Enhancing Consumer Access to Warehouse Clubs Amidst the Retail Food Access Divide: Assessing the Impact of On-Premises and E-commerce Services

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Abstract

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This study explores consumer access to warehouse clubs in regions characterized by a pronounced retail food access divide, specifically where there is a high ratio of convenience stores to supermarkets and grocery stores. Despite the cost-efficiency and broad product offerings of warehouse clubs, their limited store network and membership fees raise questions about their capacity to attract consumers in areas with substantial gaps in food access. This research focuses on three key aspects: the direct effect of the food access divide on consumer visits to warehouse clubs, the influence of on-premises services on this relationship, and the influence of e-commerce services on this relationship. The results reveal that a high ratio of convenience stores to supermarkets and grocery stores significantly reduces consumer foot traffic to warehouse clubs. However, on-premises services, especially healthcare, not only boost consumer visits to warehouse clubs but also mitigate the negative impact of limited access to healthy food options on these visits. Automotive services also contribute positively, albeit to a lesser extent. E-commerce services have a nuanced role: while both home delivery and omni-pickup options decrease foot traffic directly, delivery services moderate the negative impacts of a high retail food access divide by sustaining consumer foot traffic. Conversely, omni-pickup services exacerbate the negative effects by further reducing in-person visits. This research enriches the literature on the retail food access divide, spatial resilience of warehouse clubs, and retailers' channel capabilities. By integrating on-premises and e-commerce services, warehouse clubs can enhance retail service equity across diverse regions, particularly improving consumer accessibility in areas with significant retail food disparities.

Key words: retail food access divide, warehouse clubs, on-premises services, e-commerce services

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1. Introduction

The concept of "food deserts"—areas where a lack of nearby grocery stores significantly hampers access to healthy and affordable food—poses a critical challenge to food security and health outcomes, particularly for lower-income populations (Jang & Kim, 2018; Bitler et al., 2010). These areas are plagued by geographic, economic, and informational barriers, such as a dominance of convenience stores, elevated food prices, insufficient public transportation, and a deficiency in nutritional education, all of which contribute to poor diets and heightened health disparities in low-income and minority communities (Bader et al., 2010; Bower et al., 2014; Guy & David, 2004). According to USDA data, approximately 34 million people in the United States experienced food insecurity in 2021, with around 40.5 million Americans living in food deserts (Rachel Isaacs, 2023). Studies have shown that higher access to grocery stores and lower access to fast food outlets are associated with healthier diets, including higher consumption of fresh fruits and vegetables and lower consumption of fast food and soda (Althoff et al., 2022). Conversely, living in a food desert can lead to increased rates of chronic illness such as diabetes, obesity, and cardiovascular diseases (Rachel Isaacs, 2023). Recent studies suggest that modifications in the retail landscape, including the expansion of supercenters and warehouse clubs, can alleviate these barriers and enhance healthy food access (Howlett et al., 2015; Sharma et al., 2024; Jang & Kim, 2018).

As a distinctive retail format in the U.S., warehouse clubs (WCs) such as Costco, Sam's Club, and BJ's Wholesale Club have achieved substantial growth. Over the last two decades, WCs have seen an average annual sales growth of 3.9%, emerging as significant players in the retail sector. In 2018, WC retailers generated approximately $250 billion in annual sales and served around 40% of U.S. households. Among them, Costco Wholesale and Sam's Club collectively holding over 90% of the market share, with Costco standing out not only as the largest WC but also as the third-largest retailer in the U.S. by sales as of 2021 (Lim et al., 2020). Although WCs can offer affordable and diverse food options, *it's crucial to assess whether their business model effectively reaches and serves consumers in areas with significant disparities in retail food access.*

Operating on a membership-only basis, WCs charge an annual fee that allows customers to access a wide array of discounted merchandise. These clubs strive for high sales volumes and rapid inventory turnover, enabling them to secure lower prices from suppliers. The resultant savings are passed on to their members, who often buy in bulk, appealing to both individual consumers and small business owners. Additionally, WCs maintain low operational costs by offering a limited selection of products in straightforward, no-frills store settings with a sparse network and employing cost-saving strategies such as displaying goods on full pallets and using simple shelf price cards (Bhatnagar & Ratchford, 2004; Lim et al., 2020). This strategic approach of low prices and bulk purchasing options has fostered a loyal customer base and consistently high sales volumes (Bhatnagar & Ratchford, 2004; Courtemanche & Carden, 2013).

On the other hand, the yearly membership fees and the large purchase quantities at WCs, coupled with their parse physical network, may act as barriers to serving customers in poorer socioeconomic areas, such as food deserts.

This study examines whether WC business models is accessible to consumers living in areas with significant disparities in retail food access, focusing on the impact of on-premises and e-commerce services on their spatial resilience. Our research is structured around three critical questions: First, we evaluate the direct impact of food access disparities on consumer visits to WCs, aiming to delineate how these disparities shape consumer behavior. Second, we assess the capacity of on-premises services—such as healthcare and automotive facilities within WCs—to mitigate the adverse effects of food access challenges on consumer visits. Lastly, we explore how e-commerce options, including home delivery and omni-pickup services, can affect consumer access to WCs and potentially mitigate the broader challenges associated with the food access divide.

Previous research on the retail food access divide has focused on its causes, effects, and potential solutions. For instance, Bader (2010) show adjusting for factors like vehicle ownership and public transit affects spatial access to food, revealing that such adjustments can either increase or decrease disparities in supermarket access across different neighborhoods. Guy & David (2004) reveal that local shops in food deserts with limited access to supermarkets struggle with product availability and pricing, although inner city shops are somewhat more competitive than those in outer areas. Howlett et al. (2015) underscore the critical role of grocery store availability and accessibility in acquiring nutritious food, particularly noting the challenges faced in food deserts where healthy options are both scarce and costly. Jang & Kim (2018) investigate how the intersectionality of race/ethnicity and poverty affects geographic access to various types of food stores, such as supermarkets, grocery stores, and convenience stores. Additionally, Sharma et al. (2024) examines how the percentage of part-time to full-time employee equivalents (FTEs) dedicated to SNAP outreach, which is the primary domestic hunger relief initiative, impacts the program's effectiveness.

Given the challenges posed by the retail food access divide, where the ratio of convenience stores to supermarkets and grocery stores is notably high, the WC business model may not be attractive and accessible to these affected consumers, potentially impacting the clubs' ability to maintain spatial resilience within such environments. Notably, the business model of warehouse clubs and convenience stores represent distinct retail formats. From retailer spatial resilience perspective, there is existing an unresolved debate regarding whether inter-format competition exceeds intra-format competition (Bonfrer et al., 2022). González-Benito et al. (2005) reveal intense competition within similar store formats and significant effects of spatial accessibility on demand among competitors. Ellickson et al. (2020) find significant competition among various grocery formats like supercenters, clubs, and traditional grocers, challenging the notion that these formats serve distinct markets. Bonfrer et al. (2022) emphasize the disruptive influence of emerging

retail formats and inter-format competition on market dynamics. Lim et al. (2020) shows that although households spend significantly more at Costco compared to non-warehouse club stores, this spending advantage diminishes beyond a 21-mile radius. Recent research by Pan et al. (2024) report that while e-commerce tends to decrease foot traffic at warehouse clubs, the presence of a diverse range of nearby general merchandise retailers and grocery stores can offset this effect, suggesting a dynamic of coopetition among retailers.

Consumer accessibility to WCs in regions with significant retail food access divide is potentially shaped by WCs' channel capabilities, which are the attributes of a channel that enable consumers to fulfill their shopping goals (Avery et al., 2012). As consumer preferences evolve, retailers are progressively integrating multiple sales channels to boost customer engagement (Tang et al., 2021). Offline channels deliver sensory-rich experiences and immediate gratification, while online channels provide convenience through extensive product assortments (Wang & Goldfarb, 2017). The integration of on-premises services such as pharmacies and gas stations within WCs enhances their in-store capabilities, thereby fostering customer loyalty through a comprehensive one-stop shopping experience (Fox & Sethuraman, 2010). Concurrently, the enhancement of WCs' online capabilities through e-commerce services, efficient delivery systems, and partnerships with gig services further elevates consumer satisfaction and loyalty (Nguyen et al., 2019). The strategy of 'Buy Online, Pick Up in Club' (BOPIC) combines the convenience of online shopping with the benefits of in-store pickup, effectively increasing both foot traffic and sales (Gallino & Moreno, 2012).

This study reveals that a high ratio of convenience stores to grocers and supermarkets (CS_SOGS) significantly reduces visits to warehouse clubs (WCs), as consumers often prefer the immediate accessibility of nearby convenience stores. However, introducing on-premises services like healthcare significantly boosts foot traffic, particularly in areas underserved by supermarkets, while automotive services provide situational value. E-commerce options, notably home delivery services, while reducing foot traffic to warehouse clubs, effectively mitigate the negative impacts of a high convenience store to supermarket and grocery store (CS_SOGS) ratio by providing a level of convenience comparable to local stores. These insights emphasize the need for WCs to tailor their on-premises and e-commerce offerings to the local food environment, maintain consumer engagement and enhance accessibility.

Theoretically, our research enriches the existing business literature on the retail food access divide (i.e., Bader et al., 2010; Guy & David, 2004; Howlett et al., 2015; Jang & Kim, 2018; Sharma et al., 2024), spatial resilience of warehouse clubs (i.e., Ellickson et al., 2020; González-Benito et al., 2005; Lim et al., 2020; Pan et al. 2024), and retailers' channel capabilities (Avery et al., 2012). The local food environment significantly influences consumer visits to warehouse clubs, underlining the impact of geographical proximity on consumer behaviors in areas with notable retail food access divides. While prior studies

suggest that expanding food retail options, such as introducing large grocery stores in areas currently identified as food deserts, could substantially alleviate these disparities (Clarke et al., 2002; Hollis-Hansen et al., 2019; Wrigley et al., 2002; Jang & Kim, 2018), the effectiveness of these interventions may hinge on retailers' channel capabilities, including their on-premise and e-commerce services. By integrating both on-premises and e-commerce services, warehouse clubs can enhance customer accessibility by providing a competitive multi-channel experience (Jones et al., 2021).

In practice, we emphasize the critical need for collaboration between retailers and policymakers to create a more inclusive retail environment. While retailers frequently assess the local food landscape for optimal site selection, disparities in retail food access continue to exist. We suggest using the ratio of convenience stores to supermarkets as a strategic indicator for evaluating the retail food access environment. Integrating on-premises services, such as healthcare—which increases foot traffic—and e-commerce services like home delivery—which broadens customer reach—are essential strategies to meet the diverse needs of consumers. To prevent the emergence of retail food service deserts, policymakers should support retailers in incorporating both advanced physical and digital services into their operational frameworks through regulatory and financial measures. Ultimately, our research aims to inform policy discussions and drive interventions that enhance food access for populations residing in food deserts.

2. Research Context

2.1. Warehouse club industry

As a distinctive retail format in the U.S., WCs such as Costco, Sam's Club, and BJ's have achieved substantial growth. Founded in 1983 by Jim Sinegal and Jeff Brotman, Costco has emerged as a global retail leader through its membership-only warehouse model (Alonso, 2023; Reuter, 2023). Selling and maintaining consumer and business memberships is the core managerial strategy for Costco (Costco Wholesale Corporation, 2021). In contrast, Sam's Club, a Walmart subsidiary also established in 1983, has evolved with a strong emphasis on e-commerce and digital platforms to enhance customer value and competitiveness (Al Mamun et al., 2017; Zhang, 2023). BJ's, founded in 1984, differentiates itself with a broader product selection and a robust omnichannel approach, integrating digital tools to remain relevant in the competitive WC industry (Sampson & Tiger, 1994; Bauner & Wang, 2019).

The WC business model has demonstrated significant success. According to Statista, WCs have exhibited the fastest growth rate among retail categories. In 2023, Costco led in net sales, generating $237.7 billion, which was more than double that of its nearest competitor, Sam's Club, at $84.4 billion, and twelve times that of BJ's, which posted $19.6 billion (Ozbun, 2024). WCs typically feature large self-service outlets that offer a wide range of product categories; however, they provide a limited selection of brands within each category and sell exclusively to members. Several factors shape the consumer experience at WCs, including the limited number of locations, the annual membership fee, everyday low pricing (EDLP) strategies, and bulk packaging sizes.

These WC store chains, such as Costco, Sam's Club, and BJ's, typically have fewer store locations compared to traditional supermarkets, resulting in customers having to travel longer distances to shop at these stores. For example, at the end of the 2024 fiscal year, Costco operated approximately 580 stores in the U.S. (Costco, 2024), whereas its main supercenter competitor, Walmart, operated over 4,600 store outlets according to the Walmart website (Walmart, 2024). Research shows that the average travel distance to a warehouse club can be more than 15 miles, compared to less than 5 miles for traditional grocery stores. This increased travel distance often means that customers plan their shopping trips more meticulously, purchasing larger quantities of goods to offset the effort and cost of traveling (Ailawadi et al., 2018; Singh et al., 2006; Ailawadi & Neslin, 1998).

The concept of sunk costs significantly influences consumer behavior in WCs. Due to their sparse store network, customers who travel greater distances often perceive the travel as an investment. Membership fees, which range from $50 to $120 annually depending on the WC chain and membership type, represent another form of sunk costs. For instance, Costco charges the highest membership fee at $120 per year (Ozbun, 2024). The combination of long travel distances, membership fees, and the typically lower

prices offered by WC stores incentivizes customers to rationalize the frequency of their visits and the size of their purchase baskets to optimize value (Ailawadi et al., 2018). This strategic consumer behavior underscores that the impact of shopping at club stores on the total quantity of packaged food purchases made by households represents a unique empirical question (Ailawadi et al., 2018).

WCs adopt an Everyday Low Pricing (EDLP) strategy to attract price-sensitive consumers by consistently offering lower prices compared to other retail formats. Unlike the high-low (HILO) pricing model that relies on intermittent sales and promotions, the EDLP strategy is particularly effective due to the inelastic demand for grocery items, where consumers exhibit little sensitivity to minor price variations in their overall shopping basket (Fox et al., 2004). This price stability not only builds consumer trust but also promotes transparency, both of which are essential for fostering customer loyalty. Research indicates that Costco's prices are lower than those at traditional supermarkets (Ellickson, 2020). The consistent value offered through the EDLP model significantly enhances operational efficiencies and bolsters customer loyalty.

The EDLP strategy by WCs is complemented by a bulk purchasing model that significantly increases average transaction size, thereby enhancing customer loyalty (Ailawadi et al., 2018). These clubs typically offer large pack sizes and a limited assortment of goods, which reduces stocking and handling expenses, enabling them to offer lower per-unit prices than traditional retailers (Hartmann & Nair, 2010). The combination of large pack sizes and low unit prices encourages consumer stockpiling behaviors. Notably, the lower per-unit prices, akin to the effects of promotions, tend to boost household inventories, which not only mitigate the risk of stock-outs but also encourage higher usage rates (Ailawadi & Neslin, 1998). This leads to increased consumption and disproportionately higher spending at warehouse clubs compared to other retail formats (Ailawadi et al., 2018).

2.2. Retail food access divide

The term "food desert" refers to areas, particularly in urban settings, where finding stores that offer healthy and affordable food is challenging (Jang & Kim, 2018). According to Bitler et al. (2010), it refers to geographic areas, particularly urban settings, where residents, primarily lower-income populations, have limited access to affordable and nutritious food due to the absence of nearby grocery stores (Bitler et al., 2010). The distribution of food stores differs by neighborhood and store type, leading to the emergence of food deserts predominantly in economically disadvantaged areas (Bader et al., 2010).

People living in these areas face three main problems: geographic, economic, and informational, barriers. Geographically, many low-income and minority neighborhoods lack nearby stores that sell healthy food, with fewer supermarkets and more convenience stores that offer limited healthy options. This results in poor access to chain supermarkets but greater access to convenience stores, which can lead to less healthy

diets and higher levels of obesity (Jang & Kim, 2018). Additionally, research indicates that a disparity in access to healthy and affordable food is often found in racially segregated areas. (Bower et al., 2014).

Economically, food prices are systematically higher in high-poverty neighborhoods, with healthy options priced significantly higher than less nutritious alternatives, further exacerbating food access issues (Powell et al., 2007; Jang & Kim, 2018). Lower-income neighborhoods have fewer chain supermarkets and more convenience stores, which offer less healthy food options at higher prices, as these areas do not generate enough revenue to attract large supermarkets that operate with economies of scale and scope. Moreover, insufficient competition among food retailers in these areas allows a few firms to dominate the market, leading to higher prices and limited availability of healthy food. Additionally, limited access to transportation means residents in low-income neighborhoods cannot easily travel to distant supermarkets that offer healthier and more affordable food options. These barriers create a cycle where low-income communities face compounded challenges in accessing affordable, healthy food, leading to poorer health outcomes and perpetuating socioeconomic inequalities (Jang & Kim, 2018).

Informational barriers also play a significant role. The relationship between educational attainment and access to healthy foods complicates food accessibility issues. Communities with higher proportions of individuals without high school diplomas often face limited access to nutritious food options (Morton & Blanchard, 2007). This issue is compounded by a lack of education and awareness about healthy eating (Jang & Kim, 2018), further restricting these communities' ability to access healthy foods. For example, residents in food deserts often consume fewer fruits and vegetables (Guy & David, 2004). Cultural and social factors also influence food choices and access, interacting in complex ways with economic and geographic barriers (Jang & Kim, 2018).

People in food deserts encounter significant geographic, economic, and informational barriers, further compounded by policy and infrastructure shortcomings such as inadequate public transportation. These combined factors severely limit access to healthy food options, either due to the distance to stores or the cost of such options. These pronounced disparities in food access adversely affect the diets and health outcomes of low-income and minority communities, leading to a reduced quality of life and increased healthcare costs (Bitler et al., 2010).

Disparities in retail food access lead to limited availability of healthy food options, exacerbating nutritional inequalities and deepening socio-economic and health disparities in affected communities (Howlett et al., 2015). This study explores whether the WC business model can effectively attract more customer visits, thus alleviating food access disparities, especially in areas where convenience stores predominate over supermarkets and grocery stores. We investigate the impact of channel capabilities, including on-premises and e-commerce services, in addressing these disparities. Specifically, we evaluate the effectiveness of healthcare and automotive services as on-premises options, and home delivery and

omni-pickup as e-commerce solutions, in mitigating these challenges. The goal is to determine if strategic implementation of these services in WCs can enhance customer accessibility, thereby helping to narrow the retail food access divide.

3. Literature Review

3.1. Retail food access divide

Research in business studies has focused on various aspects of the retail food access divide. These include local shops' product availability and pricing issues in areas with limited access to supermarkets; the effects of individual or neighborhood conditions on the retail food access divide (Bader et al., 2010); the influence of the food environment on obesity rates among very young, low-income consumers (Howlett et al., 2015), an intersectional analysis of sociodemographic factors such as race/ethnicity and poverty in understanding food store access (Jang and Kim, 2018); the impact of part-time workers on the outreach effectiveness of the Supplemental Nutrition Assistance Program (SNAP) at food banks (Sharma et al., 2024).

Bader et al. (2010) explore how factors, such as vehicle ownership, public transit access, and pedestrian barriers such as crime and poor traffic conditions, influence food access disparities in New York City. The findings indicate that when adjustments are made for vehicle ownership and crime rates, disparities in supermarket access based on neighborhood race/ethnicity and income levels are accentuated. Conversely, adjustments for public transit access and traffic safety appear to reduce these disparities. Moreover, the inclusion of fruit and vegetable markets along with farmers' markets in the analysis revealed an increased density of healthy food options, particularly in areas predominantly inhabited by Hispanic, Asian, and foreign-born populations, as well as in economically disadvantaged neighborhoods.

Guy & David (2004) investigated the phenomenon of food deserts through a case study of Cardiff, a major British city. It critically analyzed the prevalent stereotype of 'food deserts', highlighting the significant value residents place on convenient access to multiple supermarkets. The study identifies potential 'food deserts' in Cardiff and investigates the availability and pricing of 'healthy food' in four specific city areas (two inner city and two outer city) where access to large supermarkets is notably deficient. The findings indicate that local shops in these areas generally fall short of competing with large supermarkets in terms of product availability and pricing, though shops in the inner-city areas show slightly more competitiveness than those in the outer areas.

Howlett et al. (2015) have examined the relationship between the retail food environment and childhood obesity rates among low-income, preschool-aged children. They found that a higher number of convenience stores in an area is associated with increased obesity rates, while an increase in grocery stores, supercenters, and club stores correlates with decreased obesity rates. Additionally, the study suggests that changes in the retail environment, particularly the introduction of additional supercenters and club stores, can mediate the relationship between participation in the Supplemental Nutrition Assistance Program (SNAP) and childhood obesity rates.

Jang & Kim (2018) investigated the combined influence of race/ethnicity and poverty on the accessibility of 2,635 food stores—categorized into supermarkets, grocery stores, and convenience stores—within the three-county Detroit metropolitan area (DMA). The authors analyzed spatial relationships among different types of food stores and their correlation with sociodemographic diversity within the DMA. They found that food stores tend to cluster in suburban and rural peripheries rather than in inner-city areas. Access to these food stores varies significantly in impoverished neighborhoods, influenced by the predominant racial/ethnic makeup of these areas. The findings of this research are intended to guide policymakers in developing targeted food policy interventions and in attracting new supermarkets and grocery stores to urban areas of the DMA.

Sharma et al. (2024) explored the effect of employing a part-time workforce dedicated to the Supplemental Nutrition Assistance Program (SNAP) outreach efforts at food banks across the United States. As the primary domestic hunger relief initiative, SNAP supports over 42 million Americans, with food banks playing a pivotal role in promoting and facilitating SNAP enrollment. Their study leverages operational data from food banks within the Feeding America network and demographic data from U.S. Census to analyze their service areas. They discovered that a higher ratio of part-time to full-time equivalents (FTEs) in these roles enhances the effectiveness of SNAP outreach, particularly where operational and contextual dynamics benefit from a flexible staffing model.

Building on previous research on the retail food access divide (i.e., Bader et al., 2010; Guy & David, 2004; Howlett et al., 2015; Jang & Kim, 2018; Sharma et al., 2024), this study explores whether the WC business model can effectively increase customer foot traffic in areas with significant retail food access disparities. Moreover, we analyze the impact of on-premises and e-commerce services on foot traffic to offer insights into how WCs can optimize their strategies for more equitable food accessibility.

Table 1: Example Literature on Retail Food Access Divide

	Author	Journal	Method	Research focus	Sample Variable of Interests	Sample Outcome Variables
1	Bader et al. (2010)	Economic Geography	Empirical	Food environments	Vehicle ownership Public transit access Impediments to pedestrian travel	Disparities in food environments
2	Guy & David (2004)	International Journal of Consumer Studies	Empirical	Food access	Prevalent stereotype of food desert	Food availability and price
3	Howlett et al. (2015)	Journal of Business Ethics	Empirical	Food environments	Retail food environment	Obesity rate
4	Jang & Kim (2018)	Journal of Public Policy & Marketing	Empirical	Food access	Race/ethnicity Poverty	Accessibility of food stores

	Author	Journal	Method	Research focus	Sample Variable of Interests	Sample Outcome Variables
5	Sharma et al. (2024)	Journal of Operations Management	Empirical	Food banks	Type of employees (part-time vs. full-time)	Effectiveness of food banks

3.2. Warehouse club spatial resilience

This study is relevant to the literature on retailer spatial resilience. Retailer spatial resilience is crucial for understanding market reach and operational profitability. Reilly's Law of Retail Gravitation demonstrates how larger cities draw disproportionate trade from surrounding areas, guiding the strategic placement of retail outlets to optimize customer inflow from smaller towns (Reilly, 1931). Similarly, Huff's Model emphasizes the significance of customer travel patterns and the attractiveness of locations in securing sufficient customer traffic (Huff, 1964). Further building on these concepts, Converse's New Laws of Retail Gravitation explore the dynamics of retail trade flows between cities, underscoring the importance of proximity to larger urban centers in retail strategies (Converse, 1949). These frameworks are indispensable for retailers aiming to effectively delineate their market areas to attract an expansive customer base, and thereby augment sales (Babin, 1991; Huff & Rust, 1984).

Spatial resilience in retail refers to the capacity of a retail network to maintain its functional integrity and competitive edge in the face of changes in its spatial configuration and market conditions (González-Benito et al., 2005). According to research by González-Benito et al. (2005), spatial resilience in retail is measured through models of spatial interaction that assess the competitive effects of store formats and locations. The study uses a combination of traditional spatial interaction models and extended models that incorporate the asymmetric competitive effects of different store formats. The results indicate that competition is more intense within store formats than between them, with spatial accessibility significantly affecting demand for competitors (González-Benito et al., 2005).

Ellickson et al. (2020) used another approach. They analyzed spatial resilience by developing a spatially aggregated discrete-choice models that capture the competitive dynamics between different grocery store formats, such as supercenters, clubs, and traditional grocers. They included demographic-driven heterogeneity and the spatial distribution of consumers to estimate how location and store format shape the competitive environment. Their results revealed substantial cross-format competition, indicating that supercenters, clubs, and traditional grocers significantly overlap in their customer base. This finding challenges the conventional wisdom that these formats operate in separate markets, demonstrating that location and consumer demographics are crucial in shaping retail competition (Ellickson et al., 2020).

Research on the spatial resilience of warehouse clubs is still emerging. Lim et al. (2020) evaluated household shopping activities across multiple markets to measure the spatial resilience of warehouse clubs. The researchers used data from household shopping trips, aggregating vehicle mileage on a weekly basis

to compute the travel costs allocated to Costco and other stores. The study shows that the household share of expenditures at Costco stores is significantly higher compared to non-WC stores, even when accounting for travel costs. Specifically, the study found that Costco's household expenditure share exceeds that of non-WC stores by 61%, illustrating Costco's advantage in markets. However, this advantage diminishes with increasing distance from customers, disappearing beyond approximately 21 miles, which serves as a critical reference point for evaluating spatial competition and demand saturation (Lim et al., 2020).

Furthermore, Pan et al. (2024) explored the impact of retail agglomeration and e-commerce activities on consumer foot traffic at warehouse clubs. Their findings reveal that ecommerce activities, particularly those related to general merchandise (GM), significantly reduce foot traffic to WC stores. However, proximity to diverse retail agglomerations, such as those including supercenters and department stores, can enhance foot traffic to WCs. Conversely, certain narrow-range merchandise agglomerations, particularly those near grocery stores, also boost foot traffic. The study underscores the importance of strategic location choices for WCs to mitigate the adverse effects of ecommerce competition, and highlights the complex dynamics between physical retail clusters and online shopping behaviors.

Drawing on prior research (Ellickson et al., 2020; González-Benito et al., 2005; Lim et al., 2020; Pan et al. 2024), this study investigates the ability of WCs to maintain spatial resilience amidst retail food access disparities, especially in environments predominantly served by convenience stores rather than supermarkets and grocery outlets. We expect that the local food environment will impact consumer traffic to warehouse clubs, shaped by the availability of on-premise and e-commerce service capabilities.

Table 2: Example Literature on Retailer Spatial Resilience

	Author	Journal	Method	Research focus	Sample Variable of Interests	Sample Outcome Variables
1	González-Benito et al., (2005)	Journal of Retailing	Empirical	Asymmetric competition	Store formats	Store competition
2	Ellickson et al. (2020)	The RAND Journal of Economics	Analytical	Spatial competition	Store formats	Cross-format competition
3	Lim et al. (2020)	Production and Operations Management	Empirical	Shopping activity	Store network	Household expenditure
4	Pan et al. (2024)	International Journal of Physical Distribution & Logistics Management	Empirical	Spatial resilience	Ecommerce activity	Foot traffic

4. Hypothesis Development

4.1. The relationship between retail food access divide and consumer access to warehouse club

Consumer access to WCs is intricately tied to retailer spatial competition, influenced by variables such as retail format, store location, and consumer demographics. Strategic decisions regarding location are significantly shaped by the proximity to and competitive strength of rivals, which can lead to asymmetric effects—dominant retailers may deter less competitive ones from entering lucrative markets (Zhu & Singh, 2009). While traditional models of spatial competition associate market share with the attraction generated by marketing efforts and geographical coverage, recent research highlights the importance of inter-format competition, emphasizing intense rivalries among various store types, such as supercenters, warehouse clubs, and traditional grocers, all of which crucially shape market dynamics (González-Benito et al., 2005; Ellickson et al., 2020).

Recent studies, including Bonfrer et al. (2022), suggest that the introduction of new retail formats can disrupt established market dynamics, significantly altering consumer behavior and market performance. In this context, WCs face specific challenges in attracting consumer visits in areas marked by substantial retail food access disparities. Despite offering a broad range of products at EDLP and the appeal of bulk savings, the operational limitations of WCs, such as fewer locations, mandatory annual memberships, and large packaging sizes, may not appeal to consumers in locales where convenience stores outweigh supermarkets and grocery stores. In these areas, the proximity and convenience of nearby stores that do not require memberships and offer smaller, more manageable quantities of products may be more attractive.

This preference for convenience is significant in both urban and rural settings, where factors like travel distances and immediate product availability heavily influence store choice (Thatcher et al., 2016). In high-density urban environments, there is a clear mismatch between consumer needs and the traditional warehouse club model, which is better suited to suburban areas where consumers typically have access to larger vehicles and ample storage space (Fitch, 2004). Conversely, in rural areas, the scarcity of grocery stores and supermarkets makes the bulk purchasing options of warehouse clubs appealing; however, the longer distances involved may result in infrequent shopping trips (Miroslava Trembošová et al., 2023).

Overall, the WC business model appeals to a demographic that prioritizes cost savings on bulk purchases over the convenience of making smaller, more frequent purchases. In areas with a high level of retail food access disparity, the immediate availability of smaller local convenient stores and the lesser need for bulk buying starkly contrast with the WC model. Consequently, in regions with significant disparities in retail food access, consumer foot traffic to WCs is likely diminished (Handbury et al., 2015; MacNell, 2018).

Therefore, we propose the following hypothesis:

H1: High levels of retail food access disparity are negatively associated with consumer foot traffic to warehouse clubs.

4.2. The moderating role of warehouse clubs' on-premises and e-commerce service offerings

Consumer access to WCs in areas with a significant retail food access divide may be influenced by WCs' channel capabilities. Channel capabilities refer to the inherent characteristics of a channel that enable consumers to achieve their shopping goals (Avery et al., 2012). As consumer preferences continue to evolve, retailers are enhancing their engagement strategies by integrating multiple sales channels, including physical stores, online platforms, catalogs, and mobile applications. This multifaceted approach enriches customer interactions and experiences, allowing for a more comprehensive and effective engagement with their target audience (Tang et al., 2021; Wang & Goldfarb, 2017; Xu et al., 2017). This study investigates the role of channel capabilities of WCs amidst the retail food access divide, focusing on their on-premise and e-commerce services.

Notably, channels differ significantly in their impact on consumer behavior. Physical stores provide a tangible, sensory-rich shopping experience and act as billboards, enhancing local brand visibility and driving sales through brand awareness (Wang & Goldfarb, 2017). They offer immediate gratification and personalized service, fostering brand loyalty (Avery et al., 2012). In contrast, online channels offer unmatched convenience and accessibility, allowing consumers to shop anytime and anywhere, with a broad assortment of products and easy comparison tools (Tang et al., 2021). Mobile channels via smartphone and tablets facilitate casual browsing and impulse purchases, often replacing traditional PCs due to their portability (Xu et al., 2017).

Previous studies have explored the dynamics of channel capabilities within retail sectors. For example, Deleersnyder et al. (2002) demonstrated that the introduction of online channels, once feared to cannibalize traditional sales, instead augmented existing channels in sectors like the newspaper industry. Wal-Mart exemplifies the expansion of channel capabilities by integrating e-commerce with physical stores, leveraging the synergistic benefits of a multichannel strategy (Avery et al., 2012). Additionally, the advent of mobile channels has enriched customer experiences, offering convenience for transactions requiring immediate fulfillment or extensive information, which in turn enhances sales performance (Bang et al., 2013). Collectively, these strategies enhance retailer channel capabilities and have led to broader market coverage, increased cost efficiencies, and improved customer satisfaction (Avery et al., 2012; Bang et al., 2013; Deleersnyder et al., 2002).

On-premises services are vital for enhancing the channel capabilities of WCs. Bundling multiple services at a single location typically improves customer convenience and satisfaction. WCs integrate pharmacies, tire centers, and gas stations to provide a comprehensive shopping experience. For instance, having a pharmacy on-site allows shoppers to fill prescriptions while grocery shopping, saving time and streamlining errands (Krafft & Mantrala, 2010). Tire centers are lauded for their efficiency and streamlined online scheduling, enhancing the tire-purchasing process (Thimou, 2019). Additionally, on-site gas stations offer discounted fuel, attracting cost-conscious consumers and adding value to memberships (Fox & Sethuraman, 2010). This on-premises service bundling not only draws more customers by providing a one-stop shopping experience but also increases the perceived value of a club membership, potentially boosting customer loyalty and visit frequency.

Moreover, e-commerce services are crucial for enhancing the channel capabilities of WCs. These clubs offer various delivery options, including standard and express services. For standard delivery, WCs leverage robust logistics infrastructures to provide rapid and reliable service, meeting high consumer expectations set by giants like Amazon (Nguyen et al., 2019). The effectiveness of these services is supported by advanced warehouse operations and real-time tracking systems that keep customers informed about their order status (Gallino & Moreno, 2012). For express delivery, WCs increasingly partner with gig services like Instacart to offer on-demand delivery, expanding capabilities without the need for a large fleet (Lien, 2017). These partnerships enhance delivery timeliness and competitive positioning by offering fast delivery times (Saphores & Xu, 2020), while the data from these collaborations help to optimize delivery strategies and to promote the better understanding of customer preferences (Fang et al., 2022).

Additionally, WCs provide omnichannel pickup options, such as buy online, pick up in club (BOPIC), and curbside pickup. These services merge the convenience of online shopping with the immediacy of physical pickup, eliminating shipping costs and providing instant product availability, which is especially beneficial for time-sensitive purchases or when customers wish to verify product quality before taking products home (Gallino & Moreno, 2012). Recent studies show that omnichannel pickup increases foot traffic to physical stores, leading to additional in-store purchases and boosting overall sales (Jones et al., 2021). This strategy also optimizes inventory management by using store stock to fulfill online orders, reducing warehousing needs and minimizing excess inventory. The seamless integration of online and offline channels through such pickup options not only enhances customer loyalty but also encourages repeat purchases, as satisfied customers are more likely to return (Gallino & Moreno, 2012).

We hypothesize that enhancing the channel capabilities of WCs through the integration of on-premises and e-commerce services will bolster their accessibility to consumers in areas primarily served by convenience stores rather than supermarkets and grocery stores. This integration delivers robust multi-channel experiences, facilitating seamless shopping both in-store and online for consumers in regions with

significant challenges in retail food access. Chircu & Mahajan (2006) note that demand-side transaction costs reflect the efficiency of transactions from the customer's perspective, and changes in these perceived costs can significantly impact consumer spending (Teo & Yu, 2005). By bundling diverse service components, consumers can leverage economies of scope, thereby enhancing utility through joint consumption (Panou et al., 2015). Consequently, this integration not only reduces overall transactional costs but also promotes greater expenditures and boosts customer loyalty (Jones et al., 2021). Ultimately, these integrated services provide effective solutions for warehouse clubs to address food access challenges in underserved areas, thereby increasing consumer access to these clubs.

Hence, we propose the following hypothesis:

H2: The offering of on-premises services mitigates the negative impact of retail food access disparities on consumer foot traffic to warehouse clubs.

H3: The offering of e-commerce services mitigates the negative impact of retail food access disparities on consumer foot traffic to warehouse clubs.

5. Research Methodology

5.1. Estimation framework

This study assesses the ability of WC business model to attract consumers in regions characterized by pronounced disparities in retail food access. It investigates how the strategic enhancement of channel capabilities via on-premises and e-commerce services can mitigate the impact of these disparities. Specifically, it evaluates the impact of healthcare and automotive services as on-premises interventions, and delivery and omni-pickup options as e-commerce interventions.

Figure 1 presents our theoretical framework. The dependent variable, customer foot traffic, quantifies visits to these clubs, highlighting consumer access to WCs. We define our primary variable of interest, the retail food access divide, as the ratio of convenience stores to supermarkets and other grocery outlets within a designated geographic area. This metric underscores the market variation consumers face in terms of retail food access. The study examines two categories of moderating variables critical to WC's channel capabilities: on-premises and e-commerce service offerings. The on-premises service bundle includes various health and automotive services, whereas the e-commerce service bundle encompasses various home delivery and omni-channel pickup options. Overall, our analysis aims to provide essential insights for WCs to refine their service strategies and enhance consumer access in areas marked by significant disparities in retail food access.

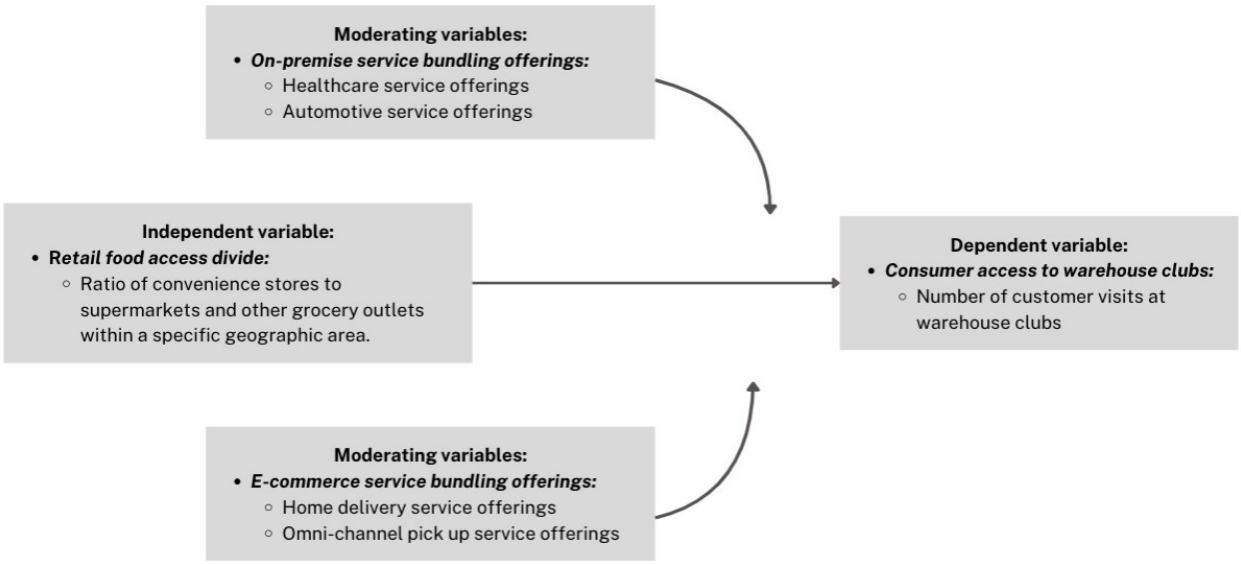

Figure 1: Theoretical Model

5.2. Data and variables

We employ multiple data sources and techniques to collect data for this study. Consumer foot traffic and warehouse club location data were obtained from Placer.ai, a leading analytics firm specializing in foot traffic analysis. Our dependent variable, $STOR\_VSIT_{ijcswy}$, is measured at the store-week level, offering a granular view of consumer engagement. The study includes comprehensive foot traffic data spanning January 2017 to December 2019 from three predominant warehouse clubs: Costco, Sam's Club, and BJ's. Specifically, the dataset covers 466 Costco outlets, 518 Sam's Club outlets, and 198 BJ's outlets. To enhance interpretability, a logarithmic transformation was applied to the foot traffic data, facilitating a more nuanced analysis of trends and patterns.

Data on on-premises services were gathered using distinct methodologies tailored to each warehouse club. For Costco and BJ's, information on on-premises services was collected via a e. Data for Sam's Club were manually sourced from the company's website, ensuring accuracy for services not readily captured by automated methods. On-premises services at these clubs include healthcare and automotive offerings. The healthcare services variable, $ONPR\_HLTH\_CNT_{ijwy}$, quantifies amenities such as pharmacies, optical departments, and hearing aid services. Similarly, the automotive services variable, $ONPR\_AUTO\_CNT_{ijwy}$, encompasses facilities like gas stations, diesel services, and tire services. These variables were standardized to $ONPR\_HLTH_{ijwy}$ and $ONPR\_AUTO_{ijwy,}$ respectively. A composite variable was then created by summing these standardized counts, which was further standardized to represent the overall on-premises service variable, $ONPR_{ijwy}$.

Data on e-commerce services were collected via internet searches. The e-commerce service offerings considered in this study include both delivery services and omni-channel pick-up options. The delivery service is a count variable, $ECOM\_DELV\_CNT_{ijwy}$, including two-day shipping services offered directly from the clubs' own platforms, as well as those services facilitated by gig workers through various delivery platforms. The omni-channel pick-up option is a count variable, $ECOM\_OMNI\_CNT_{ijwy}$, including same-day in-store pick-up, fresh pick-up for perishables such as fruits and vegetables, and curbside pick-up, which allows customers to purchase online and collect their items directly from the stores. These two variables were standardized to $ECOM\_DELV_{ijwy}$ and $ECOM\_OMNI_{ijwy}$, respectively. A composite variable was then created by summing these standardized counts, which was further standardized to represent the overall e-commerce service variable, $ECOM_{ijwy}$.

Data on the local retail food environment were sourced from the Social Determinants of Health Database provided by the Agency for Healthcare Research and Quality (AHRQ). The key variable of interest measures the ratio of convenience stores to supermarkets and other grocery stores within a county. This ratio serves as a critical indicator of the local food environment; a high ratio suggests a predominance

of convenience stores, which may limit access to fresh and nutritious food options. Conversely, a low ratio indicates greater accessibility to supermarkets and grocery stores, which typically offer a broader array of healthy food products. This metric is essential for evaluating the accessibility of nutritious food options and the potential impact on community health outcomes.

We use lagged variable for our key variable of interest, CS_SOGS_{cy-1}, to address endogeneity issues. In dynamic panel data models, including lagged dependent variables as regressors helps control for unobserved individual heterogeneity and addresses potential endogeneity of explanatory variables (Arellano & Bond, 1991). Furthermore, in time series analysis, using lagged values of independent variables to predict current values helps mitigate reverse causality issues, assuming past values influence the present but not vice versa (Wooldridge, 2010). In this study, we apply applied linear regression with multiple fixed effects with a longitudinal data (Guimarã es & Portugal, 2011; Gaure, 2013); hence, incorporating lagged variables is an effective strategy to handle endogeneity.

We also include several control variables in our analysis. First, consumer visits to warehouse clubs are likely to exhibit persistence over time. For example, if a client visited frequently in the past, s/he might continue to do so in the future. Hence, we include lagged visits to capture this inertia or habitual behavior. This persistence effect is important to model as it helps us understand the underlying pattern of consumer behavior better. $STOR\_VSIT\_L1_{ijcwy}$, $STOR\_VSIT\_L2_{ijcwy}$, and $STOR\_VSIT\_L3_{ijcwy}$ represent one, two, and three weeks of lagged store visits, respectively. Second, we also control for demographic characteristics, which can influence consumer behavior. POP_{cy} and INC_{cy} represent county-level population and household median income, respectively.

Table 3 provides the variable definitions, Table 4 presents summary statistics, and Table 5 displays the correlation matrix. According to Table 4, WC markets show significant variation in terms of retail food access disparities. This study aims to provide essential insights for WCs to refine their service strategies, both on-premises and e-commerce, to enhance foot traffic in areas marked by significant disparities in retail food access.

Table 3: Variable definitions

Variable	Definitions
$STOR\_VSIT_{ijcsdbwy}$	This refers to the number of customer visits to store location i of chain j in county c, state s, DMA d and CBSA b, recorded during week w in year y.
CS_SOGS_{cy-1}	This refers to the ratio of convenience stores to supermarkets and grocery stores within a county, designated as county c, during the year y-1, where a warehouse club is located.
$ONPR_{ijwy}$	This refers to a composite measure representing the breadth of on-premises service offerings in store location i of chain j during week w in year y. It is calculated by first standardizing the county variables for two distinct services—healthcare and automotive. These standardized variables are then summed, and the resulting sum is further standardized to create the composite metric.
$ONPR\_HLTH_{ijwy}$	This is a standardized count variable, representing the total number of healthcare-related services available on-site in store location i of chain j during week w in year y. These services may include a range of offerings, such as, pharmacies, optical departments, and hearing aid centers.
$ONPR\_AUTO_{ijwy}$	This is a standardized count variable that represents the total number of automotive-related services available on-site in store location i of chain j during week w in year y. These services may include a range of offerings, such as gas stations, diesel fuel availability, and tire service centers.
$ECOM_{ijwy}$	This refers to a composite measure representing the breadth of e-commerce service offerings in store location i of chain j during week w in year y. It is calculated by first standardizing the county variables for two distinct services—delivery and omni pickup. These standardized variables are then summed, and the resulting sum is further standardized to create the composite metric
$ECOM\_DELV_{ijwy}$	This is a standardized count variable that represents the total number of delivery-related services available in store location i of chain j during week w in year y. It quantifies the range of options provided to customers for delivery purchases, including two-day shipping and express delivery by delivery platforms
$ECOM\_OMNI_{ijwy}$	This is a standardized count variable that represents the total number of pickup-related services available at in store location i of chain j during week w in year y. It quantifies the range of options provided to customers for pickup purchases, including same-day in-store pick-up, fresh pick-up for perishables like fruits and vegetables, and curbside pick-up.
$STOR\_VSIT\_L1_{ijcwy}$	This refers to the one-week lag variable for customer visits to store location i of chain j in county c during week w of year y.
$STOR\_VSIT\_L2_{ijcwy}$	This refers to the two-week lag variable for customer visits to store location i of chain j in county c during week w of year y.
$STOR\_VSIT\_L3_{ijcwy}$	This refers to the three-week lag variable for customer visits to store location i of chain j in county c during week w of year y.
POP_{cy}	This refers to the population of county c where store i is located in year y.
INC_{cy}	This refers to the median household income of county c where store i is located in year y.

Table 4: Summary statistics

Variables	Unit	Obs	Mean	Std. dev.	Min	Max
$STOR\_VSIT_{ijcsdbwy}$	Log-transformed visits	271,440	10.051	1.566	0.000	12.036
CS_SOGS_{cy-1}	Std Ratio	271,440	0.000	1.000	-1.959	8.584
$ONPR_{ijwy}$	Std Index	271,440	0.000	1.000	-3.510	0.923
$ONPR\_HLTH_{ijwy}$	Std Index	271,440	0.000	1.000	-2.837	0.594
$ONPR\_AUTO_{ijwy}$	Std Index	271,440	0.000	1.000	-2.986	0.937
$ECOM_{ijwy}$	Std Index	271,440	0.000	1.000	-1.390	1.883
$ECOM\_DELV_{ijwy}$	Std Index	271,440	0.000	1.000	-1.380	1.233
$ECOM\_OMNI_{ijwy}$	Std Index	271,440	0.000	1.000	-0.546	2.683
$STOR\_VSIT\_L1_{ijcwy}$	Log-transformed visits	270,135	10.050	1.569	0.000	12.036
$STOR\_VSIT\_L2_{ijcwy}$	Log-transformed visits	268,830	10.048	1.572	0.000	12.036
$STOR\_VSIT\_L3_{ijcwy}$	Log-transformed visits	267,525	10.046	1.575	0.000	12.036
POP_{cy}	Million Person	271,440	1.146	1.746	0.014	10.106
INC_{cy}	Million Dollars	271,440	0.068	0.018	0.035	0.147

Table 5: Correlation table

No.	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1	$STOR\_VSIT_{ijcsdbwy}$	1.000												
2	CS_SOGS_{cy-1}	-0.054	1.000											
3	$ONPR_{ijwy}$	0.150	0.264	1.000										
4	$ONPR\_HLTH_{ijwy}$	0.190	0.074	0.830	1.000									
5	$ONPR\_AUTO_{ijwy}$	0.059	0.364	0.830	0.376	1.000								
6	$ECOM_{ijwy}$	0.075	-0.044	-0.011	0.070	-0.088	1.000							
7	$ECOM\_DELV_{ijwy}$	0.115	-0.225	-0.015	0.259	-0.284	0.687	1.000						
8	$ECOM\_OMNI_{ijwy}$	-0.011	0.164	0.000	-0.160	0.161	0.693	-0.049	1.000					
9	$STOR\_VSIT\_L1_{ijcwy}$	0.990	-0.054	0.149	0.189	0.059	0.074	0.113	-0.010	1.000				
10	$STOR\_VSIT\_L2_{ijcwy}$	0.985	-0.053	0.149	0.187	0.059	0.073	0.112	-0.010	0.990	1.000			
11	$STOR\_VSIT\_L3_{ijcwy}$	0.980	-0.053	0.148	0.186	0.059	0.073	0.110	-0.009	0.985	0.990	1.000		
12	POP_{cy}	0.099	-0.291	-0.064	0.031	-0.136	0.061	0.175	-0.091	0.098	0.098	0.097	1.000	
13	INC_{cy}	0.076	-0.375	-0.214	-0.047	-0.308	0.177	0.279	-0.034	0.076	0.076	0.076	0.027	1.000

5.3. *Estimation models*

Our study investigates the impact of food environments on foot traffic to warehouse clubs. The primary variable in our model is the ratio of convenience stores to supermarkets and other grocery outlets, which we refer to as retail food access disparities. We applied linear regression with multiple fixed effects—including state, CBSA (Core-Based Statistical Area), DMA (Designated Market Area), chain, year, and week—in our estimation (Guimarã es & Portugal, 2010; Gaure, 2013). Robust standard errors were used to account for heteroscedasticity and serial correlations (Kiefer et al., 2000).

In Equation 1, we include on-premises services and e-commerce services in aggregate, along with an interaction term between these services and the aforementioned ratio. In Equation 2, we perform a more detailed analysis by disaggregating on-premises services into health service offerings and automotive service offerings, and e-commerce services into delivery services and omni-channel services. We also include interaction terms for each of these disaggregated services with the ratio of convenience stores to supermarkets and other grocery outlets.

$STOR\_VSIT_{\text{ijcsdbwy}} =$	$\beta_0 + \beta_1 * CS\_SOGS_{cy-1} + \beta_2 * ONPR_{ijwy} + \beta_3 * ECOM_{ijwy} + \beta_4 * CS\_SOGS_{cy} * ONPR_{ijwy} + \beta_5 * CS\_SOGS_{cy} * ECOM_{ijwy} + \beta_6 * STOR\_VSIT\_L1_{ijcwy} + \beta_7 * STOR\_VSIT\_L2_{ijcwy} + \beta_8 * STOR\_VSIT\_L3_{ijcwy} + \beta_9 * POP_{cy} + \beta_{10} * INC_{cy} + \beta_{11} * STAT\_EF_s + \beta_{12} * DMA_d + \beta_{13} * CBSA_b + \beta_{14} * CHAIN_j + \beta_{15} * YEAR_y + \beta_{16} * WEEK_t$ Equation (1)

$STOR\_VSIT_{\text{ijcsdbwy}} =$	$\beta_0 + \beta_1 * CS\_SOGS_{cy-1} + \beta_2 * ONPR\_HLTH_{ijwy} + \beta_3 * ONPR\_AUTO_{ijwy} + \beta_4 * ECOM\_DELV_{ijwy} + \beta_5 * ECOM\_OMNI_{ijwy} + \beta_6 * CS\_SOGS_{cy} * ONPR\_HLTH_{ijwy} + \beta_7 * CS\_SOGS_{cy} * ONPR\_AUTO_{ijwy} + \beta_8 * CS\_SOGS_{cy} * ECOM\_DELV_{ijwy} + \beta_9 * CS\_SOGS_{cy} * ECOM\_OMNI_{ijwy} + \beta_{10} * STOR\_VSIT\_L1_{ijcwy} + \beta_{11} * STOR\_VSIT\_L2_{ijcwy} + \beta_{12} * STOR\_VSIT\_L3_{ijcwy} + \beta_{13} * POP_{cy} + \beta_{14} * INC_{cy} + \beta_{15} * STAT\_EF_s + \beta_{16} * DMA_d + \beta_{17} * CBSA_b + \beta_{18} * CHAIN_j + \beta_{19} * YEAR_y + \beta_{20} * WEEK_t$ Equation (2)

6. Estimation Results

Table 6 presents the estimation results from our econometric analysis. Model 1.1 investigates the direct effects of the local food environment, on-premises services, and e-commerce services on consumer foot traffic at warehouse clubs. Model 2.1 provides a detailed disaggregation of service offerings, differentiating on-premises services into healthcare and automobile categories, and subdividing e-commerce services into delivery and omni-pickup options. Models 1.2 and 2.2 delve into the interaction effects between these variables, examining the nuanced roles that on-premises and e-commerce services play within the context of the local food environment in influencing consumer foot traffic at warehouse clubs.

6.1. The direct effects of retail food access divide

As we mentioned, in our study, the local food environment is quantified using the ratio of convenience stores to supermarkets and grocery stores within a specific geographic area, labeled as the CS_SOGS ratio. This ratio serves as a crucial metric for assessing the accessibility and availability of food retailers, providing insights into the local food market environment. A high CS_SOGS ratio, indicating a predominance of convenience stores, typically suggests limited access to fresh and healthy food options. Conversely, a low ratio points to better accessibility to supermarkets and grocery stores, which tend to offer a more extensive selection of nutritious products.

Our analysis in Model 1.1 reveals that the coefficient for CS_SOGS is negative and statistically significant (-0.011, $p<0.001$), suggesting that a higher concentration of convenience stores is associated with decreased consumer foot traffic to warehouse clubs. Model 2.1 corroborates this finding, showing a consistent negative and significant coefficient for CS_SOGS at -0.009 ($p<0.001$). These results underscore that a dense presence of convenience stores correlates with reduced visits to warehouse clubs, indicating a substantial impact of the local retail food environment on consumer shopping behavior.

6.2. The direct effects of on-premises services

In Models 1.1 and 1.2, we find that an enriched array of on-premises services has a positive impact on consumer visits to warehouse clubs, with coefficients of 0.040 ($p<0.001$) and 0.046 ($p<0.001$) respectively. Specifically, within on-premises service offerings, healthcare services notably increase foot traffic, as evidenced by a positive coefficient of 0.066 ($p<0.001$) in Model 2.1. Conversely, automobile services do not show significant influence, with a statistically insignificant coefficient of 0.000 ($p>0.1$). However, in Model 2.2, the influence of automotive services shifts to a significant positive impact, 0.005 ($p<0.001$), suggesting that the effectiveness of automotive services on foot traffic is contingent upon the local food environment. An F-test comparing the impact of these services on foot traffic confirms that

healthcare services exert a more pronounced influence than automobile services, with a test value of 1.194 ($p<0.001$).

6.3. The directs effect of e-commerce services

Our findings from Models 1.1 and 1.2 reveal that an increase in e-commerce offerings correlates with a reduction in in-person visits, evidenced by a negative coefficient of -0.003 ($p<0.001$). Detailed analyses in Models 2.1 and 2.2 show that within e-commerce services, delivery services are associated with reductions in in-person visits, displaying coefficients of -0.003 ($p<0.01$). Similarly, omni-pickup services are linked with decreases in in-person visits, with coefficients of -0.002 ($p<0.05$) and -0.001 ($p<0.1$), respectively. An F-test comparing the impact of delivery and omni-pickup services on in-person visits shows no significant difference, with a value of 0.1891 ($p>0.1$).

6.4. The role of on-premises services amid retail food access divide

Our analysis extends to the examination of on-premises services within different local food environments. In Model 1.2, the interaction term CS_SOGS*ONPR is positive and significant (0.013, $p<0.001$), demonstrating that robust on-premises services can mitigate the negative effects of a convenience store-dominated food environment on warehouse club foot traffic. In Model 2.2, the two interaction terms, CS_SOGS*ONPR_HLTH and CS_SOGS*ONPR_AUTO, are both significant and positive, at 0.006 ($p<0.001$) and 0.008 ($p<0.001$) respectively. These findings indicate that strong on-premises services in both healthcare and automotive sectors can effectively counterbalance the adverse impacts of limited access to healthy food options on consumer visits to warehouse clubs.

6.5. The role of e-commerce services amid retail food access divide

We further investigate the role of e-commerce services within local food environments. In Model 1.2, the interaction term CS_SOGS*ECOM does not reach significance, suggesting that e-commerce offerings do not significantly modify the impact of local food access on warehouse club visits. However, in Model 2.2, the interaction term CS_SOGS*ECOM_DELV is significantly positive at 0.002 ($p<0.001$), indicating that delivery services can positively influence foot traffic in areas with restricted access to healthy food, thereby mitigating their overall negative impact. Conversely, the interaction term CS_SOGS*ECOM_OMNI shows a significantly negative effect at -0.002 ($p<0.001$), suggesting that omni-pickup services may exacerbate the adverse effects of limited healthy food access on consumer behavior. A potential explanation of this result is reduced exposure to healthy foods. In offline shopping, consumers might encounter and be tempted to try new, healthier food options while browsing. Omni-pickup services typically involve selecting items from an online inventory, which can limit spontaneous purchases of healthy foods that customers might not normally buy but could consider when seen in person.

In summary, our study delineates the significant influences of local food environments and service offerings by warehouse clubs on consumer foot traffic. We find that a higher concentration of convenience stores relative to supermarkets and grocery stores generally decreases visits to warehouse clubs, illustrating the detrimental impact of convenience store dominance. On-premises services, particularly healthcare, substantially enhance visitor numbers, contrasting sharply with the negligible effects from automobile services. Both healthcare and automotive services appear capable of mitigating the negative implications of limited access to healthy food options. In the realm of e-commerce services, both delivery and omni-pickup typically reduce in-person visits. Notably, while delivery services can mitigate the adverse effects of restricted access to healthy food, omni-pickup services may intensify these negative outcomes. These results highlight the complex interplay between service offerings and the accessibility of food retailers, critically shaping consumer behavior in warehouse club settings.

Table 6: Estimation results: on-premises and e-commerce services amid retail food access divide

STOR_VSIT	**Model 1.1**	**Model 1.2**	**Model 2.1**	**Model 2.2**
CS_SOGS	-0.011*** (0.001)	-0.012*** (0.001)	-0.009*** (0.001)	-0.010*** (0.001)
ONPR	0.040*** (0.002)	0.046*** (0.003)		
ECOM	-0.003*** (0.001)	-0.003*** (0.001)		
ONPR_HLTH			0.066*** (0.004)	0.069*** (0.004)
ONPR_AUTO			0.000 (0.001)	0.005*** (0.001)
ECOM_DELV			-0.003** (0.001)	-0.003** (0.001)
ECOM_OMNI			-0.002* (0.001)	-0.001+ (0.001)
CS_SOGS*ONPR		0.013*** (0.001)		
CS_SOGS*ECOM		0.000 (0.000)		
CS_SOGS*ONPR_HLTH				0.006*** (0.001)
CS_SOGS*ONPR_AUTO				0.008*** (0.001)
CS_SOGS*ECOM_DELV				0.002*** (0.000)
CS_SOGS*ECOM_OMNI				-0.002*** (0.000)
STOR_VSIT_L1	0.576*** (0.021)	0.575*** (0.021)	0.569*** (0.021)	0.568*** (0.021)
STOR_VSIT_L2	0.109*** (0.017)	0.108*** (0.017)	0.107*** (0.017)	0.107*** (0.017)
STOR_VSIT_L3	0.056*** (0.009)	0.056*** (0.009)	0.056*** (0.009)	0.056*** (0.009)
POP	0.007*** (0.001)	0.007*** (0.001)	0.007*** (0.001)	0.008*** (0.001)
INC	-0.537*** (0.058)	-0.406*** (0.056)	-0.573*** (0.058)	-0.435*** (0.056)
STAT_EF	Included	included	included	included
DMA_EF	Included	included	included	included
CBSA_EF	Included	Included	included	Included
CHAIN_EF	Included	included	included	included
YEAR_EF	Included	included	included	included
WEEK_EF	Included	Included	included	Included
CONS	2.690*** (0.147)	2.689*** (0.147)	2.782*** (0.150)	2.780*** (0.150)

STOR_VSIT	Model 1.1	Model 1.2	Model 2.1	Model 2.2
Model Statistics				
N	194530.000	194530.000	194530.000	194530.000
F	4048.090***	3747.726***	5138.366***	4060.465***
R2	0.908	0.908	0.909	0.910
R2_adj	0.908	0.908	0.909	0.909

Note: Robust standard errors in parentheses. + p<0.1, * p<0.05, ** p<0.01, *** p<0.001.

7. Extended Analysis

We further make an extended analysis, focusing on consumer foot traffic by home distances as the dependent variable in our study. This analysis sheds light on how various on-premises and e-commerce services influence customer willingness to travel to WCs amid retail food access divide. We segmented consumer home distances into four categories: less than 5 miles, between 5 and 10 miles, between 10 and 30 miles, and above 30 miles. The results presented in Table 7 and Table 8 assess the influence of on-premises and e-commerce services on warehouse club foot traffic across various consumer home distances. In Table 7, we focus on overall on-premises services and e-commerce services. Table 8 provides a detailed breakdown of service offerings, categorizing on-premises services into healthcare and automobile categories, and e-commerce services into delivery and omni-pickup categories.

7.1. The direct effects of retail food access divide

We investigate the impact of the local food environment, defined by the ratio of convenience stores to supermarkets and other grocery stores, on consumer foot traffic at warehouse clubs based on the proximity of consumers' homes. Table 7 indicates that all coefficients for the convenience store to supermarket/grocery store ratio (CS_SOGS) are statistically significant. For proximities less than 5 miles, there is a significant negative impact, with coefficients of -0.008 ($p<0.001$) in Model 3.1 and -0.009 ($p<0.001$) in Model 3.2. This trend continues for distances between 5 and 10 miles, with coefficients of -0.004 ($p<0.05$) in both Models 4.1 and 4.2. However, the influence becomes positive for distances exceeding 10 miles, suggesting that larger distances can offset the negative impacts of high convenience store ratios, with coefficients of 0.013 ($p<0.001$) for distances between 10 and 30 miles in Models 5.1 and 5.2, and 0.017 ($p<0.001$) for distances beyond 30 miles in Models 6.1 and 6.2. Table 6 corroborates these findings, demonstrating consistent results across models. Economies of scale and customer loyalty may explain this result. First, when consumers travel longer distances, they are likely to buy in larger quantities to make the trip worthwhile. This behavior can offset the high convenience store ratios by providing warehouse clubs with higher transaction size per visit. Second, due to membership, this shopping model creates a sense of loyalty and commitment among customers, Members are more likely to travel longer distances to utilize their membership benefits, therefore diminishing the convenience advantage of nearby stores.

7.2. The direct effects of on-premises services

In our analysis presented in Table 7, on-premises services are shown to significantly enhance foot traffic to warehouse clubs across all examined distances, as evidenced by consistently positive and highly significant coefficients. Specifically, for consumers living within 5 miles, coefficients are 0.029 ($p<0.001$)

in Model 3.1 and 0.033 ($p<0.001$) in Model 3.2. This pattern holds with coefficients of 0.031 ($p<0.001$) and 0.034 ($p<0.001$) for distances of 5 to 10 miles in Models 4.1 and 4.2, and continues with coefficients of 0.022 ($p<0.001$) and 0.025 ($p<0.001$) for distances of 10 to 30 miles in Models 5.1 and 5.2. For distances exceeding 30 miles, the coefficients increase to 0.035 ($p<0.001$) and 0.040 ($p<0.001$). These findings highlight the significant pull of robust on-premises health services, which consistently attract higher foot traffic to warehouse clubs, irrespective of consumer home distances.

Table 8 elaborates on this trend within healthcare services, showing significant boosts in visits from consumers within 5 miles, with coefficients of 0.047 ($p<0.001$) and 0.049 ($p<0.001$) in Models 7.1 and 7.2, respectively. The high value and effectiveness of healthcare services in enhancing foot traffic are evident. This impact remains robust for distances between 5 and 10 miles, with coefficients of 0.047 ($p<0.001$) and 0.049 ($p<0.001$) in Models 8.1 and 8.2, indicating their sustained appeal. For distances between 10 and 30 miles, coefficients are 0.033 ($p<0.001$) and 0.036 ($p<0.001$) in Models 9.1 and 9.2, respectively. Importantly, the appeal of healthcare services extends even to distances exceeding 30 miles, with coefficients rising to 0.056 ($p<0.001$) and 0.061 ($p<0.001$), showcasing consumers' willingness to travel substantial distances for these services.

In contrast, the influence of automobile services on consumer foot traffic shows a more nuanced pattern. Within 5 miles, the impact is minimal, with a coefficient of 0.001 (not significant) in Model 7.1 but becomes significant at 0.004 ($p<0.001$) in Model 7.2. As distances increase to between 5 and 10 miles, the positive effect becomes more pronounced, with coefficients of 0.003 ($p<0.05$) and 0.004 ($p<0.001$) in Models 8.1 and 8.2. This trend suggests that automobile services start to draw more visitors as the distance increases slightly. For distances of 10 to 30 miles, the coefficients are 0.002 ($p<0.05$) and 0.003 ($p<0.01$) in Models 9.1 and 9.2, respectively. Beyond 30 miles, the impact becomes negligible again with a coefficient of 0.002 (not significant) in Model 10.1, but it turns significant in Model 10.2, at 0.004 ($p<0.05$), indicating a complex interaction with local food environments that may influence the willingness of long-distance consumers to travel extensively for automobile services.

7.3. The direct effects of e-commerce services

In our analysis presented in Table 7, we further examine the direct effects of e-commerce services on foot traffic at warehouse clubs. Notably, these services show no significant impact on foot traffic for consumers living either within 5 miles or beyond 30 miles. However, for distances ranging from 5 to 30 miles, there is a marginally significant negative relationship, with coefficients of -0.002 ($p<0.1$) for both the 5 to 10 mile and 10 to 30 mile ranges across Models 4.1, 4.2 and 5.1, and -0.002 ($p<0.05$) for model 5.2. This pattern indicates that enhanced e-commerce offerings are slightly associated with a reduction in physical visits at these intermediate distances, with e-commerce substituting for in-store visits.

Further detailed analysis in Table 8 explores the specific effects of different types of e-commerce services. Delivery services demonstrate no significant impact on foot traffic from consumers residing within 5 miles. The negative effect becomes significant for consumers living between 5 and 10 miles, with a consistent coefficient of -0.002 ($p<0.1$) in Model 8.1, suggesting that the availability of delivery options slightly discourages physical store visits. The negative impact is more evident for distances between 10 and 30 miles, with a coefficient of -0.003 ($p<0.05$) in Model 9.1, indicating a strong preference for the convenience of delivery services over in-store visits. However, for consumers traveling distances greater than 30 miles, the impact of delivery services becomes positive, though it remains statistically insignificant, with a coefficient of 0.002 ($p>0.1$) in Models 10.1 and 10.2, suggesting a minimal influence on their decision to visit the store.

Regarding omni-channel services, their impact is consistently negative but statistically insignificant for shorter distances, including within 5 miles, and extending through the 5 to 10 mile and 10 to 30 mile ranges. This indicates that omni-channel services do not significantly influence foot traffic from these proximities. Nevertheless, for distances exceeding 30 miles, the impact becomes significantly negative at -0.004 ($p<0.01$), suggesting that omni-channel services may deter visits by long-distance consumers, likely due to a preference for completely home-based shopping solutions over traveling to pick up items.

7.4. The role of on-premises services amid retail food access divide

In Table 7, the interaction term CS_SOGS*ONPR underscores the substantial ability of on-premises services to counterbalance the negative effects of limited access to healthy food options on foot traffic to warehouse clubs across varying distances. Notably, the interaction yields significant positive coefficients, demonstrating substantial effects: 0.009 ($p<0.001$) for distances less than 5 miles in Model 3.2, 0.006 ($p<0.001$) for distances between 5 and 10 miles in Model 4.2, and consistently strong impacts for longer distances with coefficients of 0.006 ($p<0.001$) for 10 to 30 miles and 0.010 ($p<0.001$) for distances exceeding 30 miles in Model 6.2. These findings highlight the pivotal role of on-premises services in ameliorating the challenges posed by a convenience store-dense environment.

In Table 8, the interaction term CS_SOGS*ONPR_HLTH reveals substantial improvements in store visits, proving particularly beneficial for consumers residing close to warehouse clubs. The interaction shows significant positive coefficients: 0.005 ($p<0.001$) for those within a 5-mile radius in Model 7.2, and 0.004 ($p<0.001$) for distances between 5 and 10 miles in Model 8.2. Healthcare services significantly alleviate the adverse impacts of high convenience store ratios and continue to show increasing effectiveness for distances of 10 to 30 miles, with a coefficient of 0.007 ($p<0.001$) in Model 9.2, escalating further for those over 30 miles away, at 0.009 ($p<0.001$) in Model 10.2. These results demonstrate the strong draw of healthcare facilities within warehouse clubs, enhancing their appeal significantly.

Similarly, the interaction term CS_SOGS*ONPR_AUTO in Table 8 also indicates positive outcomes, especially for consumers residing within close proximity to the clubs. For those within a 5-mile radius, the coefficient is 0.006 ($p<0.001$) in Model 7.2, and for those between 5 and 10 miles, it stands at 0.003 ($p<0.05$) in Model 8.2, suggesting that automobile services effectively attract more visitors despite a high local prevalence of convenience stores. However, this positive influence wanes for distances between 10 and 30 miles, where the interaction becomes insignificant in Model 9.2, indicating a diminished appeal of automobile services at moderate distances. Yet, for distances exceeding 30 miles, the influence reasserts itself, with a coefficient of 0.003 ($p<0.05$) in Model 10.2, underscoring the capacity of automobile services to attract long-distance visitors and effectively counteract the negative impacts of a convenience store-saturated environment.

7.5. The role of e-commerce services amid retail food access divide

In Table 7, the interaction term CS_SOGS*ECOM highlights that e-commerce services exert a limited influence on warehouse club visits for customers residing within 5 miles, indicating a negligible impact on nearby consumer behavior in relation to local food access. However, as the distance from warehouse clubs increases, this interaction becomes significant, underscoring the role of e-commerce in alleviating the adverse effects associated with limited healthy food options. The coefficients are 0.001 ($p<0.1$) for distances between 5 and 10 miles, 0.002 ($p<0.001$) for distances between 10 and 30 miles, and 0.002 ($p<0.01$) for distances exceeding 30 miles. These findings illustrate that e-commerce services increasingly benefit consumers who are further from warehouse clubs, effectively compensating for the challenges posed by less accessible local food environments.

In Table 8, the interaction term CS_SOGS*ECOM_DELV further elucidates these dynamics. The interaction is not significant for consumers residing less than 5 miles away, with a coefficient of 0.001 ($p>0.1$) in Model 7.2, suggesting that delivery services do not significantly boost visits. However, the effect becomes positively significant for consumers between 5 and 10 miles, with a coefficient of 0.002 ($p<0.05$) in Model 8.2 and remains robust for those between 10 and 30 miles, at 0.002 ($p<0.01$) in Model 9.2. This pattern indicates that delivery services are particularly effective in attracting visits from moderate distances, serving as a viable solution where local food access is constrained. For those living more than 30 miles away, the positive impact intensifies significantly with a coefficient of 0.005 ($p<0.001$) in Model 10.2, highlighting the strong appeal of delivery services as an alternative to extensive travel to warehouse clubs.

In contrast, the interaction term CS_SOGS*ECOM_OMNI shows minimal impact across shorter distances, with an insignificant coefficient of -0.001 in Models 7.2 and 8.2 for consumers residing less than 10 miles away. This suggests a minimal influence on attracting visits despite high local convenience store ratios. For consumers between 10 and 30 miles, the effect remains negligible and insignificant, with a coefficient of -0.000 in Model 9.2. However, for distances exceeding 30 miles, the impact becomes

significantly negative, with a coefficient of -0.003 ($p<0.01$) in Model 10.2, suggesting that omni-channel services may actually deter visits by offering alternatives that obviate the need for physical travel to warehouse clubs. This analysis underscores the complex role of e-commerce in shaping consumer interactions with warehouse clubs amidst varying local food environments.

In summary, our analysis reveals the nuanced effects of on-premises and e-commerce services on foot traffic to warehouse clubs, which vary significantly across different consumer home distances. The local food environment, quantified by the ratio of convenience stores to supermarkets and grocery stores, markedly impacts consumer behavior. This influence is particularly negative within proximities of less than 5 miles but becomes positive as the distance increases, suggesting that the adverse effects of convenience store prevalence are mitigated by greater distances. Notably, on-premises services, especially healthcare, consistently boost foot traffic across all distances, with their impact being exceptionally strong, drawing consumers from distances extending beyond 30 miles. Conversely, e-commerce services display a complex pattern: they generally decrease in-person visits for consumers residing between 5 and 30 miles from warehouse clubs yet have minimal effects outside this range. Additionally, our models indicate that robust on-premises services can counteract the negative impacts of a convenience store-dense local food environment. Meanwhile, the attractiveness of e-commerce options increases with distance, helping maintain consumer engagement even in less favorable local shopping conditions.

Table 7: Extended analysis I: on-premises and e-commerce services (by consumer home distances)

STOR_VSIT	HM_DIS_05_BL	HM_DIS_05_BL	HM_DIS_05_10	HM_DIS_05_10	HM_DIS_10_30	HM_DIS_10_30	HM_DIS_30_AB	HM_DIS_30_AB
	Model 3.1	**Model 3.2**	**Model 4.1**	**Model 4.2**	**Model 5.1**	**Model 5.2**	**Model 6.1**	**Model 6.2**
CS_SOGS	-0.008*** (0.002)	-0.009*** (0.002)	-0.004* (0.002)	-0.004* (0.002)	0.013*** (0.002)	0.013*** (0.002)	0.017*** (0.002)	0.017*** (0.002)
ONPR	0.029*** (0.003)	0.033*** (0.003)	0.031*** (0.003)	0.034*** (0.003)	0.022*** (0.003)	0.025*** (0.003)	0.035*** (0.003)	0.040*** (0.003)
ECOM	-0.001 (0.001)	-0.002 (0.001)	-0.002+ (0.001)	-0.002+ (0.001)	-0.002+ (0.001)	-0.002* (0.001)	-0.002 (0.002)	-0.002 (0.002)
CS_SOGS*ONPR		0.009*** (0.001)		0.006*** (0.002)		0.006*** (0.001)		0.010*** (0.002)
CS_SOGS*ECOM		-0.000 (0.001)		0.001+ (0.001)		0.002*** (0.001)		0.002** (0.001)
HM_DIS_05_BL_L1	0.511*** (0.035)	0.511*** (0.035)						
HM_DIS_05_BL_L2	0.308*** (0.033)	0.308*** (0.033)						
HM_DIS_05_BL_L3	0.174*** (0.028)	0.174*** (0.028)						
HM_DIS_05_10_L1			0.433*** (0.023)	0.434*** (0.023)				
HM_DIS_05_10_L2			0.292*** (0.020)	0.292*** (0.020)				
HM_DIS_05_10_L3			0.212*** (0.020)	0.213*** (0.020)				
HM_DIS_10_30_L1					0.370*** (0.017)	0.370*** (0.017)		
HM_DIS_10_30_L2					0.289*** (0.016)	0.289*** (0.016)		
HM_DIS_10_30_L3					0.255*** (0.016)	0.255*** (0.016)		
HM_DIS_30_AB_L1							0.267*** (0.008)	0.267*** (0.008)
HM_DIS_30_AB_L2							0.246*** (0.008)	0.246*** (0.008)
HM_DIS_30_AB_L3							0.223*** (0.008)	0.223*** (0.008)
POP	0.004*** (0.001)	0.005*** (0.001)	0.007*** (0.001)	0.008*** (0.001)	0.005*** (0.001)	0.006*** (0.001)	-0.008*** (0.001)	-0.007*** (0.001)
INC	-0.444*** (0.068)	-0.350*** (0.068)	-0.065 (0.089)	-0.008 (0.085)	0.211* (0.090)	0.273** (0.088)	0.378*** (0.112)	0.487*** (0.112)
STAT_EF	included	included	included	included	included	included	included	included
DMA_EF	included	included	included	included	included	included	included	included
CBSA_EF	included	included	included	included	included	included	included	included
CHAIN_EF	included	included	included	included	included	included	included	included
YEAR_EF	included	included	included	included	included	included	included	included
WEEK_EF	included	included	included	included	included	included	included	included
CONS	1.926*** (0.188)	1.926*** (0.188)	1.880*** (0.162)	1.882*** (0.162)	1.560*** (0.147)	1.559*** (0.147)	1.372*** (0.140)	1.370*** (0.140)

STOR_VSIT	HM_DIS_05_BL	HM_DIS_05_BL	HM_DIS_05_10	HM_DIS_05_10	HM_DIS_10_30	HM_DIS_10_30	HM_DIS_30_AB	HM_DIS_30_AB
	Model 3.1	Model 3.2	Model 4.1	Model 4.2	Model 5.1	Model 5.2	Model 6.1	Model 6.2
Model Statistics								
N	194530.000	194530.000	194530.000	194530.000	194530.000	194530.000	194530.000	194530.000
F	6822.536***	6077.622***	4322.091***	3706.723***	5253.664***	4681.309***	2088.006***	1970.680***
R2	0.920	0.920	0.894	0.894	0.892	0.892	0.857	0.857
R2_Adj	0.920	0.920	0.894	0.894	0.892	0.892	0.857	0.857

Note: Robust standard errors in parentheses. + p<0.1, * p<0.05, ** p<0.01, *** p<0.001.

Table 8: Extended analysis II: on-premises and e-commerce services (by consumer home distances)

STOR_VSIT	HM_DIS_05_BL	HM_DIS_05_BL	HM_DIS_05_10	HM_DIS_05_10	HM_DIS_10_30	HM_DIS_10_30	HM_DIS_30_AB	HM_DIS_30_AB
	Model 7.1	Model 7.2	Model 8.1	Model 8.2	Model 9.1	Model 9.2	Model 10.1	Model 10.2
CS_SOGS	-0.007*** (0.002)	-0.007*** (0.002)	-0.002 (0.002)	-0.002 (0.002)	0.014*** (0.002)	0.015*** (0.002)	0.019*** (0.002)	0.021*** (0.002)
ONPR_HLTH	0.047*** (0.004)	0.049*** (0.005)	0.047*** (0.004)	0.049*** (0.004)	0.033*** (0.004)	0.036*** (0.004)	0.056*** (0.004)	0.061*** (0.004)
ONPR_AUTO	0.001 (0.001)	0.004*** (0.001)	0.003* (0.001)	0.004*** (0.001)	0.002* (0.001)	0.003** (0.001)	0.002 (0.001)	0.004* (0.002)
ECOM_DELV	-0.002 (0.001)	-0.002 (0.001)	-0.002+ (0.001)	-0.002 (0.001)	-0.003* (0.002)	-0.003+ (0.002)	0.002 (0.002)	0.002 (0.002)
ECOM_OMNI	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.000 (0.001)	-0.000 (0.001)	-0.004** (0.001)	-0.004* (0.002)
CS_SOGS*ONPR_HLTH		0.005*** (0.001)		0.004*** (0.001)		0.007*** (0.001)		0.009*** (0.002)
CS_SOGS*ONPR_AUTO		0.006*** (0.001)		0.003* (0.001)		0.000 (0.001)		0.003* (0.001)
CS_SOGS*ECOM_DELV		0.001 (0.001)		0.002* (0.001)		0.002** (0.001)		0.005*** (0.001)
CS_SOGS*ECOM_OMNI		-0.001 (0.001)		-0.001 (0.001)		-0.000 (0.001)		-0.003** (0.001)
HM_DIS_05_BL_L1	0.512*** (0.035)	0.512*** (0.035)						
HM_DIS_05_BL_L2	0.308*** (0.033)	0.308*** (0.033)						
HM_DIS_05_BL_L3	0.174*** (0.028)	0.174*** (0.028)						
HM_DIS_05_10_L1			0.435*** (0.023)	0.435*** (0.023)				
HM_DIS_05_10_L2			0.293*** (0.020)	0.293*** (0.020)				
HM_DIS_05_10_L3			0.214*** (0.020)	0.214*** (0.020)				
HM_DIS_10_30_L1					0.371*** (0.017)	0.370*** (0.017)		
HM_DIS_10_30_L2					0.289*** (0.016)	0.289*** (0.016)		
HM_DIS_10_30_L3					0.255*** (0.016)	0.255*** (0.016)		
HM_DIS_30_AB_L1							0.266*** (0.008)	0.266*** (0.008)
HM_DIS_30_AB_L2							0.245*** (0.008)	0.245*** (0.008)
HM_DIS_30_AB_L3							0.222*** (0.008)	0.222*** (0.008)
POP	0.005*** (0.001)	0.005*** (0.001)	0.007*** (0.001)	0.008*** (0.001)	0.006*** (0.001)	0.006*** (0.001)	-0.008*** (0.001)	-0.007*** (0.001)
INC	-0.468*** (0.069)	-0.372*** (0.068)	-0.112 (0.091)	-0.055 (0.086)	0.183* (0.090)	0.230** (0.089)	0.354** (0.112)	0.455*** (0.112)
STAT_EF	included	included	included	included	included	included	included	included
DMA_EF	included	included	included	included	included	included	included	included
CBSA_EF	included	included	included	included	included	included	included	included
CHAIN_EF	included	included	included	included	included	included	included	included
YEAR_EF	included	included	included	included	included	included	included	included
WEEK_EF	included	included	included	included	included	included	included	included

STOR_VSIT	HM_DIS_05_BL	HM_DIS_05_BL	HM_DIS_05_10	HM_DIS_05_10	HM_DIS_10_30	HM_DIS_10_30	HM_DIS_30_AB	HM_DIS_30_AB
	Model 7.1	**Model 7.2**	**Model 8.1**	**Model 8.2**	**Model 9.1**	**Model 9.2**	**Model 10.1**	**Model 10.2**
CONS	1.992*** (0.193)	1.991*** (0.193)	1.952*** (0.167)	1.954*** (0.167)	1.606*** (0.152)	1.606*** (0.152)	1.446*** (0.144)	1.445*** (0.144)
Model Statistics								
N	194530.000	194530.000	194530.000	194530.000	194530.000	194530.000	194530.000	194530.000
F	7747.439***	6375.209***	4078.796***	3199.942***	4685.165***	3822.608***	1999.460***	1707.637***
R2	0.921	0.921	0.895	0.895	0.893	0.893	0.857	0.858
R2_Adj	0.920	0.920	0.894	0.894	0.892	0.892	0.857	0.857

Note: Robust standard errors in parentheses + p<0.1, * p<0.05, ** p<0.01, *** p<0.001.

8. Discussion and Implications

This research assesses the accessibility of warehouse clubs' business model for consumers in areas with a significant retail food access divide, especially in regions primarily served by convenience stores instead of supermarkets and other grocery outlets. Our findings highlight the profound influence of the local food environment—quantified by the ratio of convenience stores to supermarkets and grocery stores (CS_SOGS)—on consumer traffic to warehouse clubs. A high CS_SOGS ratio, indicative of limited access to healthy food options, negatively impacts visits to warehouse clubs. The retail environment significantly influences consumer behavior, with higher ratios of convenience stores to supermarkets correlating with decreased visits to more distant retail options such as warehouse clubs (Bhatnagar & Ratchford, 2004). Consumers often favor the immediate accessibility of nearby convenience stores over the effort required to travel to warehouse clubs (Bhatnagar & Ratchford, 2004). Consequently, these consumers are less likely to benefit from the EDLP strategy integral to the WC business model (Fox & Sethuraman, 2010), underscoring the critical role of geographical proximity in shaping shopping behaviors in areas with a significant retail food access divide.

Our analysis reveals that integrating on-premises services such as healthcare and automotive significantly enhances consumer visits to warehouse clubs. This supports the findings of other research claiming that on-premises service bundling may enable stores to generate more revenue, which could in turn lead to a greater physical footprints (Krafft et al., 2005; Emrich et al., 2015). The impact is most pronounced for healthcare services, which not only attract consumers looking to combine routine shopping with health-related visits but also substantially improve the overall value proposition of WCs. Integrating healthcare services into retail settings has been shown to increase consumer visits by providing additional value and convenience, making it a crucial strategy for attracting foot traffic. According to Krafft et al., the presence of pharmacies helps customers save time and energy by easily getting their prescriptions while shopping (Krafft et al., 2010). In contrast, automotive services do not consistently increase foot traffic, serving more as supplementary rather than primary attractions. However, their significance increases in areas with limited access to comprehensive supermarkets, highlighting the contextual effectiveness of these services. There are significant interactions between on-premises services and the CS_SOGS ratio, demonstrating that these services can effectively counteract the negative impacts of environments dense with convenience stores. These insights underscore the need for WCs to tailor their service offerings to local consumer needs and adapt to existing retail structures, affirming that the strategic importance of specific services is deeply influenced by the local retail environment.

In terms of e-commerce, our research delineates a complex relationship between digital services and physical store visits. E-commerce options, such as delivery and omni-channel pickup, generally reduce the frequency of in-store visits by providing the convenience of home delivery and streamlined online-to-

offline pickup solutions (Gawor & Hoberg, 2019). Delivery services, in particular, effectively mitigate the negative impacts of a high CS_SOGS ratio on foot traffic to warehouse clubs. They not only enhance customer satisfaction but also add more value to the store by providing diverse shopping channels and a broader range of offerings compared to competitors who might only focus on a single channel (Jones et al., 2021). These services provide warehouse clubs with a distinctive competitive advantage by matching—and sometimes exceeding—the convenience offered by nearby convenience stores (Ellickson et al., 2020). This suggests that in areas predominantly served by convenience stores, warehouse clubs can adeptly utilize e-commerce strategies to maintain robust consumer engagement. The evidence underscores the imperative for WCs to adopt sophisticated digital retail strategies that respond adaptively to the evolving consumer landscape in densely populated urban areas.

These findings emphasize the necessity for both retailers and policymakers to ensure that advancements in retail services are inclusive and accessible to all communities, particularly those disadvantaged by significant retail food access divides. Ensuring equitable access to essential services, including e-commerce services such as home delivery and on-premises such as healthcare, is crucial for addressing disparities in food access and enhancing consumer welfare. Strategic initiatives are crucial to prevent the emergence of service deserts and to guarantee equitable access to both physical and digital retail channels. This involves deploying retail facilities and services in underserved areas, providing targeted support for the establishment of essential services in neighborhoods devoid of such amenities, and enhancing broadband access and digital literacy to effectively bridge the digital divide.

Marketing efforts should underscore the unique advantages of WCs, such as cost-efficiency and a diverse selection of healthier products, to attract consumers from areas with high CS_SOGS ratios. Additionally, the integration of essential services like healthcare, pharmacies, and optical services has proven to significantly boost foot traffic (Krafft et al., 2010). WCs should not only expand these services but also actively promote them. Considering the varied impact of services such as automobile care across different locales, it is crucial for retailers to tailor their offerings to meet local consumer preferences and market conditions. Furthermore, sophisticated e-commerce fulfillment strategies that adapt to the changing consumer landscape are particularly valuable in areas with high retail food access divides.

Policymakers should champion policies that promote service bundling which would make customers' shopping experience much more convenient, since it will make them gain time and energy while also adding more value to the warehouse club (Panou et al., 2018). Incentives such as zoning adjustments, tax breaks, or subsidies could be devised to support the integration of crucial services, such as healthcare, within retail settings, making these amenities more accessible and convenient for the public.

As e-commerce services like home delivery increasingly become crucial for retailers to maintain a competitive edge (Jones et al., 2021), policymakers could bolster these initiatives through improved digital

infrastructure, regulatory support for e-commerce endeavors, and financial incentives for businesses that integrate advanced digital services. Policy developments like the Supplemental Nutrition Assistance Program (SNAP) pilot program, which allows clients to purchase groceries online, have significantly enhanced access to healthy food, improving diet quality and reducing the risk of serious health issues (Click, 2020).

Overall, this study underscores the critical need for retail strategies that are dynamically adaptable and policymaking that is informed and responsive to create a retail environment that accommodates diverse consumer demands. In areas marked by significant disparities in retail food access, it is imperative to utilize existing resources, such as distribution networks and physical store infrastructure, to formulate inclusive service offerings. While retailers routinely assess the local food environment to determine optimal site locations, discrepancies in retail food access continue to persist. To counteract this, we advocate for a more uniformly distributed retail landscape to prevent the formation of retail food service deserts. Our proposed approach involves the strategic deployment of resources in underserved areas and the integration of advanced digital and essential services into retail frameworks through both regulatory and financial means. The aim of our integrated strategy is to develop a fairer, more competitive retail landscape that effectively caters to a wide consumer base.

Table 9: Summary of Results

				HM_DIS_05_BL		HM_DIS_05_10		HM_DIS_10_30		HM_DIS_30_AB	
		Model 1.2	**Model 2.2**	**Model 3.2**	**Model 7.2**	**Model 4.2**	**Model 8.2**	**Model 5.2**	**Model 9.2**	**Model 6.2**	**Model 10.2**
H1 (-)	CS_SOGS	-0.012*** (Supported)	-0.010*** (Supported)	-0.009*** (Supported)	-0.007*** (Supported)	-0.004* (Supported)	-0.002 (Not supported)	0.013*** (Not supported)	0.015*** (Not supported)	0.017*** (Not supported)	0.021*** (Not supported)
	ONPR	0.046***		0.033***		0.034***		0.025***		0.040***	
	ONPR_HLTH		0.069***		0.049***		0.049***		0.036***		0.061***
	ONPR_AUTO		0.005***		0.004***		0.004***		0.003**		0.004*
	ECOM	-0.003***		-0.002		-0.002+		-0.002*		-0.002	
	ECOM_DELV		-0.003**		-0.002		-0.002		-0.003+		0.002
	ECOM_OMNI		-0.001+		-0.001		-0.001		-0.000		-0.004*
H2 (+)	CS_SOGS*ONPR	0.013*** (Supported)		0.009*** (Supported)		0.006*** (Supported)		0.006*** (Supported)		0.010*** (Supported)	
	CS_SOGS*ONPR_HLTH		0.006*** (Supported)		0.005*** (Supported)		0.004*** (Supported)		0.007*** (Supported)		0.009*** (Supported)
	CS_SOGS*ONPR_AUTO		0.008*** (Supported)		0.006*** (Supported)		0.003* (Supported)		0.000 (Not supported)		0.003* (Supported)
H3 (+)	CS_SOGS*ECOM	0.000 (Not supported)		-0.000 (Not supported)		0.001+ (Supported)		0.002*** (Supported)		0.002** (Supported)	
	CS_SOGS*ECOM_DELV		0.002*** (Supported)		0.001 (Not supported)		0.002* (Supported)		0.002** (Supported)		0.005*** (Supported)
	CS_SOGS*ECOM_OMNI		-0.002*** (Not supported)		-0.001 (Not supported)		-0.001 (Not supported)		-0.000 (Not supported)		-0.003** (Not supported)

Note: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001.

9. Conclusions and Limitations

The retail food access divide highlights significant societal challenges, as disparities in the availability of healthy and affordable food options frequently correlate with socioeconomic inequalities. WCs known for their cost-efficiency and extensive selection of products, have emerged as pivotal players in the retail sector, potentially offering a solution to these disparities. This study aims to understand how the WC business model can enhance consumer accessibility, especially in areas predominantly served by convenience stores rather than full-service supermarkets and grocery stores, with a particular focus on the impact of on-premises and e-commerce service offerings. Our investigation is centered on: the direct effect of the food access divide on consumer visits to warehouse clubs, and the influence of on-premises and e-commerce services on the relationship between the food access divide and warehouse club visits.

The findings highlight that the local food environment, quantified by the ratio of convenience stores to supermarkets and grocery stores (CS_SOGS), significantly influences consumer foot traffic to warehouse clubs. A high CS_SOGS ratio is associated with decreased visits to warehouse clubs, underscoring the negative impact of a predominance of a "food desert" environment on consumer behavior. This study reveals that the integration of on-premises services, particularly healthcare, not only substantially enhances consumer visits to warehouse clubs, but also mitigate the adverse effects of limited access to healthy food options. Automotive services, although not as impactful as healthcare services, also contribute positively.

Conversely, e-commerce services display a nuanced role in influencing consumer visits. Delivery services, while reducing foot traffic to warehouse clubs, are found to mitigate the negative impacts of a high retail food access divide ratio, effectively attracting consumers from moderate distances by offering convenience comparable to nearby convenience stores. Conversely, omni-pickup services tend to exacerbate the negative effects of limited healthy food access by reducing the frequency of in-person visits and limiting spontaneous purchases of healthy foods.

Our study contributes to the business literature on the retail food access divide (e.g., Bader et al., 2010; Guy & David, 2004; Howlett et al., 2015; Jang & Kim, 2018; Sharma et al., 2024), the spatial resilience of warehouse clubs (WCs) (Ellickson et al., 2020; González-Benito et al., 2005; Lim et al., 2020; Pan et al., 2024), and retailers' channel capabilities (Avery et al., 2012). The findings highlight the strategic importance of warehouse clubs tailoring their on-premises and e-commerce services to local retail food environments. This approach is vital for improving consumer access to warehouse clubs in regions with significant disparities in retail food access, thereby promoting more equitable consumer services across various areas.

Our study has several limitations. First, it centers on a single case study within one retail format, examining the three major retail chains in the WC industry. Future research could broaden the scope to include various retail formats, such as supercenters, discount stores, grocery stores, dollar stores, and drug

stores. Second, the retail food access divide may vary between urban and rural areas. Future studies could extend this research to incorporate factors such as the proportion of urban versus rural populations and housing distributions. Moreover, our analysis is confined to the pre-pandemic period from 2017 to 2019. Future studies could extend this timeline to encompass the pandemic and post-pandemic periods, examining shifts in how the retail food access divide influences physical store traffic in light of COVID-19. Lastly, while our study employs foot traffic metrics to analyze shopping behaviors, integrating consumer transaction data could provide deeper insights into how the retail food access divide and service bundling strategies impact consumer behaviors at WCs.

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