, as well as the Philadelphia market.

In the south region, Costco operates five distribution centers, accounting for 41.6% of their total store network. The South region is home to the highest percentage of population of any census region, 37.56%. Costco's first depot to open in the area was in Laredo, Texas in 1999, although this distribution center is located just before the border with Mexico, and acts primarily in support of Mexican warehouses in the region (Testa 2014). This was their third distribution center to open at the time, and was the first to open outside of the West region. The next regional distribution center opening came in 2001 in College Park, Georgia. A third depot would open that same year in Dallas, Texas, Costco's second depot in the state. Texas and California are the only two states with multiple distribution centers. The fourth depot to open in the region was in 2003 in West Palm Beach, Florida. The last and final depot in the south is also the most recent distribution center that Costco has opened, a location in Monrovia, Maryland, which opened in 2010.

Bivariate K depot analysis

The second portion of answering this research question was done, once again, using a Bivariate K methodology. The goal of this approach was to assess and quantify what level of clustering is present in Costco's major markets in relation to their distribution network. The goal of this approach was to quantify and thoroughly understand how Costco has chosen to locate stores around their depots. The analysis was done using a regional approach, however, only three Bivariate K analyses were performed, with each distribution center serving as the starting point. The Midwest and Northeast regions were combined because each region only has one depot, which was not sufficient for R to properly perform the analysis. The results were as follows.

The arrangement of stores in the west region, compared to the distribution center network, is significantly denser when moving outward from the depots (see figure 12). As with the previous analysis done for the store network, a maximum level of around 255,000 extra events was reached. This number is based on thousands of calculations performed by R. This abrupt increase in density begins to stabilize at a distance of around 51 miles, about 23 miles farther than that of the store network for the same region. This indicates that the depots are located farther away from the store network, in general, but still are close enough to major clusters to generate a high level of clustering on the chart.

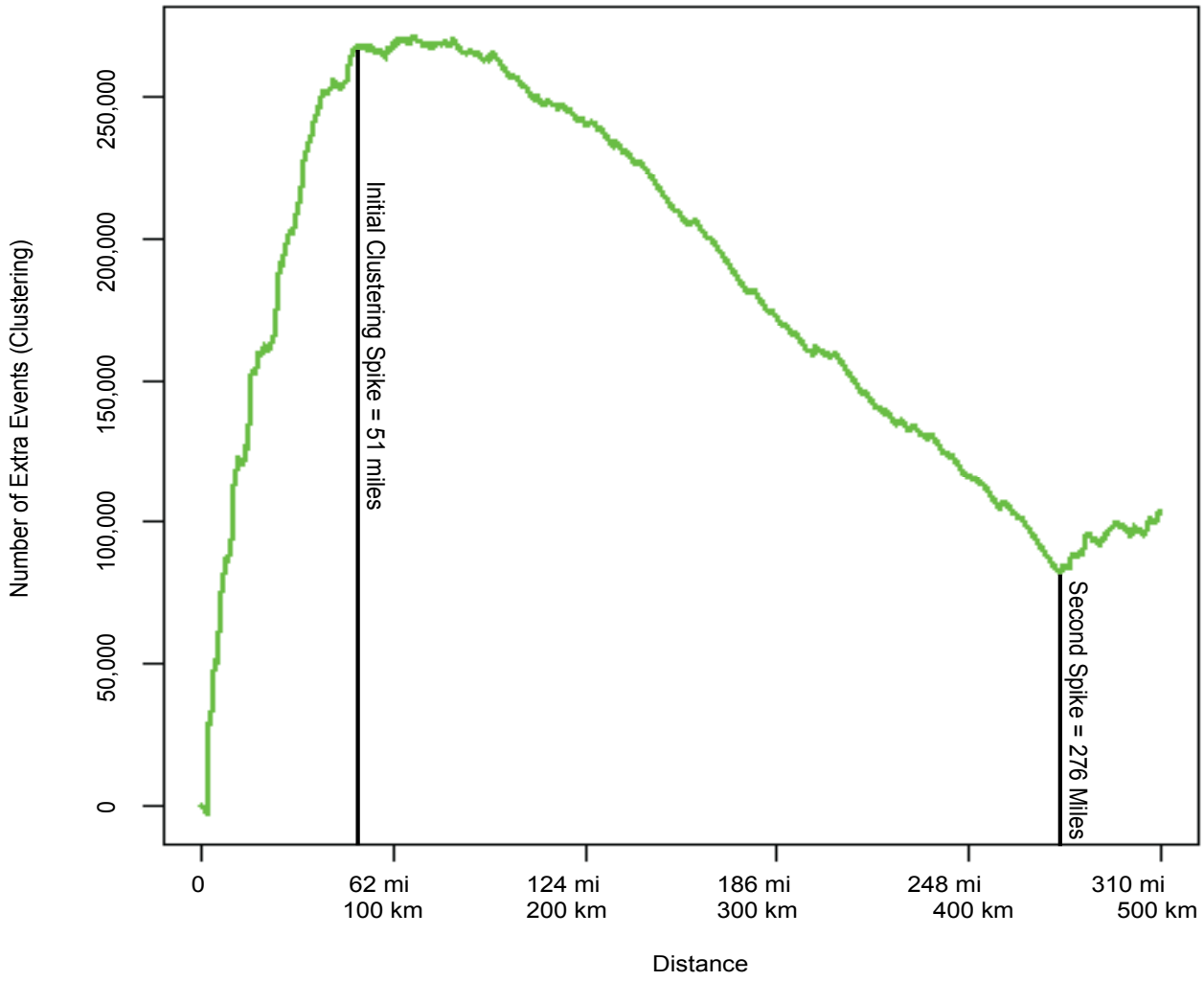

Figure 12: Bivariate K for West Region Distribution Centers

Another important number produced by the analysis, was an initial clustering level, or number of extra events, of 0. This indicates an almost perfectly uniform pattern, one almost identical to a Poisson process for CSR. However, a quick spike in this clustering level follows soon after. What follows this initial spike in clustering is a steady decline in density, culminating in another small upward trend at a distance of 276 miles. The graph in figure 12 does indeed look quite similar to the West region stores, mainly because Costco has a large, developed network of depots in this region, all of which are

spread across large geographic areas, in some of their biggest markets. The Bivariate K shows that the store network is significantly clustered for at least 310 miles outward from all five distribution centers. It is important to note that this is an aggregate figure; each calculation is run from each distribution center, which ultimately leads to the entire region receiving coverage from the Bivariate K.

As previously mentioned, the Midwest and Northeast regions were combined in this portion of the analysis to form one points layer comprised of two separate distribution centers. This yielded a fairly large combined geographic area with only two points for the R to use as initial points for the analysis. As a result, the level of clustering for this combined area fluctuates considerably more than other Bivariate K analyses for other census regions. It becomes clear when looking at the graph in figure 13 that this region has a store network that is highly clustered yet has considerable areas with few to no stores, enough that the chart shows upward and downward movement, although the general trend is moving in the direction of increased density.

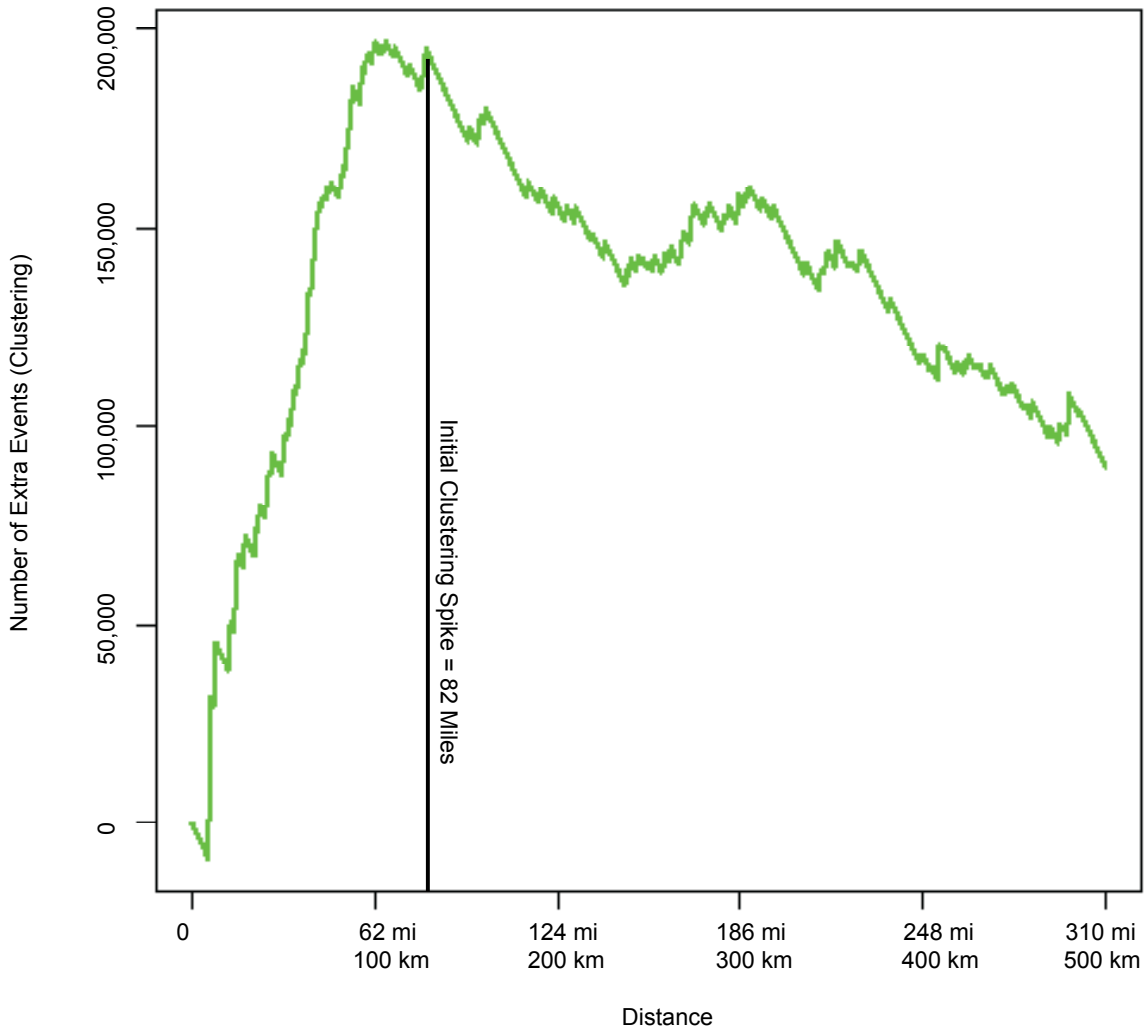

Figure 13: Bivariate K for Midwest and Northeast Depots

Like the West region depot graph (figure 12), the initial number of extra events begins at a level of 0, and quickly moves to a slow, gradual increase to a distance of 82 miles and a number of extra events of 190,000. This level is fairly low compared to other census regions. This increase changes to a slower, more gradual downward trend with distance and shifts back to more clustering and densely concentrated areas of stores. It is interesting in this graph to see how fewer initial starting points seem to increase fluctuations and movement within the amount of extra events. As with all other regions

in the study, there is a significant amount of density within the store network, in relation to the distribution network, for this region. The graph in figure 13 also shows clustering in excess of 100,000 extra events to a distance of 310 miles, the maximum possible distance for the analysis.

The South region distribution center Bivariate K analysis was unlike any other depot analysis, or store analysis (see figure 14). For the only time on any of the seven graphs, a negative level of clustering appeared on the Y-axis. However, similar to the other graphs in the analysis, a quick, initial level of clustering is present eventually culminating at a distance of 40 miles and a level of 50,000 extra events. It is clear, in this region, that Costco has located their store network in close proximity to their distribution network but for the first time, the Bivariate K shows clustering drop to a level blow zero, at a distance of about 120 miles.

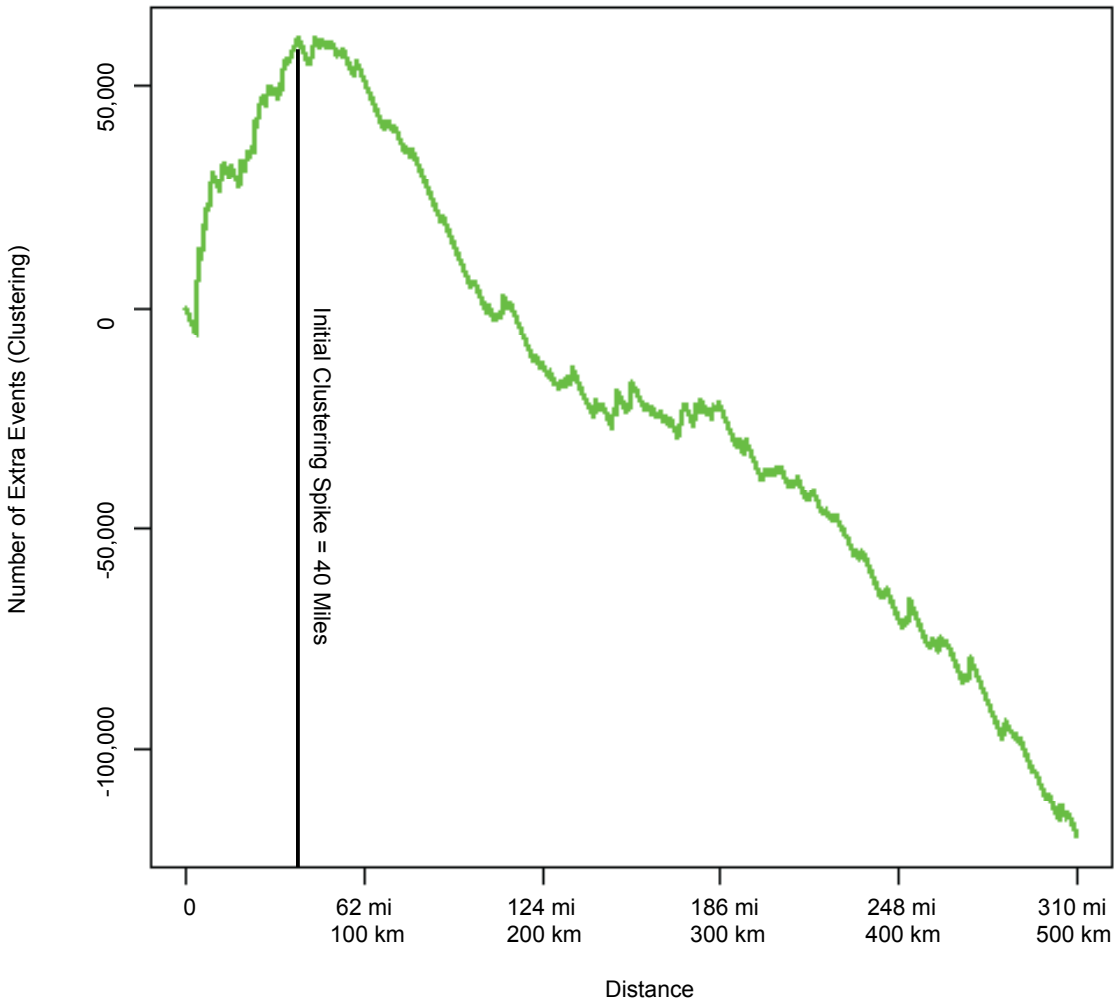

Figure 14: Bivariate K for South Region Distribution Centers

This means that Costco stores are not located nearly as close to the distribution centers as they are in other census regions, following the initial wave of clustering. It also tells us that the distribution network does not possess the level of coverage that it does in the other census regions. This is important because it clearly distinguishes the composition of the store network in comparison to the distribution network in this census region in a quantifiable way. This is attributed to several factors, but mainly that the geography of this regions distribution center network is unique. Following this dip in

clustering, the graph in figure 14 continues its downward trend, indicating a significantly dispersed pattern of stores, and eventually culminating at a level below -100,000 extra events at a distance of 310 miles. Part of the reason the chart in figure 14 looks so different from the others is: 1) The isolated peninsula of Florida means that no stores will be registered in three directions. 2) The Laredo, Texas distribution center is the only distribution center in the study to not have a significant store cluster located nearby. After further investigation, it was determined that this depot supports primarily Mexican Costco stores located in the northeastern portions of Mexico, and, because of its isolation, contributed significantly to low levels of density. This Laredo store is unique from a geographical perspective because it holds goods in the United States and exports them into Mexican warehouses. According to independent research (Testa 2014), this approach is more advantageous for Costco in terms of costs, transportation, and feasibility. 3) Large states such as Arkansas, Oklahoma, and Mississippi, without a single Costco location (Oklahoma did open a store in 2015, but it was not included in this study).

Question 3: North Texas case study analysis

The first part of the results for this research questions provided a detailed look at the market makeup for the surrounding areas in Costco's North Texas market. With 10 locations, North Texas is a large and important market for Costco (see figure 14).

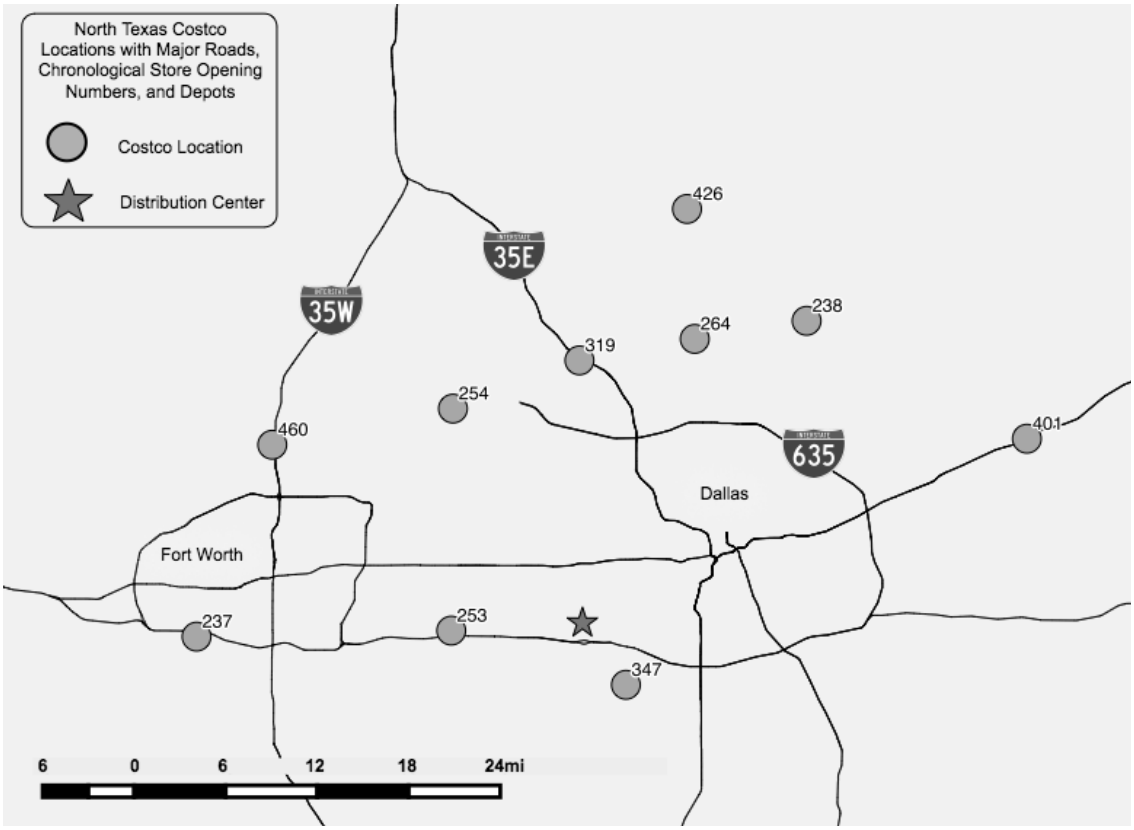

Figure 15: North Texas Costco's with Major Roads, Chronological Store Opening Numbers, and Distribution Centers

Costco did not enter this metropolitan region until 2000, but has opened almost one store per year over the last 14 years (see table 13). This is quite a high rate when considering Costco opens about 15 new stores per year in the United States as a whole. This high rate of store openings is a reflection of the region's recent rapid population growth (Young 2015).

Business summary

Table 13: 1-Mile Diameter Business Summary for North Texas Costco's

City	Opening Date	Total Businesses 1-Mile Ring	Total Employees 1-Mile Ring	Residential Population 1-Mile Ring	Employee/ Residental Population Ratio	2014 Total Sales 1-Mile Ring	Daytime Population of 1-Mile Ring	Residential Population 1-Mile Ring
E Plano	9/21/00	248	2175	2234	.97:1	$179,294,951	1,699	0.76:1
Frisco	10/22/11	34	166	21	7.9:1	$144,011,045	1,181	56.24:1
W Plano	9/27/01	398	3957	707	5.6:1	$1,569,387,761	3,047	4.31:1
Lewisville	8/25/04	114	1550	175	8.86:1	$326,361,863	2,174	12.42:1
Fort Worth	9/21/00	201	2657	3656	.73:1	$431,323,656	2,478	0.68:1
Arlington	4/27/01	397	4084	2993	1.36:1	$646,029,419	4,371	1.46:1
Southlake	4/27/01	523	4076	578	7.05:1	$291,894,633	3,211	5.56:1
N Fort Worth	5/9/14	3	4	303	.01:1	$240,000	4	0.01:1
Duncanville	8/9/06	176	536	2408	.22:1	$299,567,364	694	0.29:1
Rockwall	4/8/09	65	339	1158	.29:1	$128,573,233	1,841	1.59:1
		2,159	**19,544**	**14,233**		**4,016,683,925**	**20,700**	**10**

Costco's first location in this market opened in East Plano on September 21st, 2000. Costco's second location in Texas opened on the same day, in Ft. Worth, Texas. Costco also opened their third and fourth stores on the same day in 2001. Their third location, a store in Arlington, has 397 businesses located within a 1-mile diameter. This area employs 4,084 total workers, the highest of any store in the market. Costco's fourth store was the location in Southlake, Texas. Within a 1-mile diameter there are 523 total businesses employing 4,076 total people. This is the highest number of businesses within a 1-mile ring of any store and the second highest number of employees. Costco's fifth store in North Texas opened in West Plano on September 27th, 2001. The 2014 total sales for this area are $1,569,387,761, by far the highest of any surrounding business area in the study. Two of the main employers responsible for bringing this number up so high are Exxon, with $292,000,000 in sales, and Apple, with $636,000,000 in sales.

Costco's sixth North Texas location opened in Lewisville three years after their fourth, in 2004. Within a 1-mile diameter, this store has 114 total businesses and employs 1,550 people. The seventh Costco location to open in North Texas was in Duncanville, in August of 2006. Costco continued the trend of opening stores every 2-3 years by opening their eighth North Texas location in Rockwall in 2009. As you will see, the more recent the store opening, the fewer businesses located within a 1-mile diameter, generally. Within this business area there are 65 total businesses employing 339 people. Two years after opening their Rockwall location, Costco opened their ninth North Texas location in Frisco, in 2011. This business area has 34 total businesses, and employs 166 people. Both of these figures are second lowest of any store in the case study. The total residential population for this 1-mile area is 21, the lowest of any store in the market by a considerable amount.

The tenth and final North Texas Costco to open, and to be included in this study, opened in 2014 in North Ft. Worth. This particular store was a greenfield location in a distinctively undeveloped area. Consequently, there are only three businesses located within a 1-mile diameter as of December 2014, employing only four people. Both of these figures are the lowest of any store included in the analysis. This business area had total sales of $240,000 for 2014, most of which can be attributed to this Costco location.

27-minute drive time

The 27-minute drive time analysis provided an overall market makeup for Costco's North Texas market. Many of the populations for these areas were over 1 million people, indicating high levels of population density. The median household incomes were actually lower than usual, for Costco standards (see table 14). This however was not a surprise in a state with a very low cost of living.

Table 14: 27-Minute Drive Time Residential Summary for North Texas Costcos

Store Number	City	Opening Date	27-Minute DT Population	Median Household Income	Average Household Size
664	E Plano	9/21/00	1,844,478	$72,573	2.6
1097	Frisco	10/22/11	1,542,064	$79,299	2.6
684	W Plano	9/27/01	2,501,814	$67,285	2.61
683	Lewisville	8/25/04	2,440,459	$68,680	2.59
489	Fort Worth	9/21/00	1,164,210	$50,926	2.74
668	Arlington	4/27/01	1,824,545	$47,424	2.79
669	Southlake	4/27/01	1,274,441	$64,639	2.66
1173	N Fort Worth	5/9/14	1,220,684	$55,529	2.75
636	Duncanville	8/9/06	1,741,211	$47,047	2.84
1049	Rockwall	4/8/09	977,897	$56,343	2.88

The 27-minute drive time population for the East Plano location, Costco's first in this market, is 1,844,478 and the median household income for this area is $72,573, the second highest of any 27-minute area in the analysis. The Arlington Costco has a 27-minute drive time population of 1,824,545 and a median household income of $47,424. This median household income was the second lowest of any Costco store in the case

study. Costco's sixth store in this market, the Lewisville location, has the second highest 27-minute drive time population at 2,440,459. Costco's Duncanville location, the seventh to open in the market, has a trade area population of 1,741,211 and a median household income of $47,047. This income is the second lowest of any store in the market. The average household size for this 27-minute drive time is 2.84, the second highest of any trade area. The Rockwall location had the lowest 27-minute drive time population at $977,897. The median household income for this trade area is $56,343 and the average household size is 2.88, the highest in the market. Costco's ninth North Texas store, the Frisco location, has a trade area population of 1,542,064 and a median household income of $79,299, the highest of any trade area by a considerable amount.

Discussion

This thesis has focused on three questions that relate to the composition of a major retail store network, specifically a wholesale retailer network. This final section briefly summarizes the results related to each research question and explains conclusions that may be subsequently drawn from each. These conclusions offer insight into how location, demographics, and other variables affect the decision making process of a major retailer, and shed light on the overall progression that Costco's store network has undergone since its inception in 1978. Although these conclusions have been drawn specifically from the context of Costco Wholesale Corporation, the implications of this research can contribute to an understanding of the process with which a major retail store network approaches maturity.

Store network

The first research question asks - what was the general expansion pattern and sequence of Costco's expansion? This question was approached broadly but yielded both general and specific results. As explained earlier, Costco's expansion was somewhat unconventional in that they decided to open their second store in Phoenix, Arizona, following their first store opening in San Diego. What makes this unusual, and in Costco's case, impressive, was their willingness to expand their network coverage almost immediately. This is especially interesting from a geographical standpoint, because operating multiple stores over large distances, especially in the beginning, is inherently more difficult than approaching expansion the way Wal-Mart did by expanding outward over short distances.

What is also interesting about Costco's expansion is how they decided to locate stores in Florida, and New York, beginning in the mid 1980's, but opted not to enter Midwestern major markets like Chicago until the late 1990's. This is quite a bit of time to avoid one of the largest markets in the country, and still something that this thesis was not able to pinpoint from a reasoning standpoint, although it was never a major focus. It appears that Costco has avoided the Midwest for two major reasons: 1. The median household income levels, and overall demographics of the region are generally a bit different than Costco's target market. 2. Wal-Mart and Sam's Club beginnings in Arkansas have enabled them to establish a high level of saturation in this region. The

presence of Wal-Mart and Sam's Club in the Midwest has likely affected Costco's willingness to fully penetrate the market, however, in recent years, store openings in Nebraska, Indiana, and Ohio are occurring at the highest rate historically for the warehouse retailer, indicating a desire to begin saturating this region.

In terms of overall expansion patterns, it appears that Costco's would not focus their efforts in most California and Pacific Northwest. The majority of Costco's store network is located in these two areas and while population in the Seattle and Portland areas continues to rise, network expansion seems to no longer be focused on this region. Northeastern markets like New York and Philadelphia also appear to be approaching maturity, while Boston appears to be a market where Costco could continue to expand, albeit it at a moderate level. Based on the expansion patterns and analysis performed in this thesis, the Midwest, South (mostly Texas and Florida), and international markets (which weren't focused on in this thesis), are areas where Costco could potentially expand their networks considerably.

From a clustering perspective, it is clear that Costco's markets are heavily clustered in conjunction with high population densities within cities. What Costco does is only locate stores in areas with at least 150,000 people located within a 20-30 minute drive time. Usually, the number of people within this drive time is significantly higher, often approaching and even exceeding 1,000,000. Costco's business model simply cannot be supported without a high capture rate, something that is not the case for other, smaller retailers. The other interesting finding from this thesis regarding capture

was that Costco's network in most markets is in some ways supported by their initial market store, meaning that subsequent stores are located in every direction from the first store. The results would indicate that this is intentional, to some degree. Costco's expansion within the United States has also been almost entirely focused on suburban areas, with only a very low percentage of stores actually located within the central business districts. Costco's business model simply requires large amounts of space for stores to function optimally. According to independent research conducted at the Costco headquarters in Issaquah, Washington in May of 2014, almost all greenfield operations require large, flat building lots of roughly 14-16 acres. The goal with almost every new Costco is to construct in excess of 700 parking spots and have additional facilities like gas and automotive services. This type of construction simply doesn't lend itself to constrictive, often high priced commercial real estate spaces inside major cities. Furthermore, Costco's dedication to low-cost, no frills operations means they are usually unwilling to pay high prices for real estate, often resulting in store locations chosen for low construction and property acquisition costs that do not exactly merge well with the surrounding business areas.

The second research question asks - how is geography important to Costco's network of distribution centers and what role does this network serve for Costco's current and future warehouse network? This was approached in the same way as the first, beginning with a general overview of Costco's distribution network. As stated before, Costco has 12 distribution centers located across the United States. Most of these depots are located in the West and South census regions. What is obvious when

looking at distribution center and store-opening dates is that Costco recognized the necessity of using depots to support significant store expansion in terms of new store openings. As a result, depots opened following significant regional expansion, and acted as support for future openings. When looking at the current arrangement of distribution centers throughout the United States, it is clear that Costco has used this network to support significant store clusters, and often miniature store networks within the overall network. For example the distribution center in South Florida is essential for supporting a significantly sized miniature store network in the state. The geographic peninsula that is Florida means that transportation to stores within the state has to come in and go out on basically the same path. This issue is exacerbated by the large concentration of stores in the extreme southern portion of the state. Essentially, a distribution center in Florida is a necessity.

Other distribution centers that clearly are purposed to support large store networks are those in southern and northern California, the Seattle metro area, New Jersey, and Monrovia, Maryland. The sheer density of Costco's store network in the New York-New Jersey-Washington DC region are the reason why two distribution centers are needed only about 190 miles from each other. This proximity of distribution centers is by far the closest of any two within the 12 depot network. Other distribution centers are unique are those in Dallas-Fort Worth and Salt Lake City. Each of these two distribution centers supports significantly less store than the others within the network. This perhaps could indicate Costco's future expansion plans for these areas. It is obvious that store expansion will continue to occur in North Texas based on economic

and population trends, but the Salt Lake City distribution center may be positioned for a different purpose. The generally tougher driving conditions, higher altitudes, and population scarcity all seem like reasonable reasons for locating a distribution center in Salt Lake City. Time will tell if Costco will ultimately be willing to adapt their business model and locate stores in more rural areas, once their current store network becomes fully saturated. If this occurs, the Salt Lake City depot could support additional expansion in this form, and likely would be followed by additional depots opening somewhere in the Midwest, where currently, there is only one, in Northern Illinois.

The distribution center network grew considerably in the early to late 90's when Costco store openings were occurring at a rapid rate. Today, these depots are the anchors for Costco stores and enable the company to move massive amounts of product quickly and efficiently. Obtaining information on these distribution centers was not easy, as they remain somewhat of a mystery to the average retail geographer. Luckily, independent research conducted for this thesis produced ample information on Costco's depot network that could not have been obtained any way else.

In terms of clustering and analysis done using the Bivariate K methodology, Costco's distribution network produced similar results to that of the store network analysis. Costco does not locate distribution centers in remote areas, therefore the initial points layer was located close enough to existing store clusters that the results generated in R showed high levels of initial clustering. One of the exceptions to this was the distribution center by the Texas/Mexico border that does not have any stores

located close by. This produced results that were a bit skewed, however it was not something that went unnoticed. Overall, the relationship between distribution centers and stores is similar to the relationship within only stores.

Overall, the North Texas market has a considerable amount of room to grow when assessing the baseline numbers for adequate market support in other areas of the country. 27-minute drive time populations of 200,000 or more can adequately support most Costco stores throughout various regions of the country. In North Texas, almost every store included in this study had a 27-minute drive time population of 1,000,000 or more. Granted, a considerable portion of this population is overlap, however, the analysis would support the notion that Costco can and will continue to expand their store network in this region. What is also interesting for Costco from an expansion perspective is how much available, low-cost land there is available in North Texas. It seems that this region is bound for large expansion efforts within the coming decade.

It is important to note when analyzing this store region's network that the first Costco location to open in North Texas occurred only 15 years ago. For such a high-population area, 10 stores in 15 years is a fairly rapid rate of expansion, even for Costco standards. Yet, given the fact other markets with fewer populations have more than 10 stores, along with the high level of population growth in the metro area, it seems likely that the North Texas market will continue to grow. In contrast, other retailers in this market like Wal-Mart have all but ceased expansion efforts with supercenter locations and shifted their focus to neighborhood market locations. Independent research has

found that Wal-Mart plans to open 18 neighborhood markets in Dallas-Fort Worth by the end of 2016 (Testa 2014). While Costco continues to grow and expand in North Texas, they are not alone.

Conclusion

From a research perspective, Costco remains one of the most understudied retailers in the industry. This thesis provides a solid framework for future, more detailed studies of Costco's retail site location strategies, or other retail site location strategies of other retailers similar to Costco. It would be interesting, and beneficial, if more point pattern analyses were done on Costco's historical and future expansion, particularly their future plans. Although the decision makers within Costco's real estate department say there is no definitive methodology for their site selection process, perhaps retail geographers could discover, and quantify, otherwise. An international study on Costco Wholesale would likely yield the most detailed results, as their international expansion plans account for roughly two thirds of their overall expansion. It would also be interesting and meaningful for further research to be conducted on the demographic and psychographic characteristics of Costco's customer base. Such research could utilize a regional approach to uncover how marketing and branding strategies differ among various geographies. Part of this research could assess the decision making process of Costco's customers, and how their psychology aligns with Costco's business model. The geographical component would be the differences over space. Qualitative surveys could prove useful in such an undertaking.

Furthermore, research on the commodity chain and inventory management of Costco would provide an important contribution to the retail geography literature. It is obvious that Costco is responsible for the transport of massive amount of products and other goods, but the geography of how this process occurs remains almost entirely unknown to the public. Still, the reason Costco does not receive the attention they perhaps deserve stems from their desire to remain low maintenance, no frills, and purely functional. Costco is not concerned with being at the forefront of research on the industry because their customer base is as strong as it has ever been, which is what is most important.

In terms of this thesis, the findings could prove useful to current retailers, those studying retail geography, and even Costco themselves. The results generated by this thesis not only highlight the importance of examining the warehouse club industry, but provide a solid methodological model for approaching further studies in retail geography as a whole. This thesis proves that warehouse style retailers do in fact strategically plan and execute a calculated geographical approach to network building. From here, further studies on both Costco, and other retailers can be conducted using this thesis as a model. Ultimately, this thesis benefits those involved in retail geography in both the academic and professional context.

It was my intention from the beginning of this research to eventually distribute the results to Costco's real estate department and hope for at least a favorable response. It seems reasonable to believe that this thesis contains a reasonable amount of useful

information that Costco could utilize for future expansion plans, particularly the Bivariate K analysis on major market expansion. Costco would benefit, at the very least, in my opinion, from obtaining the results of this thesis and using them when they deemed necessary.

For current retail geographers, this thesis provides an easy to follow, yet thorough Bivariate K methodology for quantifying the expansion of a major retail chain. It would be interesting to see additional studies that use this approach conducted on other major retailers. Even geographers who are not focusing their efforts on the retail sector could benefit from utilizing such an approach, as it can be applied to almost any category of point pattern. The findings in this thesis could have been even more useful had Canadian, and international locations been included. It would have been quite interesting to see how clustering, and market density differs in certain countries, and possibly attribute those differences to other geographic or socio-economic factors. However, such a detailed study was out of the scope for this thesis. This thesis could also have benefitted from more demographic and psychographic data at the regional level in other census regions besides North Texas. Cross border implications could have also provided an interesting examination in terms of the flow of product from the United States to Mexico. The Laredo distribution center in particular could have been examined in more detail in order to highlight economic implications of locating distribution centers in one country and having them serve stores in another. Nevertheless, the results generated from this study have proven to be meaningful.

Costco has come a long way since their first location in a converted airplane hanger in San Diego. They have risen to become the undisputed worldwide leader in the warehouse retail market, and show no signs of slowing down. Their expansion efforts have followed a somewhat unconventional path with components of hierarchical and contagious diffusion. The results of this thesis quantify how Costco's store and distribution network relate over space, and prove that the retailer not only clusters their stores in major markets, but also does so systematically and strategically over time. The findings also support the growing notion that Costco will focus its future expansion in the Midwest, an area where they clearly have not established a presence the same way they have in other regions. Costco remains a difficult retailer to understand because of their unique positioning within the retail sector. This thesis will hopefully provide a framework for future applied geographical research on Costco Wholesale, and bring attention to the current state of the retail giant.

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