Distributional Impacts of the Changing Retail Landscape

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Abstract

We consider the common empirical tactic of estimating consumer value for a good or service by examining consumer willingness-to-travel. We argue that distance to suppliers is endogenous because suppliers strategically choose locations to target consumers; we introduce a novel instrument to address this form of endogeneity. Using geolocation data from millions of smartphones, we estimate preferences for specific retail chains across income groups and regions and show that accounting for distance endogeneity significantly alters willingness-to-travel measures. Contrary to the prevailing "retail apocalypse" narrative, we find that consumer surplus per trip to general merchandise stores did not significantly decline from 2010 to 2019. For the lowest-income consumers, the expansion of national chains, particularly dollar stores, nearly compensates for the closure of traditional department stores and regional chains. Notably, failing to account for distance endogeneity leads to the erroneous conclusion that lower-income households experienced statistically significant consumer surplus declines.

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1 Introduction

In diverse settings such as retail, healthcare, public transportation, and school choice, economists frequently infer an individual's value for a service or amenity by measuring their willingness-to-travel to obtain it. In doing so, this work predominantly treats the locations of these services or amenities as predetermined. While it is well understood that correctly measuring willingness-to-pay requires addressing the endogenous price-setting behavior of firms, most of the spatial literature has abstracted from the endogenous location-setting behavior of suppliers. We highlight the importance of addressing this form of endogeneity in order to accurately measure willingness-to-travel and, hence, consumer value because suppliers strategically choose locations based on targeted consumers. We introduce a novel instrument to address distance endogeneity that can be applied to a variety of spatial contexts. We demonstrate its use with an empirical application to retailing and investigate changes in consumer surplus for brick-and-mortar retail over time.

The transformation of the U.S. retail landscape over the last decade has been characterized as the "retail apocalypse."[1] This shift from traditional brick-and-mortar retail to a hybrid physical/online retail environment may leave some shoppers, particularly low-income ones, traveling farther to reach diminished retail opportunities. To measure how well-served consumers are by brick-and-mortar retail, we first need to know the spatial locations of retailers, consumer shopping patterns, and their underlying preferences. Our study leverages smartphone geolocation data for over 2.7 million devices in 18 metropolitan areas. Smartphone data us to observe visits to a wide set of specific named chains, regardless of payment choice (e.g., credit card versus cash). We show that the household income composition of visitors varies substantially across general merchandise chains. For example, low-income consumers represent a higher share of visitors to Dollar General and Family Dollar than other general merchandise chains. High-income consumers gravitate to large warehouse clubs, such as Costco, as well as luxury department stores, such as Nordstrom.

[1] See, for example, Peterson [2017], Townsend et al. [2017], and Thompson [2017].

Differences in visit propensity could be attributed to dissimilar consumer preferences and/or differential proximity to chains across consumer incomes. To disentangle preference effects from proximity effects, we estimate a model of consumer shopping behavior.

In our model, consumers have individual-level choice sets based on their residence and surrounding retail opportunities. We use the cell data to measure visits and travel distance.[2] We estimate preferences at the income quartile, region level. Retail chain fixed effects encompass the product assortment, prices, and store amenities that the chain offers. While we do not formally model trip chaining, we account for reduced travel costs based on the density of nearby retail opportunities.

A key challenge in estimating this type of location-choice model is the potential endogeneity of the distance between consumers and choices—in this case, stores. Despite the growing understanding of the importance of consumption-based spatial sorting [see, e.g. Almagro and Domínguez-Iino, 2022, Diamond and Gaubert, 2022, Couture et al., 2019], most empirical work using travel costs as an indicator of preferences does not address this endogeneity.[3] Stores presumably locate themselves strategically based on consumer preferences, balancing accessibility to agglomerations of consumers who they expect to like those stores with harvesting the willingness-to-travel of their most loyal customers. These location strategies potentially lead to a correlation between unobserved consumer characteristics (e.g., family size) and distance that may bias our estimates of distance parameters and tastes for individual stores. This form of endogeneity is likely relevant in the literature more broadly—for example, in hospitality, consumer finance, transit, school, or hospital choice.

We introduce a novel instrumenting strategy to control for endogenous distances and show that using this strategy substantially influences our estimates. The instruments are built using publicly-available spatial demographic data, so can be adapted to other settings. Their relevance relies on the idea of preference externalities introduced in Waldfogel

[2] In a robustness check, we substitute distance for travel times, measured at the Census block level using data provided by Cook [2022].

[3] Kluser et al. [2024] use the exogenous timing of entry to estimate distance elasticities of grocery consumers, but this does not address the endogeneity of the locations where stores enter. Shoag and Veuger [2018] and Qian et al. [2023] address the endogeneity of retail locations to estimate spillovers on surrounding retail stores, rather than consumer store choice.

[1999]. The local density of consumers with different observable characteristics affects the attractiveness of different sites for retailers. However, unobservable factors that influence store-location choice may also influence residential choice locations. For example, a chain considers family size, unobservable to the econometrician, but families also like co-locating near other families. To address this, we adopt a control function approach in which the first stage balances the ability to predict store locations as distances while minimizing the influence of potential local agglomeration of consumers on unobservables.

For each metropolitan area, for each distance ring outward from the central business district (CBD), the control function recovers the predicted distance between consumers on that ring to each chain. The instruments are the fraction of population for each income quartile that lives within the ring (a disc), interacted with chain indicators. These instruments exploit that (i) the optimal income composition of the local customer base varies across retailers; (ii) U.S. cities have a strong income gradient from the CBD; and (iii) consumers locally agglomerate. The ring instrument minimizes local agglomeration forces by holding the predicted distance (first stage) to each chain fixed across any location around the edge of the same ring, thereby pooling households that are maximally far away from each other (on the opposite side of the ring). Chain-specific coefficients allow us to capture differential entry strategies of retailers, e.g., distance (and predicted distance) to dollar stores is small because of the proliferation of these establishments. We also discuss alternative spatial demographic instruments and compare our findings.

The second step of estimation uses simulated maximum likelihood following Petrin and Train [2010]. We estimate chain fixed effects (for 25 national retail chains) and five random coefficients (on chain categories) for every metropolitan area, income quartile. We contrast our estimates to those where we abstract from the potential endogeneity problem. We find a strong attenuation bias—assuming distance is exogenous understates the magnitude of the distance coefficients by 37% on average for income quartile one and 43% on average for income quartile four.

Combining our demand estimates with historical data on retail locations provided by Data Axle (formerly ReferenceUSA), we estimate consumer surplus changes for general merchandise retail trips over the last decade. We then decompose the welfare changes

due to national chain entry and exit and the entry and exit of small regional chains. Contrary to the retail apocalypse narrative, we find that consumer surplus (per-trip) has not significantly declined over the past decade. Higher-income households have benefited on net while the lowest-income households have experienced statistically insignificant declines. Gains attributable to the expansion of discount department stores, supercenters, and highly proximate dollar stores nearly cancel out the welfare losses attributable to the exit of smaller regional chains and traditional department stores. Crucially, we show that abstracting from distance endogeneity leads to nearly opposite conclusions that falsely align with the retail apocalypse narrative; these estimates would suggest that the lowest-income households have experienced larger (3×), statistically significant surplus declines while the highest-income households have experienced statistically insignificant surplus increases.

Our paper proceeds as follows. Section 2 briefly describes background information and the prior literature. Section 3 describes our data sources. Section 4 provides model-free evidence documenting that substantial exit and entry of brick-and-mortar retailers over the last decade have changed the US brick-and-mortar retail landscape. Section 4 also documents that consumers of different incomes differ substantially in their propensity to visit different retailers. Section 5 describes our model of consumer shopping choices. Section 6 discusses identification. Section 7 and 8 discuss our estimation and welfare results. Section 9 concludes.

2 Literature and Background

While there is a growing literature estimating the process by which consumers and amenities make location decisions (see, e.g., Almagro and Domínguez-Iino [2022]), the resulting endogeneity of the distance between consumers and service providers has been largely overlooked in demand estimation. This distance endogeneity is a concern whenever willingness-to-travel is being used to infer preferences and remains a concern whether or not prices and price endogeneity are also being considered.

Procedures have been introduced for specific settings or with specific data availability.

For example, Bayer et al. [2007] proposes a method to estimate preferences for schools while addressing the endogeneity of neighborhood sorting using jurisdictional boundary discontinuities. Boundary discontinuities will likely not aid identification in circumstances such as full-choice school districts (as in Agte et al. [2024]) or consumer retail because location relative to a particular boundary is not a discontinuous determinant of school attendance or store patronage.

Endogeneity due to switching costs has been addressed by Raval and Rosenbaum [2018] and Raval and Rosenbaum [2021], who show that standard logit methodologies overestimate distance disutilities in the context of hospital choice. Distance disutilities are biased because patients have an unobserved preference for the characteristics of their closest hospital which conflates with travel elasticity. In particular, this "home bias" is partially due to switching costs; consumers prefer to return to a previously-visited hospital which is likely to be the closest hospital. Raval and Rosenbaum [2018] and Raval and Rosenbaum [2021] use a "movers" fixed effects design to disentangle the "home bias" and travel disutility. The bias in naive logit estimates of the travel disutility that these authors identify is directionally opposite the one identified in this paper. In our setting, the bias is driven in part by profit-maximizing firms harvesting the willingness-to-travel of loyal consumers, a bias more akin to the familiar price endogeneity. In a separate application, Kalnins and Lafontaine [2013] consider the location of headquarters and establishments. They instrument for distance using the percentage of local population with short commutes and find that firm survival is more negatively impacted by distance, controlling for endogeneity.

The problem of estimating demand in the presence of endogeneous distance is closely related to the problem of estimating demand in the presence of endogeneous entry because the endogeneous distance problem in the retail setting is due to the strategic entry behavior of retailers. Recent work by Aguirregabiria et al. [2023], for example, addresses selection bias in demand estimation due to endogeneous entry in the context of airline routes. The methods introduced there apply to zero-one entry into discrete markets and cannot be applied readily in the context of endogeneous entry in retail, which requires a finer discretization of space to capture the spatial variation relevant to consumers. In our

model, the entry decision is relevant through continuous distance.

The motivation behind our distance instrument and the rationale for our welfare analyses are both closely related to the study of preference externalities, a term first coined by Waldfogel [1999]. Presumably, if a chain exits, that is because insufficient consumers value its presence enough to induce the chain to pay the fixed costs of remaining in business. However, consumers can be worse off when their preferences differ from those of others in their community (see, e.g. George and Waldfogel [2003] and Waldfogel [2008]). This observation forms the basis for an instrumenting strategy in Fan [2013], where firm presence overlaps markets.

Our estimates of the per trip income-specific welfare gains and losses from the changing configuration of brick-and-mortar retail are of interest in part because one could be concerned that the migration of higher-income consumers to e-commerce has led to the exit of stores that lower-income consumers would still substantially value. This preference externality effect could lead low-income consumers to suffer welfare losses due to increased travel to retail opportunities. Indeed, Dolfen et al. [2022] estimate the gains from e-commerce and show that they are substantially higher for richer households. This finding stems in large part from the differential take-up of e-commerce: households earning less than $50,000 spend 3.4% of their consumption spending online versus 9.7% for higher income consumers. Estimates from their model also suggest that online competition led to a modest contraction (3%) of brick-and-mortar stores. This finding is consistent with Tran [2022], who exploits the uneven expansion of broadband on trips to physical stores and finds little evidence of a "retail apocalypse" as consumer spend has not declined significantly.

The question of how changing proximity to retail opportunities impacts different demographic groups differently has previously been studied most extensively in the area of food, grocery stores, and "food deserts" whereas our study focuses on potential "retail deserts." Allcott et al. [2019] estimate a model of food demand and obtain counterfactuals suggesting that offering low-income households the same products and prices available to high-income households reduces nutritional inequality by only about 10%; the remaining 90% is driven by differences in product demand, rather than proximity. Both Caoui

et al. [2022] and Chenarides et al. [2021] explore the impacts of dollar store expansion on grocery stores and access to food. Cao [2022] finds that a substantial fraction of dollar store sales stem from low-priced, private-label goods, creating welfare gains for low-income households. Both Cao [2022] and Chevalier et al. [2022] show that dollar stores tend to choose locations close to low-income consumers.

A closely related paper to ours is Cook [2022], who uses smartphone geolocation data to examine the willingness of above-median income and below-median income consumers to travel to a variety of amenities including restaurants, shops, services, and entertainment places. The focus is on measuring the extent to which the preferences of above- and below-median income are correlated. The author shows that preferences are somewhat heterogeneous but that the income sorting of locations is limited: neighborhoods that are amenity-rich have amenities favored by both income types and neighborhoods that are amenity-poor lack amenities desired by both income types. Cook [2022] does not estimate a demand system accounting for location endogeneity.

3 Data

3.1 Data Sources

Our primary data are smartphone geolocation data for 2.7 million devices for 2019 provided by Precisely PlaceIQ, a location data and analytics firm. Precisely PlaceIQ processes location data from users who have opted into geolocation for different smartphone applications. The raw pings from smartphones are joined with a map of establishments, which are characterized by two-dimensional polygons. A timestamped set of pings in a polygon within a short period of time are characterized as a visit by the smartphone owner to the establishments included in the polygon. Often, the polygon contains a single store, e.g., a Walmart and its parking lot. Our project leverages the visits data, not the raw ping data.

Data Axle, formerly known as Infogroup Reference USA, provides identity and outlet locations for multi-unit retail chains. We use these data in our counterfactuals to define consumer access (and distance) to retail in 2010. We check the reliability of these data by

comparing the county-level store counts derived from Data Axle for NAICS code 452 with the corresponding store counts from the US Census Bureau's County Business Patterns (CBP) data. CBP provides county-level establishment counts by NAICs code but does not identify particular establishment names. The county-level store counts from Data Axle are extremely similar to those from CBP (see Figure 1 for evidence).

We leverage a number of other Census data files and surveys to obtain tract-level and zip-level estimates of population by income bin and boundaries for 2010 and 2019.[4] Finally, in a robustness check, we use Census block to Census block travel times provided by Cook [2022].

3.2 Strengths and Weaknesses of Using Cell Data

Smartphone geolocation data have strengths and weaknesses for this kind of analysis. Previous studies of how shopping behavior varies with demographics typically relied on either microdata from a selected consumer panel [e.g., Cao, 2022, Caoui et al., 2022] or on consumer credit and debit card data [e.g., Dolfen et al., 2022, Relihan, 2022].[5] These studies provide important results on shopping behavior. However, Canilang et al. [2020] and Dolfen et al. [2022] show that the consumer propensity to own credit cards is lower for low-income consumers than high-income consumers. Furthermore, credit card usage varies by age, income, and transaction type [see Foster et al., 2020]. For example, the 2019 Survey of Consumer Payment Choices shows that, in a typical month, consumers with income less than $40,000 per year made 8 credit card transactions, 17 cash transactions and 18 debit card transactions. In contrast, consumers with income greater than $75,000 made 26 credit card transactions, 13 cash transactions, and 28 debit card transactions. The survey also reports that 30% of in-person retail purchase transactions were made with cash. This makes the use of cell data appealing, because we capture visits, regardless of payment choice.

[4] We use the 2010 Census and 2015-2019 American Community Survey, the 2019 TIGER/line for tract, zip, and CBSA shapefiles.

[5] Dolfen et al. [2022] use data from credit and debit purchases excluding PIN-enabled debit card purchases. Relihan [2022] uses data from credit and debit purchases for JP Morgan Chase customers and finds them to skew somewhat more male and higher-income than the census at large.

Additionally, cell phone data is largely representative of the US population [e.g., Chen and Pope, 2020, Couture et al., 2022]. Couture et al. [2022] and Couture et al. [2024] discuss the reliability of the Precisely PlaceIQ data that we use in this study. Recently, Klopack and Luco [2024] compare the use of cell visits and card expenditures in measuring local consumption.

Another advantage of smartphone data is that it permits disclosing retailer identities. The providers of payment card, government, and shopper panel datasets typically forbid the disclosure of identifiable information, such as the identities of specific retailers. This forecloses identifying which specific retailers influence consumer shopping behavior and hence, contribute disproportionately to welfare. In contrast, our smartphone data have no such data use restrictions.

While the Precisely PlaceIQ data provides rich detail on individual visit decisions, there are several limitations and challenges inherent in geolocation data that that affect our estimation approach and welfare quantification. First, these smartphone data have only become available in recent years; we cannot examine historical shopping behavior. Therefore, we combine our model estimates with alternative data sources in order to examine changes in retail opportunities over time as well as the ensuing consumer welfare changes. Second, like credit card data, smartphone data do not provide information on what specific items consumers purchased or at what prices. Third, smartphone data also do not provide the overall transaction size or prices. This motivates our decision to capture the price-assortment bundle through chain fixed effects and report consumer surplus measures in terms of willingness-to-travel.

3.3 Summary Statistics

We limit our analysis to cell phone visits to polygons that Precisely PlaceIQ identifies as containing a general merchandise store. These stores are found within the NAICS classification 452. We conduct a number of cleaning steps, including removing visits to polygons that last for short periods of time and removing device-week observations in which a device visits a store more than ten times in a week. We do this in order to avoid misclassifying devices that are visiting stores versus going to stores on someone else's

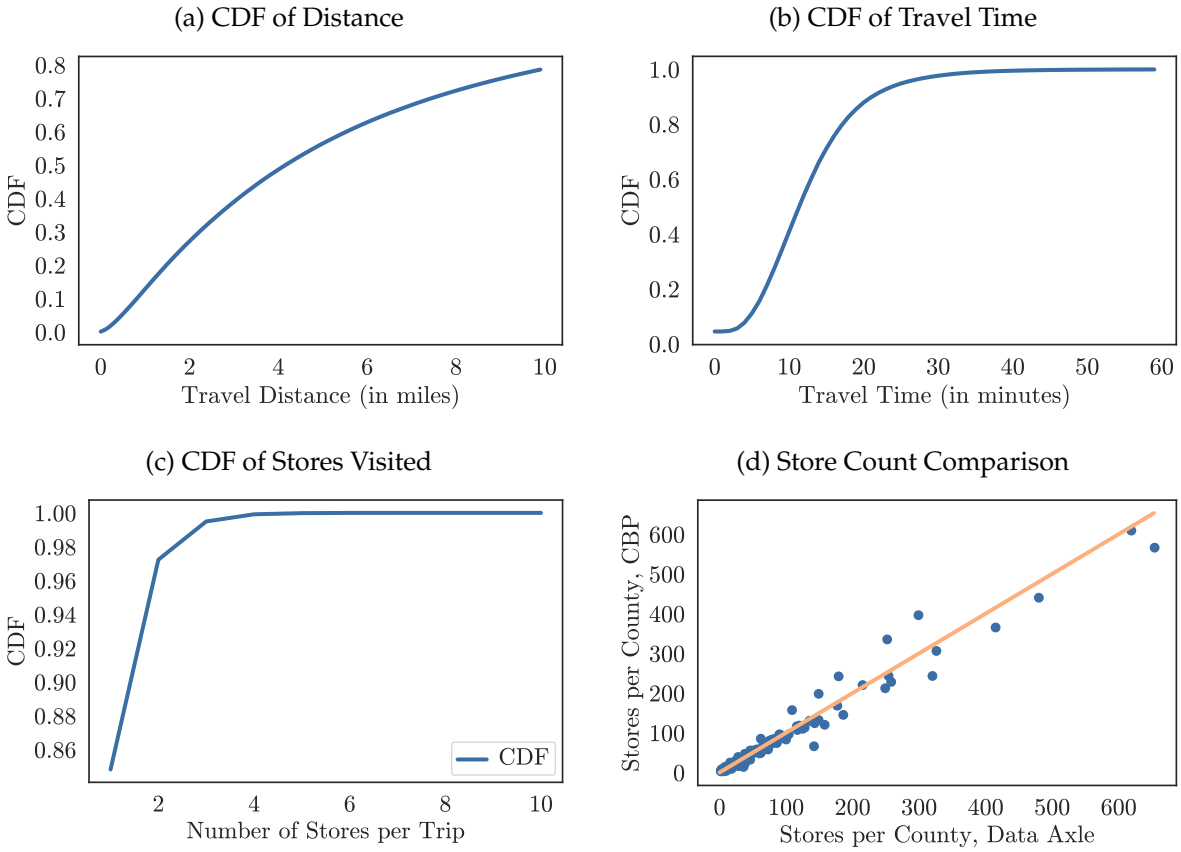
behalf, i.e., a delivery service.

We further restrict our attention to devices originating in 18 of the top twenty largest Core-Based Statistical Areas (CBSAs). We exclude New York and Los Angeles for computational reasons. The CBSAs we consider together comprise over 28% of US population and about 29% of the urban population in the US. In total, we observe over 2.7 million devices. For a subset of devices, Precisely PlaceIQ provides income estimates based on the building in which the device resides. Since we are mainly interested in the impact of the changes in retail opportunities along the income dimension, we assign devices to income quartiles calculated using the Precisely PlaceIQ data and national Census income quartile cutoffs.

We identify and study a set of 25 retail chains that are (or were) commonly present in the CBSAs we study. We provide a list of these chains in Table 2 in the Appendix. These national chains account for over 63% and over 82% of establishments in the general merchandise sector in 2010 and 2019, respectively. They also represent 93% of visits to general merchandise stores in 2019 in our smartphone data sample. We classify visits to other identified establishments belonging to NAICS 452 as visits to "fringe" stores. Typically these are smaller and regional chains. In our model, we collapse the fringe into a single representative option.

While in principle a consumer can visit any store at any distance and combine multiple store visits into a trip, most trips consist of a visit to a single store and to the outlet of a chain that is closest to home. Panel (a) in Figure 1 shows the distribution of visits by the distance between a consumer's home location and the general merchandise establishment the consumer visits up to 10 miles. We find that 79 percent of store visits are within 10 miles of an individual's residence. In our estimation, for tractability reasons, we confine each device's choice set to the set of general merchandise stores within 10 miles of the device's home location. In panel (b), we show the distribution of travel times (in minutes) for the visits included in panel (a) using the data provided by Cook [2022]. The panel shows that overwhelmingly, consumers visit retailers that are are within 30 minutes of their residence. In panel (c), we plot the CDF of the number of stores visited per trip. Nearly 85% of trips to general merchandisers contains a single chain only. The average

Figure 1: Key Data Distributions and Store Count Comparison



Note: Panels (a) uses the universe of shopping trips to general merchandise stores in the CBSAs we study over the study period. Panels (b) and (c) select the visits that are included in panel (a). Panel (d) shows concordance between Data Axle store counts and store counts in County Business Patterns (CBP) in 2019.

number of stores visited per trip is 1.2. In our estimation, we will adjust for the potential for "trip chaining" using the proximity of a given store to other general merchandise stores.

After data cleaning and limiting our attention to the regions and devices selected above, we obtain a final data sample of over 2.7 million devices. In total, our analysis studies nearly 11,000 unique retail outlets, 43 retail chains, and over 44 million retail visits. Table 1 contains summary statistics for the sample. On average, a device visits over three general merchandise stores each week. A majority of these visits are to the set of identified chains. On average, a device has access to 16 of the 25 identified chains within 10 miles of their residence. There are often several outlets of a given chain within the 10 mile radius; we estimate that the number of outlets of inside chains is roughly 73. The number of

fringe outlets a consumer has access to is much lower—at only around five options. We report summary statistics by income quartile in Table A.2 in the Appendix.

Table 1: Summary Statistics for the Data Sample

Variable	Mean	25th Pctile.	Median	75th Pctile.
per device, week				
Number of visits to inside chains	1.86	1.00	1.00	2.00
Number of visits to fringe stores	1.26	1.00	1.00	1.00
per device				
Number of inside chains in choice set	15.99	14.00	17.00	20.00
Number of fringe outlets in choice set	4.63	2.00	4.00	7.00
Number of outlets of inside chains	73.46	34.00	64.00	104.00
Number of stores visited per trip	1.20	1.00	1.00	1.00
Number of unique chains	43			
Number of outlets	10,882			
Number of devices	2,759,690			
Total number of visits	44.256 mil.			

Note: Summary statistics for the 2019 Precisely PlaceIQ cell phone data.

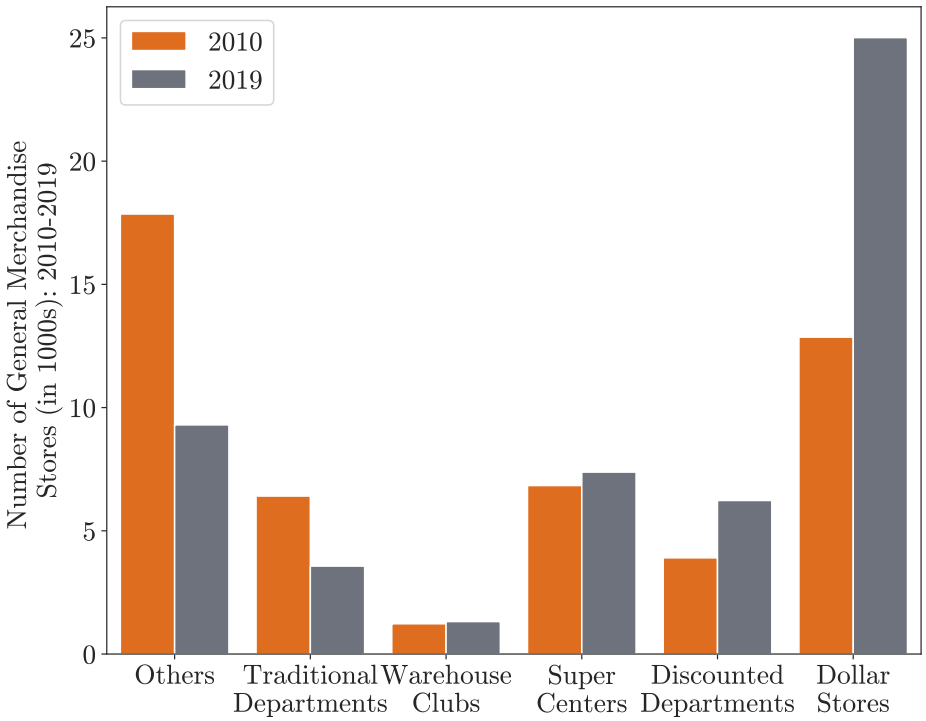
4 Evidence on the Changing Retail Landscape

We provide three new facts about the evolution of the general merchandise store category over the 2010 to 2019 period and about the shopping patterns of consumers by their demographics.

Fact 1: The number of general merchandise stores in the United States increased between 2010 and 2019. In contrast to the press around the "retail apocalypse," the total number of general merchandise stores increased from 49,089 to 52,807 between 2010 and 2019. Figure 2 shows the count of general merchandise stores (NAICS: 452) across the U.S. for 2010 and 2019 using the data from Data Axle. To better understand the changing retail landscape, we group the "inside good" general merchandise stores into six types: Traditional Department Stores, Warehouse Clubs, Supercenters, Discount Department Stores,

and Dollar Stores.[6]

Figure 2: Number of General Merchandise Stores in the U.S. in 2010 and 2019



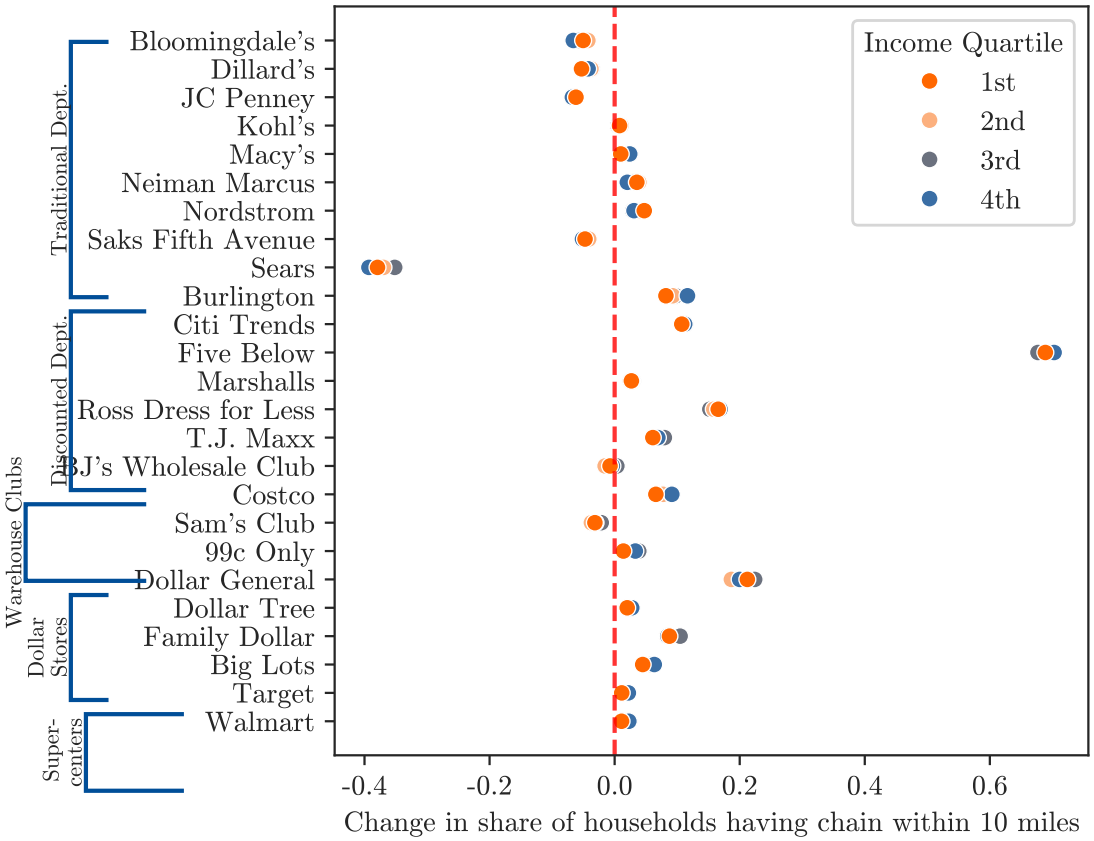
Note: The figure reports the number of general merchandise (NAICS 452) stores with more than 5 employees listed in Data Axle reference Solutions in the U.S. in 2010 and 2019 by category. "Traditional Departments" includes Bloomingdales, Dillard's, JCPenney, Kohl's, Macy's, Neiman Marcus, Nordstrom, Saks Fifth Avenue, and Sears; "Warehouse Clubs" includes BJ's Wholesale Club, Costco, and Sam's Club; "Super Centers" includes Target, Walmart, and Big Lots; "discount departments" includes Burlington Coat Factory, Marshalls, Ross Dress For Less, TJ Maxx, Citi Trends, and Five Below; "Dollar Stores" includes Dollar General, Dollar Tree, Family Dollar, and 99 Cents Only; and "Others" includes general merchandise stores that are not associated with the aforementioned national chains.

The plot reveals that the increase in the number of general merchandise stores was mainly driven by dollar stores and, to a lesser extent, supercenters and discount department stores. The number of dollar stores—including Dollar General, Dollar Tree, and Family Dollar—more than doubled over the decade and, by 2019, was greater than the total count of all other general merchandise stores. During the same period, however, traditional department stores and regional chains have been on the decline.

[6]The chains categorized are the 25 chains enumerated in Table 2. Kmart is excluded from our analysis due to having very few locations and visits.

Fact 2: Access and proximity to the set of identified chains has increased from 2010 to 2019. Figures 3 and 4 depict how access to general merchandise chains changed differently for households in different income quartiles. Figure 3 shows, for each income quartile, the change in the share of households with access to each general merchandise chain from 2010 to 2019, where access is defined as having a store within 10 miles. Figure 4 shows the change in the average distance to the closest store of each general merchandise chain over the same period, selecting on Census blocks in which stores are present within 10 miles in both years.[7]

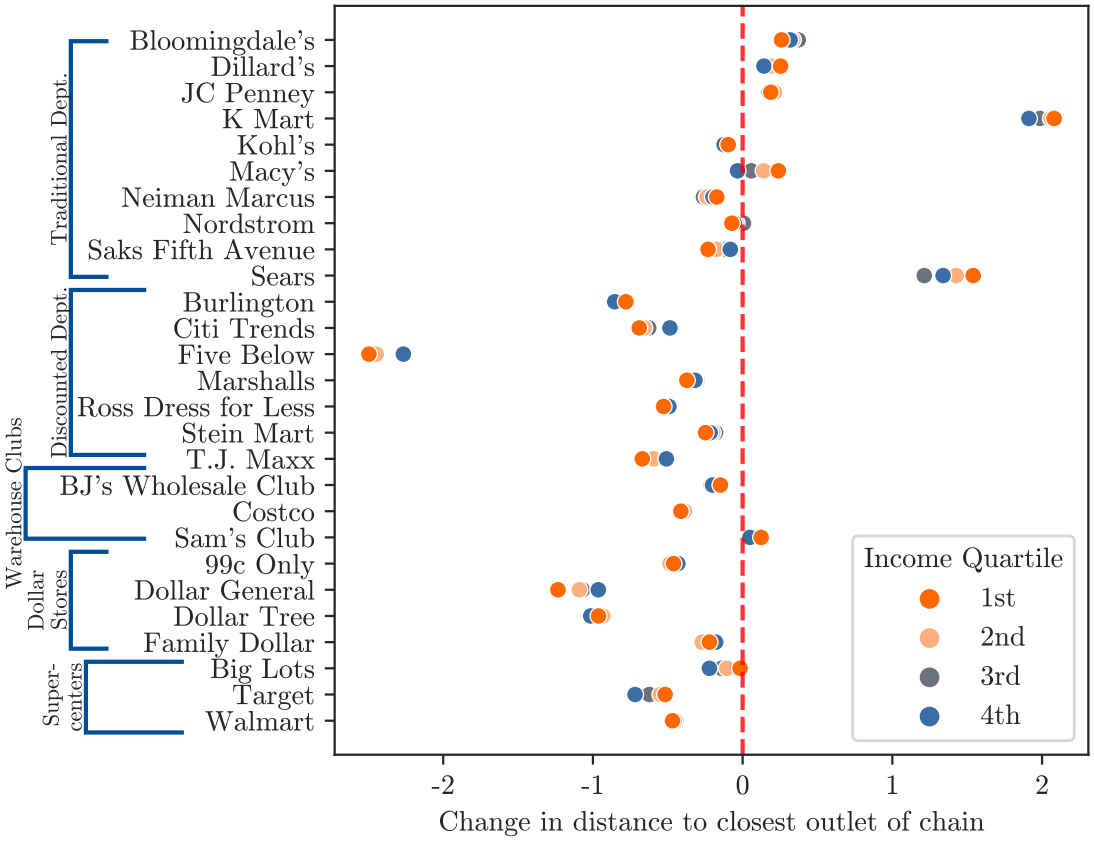
Figure 3: Share of households within 10 miles of General Merchandise Stores in 2010 and 2019 By Household Income Groups



Note: This figure uses U.S. Census data on household residences and income combined with Data Axle data on store locations. The figure shows the change in the share of households having at least one outlet of a particular chain within 10 miles by income quartile for 2010 and 2019.

[7]This is because the distance for a location in which a chain exits completely is undefined. Figure 3 incorporates all Census blocks and measures access as a probability.

Figure 4: Household Proximity to General Merchandise Stores in 2010 and 2019 By Household Income Groups



Note: This figure uses U.S. Census data on household residences and income combined with Data Axle data on store locations. The figure shows the average change in miles to the closest outlet of each change over the 2010 to 2019 period.

The expansion of dollar stores has increased their proximity to households of all income levels. In 2019, more households had access to dollar stores within 10 miles of their census tract of residence and the average household needed to travel fewer miles to visit dollar stores. The degree of improved access varies across household incomes and dollar store chains. The share of households within ten miles of a Dollar General increased by over 20 percent for all income groups. The distance to the closest Dollar General decreased more for lower-income households, while the accessibility of Dollar Tree stores improved slightly more for higher-income households. In addition, households' access to discount department store chains, especially Five Below, improved on both the intensive and extensive margins. The share of households with access to Five Below stores increased

by more than 60 percentage points and the closest Five Below stores were located more than two miles closer for the average household. Among supercenter chains, Big Lots expanded more on the extensive margin, while Walmart and Target expanded more on the intensive margin. The Big Lots and Target expansions were both concentrated among higher-income households.

Fact 3: There are substantial differences in income of consumers who visit the set of identified chains. We now ask whether the differential changes in households' access to general merchandise chains are correlated with the shopping choices of households of different incomes. Figure 5 plots the income distribution of individuals who visited each general merchandise chain in 2019.[8] While the income distributions of our CBSAs are similar to the national distribution, our cell phone data skew toward higher-income consumers. So, we normalize the plot so that each (national) income quartile represents 25% of visits.[9] Dollar stores are among the chains with the largest share of visitors from the lowest income quartile. Among discount department store chains, Cititrends stands out from other chains. The majority of visits to Cititrends are from the two lowest income quartiles, while other discount department store chains see at least 60% of visits coming from the two highest income quartiles and around 40% from the highest income quartile.[10] High-end department stores, Nordstrom, Bloomingdale's, Saks Fifth Ave, and Nieman Marcus draw over half of their visits from the highest income quartile. The visitor mix at supercenters falls somewhere in between, with Walmart's customers skewing low-income, while Target's customers skew high-income. The chain with the most representative clientele is Five Below, access to which increased dramatically between 2010 and 2019.

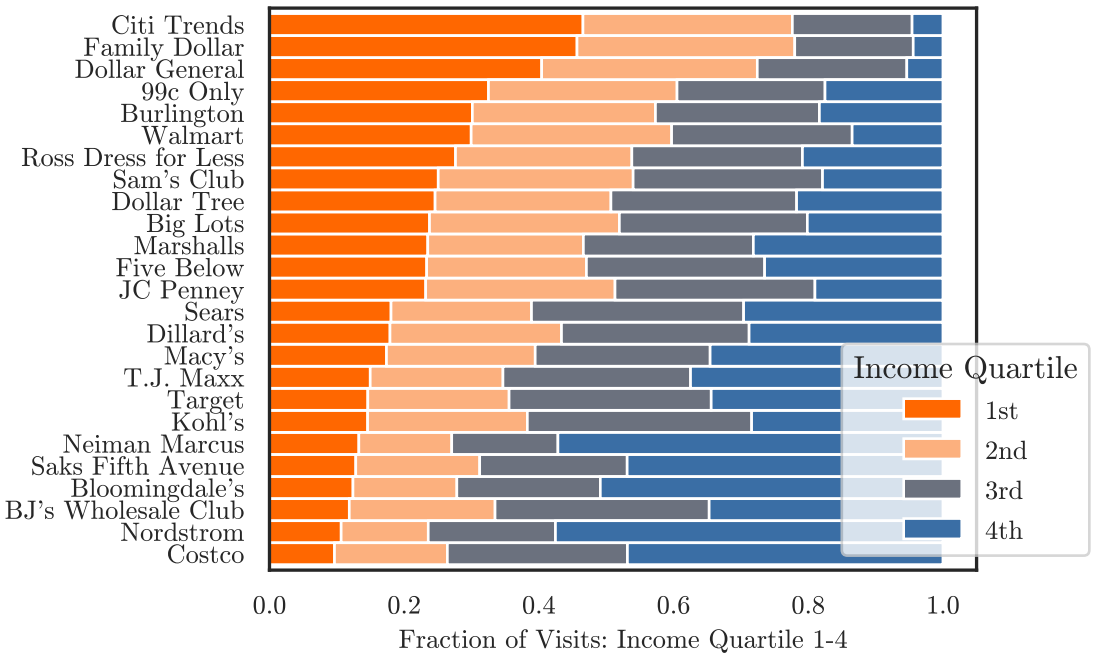
The differences in chain visits across income quartiles potentially reflect a mix of both proximity and preferences. For example, Target improved its proximity to higher-income

[8] We are not able to document the changes in households' shopping patterns from 2010 to 2019 because the Precisely PlaceIQ smartphone location data is not available for 2010.

[9] More precisely, let $s_{i,j}$ be the percentage of visits of income quartile i visiting chain j. In the data, $\sum_i s_{i,j} = 1 \forall j$, but $\sum_j s_{i,j} / \sum_i \sum_j s_{i,j} \neq .25 \ \forall i$. In the figure, we re-weight $s_{i,j}$ by first calculating $\tilde{s}_{i,j} = s_{i,j} / \sum_j s_{i,j}$ for each i, and then re-scaling the distribution for each j, i.e., $\hat{s}_{i,j} = \tilde{s}_{i,j} / \sum_i \tilde{s}_{i,j}$.

[10] According to its 2022 10-K filing, Cititrends is a "value retailer of apparel, accessories and home trends for way less spend, primarily for African American and Latinx families in the United States" and stores are located "at the crossroads of low to moderate income households."

Figure 5: Household Shopping Patterns By Household Income Groups



Note: The figure uses Precisely PlaceIQ data to show the share of 2019 visitors to each chain represented by members of each household income quartile. Chains are ordered from highest to lowest share of income quartile one visitors. The figure is normalized so that each income quartile represents 25% of the total area. The same figure, without the normalization, is shown in Figure A.1.

households between 2010 and 2019 by more than Walmart. The higher share of high-income visitors to Target relative to Walmart likely reflects both the differences in their location strategies and the differences in product prices and assortment varieties at the two stores.

5 A Model of Consumer Shopping Choices

We model consumer store-choice decisions using a discrete choice framework and study the trade-offs from visiting physical stores. We abstract from the decision to shop online but discuss the impact of online shopping on our results below. We present the model for a representative CBSA to minimize the number of indices required. However, in estimation, all model parameters are CBSA-specific.

Let i denote a consumer and $y(i)$ their income. We assign $y(i)$ to be the quartile of

national household income based on the residence-level income information observed in the Precisely PlaceIQ demographic data. All parameters also vary by income quartile, as we show below.

We define J_i to be consumer i's choice set. This set contains all stores located within 10 miles of consumer i's residence. Recall that we impose this restriction because it keeps data construction manageable but also captures 79% of consumer trips within their CBSA. We partition consumer i's choice set J_i into two sets, denoted by J_i^c and J_i^f. The first set contains the set of brick-and-mortar stores of identified retail chains. The second set denotes fringe (e.g., regional and smaller chain) stores. We include both K Mart and Stein Mart in the fringe due to drastic reductions in number of open stores from 2010 to 2019. We capture this welfare effect (via the fringe term) in counterfactuals.

We use j to denote an arbitrary choice. We abstract from the choice among stores that are part of the same chain as this approach greatly simplifies the choice set without introducing substantial measurement error. We estimate that 78% of consumer visits to a chain store are to the closest location of that chain from consumer i's residence.

A consumer's indirect utility of visiting chain j is given by

$$u_{i,j} = \begin{cases} v_{i,j}\left(x_{i,j}, dist_{i,j}; \beta_{y(i)}\right) + \xi_{i,j} + \varepsilon_{i,j} & j \in J_i^c \\ \Gamma(J_i^f) + \varepsilon_{i,0} & j \in J_i^f \end{cases}, \tag{5.1}$$

where $v_{i,j}(\cdot)$ is a function of covariates $x_{i,j}$ and straight line distance from i to chain j, $dist_{i,j}$. The terms $\xi_{i,j}$ and $\varepsilon_{i,j}$ are unobserved preferences. The function $v_{i,j}(\cdot)$ characterizes chain quality and distance costs, which we assume is linear and of the form

$$v_{i,j} = \beta^{(1)}_{y(i),j} + \beta^{(2)}_{y(i)} dist_{i,j} + \beta^{(3)}_{y(i)} density_{i,j}. \tag{5.2}$$

The parameter $\beta^{(1)}_{y(i),j}$ is a chain-income-quartile fixed effect that captures the average utility consumer i of income $y(i)$ derives from visiting chain j. It is offset by a shopping cost, which also varies by income grouping.

The shopping cost has two elements. The first element captures the travel cost consumers incur and increases in distance, $dist_{i,j}$. Because we assume consumers choose a

representative store, we calculate distance as the trip-weighted mean distance between consumer i and stores of chain j. If a consumer never visits a specific chain, we use the trip-weighted mean distance to the specified chain among consumers living in the same zip code.

The second element in our shopping cost specification is $density_{i,j}$, which we include to account for trip chaining. Trip chaining occurs when a consumer visits multiple retail outlets on a single trip, reducing the effective distance traveled to a store.[11] Trip chaining may be more likely to occur when stores are co-located—for example, within a mall. To account for the possibility that consumers experience a lower effective travel cost when stores are co-located, we control for density. Like distance, density is measured for each consumer-chain pair. We define $density_{i,j}$ as the natural log of one plus the number of other general merchandise stores within 0.1 miles of that location of chain j. When there is more than one outlet of chain j within 10 miles of consumer i, we take the trip-weighted average of this log proximate store count across each of the outlets of chain j within 10 miles of consumer i's residence. For an isolated store, $density_{i,j}$, is zero.

We assume that the deterministic utility of choosing a fringe store is equal to

$$\Gamma(J_i^f) = \omega_{y(i)} \log\left(\left|J_i^f\right| + 1\right), \tag{5.3}$$

where $\omega_{y(i)}$ captures the income-specific taste for fringe stores, and $\left|J_i^f\right|$ is the total number of fringe stores available in consumer i's location. This functional form allows utility to increase with the number of the fringe stores available to consumer i residing at their location as in Ackerberg and Rysman [2005]. We normalize preferences to choosing a fringe store instead of specifying the outside option to be not visiting any store because this allows us to avoid modeling the frequency of store visits. For example, if we chose to the model the frequency to be daily, then devices that visit more than store violate the assumption of a single discrete choice. We do not follow the approach of Berry [1994] and Berry et al. [1995] due to the significant number of zero-visit observations.[12] Even

[11] A complete analysis of trip chaining is complex and is the focus of ongoing research in the geolocation data field (see, for example, Relihan [2022], Miyauchi et al. [2021], Oh and Seo [2023]).

[12] In both approaches, estimation requires taking the log of quantity, which is undefined when zero devices

aggregating geography to the zip code level, we find that the percentage of zeros to be 66% and 41% at the daily and weekly level, respectively.

We allow parameters to vary across income quartiles but not over time. This is reasonable given that the typical device is only tracked for a couple of months.

Unlike prior work that involves location-choice models, we allow for the possibility that the unobservable chain preferences ($\xi_{i,j}$s) are potentially correlated with distance. We assume that the second set of unobservables ($\varepsilon_{i,j}$s), are independently and identically distributed and follow a type-1 extreme value distribution and that a single unobservable ($\varepsilon_{i,0}$) is associated with choosing a store in the fringe (J_i^f).

5.1 Estimation

We address potential endogeneity between distance and ξ, or the co-location of stores and consumers, using instrumental variables in a control function approach following Petrin and Train [2010]. The control function is

$$dist_{i,j} = \Pi\left(z_{i,j}, x_{i,j}; \delta_{y(i)}\right) + \mu_{i,j}, \tag{5.4}$$

where z are instruments that are relevant for distance, but do not enter consumers' utility functions, and μ and ξ are jointly normal over j. We assume that Π is linear in parameters, i.e., $\Pi := [z_{i,j}, x_{i,j}]^T \delta_{y(i)}$. With our assumptions on the unobservables, we can rewrite utility of choosing a non-fringe chain as

$$u_{i,j} = v_{i,j}\left(x_{i,j}, dist_{i,j}; \beta_{y(i)}\right) + \rho\mu_{i,j} + \sigma_j\eta_{i,j} + \varepsilon_{i,j}, \tag{5.5}$$

visit a store.

where η are standard normal distributions. Integrating over the unobservables, we obtain individual choice probabilities of the mixed-logit model, i.e.,

$$s_{i,j} = \int \int \mathrm{I}\left[u_{i,j} > u_{i,j'} \ \forall j' \in J_i\right] dF(\eta)\, dF(\varepsilon) \tag{5.6}$$

$$= \int \frac{\exp\left(v_{i,j} + \mu_{i,j}\rho + \sigma_j \eta_{i,j}\right)}{\exp\left(\Gamma(J_i^f)\right) + \sum_{j' \in J_i^c} \exp\left(v_{i,j'} + \mu_{i,j'}\rho + \sigma_j \eta_{i,j'}\right)} dF(\eta_1 \mid \sigma_1) \times ... \times dF\left(\eta_{J_i} \mid \sigma_{J_i}\right). \tag{5.7}$$

Estimation proceeds in two steps. Due to the size of the data, we split estimation by CBSA-income quartile. In the first step, we estimate the control functions using OLS and compute their residuals as

$$\widehat{\mu}_{i,j} = dist_{i,j} - \Pi\left(z_{i,j}, x_{i,j}; \widehat{\delta}_{y(i)}\right). \tag{5.8}$$

We plug these residuals into equation 5.7. Because equation 5.7 does not have a closed-form solution, we use Monte Carlo integration to numerically compute its values.[13]

In the second step, we estimate the demand parameters, $\theta_{y(i)} := (\beta_{y(i)}, \rho_{y(i)}, \sigma_{y(i)})$, via simulated maximum likelihood. Specifically, given a set of devices (I) for a particular CBSA-income quartile group, we define $N_{i,j}$ to be the total number of visits i makes to option j. We can aggregate visits because the model does not have time-varying parameters. The log-likelihood for the data is

$$\max_{\boldsymbol{\theta}_{y(i)}} \ \frac{1}{H} \sum_{h=1}^{H} \sum_{i,j} \left(N_{i,j} \cdot \log\left(s_{i,j}^{(h)}\left(\theta_{y(i)}\,;\, x_{i,j}, dist_{i,j}, \widehat{\mu}\right)\right)\right). \tag{5.9}$$

We estimate CBSA-income quartile-specific random coefficient parameters for each of five groups of chains: warehouse stores, traditional stores, discount stores, supercenters, and dollar stores. The mapping of chains into groupings is shown in Figure 3. In total, we estimate distance, density, and fringe preferences, (up to) 25 chain preferences, five random coefficients, and the control function parameters for each CBSA-income quartile. We compute standard errors using bootstrap, sampling devices with replacement.

[13] We select $H = 100$ Halton draws per consumer-chain to compute choice probabilities.

As a robustness check, we also estimate the model using travel times (in minutes) between Census block of consumer i's residence and the Census block of the store using the data provided by Cook [2022] instead of distance. We allow travel time to be endogenous and estimate the model using the same approach.

6 Endogeneity Problem, Instruments, and Identification

The disutility from traveling is identified by measuring the propensity of individuals within an income quartile to visit more proximate versus more distant stores. Conditional on the disutility of distance, we infer willingness-to-travel to a given chain relative to another by the relative frequency with which consumers visit stores from each chain. Intuitively, if we observe a consumer driving past a Walmart to visit a Target, it must be because that consumer values shopping at Target more.

We instrument for distance because store locations are endogenous. Match quality between consumers and a given chain likely varies by consumer characteristics that are unobserved by the econometrician but potentially observed by chains. A profit-maximizing chain will choose store locations strategically based on—among other factors—the spatial distribution of these consumer characteristics. This endogeneity problem is also conceivably a concern for other settings where distances are commonly taken as exogenous, including transportation, school choice, healthcare, etc.

The potential bias introduced by endogenous distance is more complex than the familiar price endogeneity. The standard price endogeneity problem involves unobservable qualities ξ_js, that are typically assumed to be common to all customers, being correlated with prices, which are also commonly assumed to be common to all consumers. In our setting, individual-specific match quality may be correlated with individual-specific distance, i.e., $\xi_{i,j}$ is correlated with $dist_{i,j}$.

To be concrete about the concern, consider that chain location preferences vary with consumer characteristics. Our model explicitly accounts for one such characteristic: consumer income. Chain preferences may also vary across other dimensions of household characteristics, such as household composition and ethnicity, that are unobserved to the

econometrician. That is, just as households have chain tastes specific to their income group y, $\beta^{(1)}_{y(i),j}$, they may also have chain tastes specific to an unobserved household type k and have type-specific chain preferences, $\beta^{(0)}_{k(i),j}$. Since we do not explicitly model these type-specific chain preferences, they enter the unobserved component of indirect utility, $\xi_{i,j}$.

Suppose that households sort spatially by type k and this type is observable to chain executives, who pay a fixed cost of entry so select a finite number of locations in which to enter. If chains locate stores strategically with respect to agglomerations of their most loyal customers, distance $dist_{i,j}$ will reflect unobserved type-specific preferences, $\beta^{(0)}_{k(i),j}$, that enter the unobserved component of utility, $\xi_{i,j}$.

The direction of the bias this creates is ambiguous. On the one hand, the chain may systematically locate its stores to be accessible to those consumers who particularly value it. This co-location will result in a negative correlation between $dist_{i,j}$ and $\xi_{i,j}$. Were one to infer a distance disutility and taste for the store ignoring this, consumers would appear to be very unwilling to travel, biasing the distance disutility parameters away from zero. Further, consumers would not appear to value the store very much because its visitors would not travel far from home to visit it.[14]

On the other hand, if the chain exploited their loyal customer type's willingness-to-travel and located closer to agglomerations of other household types, we would observe a positive conditional correlation between $dist_{i,j}$ and $\xi_{i,j}$. In this case, abstracting from distance endogeneity would result in consumers appearing less sensitive to distance than they indeed are, biasing the estimates of distance disutility parameters towards zero. Note that this latter intuition is closest to the classic price endogeneity problem.[15]

One approach to addressing this endogeneity problem is to fully model the location-choice problem. However, that is challenging, due to the combinatorics of potential entry

[14]Similarly, consider a policymaker locating transportation infrastructure. The policymaker may locate train or bus routes near people who particularly like public transportation. People who particularly like public transportation will choose to live near this infrastructure. Inference regarding tastes for the infrastructure and distance costs could be biased.

[15]Indeed, if consumers have high willingness-to-pay due to an unobserved demand shock, the producer will raise the price to appropriate some of the consumer surplus. In the distance context, if a consumer has a high willingness-to-travel due to an unobserved match with the chain, the retailer can appropriate some of the consumer surplus by building fewer stores, in less costly locations.

points and modeling strategic response. We instead pursue an instrumental variables approach that exploits the fact that our endogenous variable—the distance between consumers and stores—is continuous. We model the distance of a given chain j from a consumer i's residence as a function of the observed demographic mix near i's residence that make locating proximate to i more or less attractive to chain j. This approach can be used in a variety of settings using publicly available data.

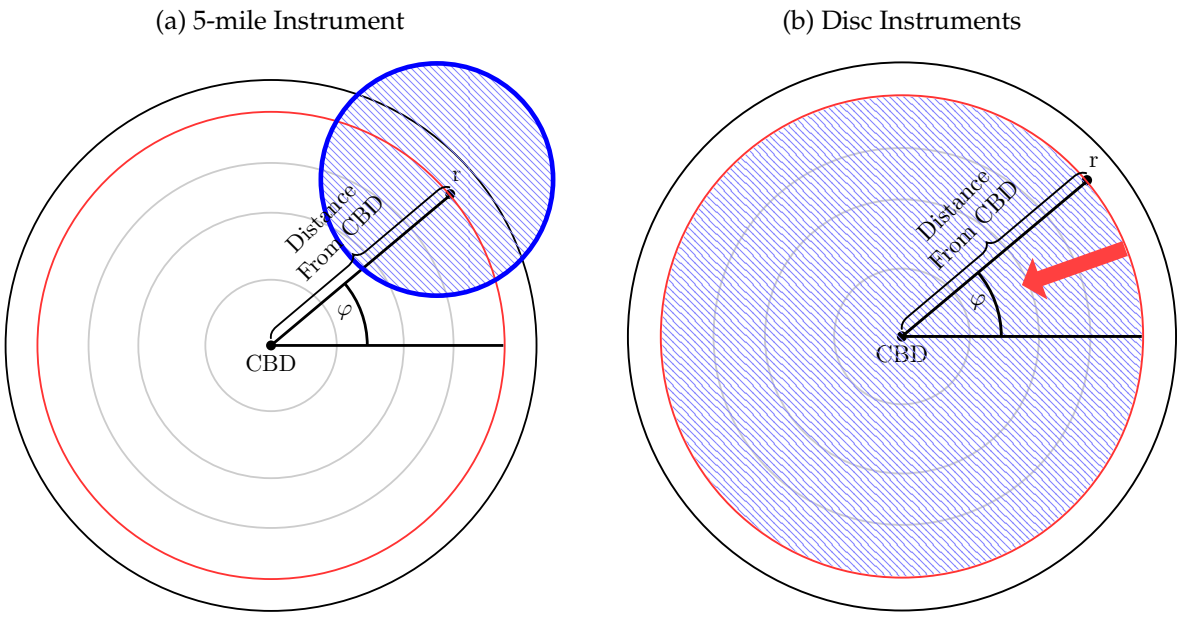
Our instrumental variables strategy exploits strategic chain siting relative to consumers of different observable income types within a CBSA. That is, we expect that a consumer's proximity to agglomerations of different income groups will partially explain their proximity to different retail chains. Then, conditional on the consumer's income-specific tastes, we predict which chains they visit through this channel (and not through a channel in which distance predicts unobserved preferences $\xi_{i,j}$).

Formally, we seek instruments $z_{i,j}$ that, conditional on covariates, (i) predict distance of consumer i from chain j and (ii) are not correlated with unobserved chain preferences $\xi_{i,j}$. Since one of the covariates is consumer i's income group $y(i)$, the relevance condition (i) requires that the instruments predict how much closer to (or further from) chain j household i is than members of the same income group in the same CBSA. The exclusion restriction (ii) implies that the instruments cannot predict why, for a given $dist_{i,j}$, a given household i may be more or less likely to select a chain j than other members of the same income group in the same CBSA. This exclusion restriction will be violated if the instruments predict household i's unobserved chain preferences because, for example, the instruments predict household characteristics that explain within-income differences in chain tastes.

At first pass, it may appear to be desirable to directly instrument for distance using the income mix proximate to a consumer's neighborhood, e.g., within a 5-mile radius around their home. This is depicted in Figure 6-(a). If there is sufficient mass of certain incomes of households, it may be more (or less) likely that a particular chain is close by and the interaction between a chain fixed effect and the share of each income quartile q within 5 miles of a consumer i's residence, $share^{\text{5-mile}}_{q,l(i)}$, will predict the distance of i. Suppose again that consumers have type-specific chain preferences $\beta^{(0)}_{k(i),j}$ that are unobserved to

the econometrician but used by chains for store siting purposes. If consumers of the same income y sort by type k into neighborhoods with different income mixes, such that $Cov[k, share_{q,l}^{5\text{-mile}}|y] \neq 0$ for some income quartile q, the neighborhood income mix instrument will violate the exclusion restriction. For example, conditional on household income, households with school-age children tend to reside in neighborhoods in which everyone is high income in order to access schools with better test scores. If high-income households with school-age children also have stronger unobservable preferences for, say, Costco than high-income households without school-age children and Costco considers both income and family size in their siting decisions, then an instrument based only on local neighborhood income mix will be correlated with household type-specific preference component of $\xi_{i,j}$ and violate the exclusion restriction.[16]

Figure 6: Instrument Construction for Spatial Data



Note: Panel (a): Exploiting the preference externality idea, the figure shows instruments constructed based on a 5-mile radius around each consumer. Panel (b): Depicted are disc instruments of radius r from the CBD. We compute, by income quartile, the share of the CBSA population that resides within r.

For our application, rather than adopt the instrumenting strategy suggested by Figure 6-(a), we exploit regularities in the landscape of US cities with a "disc" instrument. In

[16]We show demand estimates using the Figure 6-a instruments in the Appendix. While they have a stronger first stage than our preferred instruments, the results using them in our context are quite similar to our preferred instruments.

US cities, land values and commuting times vary systematically with distance from the central business district (CBD). Depending on the income elasticity of demand for land and income elasticity of commuting costs, the income mix of residents will also vary with distance to the CBD (see, for example, Duranton and Puga [2015]). Our disc instruments exploit this variation. Figure 6-(b) provides a graphical representation of their construction. Consider that any location (latitude and longitude) can be characterized by its polar coordinates relative to the CBD: (r, φ). Going outward from the CBD, we define a disc for every consumer equal to the region from the CBD bounded by their r, as determined by their residence. For every disc, we calculate the share of the CBSA's income quartile q population that resides the same distance r or closer to the CBD, which we denote by $share_{q,r}$.[17]

We then model the distance of an individual i to chain j, or the control function, as a linear function of the share of the CBSA's residents in income quartile q that reside the same or closer distance to the CBD as individual i, or $share_{q,r(i)}$.We include all income quartiles in the control function. That is, $dist_{i,j}$ is modeled as

$$dist_{i,j} = \sum_{q \in \{1,2,3,4\}} \delta^{(1)}_{q,y(i),j} share_{q,r(i)} + x_{i,j}\beta_{y(i)} + \mu_{i,j}, \tag{6.1}$$

Critically, parameters are chain-specific and vary by the income quartile of consumer i, which allows us to estimate differences across chains in their their predicted distance from the same consumer. The unobservable and potentially endogenous component of the distance instrument is $\mu_{i,j}$. We estimate equation 6.1 using OLS. While the predicted distance for a consumer located at (r, φ) includes the income share and density data for the entire disc formed by r, the difference in the predicted distance for a consumer located at (r, φ) and (r', φ') would be due to the characteristics of the annulus from r to r'.

Importantly, the disc instruments only use information about the income mix at the consumer's radius from the CBD, regardless of the direction the consumer resides relative to the CBD (φ). They can improve on the 5-mile instruments since they do not rely on

[17] In practice, we calculate the share of the population that resides in Census tracts whose centroids are a distance r or less from the CBD.

the income mix in the household's immediate neighborhood, which could be correlated with other household characteristics that households sort on and that chains account for in siting decisions. Using the notation introduced above, we expect that $Cov[k, share_{q,r}|y] \leq Cov[k, share_{q,l}^{5\text{-mile}}|y]$, since centrality r is more general than location l, as location l potentially involves sorting on both centrality r and direction φ. These instruments will better satisfy the exclusion restriction to the extent that there is less within-income sorting on observables by distance to the CBD, r, than there is by direction, φ, around rings the same distance from the CBD. [18]

Alternative Instruments and Additional Endogenous Variables

Other instruments can be constructed depending on the application. It may be desirable to exclude proximate neighbors when constructing the instruments if the threat to identification is particularly strong. One approach is to exclude a region around a given consumer's angle φ. With this approach, a sector (or, in simpler terms, a slice) is removed from our original disc instruments. Alternatively, it may be desirable to exclude some distance bands from the CBD entirely. This would result in constructing annuluses, or regions defined between concentric circles. That is, the instrument would be a "washer." Figure A.2 in the Appendix depicts how these alternative instruments can be constructed with the same underlying data.

Our control function (6.1) could instead be written as a function of the product of the share of the total CBSA population residing at the same or closer distance as i to the CBD and the shares of those residents that fall in each income quartile. Some of the power of this set of instruments may therefore be derived from the factors related to the population density at different distances from the city. To the extent that these factors drive supply (e.g., land values acting as a direct cost shifter), they do not threaten our identification argument. Using population density alone, however, provides insufficient power to estimate our model. Cost shifters that vary with population density – e.g., the availability and cost of certain retail footprints – likely impact siting decisions of different

[18] As is often the case with instrumenting strategies, there may be a tradeoff between the explanatory power of the instruments and the degree of bias. Below we show that our preferred instruments still have substantial explanatory power.

chains similarly. To predict chain-specific distances, we rely on the additional power that we get from the income-specific population shares.

Our approach addresses the endogeneity concern that retailers strategically locate based on local demographics, however, it may also be that the fringe count itself is endogenous. We also consider this possibility and instrument for both. The results are in the Appendix. Overall, we find that our estimates are qualitatively similar to when using alternative instruments and also when instrumenting for the fringe.

7 Parameter Estimates

Due to the large number of parameters estimated, we summarize our results here. In the Appendix, we provide parameter estimates for every CBSA-income quartile separately. In Table 2, we report income quartile-level estimates, aggregated over CBSAs using income quartile-specific population counts. Standard errors are reported using bootstrap aggregation.

For comparison purposes, we also estimate a variant of our model where distance is assumed to be exogenous. When distance is exogenous, we remove the control function and estimate the model using a single step, retaining ξ as random effects and estimating the variances using the same chain groupings. We report a summary of these demand estimates in Table 3. Just like the endogeneous case, we report estimates for every CBSA-income quartile separately in the Appendix.

Table 2: Summary of Demand Estimates, Distance Endogenous (Disc Instruments)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.444	(0.020)	-0.469	(0.010)	-0.475	(0.009)	-0.540	(0.010)
Density	β^{d2}	0.339	(0.083)	0.206	(0.018)	0.177	(0.014)	0.141	(0.015)
Fringe	ω	1.478	(0.769)	1.354	(0.066)	1.340	(0.023)	1.130	(0.018)
Control Function	ρ	0.181	(0.016)	0.221	(0.007)	0.212	(0.006)	0.242	(0.007)
Chain Preferences									
BJ's Wholesale Club		1.903	(1.436)	2.474	(0.730)	2.389	(0.584)	2.577	(0.450)
Costco		2.236	(0.929)	3.248	(0.328)	3.545	(0.406)	4.217	(0.354)
Sam's Club		0.636	(1.348)	1.478	(0.898)	2.633	(0.703)	2.427	(0.819)
Bloomingdale's		-0.856	(1.590)	0.998	(0.872)	0.259	(0.647)	2.206	(0.568)
Dillard's		-2.771	(1.654)	0.443	(0.727)	-0.363	(0.801)	1.054	(0.508)
JC Penney		0.104	(0.784)	1.168	(0.558)	0.860	(0.453)	0.726	(0.390)
Kohl's		-0.164	(0.862)	1.672	(0.446)	1.271	(0.569)	1.567	(0.323)
Macy's		0.562	(0.973)	1.685	(0.577)	1.402	(0.468)	2.027	(0.378)
Neiman Marcus		-1.805	(1.272)	-0.133	(0.758)	-0.091	(0.685)	1.207	(0.484)
Nordstrom		-0.538	(1.066)	0.602	(0.710)	0.408	(0.683)	1.953	(0.489)
Saks Fifth Avenue		-1.194	(1.213)	0.074	(0.816)	0.124	(0.747)	0.787	(0.680)
Sears		-3.595	(1.229)	-1.006	(0.717)	-1.250	(0.734)	-1.083	(0.572)
Burlington		3.000	(0.881)	3.144	(0.437)	3.012	(0.305)	3.130	(0.267)
Citi Trends		3.111	(1.647)	2.942	(0.427)	2.730	(0.828)	2.117	(0.630)
Five Below		0.845	(0.941)	1.175	(0.491)	1.227	(0.445)	1.437	(0.401)
Marshalls		2.406	(0.862)	2.743	(0.524)	2.869	(0.603)	3.149	(0.363)
Ross Dress for Less		3.399	(1.043)	3.467	(0.815)	3.451	(0.707)	3.933	(0.521)
T.J. Maxx		2.299	(1.026)	2.851	(0.718)	3.047	(0.646)	3.228	(0.559)
Big Lots		0.061	(0.752)	1.340	(0.301)	1.363	(0.261)	1.618	(0.234)
Target		3.125	(1.014)	3.730	(0.709)	4.126	(0.706)	4.733	(0.471)
Walmart		5.424	(1.091)	5.330	(0.660)	5.257	(0.593)	4.875	(0.516)
99c Only		2.033	(1.192)	2.910	(0.315)	1.322	(0.583)	1.617	(0.255)
Dollar General		2.522	(0.860)	2.419	(0.467)	2.042	(0.519)	1.266	(0.419)
Dollar Tree		3.814	(0.847)	3.874	(0.376)	3.607	(0.395)	3.818	(0.327)
Family Dollar		3.010	(0.846)	3.080	(0.442)	2.593	(0.446)	1.816	(0.374)
Random Coefficients	σ_k								
Warehouse Stores		2.438	(0.286)	1.788	(0.172)	1.915	(0.122)	2.148	(0.118)
Traditional Stores		2.935	(0.335)	1.998	(0.225)	2.378	(0.195)	2.411	(0.153)
Discount Stores		0.990	(0.265)	0.763	(0.150)	0.627	(0.130)	0.437	(0.100)
Supercenters		2.094	(0.281)	1.284	(0.121)	1.066	(0.107)	0.855	(0.111)
Dollar Stores		1.459	(0.233)	1.028	(0.144)	1.388	(0.128)	1.339	(0.127)
Summary									
Number of Visits		1,476,820		7,737,705		11,797,999		13,796,397	
Number of Devices		130,157		605,128		886,500		1,132,056	
Avg. First Stage Partial R^2		18.9%		13.5%		11.6%		12.8%	
Avg. First Stage Partial F-stat		237.1		720.4		873.9		1514.0	

This table summarizes our demand estimates across 18 CBSAs and all income quartiles allowing for distance to be endogenous. To aggregate our estimates, we use income-specific CBSA populations as weights. Standard errors are also aggregated using bootstrap aggregation with 1,000 block bootstraps.

Table 3: Summary of Demand Estimates, Distance Exogenous

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.278	(0.016)	-0.270	(0.006)	-0.274	(0.005)	-0.310	(0.006)
Density	β^{d2}	0.357	(0.074)	0.245	(0.021)	0.193	(0.017)	0.148	(0.016)
Fringe	ω	1.404	(0.799)	1.292	(0.078)	1.248	(0.025)	0.994	(0.017)
Chain Preferences									
BJ's Wholesale Club		1.299	(1.559)	1.540	(0.593)	1.522	(0.511)	1.485	(0.427)
Costco		1.698	(0.939)	2.254	(0.323)	2.738	(0.385)	3.088	(0.358)
Sam's Club		0.066	(1.427)	-0.424	(1.075)	1.834	(0.663)	1.299	(0.931)
Bloomingdale's		-1.482	(1.618)	-0.288	(0.854)	-0.658	(0.588)	1.197	(0.577)
Dillard's		-3.301	(1.798)	-1.005	(0.717)	-0.750	(0.770)	0.348	(0.492)
JC Penney		-0.286	(0.785)	0.135	(0.584)	0.109	(0.437)	-0.133	(0.382)
Kohl's		-0.464	(0.867)	0.734	(0.423)	0.680	(0.494)	0.901	(0.322)
Macy's		0.011	(0.971)	0.508	(0.570)	0.601	(0.437)	1.057	(0.358)
Neiman Marcus		-2.548	(1.384)	-1.375	(0.761)	-0.929	(0.634)	0.259	(0.500)
Nordstrom		-1.103	(1.050)	-0.584	(0.707)	-0.418	(0.651)	1.021	(0.489)
Saks Fifth Avenue		-1.875	(1.260)	-1.156	(0.793)	-0.996	(0.685)	0.073	(0.688)
Sears		-4.219	(1.289)	-2.125	(0.691)	-1.997	(0.695)	-2.102	(0.592)
Burlington		2.195	(0.923)	2.129	(0.452)	2.052	(0.288)	2.030	(0.283)
Citi Trends		2.367	(1.764)	1.928	(0.437)	1.646	(0.960)	0.943	(0.638)
Five Below		-0.007	(1.022)	0.079	(0.477)	0.318	(0.410)	0.469	(0.367)
Marshalls		1.683	(0.871)	1.713	(0.526)	1.896	(0.569)	2.165	(0.338)
Ross Dress for Less		2.613	(1.088)	2.490	(0.794)	2.639	(0.646)	2.748	(0.525)
T.J. Maxx		1.518	(0.973)	1.813	(0.718)	2.121	(0.604)	2.478	(0.556)
Big Lots		-0.990	(0.771)	-0.005	(0.325)	0.180	(0.264)	0.053	(0.232)
Target		2.174	(0.974)	2.614	(0.668)	3.155	(0.668)	3.626	(0.481)
Walmart		4.628	(1.076)	4.462	(0.629)	4.355	(0.543)	3.742	(0.511)
99c Only		0.943	(1.162)	1.941	(0.335)	0.730	(0.568)	0.458	(0.267)
Dollar General		1.672	(0.910)	1.364	(0.483)	0.891	(0.489)	-0.285	(0.464)
Dollar Tree		3.031	(0.863)	3.000	(0.363)	2.734	(0.377)	2.685	(0.337)
Family Dollar		2.244	(0.862)	2.103	(0.435)	1.481	(0.392)	0.162	(0.389)
Random Coefficients	σ_k								
Warehouse Stores		2.085	(0.298)	1.740	(0.170)	1.612	(0.126)	1.933	(0.113)
Traditional Stores		2.520	(0.339)	1.952	(0.221)	2.027	(0.182)	1.935	(0.169)
Discount Stores		0.894	(0.275)	0.650	(0.143)	0.381	(0.125)	0.223	(0.102)
Supercenters		2.125	(0.284)	1.512	(0.123)	1.095	(0.116)	0.941	(0.107)
Dollar Stores		1.553	(0.242)	1.235	(0.147)	1.462	(0.126)	1.445	(0.136)
Summary									
Number of Visits		1,476,820		7,737,705		11,797,999		13,796,397	
Number of Devices		130,157		605,128		886,500		1,132,056	

This table summarizes our demand estimates across 18 CBSAs and all income quartiles assuming that distance is exogenous. To aggregate our estimates, we use income-specific CBSA populations as weights. Standard errors are also aggregated using bootstrap aggregation with 1,000 block bootstraps.

7.1 Disutility from Distance

Focusing on Table 2, we first highlight that the average first-stage partial F-stat and partial R^2 suggest that our instruments are strong and explain significant variation in the

observed distances. Directionally, our estimates show that consumers have a disutility of travel to stores. The similarity of the travel disutility estimates across income groups may be surprising. There are likely two countervailing effects; while higher income groups likely have higher time costs, lower income groups may have worse travel options for traversing distance.

Figure 7a demonstrates that the disutility from distance is greater (more negative) when we account for endogenous proximity. This result, that consumers appear to view distance as more costly when controlling for the endogeneity of distance, echoes the familiar results regarding price endogeneity. Figure 7a also shows that the distance disutility parameters are more dispersed across CBSAs when we account for endogenous proximity.

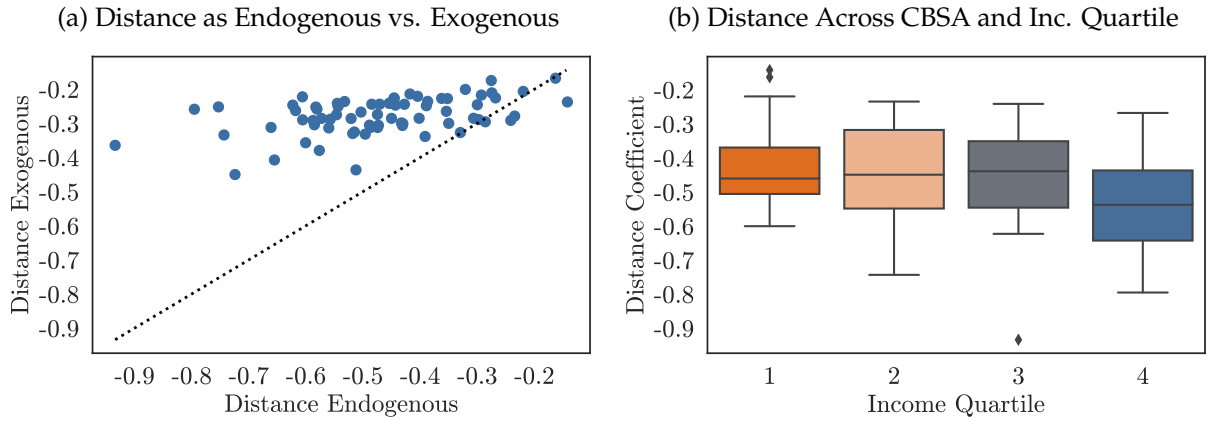
One concern is that our distance from CBD instrument is correlated with travel speed. Appendix Tables C.1 and C.2 and Figure C.1 summarize parameter estimates using time in place of distance. When using time to proxy for travel cost, we find again that accounting for endogenous proximity reveals larger and more disperse travel cost elasticities. The time and distance elasticities both increase by approximately 60% when we account for endogenous proximity.

Consistent with our hypothesis about trip chaining, the estimates on the log density parameter are positive, meaning that consumers prefer stores that are co-located with other stores over stand-alone stores, ceteris paribus. For example, a low-income consumer is willing to travel 1 mile further to visit a store that has 1 neighboring store than they would to visit a stand-alone store of the same chain.

7.2 Chain Tastes

To examine the tastes for the various chains and the differences in tastes across consumer incomes, for each CBSA, we use the parameter estimates to calculate a mile-normalized

Figure 7: Distance Coefficients



Notes: Panel (a) shows distance coefficient estimates both accounting for and not accounting for endogeneity for all CBSA-income quartiles. Panel (b) presents a histogram of distance coefficients, accounting for endogeneity, across CBSAs for each income quartile separately.

taste measure for each pair of chains and income quartiles:

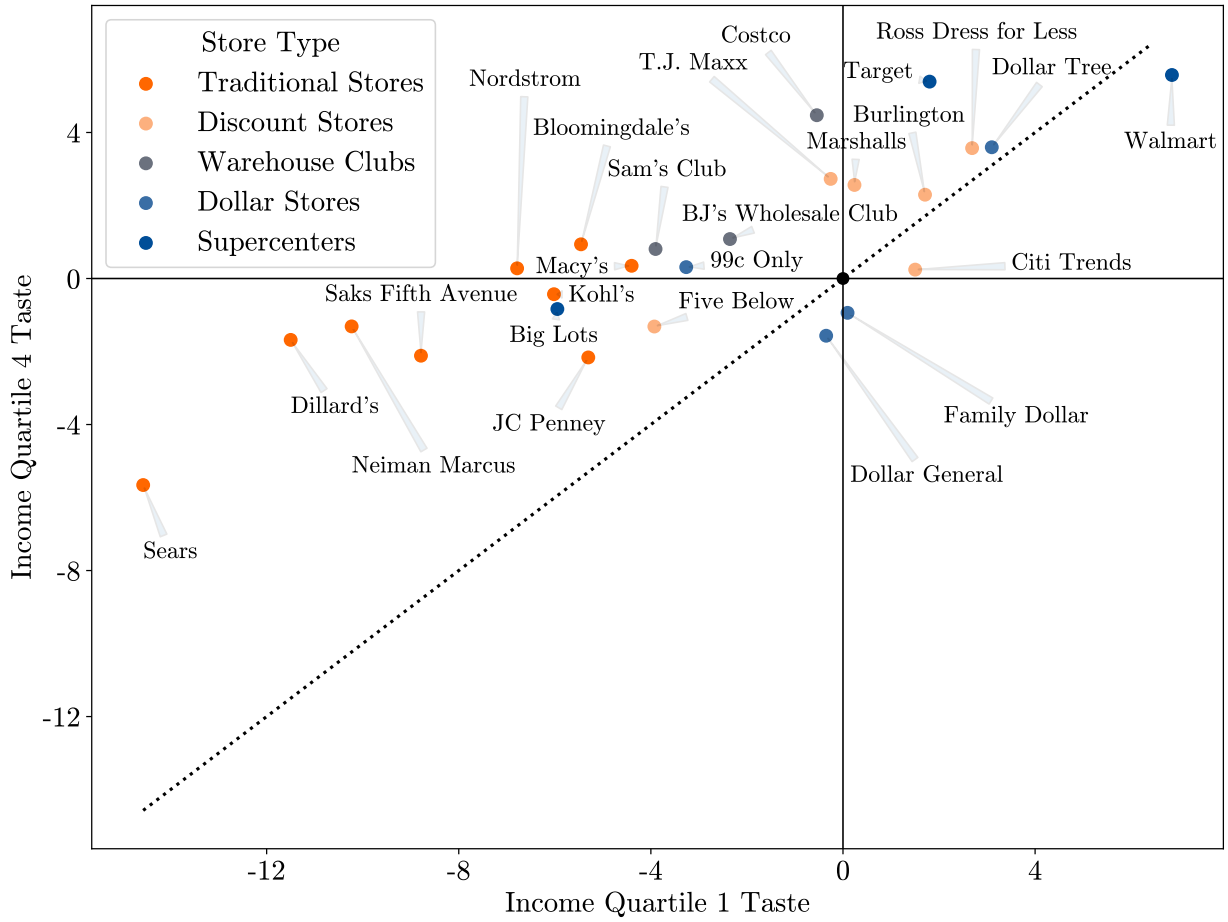
$$\tilde{\beta}_{y(i),j} = \int \frac{\beta_{y(i),j} + \beta^{d2}_{y(i)} \text{median}\left(density_{\cdot,j}\right) + \sigma_j \eta_{i,j} - \omega_{y(i)} \text{median}\left(\Gamma(J^f_{\cdot})\right)}{\left|\beta^{d1}_{y(i)}\right|} dF\left(\eta \,|\, \sigma\right) \tag{7.1}$$

$$= \frac{\beta_{y(i),j} + \beta^{d2}_{y(i)} \text{median}\left(density_{\cdot,j}\right) - \omega_{y(i)} \text{median}\left(\Gamma(J^f_{\cdot})\right)}{\left|\beta^{d1}_{y(i)}\right|} \tag{7.2}$$

This taste measure uses the CBSA-specific median store density surrounding stores of each chain (i.e. median($density_{r(j)}$)) to adjust for the differences in travel cost across chains, which arise from the varying degree of store co-location across chains. It is calculated relative to the fringe store set of the median size (i.e. median($|J^f_\ell|$)) in each CBSA and can be interpreted as the number of additional miles a consumer in income quartile y would be willing to travel to visit a store of chain $r(j)$ rather than patronize the fringe store opportunities.

Figure 8 graphically illustrates these normalized taste parameter estimates for the 25 identified chains, averaged across CBSAs. We plot the taste parameters for consumers in the lowest-income quartile on the x-axis against those for consumers in the highest-income quartile on the y-axis. The positive correlation exhibited in Figure 8 shows that the preference ranking over general merchandise chains is similar between low- and high-

Figure 8: Distance normalized chain taste parameters



income consumers. For example, Walmart is the most preferred chain for both lowest- and highest-income consumers and traditional department store chains are among the least preferred chains by consumers. The overall low taste for the chains relative to the fringe opportunities reflects our specification's amalgamating the fringe opportunities; each trip to the fringe represents a consumer's trip to their most preferred option within the fringe and the fringe is likely more tailored to local tastes than the national chains.

While the chain tastes of high- and low-income consumers are positively correlated overall, there are notable differences in chain tastes across consumer incomes. For example, while higher-income consumers are nearly indifferent between Walmart and Target, lower-income people much prefer Walmart.

These differences in consumer tastes between high- and low-income consumers can be seen in where the taste parameters fall relative to the 45-degree line in Figure 8.

Unsurprisingly, Family Dollar, Dollar General dollar stores and Cititrends sit below the 45-degree line; they are more valuable to low-income consumers relative to the fringe chains than for high-income consumers, a finding consistent with Cao [2022]. Meanwhile, both warehouse clubs (Costco, BJ's, and Sam's Club) and department stores (such as Dillards, Nordstrom, Bloomingdales, and Macy's) tend to be relatively more favored by higher-income consumers.

There are also stark differences within categories of stores that the casual observer might view as close substitutes. For example, our estimates suggest that Dollar General, Family Dollar, and Dollar Tree are quite different, with Dollar Tree being relatively more valued by higher-income consumers than Dollar General and Family Dollar. While Walmart is the most-preferred chain, its sister chain Sam's Club is less preferred to rival warehouse clubs Costco and BJ's by both lower-income and higher-income consumers.

Our estimates allow us to quantify the relative utility that the income groups receive from the different chains. In Figure 8, the horizontal distance between two points defines the additional distance a consumer in income quartile 1 would be willing to travel to visit an outlet of the right-hand chain relative to the left-hand chain. The vertical distance reflects the same marginal willingness-to-travel of a consumer in income quartile 4.

For example, our estimates suggest that, given the disutility for distance and the tastes for each chain, a consumer in the lowest income quartile would be close to indifferent between having a Dollar General co-located with the consumer (at a distance of zero) and having a Walmart located 6 miles away. For a Walmart any closer than 6 miles, the consumer is estimated to prefer the Walmart to the co-located Dollar General.

8 Consumer Surplus Estimates for 2010-2019

Given the expansion of some national chains, particularly dollar stores, and the decline of regional chains over the past decade, we next consider whether consumers of different income levels obtain higher or lower per-trip consumer surplus from the 2010 brick-and-mortar retail options than from the 2019 store configurations. To do this, we combine the consumer preferences estimated above with DataAxle data on store locations in 2010

and 2019 and Census data on household locations in 2019. Recall that we do not have smartphone data for 2010. Thus, we consider, holding the consumer preferences estimated for 2019 and consumer locations from 2019 fixed, how would consumer surplus per trip differ if the identities and locations of retail stores were as they were in 2010? Suppose, for example, many stores that were liked by and proximate to a particular demographic group closed and were not replaced. Our methods would estimate lower per-trip welfare both due to consumers traveling farther to visit their preferred stores and due to visiting less-preferred proximate stores.

To calculate the overall consumer surplus per trip for a representative consumer from each income quartile, we first calculate the number of consumers in each income quartile residing in each census tract of our CBSAs in 2019. We assume that each consumer resides at the centroid of his/her census tract of residence in 2019. We then calculate distances from these consumers to stores available in 2019 and the stores available in 2010 using the DataAxle data on store locations. For each income quartile, we calculate the population-weighted average consumer surplus per trip for a representative consumer in that income quartile in 2019 based on the estimated preferences for each store. Then, we recalculate this using the 2010 store locations. Changes in the general merchandise sector affect consumer welfare through store entry and exit from each consumer's choice set and through changes in the distance cost paid to visit individual stores. As a robustness check, we also consider consumer locations and population weights using the 2010 Census, thereby allowing for changes in both retailer and consumer locations. These results can be found in the appendix.

We measure, for each consumer, the change in per trip consumer welfare associated with the changing retail landscape as the change in the inclusive value over the consumer's choice set; that is, for consumer i,

$$\Delta CS_i = \frac{\int \ln\Big(\sum_{j\in J_{i,2019}} \exp(v_{i,j}^{2019} + \sigma_j \eta_{i,j})\Big) dF(\eta) - \int \ln\Big(\sum_{j\in J_{i,2010}} \exp(v_{i,j}^{2010} + \sigma_j \eta_{i,j})\Big) dF(\eta)}{|\beta_i^{d1}|} \tag{8.1}$$

where $v_{i,j}^t$, defined in Equation 5.2, is the deterministic indirect utility consumer i de-

rives from chain j and is calculated using the estimated consumer preference estimates combined with the distances between consumers and stores of the chain in $t = 2010$ and $t = 2019$.

Note that Equation 8.1 is denominated in mileage equivalents. That is, if the change in consumer surplus from 2010 to 2019 was -1, the representative consumer would have their consumer surplus fall over the time period by an amount equivalent to the disutility of traveling an extra mile per trip. We can also express the consumer surplus changes in dollars. To do so, we can follow Dolfen et al. [2022] and calculate a travel cost that is derived from evidence in the literature and includes both a time and direct cost of travel. During the period we study, the travel cost estimate is $c = \$3.36$ per mile round-trip.

The calculated consumer surplus change captures both the extensive and intensive changes of a consumer's choice set characterized in Figures 3 and 4. Thus, for example, if consumers were visiting all of the same stores in 2010 and 2019 but traveling less far for them, we would observe a welfare increase. If they were making the same number of trips and traveling the same distances but more-preferred stores had replaced less-preferred ones, we would also observe a welfare increase.

Since consumers live in different locations with different choice sets, we aggregate the welfare measure across consumers and present in Table 4 the average consumer welfare change associated with the changing retail landscape for each income quartile per trip. Table 5 presents these consumer welfare results assuming exogenous distance per trip. In addition, we compute bias-corrected confidence intervals for counterfactuals, which we report at the 95th percentile.

The first row of Tables 4 and 5 present the overall consumer surplus change per trip by income quartile for the case in which preferences are estimated treating distance as endogeneous and for the case in which preferences are estimated treating distance as exogenous, respectively. Note that the estimated consumer welfare change from 2010 to 2019 is substantially more negative in the exogenous distance specifications; neglecting distance endogeneity biases welfare estimates substantially.

Focusing on Table 4, three of the four income quartiles have slightly lower welfare in 2019 vs. 2010. The first row suggests that, for the lowest-income consumers, the change in

Table 4: Consumer Welfare Change from 2010-2019 by Income Quartile, Distance Endogeneity Accounted for with Disc Instrument

Income Quartile	1	2	3	4
ΔW	-0.220	-0.139	-0.053	0.115
Conf. Interval	$(-0.477, 0.275)$	$(-0.320, -0.043)$	$(-0.245, 0.093)$	$(0.034, 0.231)$
Δ Fringe Only	-0.577	-0.400	-0.382	-0.183
Conf. Interval	$(-1.851, -0.471)$	$(-1.049, -0.376)$	$(-0.387, -0.387)$	$(-0.246, -0.166)$
Δ Chains Only	0.372	0.312	0.283	0.359
Conf. Interval	$(0.273, 1.942)$	$(0.245, 0.414)$	$(0.160, 0.509)$	$(0.338, 0.474)$

Aggregate welfare per trip by income quartile is reported using our preference estimates that adjust for endogeneous distances using our disc instrument. The first row represents our overall estimates and the subsequent rows provide counterfactuals with different assumptions. Specifically, the second row calculates the consumer surplus change from 2010 to 2019 holding the configuration of national chains at their 2019 values but the regional and smaller chains adjust from 2010 to 2019 configurations. The third row calculates the consumer surplus change from 2010 to 2019 holding the smaller regional chains fixed at the 2019 level for both timepoints, but the national chains adjust from 2010 to 2019 configurations. Confidence intervals for the counterfactuals are reported at the 95th percentile level and are bias-corrected.

Table 5: Consumer Welfare Change from 2010-2019 by Income Quartile, Distance Exogenous

Income Quartile	1	2	3	4
ΔW	-0.514	-0.459	-0.261	0.061
Conf. Interval	$(-1.705, -0.222)$	$(-0.755, -0.367)$	$(-0.626, -0.060)$	$(-0.101, 0.221)$
Δ Fringe Only	-0.987	-0.786	-0.584	-0.313
Conf. Interval	$(-1.990, -0.837)$	$(-1.137, -0.780)$	$(-0.673, -0.591)$	$(-0.386, -0.315)$
Δ Chains Only	0.354	0.388	0.346	0.466
Conf. Interval	$(0.038, 0.692)$	$(0.209, 0.614)$	$(0.105, 0.653)$	$(0.413, 0.679)$

Aggregate welfare per trip by income quartile is reported using our preference estimates that do not adjust for endogeneous distances. The first row represents our overall estimates and the subsequent rows provide counterfactuals with different assumptions. Specifically, the second row calculates the consumer surplus change from 2010 to 2019 holding the configuration of national chains at their 2019 values but the regional and smaller chains adjust from 2010 to 2019 configurations. The third row calculates the consumer surplus change from 2010 to 2019 holding the smaller regional chains fixed at the 2019 level for both timepoints, but the national chains adjust from 2010 to 2019 configurations. Confidence intervals for the counterfactuals are reported at the 95th percentile level and are bias-corrected.

consumer surplus is as if low income consumers have to travel 0.220 miles farther in 2019 to reach equivalent retail opportunities to those that were available in 2010. However, the estimate is not significantly different from zero. For income quartile two, we find a

statistically significant decline in consumer surplus equal to 0.140 miles per trip. Using the travel cost of $3.36 per mile leads to a consumer surplus decline estimate of 47 cents per trip. We find insignificant surplus declines for income quartile three and a small, but positive surplus change for the highest-income individuals.

The second row repeats the exercise but holds the 25 named national chains at their 2019 levels and calculates the consumer surplus change from 2010 to 2019 resulting from the change in smaller and regional chains. These regional chains have shrunk substantially over the decade. The last rows limit our attention to the 25 named chains rather than the smaller fringe stores. When considering only the 25 named national chains, welfare per trip is estimated to have grown over the decade for all consumer groups. Our estimates suggest that the largest consumer surplus loss attributable to the shrinkage of regional chains and the largest gains attributable to the growth of national chains are both estimated to accrue to the lowest income groups.

By comparing Table 4 (distance is endogenous) to Table 5 (distance is exogenous), we find that abstracting from distance endogeneity leads to the incorrect conclusion—consistent with the retail apocalypse narrative—that consumers have experienced statistically significant surplus declines over the last decade. Focusing on row one, we see coefficients of near -0.5 for below median income households. This translates to over a $1.5 decline in surplus per trip using the miles-to-dollars conversion in Dolfen et al. [2022]. The overstatement in the surplus loss for income quartile two is over a factor or three. For income quartile 1, the overstatement is a factor of two; accounting for distance endogeneity, we cannot conclude that there has been a decline for these consumers.

Given the large growth in ecommerce over this time period, our focus here on per-trip welfare may be counterintuitive. While we have learned from Dolfen et al. [2022] that ecommerce gains have accrued disproportionately to high-income consumers, there are some gains for all consumer groups. For any group to be dramatically worse off, following the 2010 to 2019 ecommerce growth/brick and mortar readjustment, the per-trip welfare experienced by that group would likely have to fall substantially. Indeed, we do not find evidence of that, as even the lowest-income consumers, who have benefited the least from ecommerce, have a mile-equivalent per-trip utility change close to zero.

To further understand the pattern of consumers' welfare changes across incomes, we measure the consumer welfare contribution of the change of each individual specified general merchandise chain during the 2010-2019 period, using the estimates that account for distance endogeneity, holding consumers and other chains at their 2019 locations.

To put it formally, for chain k, its welfare impact on consumer i of returning that chain to its 2010 location, holding constant the rest of the consumer's 2019 choice set is defined as follows:

$$\Delta CS_{i,k} = \frac{\int \ln\Big(\sum_{j\in J_{i,2019}} \exp(\nu_{i,j}^{2019} + \sigma_j \mu_{i,j})\Big) dF(\mu)}{|\beta_i^{d1}|} \tag{8.2}$$

$$\frac{-\int \ln\Big(\sum_{j\in J_{i,2010}\setminus k} \exp(\nu_{i,j}^{2019} + \sigma_j \mu_{i,j}) + \exp(\nu_{i,k}^{2010} + \sigma_j \mu_{i,k})\Big) dF(\mu)}{|\beta_i^{d1}|}. \tag{8.3}$$

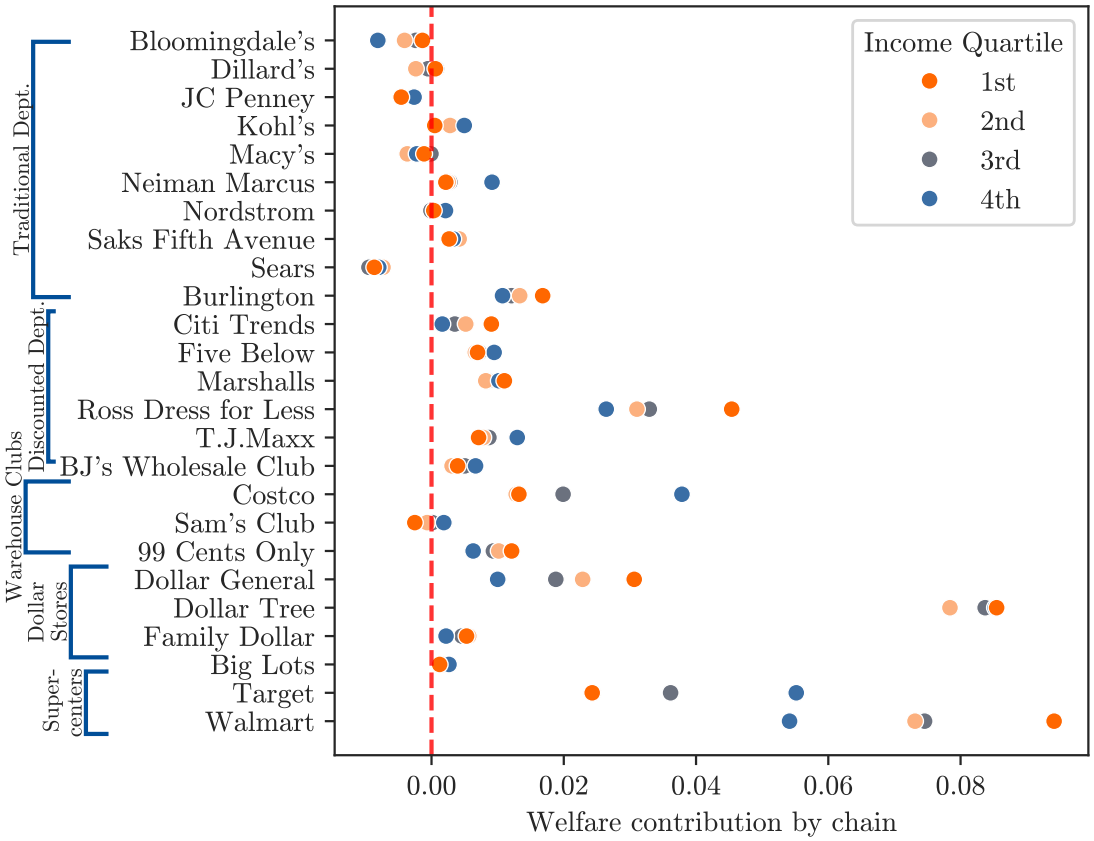
Essentially, this isolates the welfare change based on entry/exit for firm k, holding all else the same. We calculate this for each income quartile for each chain.

We report results in Figure 9. The units are consumer surplus changes per (representative) trip expressed in mileage equivalents, again aggregated using population weights. Consider Walmart, Dollar Tree, and Ross Dress for Less. Table 2 shows that the highest preference coefficients for the lowest-income quartile consumers are for these chains. All of those chains expanded on net over the decade. Figure 9 shows that the growth of these three chains accounted for about half of the total consumer surplus per representative trip gain that low-income consumers received from national chain expansion over the decade.

The Walmart expansion is in particular instructive. As shown in Figures 3 and 4, the probability of having Walmart available did not improve substantially over the decade and average distance to Walmart improved modestly for all income quartiles. However, the very large preference for Walmart, particularly for low-income consumers, leads this modest expansion to contribute substantially and disproportionately to the consumer surplus growth of the lowest income quartile.

Taken together with Table 4, the results suggest that the expansion of discount chains, particularly the dollar and discount stores and Walmart, improved per-trip welfare for lower-income consumers that nearly compensated for the decline in traditional depart-

Figure 9: Consumer Welfare change drivers: chain-level contributions



ment stores and the smaller regional chains. The sources of gains for the highest-income consumers are more broadly dispersed. While Dollar Tree is only the fifth most preferred of the chains overall for this group, its massive expansion over the decade leads it to be the largest positive driver of consumer surplus over the decade for this income group.

9 Conclusion

We introduce a novel instrument for the endogeneous distance between consumers and stores. Echoing the familiar bias in estimating the price elasticity of demand, we show that accounting for distance endogeneity leads us to estimate consumers to be more sensitive to distance than we find not accounting for distance endogeneity.

We apply our method to the setting of retail choice, examining preferences for brick-and-mortar general merchandise retailers. By using smartphone data, we are able to examine situations in which consumers pay with cash and are able to report findings for individual identified chains. We show substantial differences in preferences across chains by consumers of different income groups. We use our preference estimates to estimate the consumer surplus change experienced by consumers of the four income quartiles over the 2010-2019 decade. Perhaps due to ecommerce, there has been a substantial decline in regional chains and department stores over the past decade but an expansion in discount and dollar stores. Our estimates suggest that these roughly cancel each other out for the lowest-income consumers but the highest-income consumers have benefited from the retail changes over the past decade when measured as consumer surplus per trip. Our results show however that welfare estimates that do not account for endogeneity overstate the welfare loss to the lowest-income consumers leading to an incorrect conclusion that is consistent with the "retail apocalypse" narrative.

Looking forward, the near-saturation of dollar store retailers may limit the potential welfare gains achievable by their continued expansion in the future. Our results also suggest that regulations that restrict the siting of large big-box supercenters, particularly Walmart, could have disproportionate negative impacts on low-income consumers.

Our instrumenting approach may be useful in other settings where economists infer

tastes for different services by measuring willingness-to-travel. These include transportation, school choice, and health care choices; the direction of the bias in measuring distance disutility may vary across settings. Our instrumenting method relies only on publicly available data for a single cross-section and thus may be particularly useful when border discontinuity or panel data approaches are unavailable.

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Appendix – For Online Publication

A Additional Tables and Figures

Table A.1: Chains in each type of general merchandise stores

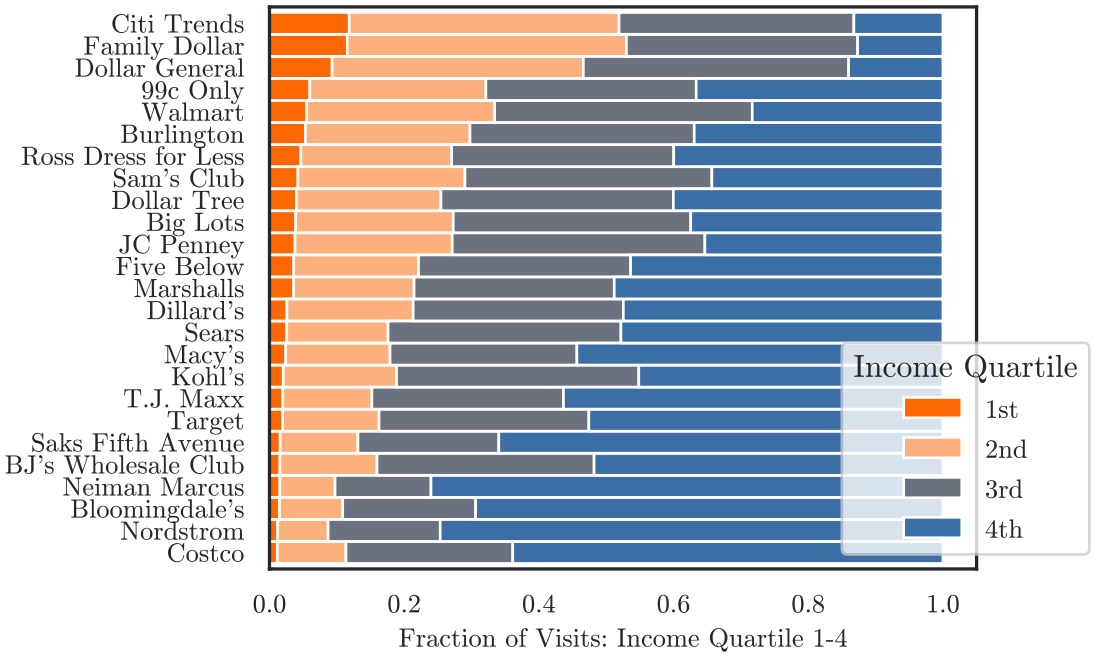
	Chain
Traditional Department	Bloomingdale's, Dillard's, JC Penney Macy's, Neiman Marcus, Nordstrom Saks Fifth Avenue, Kohl's, Sears
Discount Department	Citi Trends, Five Below, Burlington, Marshalls, Ross Dress for Less, T.J. Maxx
Warehouse Club	BJ's Wholesale Club, Costco, Sam's Club
Dollar Store	99c Only, Dollar General, Dollar Tree, Family Dollar
Supercenters	Big Lots, Target, Walmart
Others	Soma, Meijer, Dollar Plus, Von Maur, Boscov's, 99 Ranch Market, Christmas Tree Shops, etc.

Table A.2: Summary Statistics for the Data Sample, by Income Quartile

Variable	1st	2nd	3rd	4th
per device, week				
Number of visits to inside chains	1.98	1.95	1.89	1.78
Number of visits to fringe stores	1.28	1.28	1.27	1.23
per device				
Number of inside chains in choice set	16.04	15.96	15.72	16.23
Number of fringe stores in choice set	5.33	5.09	4.54	4.40
Number of weeks observed	6.96	7.91	8.62	8.52
Number of outlets of inside chains	97.87	85.29	72.19	65.31
Number of stores visited per trip	1.22	1.21	1.20	1.19
Number of unique chains	43	43	43	43
Number of outlets	10,492	10,828	10,803	10,590
Number of devices	130,455	606,531	888,539	1,134,165
Total number of visits	1.858 mil.	9.681 mil.	15.023 mil.	17.694 mil.

Summary statistics for the sample split by income quartile. We use the household income provided by Precisely PlaceIQ and calculate the quartiles based on the national distribution of income.

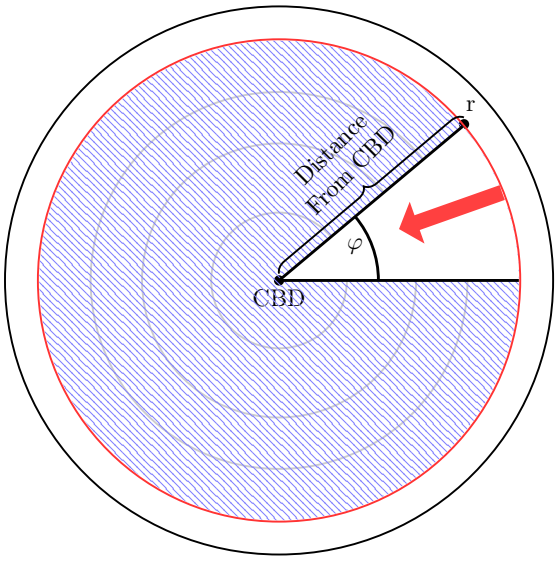
Figure A.1: Household Shopping Patterns By Household Income Groups



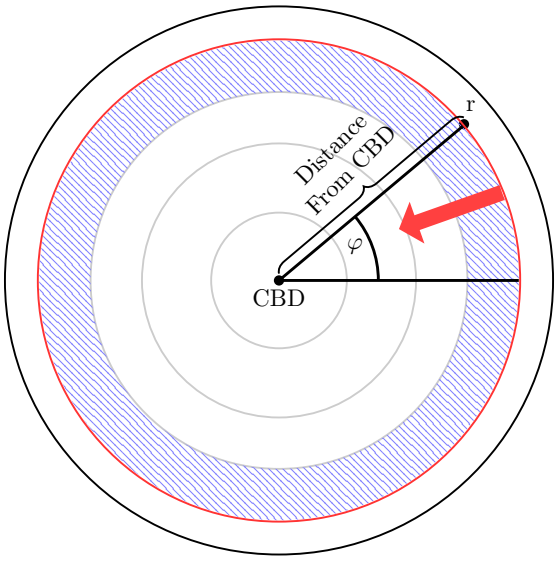
Note: The figure uses Precisely PlaceIQ data to show the share of 2019 visitors to each chain represented by members of each household income quartile. Chains are ordered from highest to lowest share of income quartile one visitors.

Figure A.2: Alternative Instrument Constructions for Spatial Data

(a) Disc with Circular Sector Removed



(b) Annulus



Note: Panels (a) and (b) depict alternative spatial instruments that can be used depending on the application.

Table A.3: Consumer Surplus Contributions by Chain, Accounting for Endogeneity

Chain	Welfare Change (2010-2019)			
	1	2	3	4
99 Cents Only	0.012	0.010	0.009	0.006
Big Lots	0.001	0.002	0.002	0.003
BJ's Wholesale Club	0.004	0.003	0.005	0.007
Bloomingdale's	-0.001	-0.004	-0.002	-0.008
Burlington	0.017	0.013	0.012	0.011
Citi Trends	0.009	0.005	0.004	0.002
Costco	0.013	0.013	0.020	0.038
Dillard's	0.001	-0.002	-0.001	0.001
Dollar General	0.031	0.023	0.019	0.010
Dollar Tree	0.085	0.078	0.084	0.085
Family Dollar	0.005	0.006	0.005	0.002
Five Below	0.007	0.007	0.007	0.009
JC Penney	-0.005	-0.003	-0.003	-0.003
Kohl's	0.000	0.003	0.003	0.005
Macy's	-0.001	-0.004	-0.000	-0.002
Marshalls	0.011	0.008	0.009	0.010
Neiman Marcus	0.002	0.003	0.003	0.009
Nordstrom	0.000	0.000	-0.000	0.002
Outside	-0.543	-0.410	-0.342	-0.200
Ross Dress for Less	0.045	0.031	0.033	0.026
Saks Fifth Avenue	0.003	0.004	0.003	0.003
Sam's Club	-0.003	-0.001	0.000	0.002
Sears	-0.009	-0.007	-0.009	-0.008
Target	0.024	0.024	0.036	0.055
T.J.Maxx	0.007	0.008	0.009	0.013
Walmart	0.094	0.073	0.075	0.054

Consumer surplus changes for each chain separately. These are the numbers that inform Figure 9. Each entry corresponds to the surplus change in miles per trip of going from 2010 to 2019 with only that chain's entry/exit. Other chains and population are held constant.

Table A.4: Additional Counterfactuals, Accounting for Endogeneity

Income Quartile	1	2	3	4
ΔW, Actual	-0.299	0.360	-0.199	0.027
ΔW, No Moves	-0.220	-0.088	-0.141	0.078
ΔW, No Δ Fringe	0.282	0.763	0.185	0.212
ΔW, No Δ Fringe nor Moves	0.367	0.277	0.293	0.275

These counterfactuals also take into account population changes from 2010 to 2019.

Table A.5: Additional Counterfactuals, Abstracting from Endogeneity

Income Quartile	1	2	3	4
ΔW, Actual	-0.433	0.788	-1.298	0.022
ΔW, No Moves	-0.512	-0.333	-0.441	0.006
ΔW, No Δ Fringe	0.561	1.579	-0.710	0.336
ΔW, No Δ Fringe nor Moves	0.471	0.350	0.296	0.340

These counterfactuals also take into account population changes from 2010 to 2019.

B Alternate and Detailed Demand Results

B.1 Aggregate Summaries

Table B.1: Summary of Demand Estimates, Distance Endogenous (5 mile)

Income Quartile		Income Quartile 1	Income Quartile 2	Income Quartile 3	Income Quartile 4
Parameter					
Distance	β^{d1}	-0.450	-0.448	-0.445	-0.495
Density	β^{d2}	0.316	0.197	0.156	0.127
Fringe	ω	1.446	1.381	1.366	1.123
Control Function	ρ	0.211	0.220	0.201	0.218
Chain Preferences					
BJ's Wholesale Club		1.980	2.526	2.603	2.755
Costco		2.504	3.257	3.728	4.144
Sam's Club		0.709	1.343	2.819	2.358
Bloomingdale's		-1.482	0.902	0.614	2.319
Dillard's		-3.852	-0.363	-0.224	1.314
JC Penney		-0.172	0.753	0.927	0.855
Kohl's		-0.378	1.262	1.313	1.704
Macy's		0.322	1.344	1.486	2.103
Neiman Marcus		-2.290	-0.628	-0.007	1.341
Nordstrom		-0.838	0.151	0.411	2.042
Saks Fifth Avenue		-1.542	-0.476	-0.057	0.919
Sears		-3.955	-1.402	-1.134	-1.016
Burlington		3.354	3.214	3.157	3.258
Citi Trends		3.218	2.886	2.756	2.335
Five Below		1.288	1.330	1.461	1.667
Marshalls		2.795	2.817	3.034	3.318
Ross Dress for Less		3.621	3.546	3.604	3.865
T.J. Maxx		2.711	2.873	3.144	3.593
Big Lots		0.189	1.513	1.456	1.633
Target		3.237	3.846	4.172	4.680
Walmart		5.406	5.323	5.188	4.819
99c Only		1.332	2.752	1.752	1.747
Dollar General		2.461	2.314	1.906	1.091
Dollar Tree		3.783	3.822	3.576	3.702
Family Dollar		2.902	2.985	2.443	1.633
Random Coefficients	σ_k				
Warehouse Stores		2.254	1.761	1.670	2.011
Traditional Stores		3.039	2.286	2.264	2.196
Discount Stores		0.730	0.539	0.347	0.187
Supercenters		1.941	1.090	0.917	0.611
Dollar Stores		1.527	1.087	1.404	1.291
Summary					
Number of Visits		1,476,820	7,737,705	11,797,999	13,796,397
Number of Devices		130,157	605,128	886,500	1,132,056
Avg. First Stage Partial R^2		31.5%	27.2%	25.5%	25.7%
Avg. First Stage Partial F-stat		290.8	1094.3	1426.3	2078.4

Demand estimation parameters, summary over all CBSAs. Each column represents an income quartile, with 1 being the lowest income group. This version of the model treats distance as exogenous.

Table B.2: Summary of Demand Estimates, Dist. & Fringe Endogenous (Disc)

Income Quartile		Income Quartile 1	Income Quartile 2	Income Quartile 3	Income Quartile 4
Parameter					
Distance	β^{d1}	-0.446	-0.467	-0.462	-0.535
Density	β^{d2}	0.252	0.182	0.151	0.075
Fringe	ω	1.409	1.460	1.466	0.899
Control Function	ρ_1	0.182	0.220	0.201	0.238
Control Function	ρ_2	-0.213	0.038	0.149	-0.198
Chain Preferences					
BJ's Wholesale Club		2.000	3.118	2.324	1.565
Costco		2.152	3.468	3.731	3.768
Sam's Club		0.562	1.592	2.770	1.963
Bloomingdale's		-1.035	0.428	0.439	1.814
Dillard's		-2.676	-0.334	-0.263	0.264
JC Penney		0.073	0.724	1.010	0.360
Kohl's		-0.147	1.347	1.446	1.210
Macy's		0.503	1.389	1.535	1.623
Neiman Marcus		-2.015	-0.615	-0.022	0.853
Nordstrom		-0.612	0.139	0.548	1.593
Saks Fifth Avenue		-1.506	-0.545	0.137	0.485
Sears		-3.761	-1.456	-1.135	-1.539
Burlington		3.085	3.385	3.236	2.713
Citi Trends		3.043	3.198	2.980	1.638
Five Below		0.919	1.301	1.172	1.017
Marshalls		2.554	2.971	3.094	2.755
Ross Dress for Less		3.485	3.813	3.841	3.572
T.J. Maxx		2.440	3.074	3.280	2.833
Big Lots		0.033	1.576	1.584	1.198
Target		3.091	3.966	4.303	4.280
Walmart		5.376	5.556	5.419	4.420
99c Only		2.213	3.147	1.965	1.752
Dollar General		2.450	2.685	2.082	0.759
Dollar Tree		3.775	4.166	3.837	3.389
Family Dollar		2.829	3.223	2.467	1.291
Random Coefficients	σ_k				
Warehouse Stores		2.437	1.765	1.858	2.124
Traditional Stores		2.926	2.302	2.333	2.351
Discount Stores		0.949	0.716	0.496	0.407
Supercenters		2.110	1.300	1.030	0.857
Dollar Stores		1.506	0.919	1.312	1.323
Summary					
Number of Visits		1,476,820	7,737,705	11,797,999	13,796,397
Number of Devices		130,157	605,128	886,500	1,132,056
Avg. First Stage Partial R^2		18.4%	13.1%	11.0%	12.2%
Avg. First Stage Partial F-stat		222.7	669.6	773.0	1344.2

Demand estimation parameters, summary over all CBSAs. Each column represents an income quartile, with 1 being the lowest income group. This version of the model treats distance as exogenous.

B.2 CBSA-Specific Parameter Estimates

Table B.3: Atlanta-Sandy Springs-Alpharetta, GA Metro Area — Endo. Dist (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.532	(0.074)	-0.606	(0.057)	-0.623	(0.037)	-0.587	(0.031)
Density	β^{d2}	0.036	(0.075)	0.119	(0.034)	0.184	(0.027)	-0.075	(0.025)
Fringe	ω	1.092	(0.126)	1.045	(0.074)	1.225	(0.052)	1.075	(0.038)
Control Function	ρ	0.302	(0.060)	0.405	(0.045)	0.377	(0.027)	0.312	(0.020)
Chain Preferences									
BJ's Wholesale Club		1.231	(2.147)	1.832	(3.721)	0.888	(1.557)	0.560	(0.941)
Costco		1.586	(2.454)	2.470	(2.644)	1.920	(3.754)	2.974	(1.114)
Sam's Club		2.112	(5.352)	3.043	(4.211)	1.904	(3.845)	1.511	(2.678)
Bloomingdale's		-3.076	(5.573)	-0.483	(3.024)	-2.555	(2.728)	1.331	(2.289)
Dillard's		-3.908	(5.767)	0.306	(2.577)	-2.448	(3.335)	0.356	(1.525)
JC Penney		-2.718	(2.352)	0.158	(3.040)	-1.777	(2.084)	0.472	(1.247)
Kohl's		-3.329	(3.071)	0.398	(2.952)	-1.689	(3.002)	1.419	(1.632)
Macy's		-0.040	(2.737)	1.681	(2.375)	-2.012	(2.866)	2.004	(1.786)
Neiman Marcus		-4.418	(4.357)	0.290	(2.695)	-1.082	(2.484)	1.378	(2.961)
Nordstrom		-2.084	(4.183)	-0.706	(3.860)	-2.008	(3.600)	1.238	(2.054)
Saks Fifth Avenue		-1.110	(4.702)	2.112	(3.169)	-0.098	(3.319)	3.199	(4.374)
Sears		-7.756	(5.683)	-3.403	(4.098)	-7.365	(3.640)	-5.211	(2.778)
Burlington		0.029	(2.111)	2.976	(1.946)	2.085	(1.199)	2.516	(1.152)
Citi Trends		0.800	(2.409)	3.285	(1.578)	2.523	(1.899)	3.291	(0.565)
Five Below		-3.211	(2.085)	0.544	(2.208)	-0.375	(2.303)	0.563	(0.990)
Marshalls		-1.690	(4.311)	2.140	(3.390)	2.057	(2.402)	3.631	(1.447)
Ross Dress for Less		0.136	(6.285)	3.198	(3.956)	2.460	(2.624)	3.661	(1.154)
T.J. Maxx		-1.649	(5.157)	2.579	(3.798)	1.844	(3.253)	3.233	(2.407)
Big Lots		-5.014	(2.680)	0.264	(0.852)	0.934	(0.530)	2.075	(0.349)
Target		-1.260	(5.982)	2.364	(3.991)	3.115	(3.085)	4.273	(2.424)
Walmart		4.524	(5.578)	5.076	(3.899)	4.979	(3.088)	4.589	(1.336)
99c Only		–	–	–	–	–	–	–	–
Dollar General		2.703	(2.946)	2.902	(2.682)	2.914	(2.414)	2.006	(0.740)
Dollar Tree		3.369	(2.405)	3.699	(2.334)	3.818	(2.180)	3.731	(0.841)
Family Dollar		2.671	(2.227)	2.884	(2.555)	2.892	(2.205)	2.216	(1.175)
Random Coefficients	σ_k								
Warehouse Stores		3.902	(1.330)	2.418	(1.309)	4.109	(1.269)	2.238	(0.638)
Traditional Stores		4.432	(1.042)	1.984	(0.420)	1.988	(0.365)	0.000	(0.474)
Discount Stores		0.000	(0.324)	0.000	(0.139)	0.409	(0.195)	0.000	(0.346)
Supercenters		3.154	(1.057)	0.912	(1.016)	1.804	(0.721)	0.000	(0.121)
Dollar Stores		2.335	(1.089)	1.905	(0.836)	2.794	(0.381)	2.734	(0.254)
Summary									
Log Likelihood		-183084.4		-1442782.1		-2829354.4		-2369548.1	
Number of Visits		93,187		710,037		1,356,299		1,081,661	
Number of Devices		9,257		58,953		101,608		88,523	
First Stage Partial R^2		15.5%		10.4%		9.2%		16.0%	
First Stage Partial F-stat		251.4		949.4		1435.9		2509.3	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.4: Boston-Cambridge-Newton, MA-NH Metro Area — Endo. Dist (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.512	(0.152)	-0.430	(0.064)	-0.354	(0.037)	-0.518	(0.034)
Density	β^{d2}	-0.099	(1.285)	0.113	(0.125)	0.278	(0.076)	0.769	(0.059)
Fringe	ω	0.546	(11.180)	1.181	(0.127)	1.430	(0.079)	1.036	(0.040)
Control Function	ρ	0.089	(0.169)	0.162	(0.037)	0.094	(0.023)	0.198	(0.019)
Chain Preferences									
BJ's Wholesale Club		3.241	(5.051)	3.243	(1.056)	3.257	(0.693)	3.726	(0.643)
Costco		0.681	(5.038)	2.555	(1.300)	2.817	(0.775)	3.958	(0.898)
Sam's Club		-29.308	(15.207)	-25.718	(10.937)	-2.968	(2.873)	-3.786	(11.708)
Bloomingdale's		0.312	(6.256)	0.283	(1.665)	1.346	(2.381)	1.995	(0.752)
Dillard's		–	–	–	–	–	–	–	–
JC Penney		2.344	(5.187)	-0.060	(7.134)	1.577	(1.103)	0.063	(3.241)
Kohl's		0.873	(5.369)	-0.296	(2.347)	1.809	(1.213)	1.079	(1.661)
Macy's		3.310	(5.123)	0.776	(2.080)	1.975	(1.118)	1.321	(1.490)
Neiman Marcus		1.793	(4.918)	0.009	(2.730)	1.819	(1.735)	0.485	(1.746)
Nordstrom		0.954	(5.266)	-1.666	(3.276)	0.838	(2.034)	0.970	(1.852)
Saks Fifth Avenue		1.299	(5.474)	-0.993	(3.028)	0.901	(2.391)	0.022	(2.183)
Sears		1.739	(5.055)	-1.110	(3.251)	1.304	(1.592)	-1.075	(2.520)
Burlington		4.504	(4.984)	3.421	(1.356)	2.333	(0.674)	3.448	(0.697)
Citi Trends		3.995	(17.186)	2.625	(4.374)	1.837	(8.929)	2.131	(5.928)
Five Below		2.944	(5.043)	2.713	(2.439)	2.110	(0.976)	4.234	(2.295)
Marshalls		4.987	(4.964)	3.663	(2.459)	3.327	(1.455)	4.027	(1.514)
Ross Dress for Less		–	–	–	–	–	–	–	–
T.J. Maxx		4.966	(5.510)	3.049	(2.985)	2.717	(1.626)	4.078	(1.809)
Big Lots		0.725	(4.351)	2.313	(0.803)	2.592	(0.711)	2.777	(0.789)
Target		4.570	(5.747)	4.063	(5.332)	4.421	(1.694)	5.116	(2.917)
Walmart		6.090	(6.145)	4.911	(6.025)	4.811	(2.992)	5.038	(3.368)
99c Only		–	–	–	–	–	–	–	–
Dollar General		2.822	(5.247)	2.568	(4.648)	2.037	(0.838)	2.891	(2.676)
Dollar Tree		4.493	(5.778)	3.992	(2.493)	3.763	(2.015)	4.555	(1.670)
Family Dollar		3.557	(4.827)	3.596	(3.257)	3.224	(1.745)	3.339	(2.247)
Random Coefficients	σ_k								
Warehouse Stores		2.628	(1.576)	3.224	(0.945)	2.039	(0.511)	3.237	(0.391)
Traditional Stores		1.608	(1.133)	1.060	(0.561)	0.000	(0.432)	0.464	(0.541)
Discount Stores		1.758	(1.250)	0.000	(0.668)	0.637	(0.465)	0.000	(0.326)
Supercenters		0.264	(1.535)	0.304	(0.587)	0.886	(0.463)	0.301	(0.247)
Dollar Stores		3.089	(1.440)	1.693	(0.959)	1.470	(0.800)	1.805	(0.407)
Summary									
Log Likelihood		-17447.7		-164519.0		-489063.6		-1492554.2	
Number of Visits		8,440		78,649		232,927		655,870	
Number of Devices		1,028		8,203		23,474		73,247	
First Stage Partial R^2		24.3%		15.3%		13.6%		15.9%	
First Stage Partial F-stat		58.0		218.4		519.0		2156.3	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.5: Chicago-Naperville-Elgin, IL-IN-WI Metro Area — Endo. Dist (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.473	(0.055)	-0.489	(0.029)	-0.547	(0.049)	-0.661	(0.044)
Density	β^{d2}	0.244	(0.055)	-0.025	(0.028)	-0.033	(0.030)	-0.192	(0.024)
Fringe	ω	0.316	(0.125)	0.494	(0.047)	0.735	(0.047)	0.603	(0.042)
Control Function	ρ	0.184	(0.034)	0.193	(0.019)	0.278	(0.030)	0.360	(0.028)
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		2.007	(0.801)	1.745	(0.748)	3.226	(1.061)	3.599	(0.772)
Sam's Club		1.834	(3.090)	1.075	(4.232)	2.607	(3.538)	2.214	(3.043)
Bloomingdale's		-3.070	(3.729)	-1.992	(3.606)	-2.829	(2.503)	0.093	(1.431)
Dillard's		–	–	–	–	–	–	–	–
JC Penney		-2.091	(1.248)	-1.926	(1.963)	-2.743	(2.211)	-0.007	(1.031)
Kohl's		-1.953	(2.064)	-1.525	(2.413)	-1.145	(3.903)	0.412	(1.269)
Macy's		-3.922	(2.596)	-3.428	(3.825)	-0.747	(2.833)	0.561	(1.893)
Neiman Marcus		-6.292	(2.617)	-5.804	(4.878)	-5.018	(3.778)	-0.542	(1.744)
Nordstrom		-3.939	(2.558)	-3.459	(3.635)	-3.130	(4.375)	0.828	(2.269)
Saks Fifth Avenue		-6.873	(2.758)	-6.645	(4.568)	-6.844	(4.494)	-2.575	(2.819)
Sears		-7.333	(3.468)	-5.269	(3.484)	-3.430	(3.630)	-1.516	(2.070)
Burlington		2.235	(1.403)	1.703	(2.350)	2.252	(0.597)	2.538	(0.650)
Citi Trends		1.941	(0.492)	1.663	(0.401)	2.392	(0.755)	2.381	(2.297)
Five Below		-0.192	(1.676)	-0.724	(2.597)	0.027	(1.900)	-0.169	(1.198)
Marshalls		1.542	(1.835)	1.149	(2.839)	1.774	(3.469)	1.940	(1.510)
Ross Dress for Less		2.490	(3.209)	2.194	(4.025)	2.751	(4.335)	3.009	(2.906)
T.J. Maxx		1.650	(2.643)	1.421	(4.463)	2.610	(4.321)	3.246	(2.850)
Big Lots		-2.379	(1.715)	-0.961	(1.562)	0.363	(1.194)	0.283	(0.853)
Target		1.538	(2.502)	2.409	(4.283)	3.653	(4.806)	3.839	(2.316)
Walmart		3.572	(3.927)	3.516	(3.471)	4.025	(3.400)	3.765	(2.618)
99c Only		–	–	–	–	–	–	–	–
Dollar General		1.096	(0.927)	1.462	(0.962)	2.008	(1.914)	1.776	(1.064)
Dollar Tree		2.610	(1.124)	2.681	(1.918)	3.113	(2.185)	3.112	(1.234)
Family Dollar		2.059	(1.633)	2.128	(2.280)	2.367	(2.283)	2.171	(1.450)
Random Coefficients	σ_k								
Warehouse Stores		3.598	(1.125)	3.610	(0.771)	3.749	(0.720)	2.766	(0.473)
Traditional Stores		2.347	(0.577)	1.479	(0.224)	0.126	(0.568)	0.121	(0.507)
Discount Stores		1.200	(0.525)	0.424	(0.451)	0.000	(0.581)	0.607	(0.589)
Supercenters		0.691	(0.655)	0.897	(0.404)	0.000	(0.229)	0.202	(0.308)
Dollar Stores		1.561	(1.113)	2.015	(0.527)	1.284	(0.451)	1.600	(0.312)
Summary									
Log Likelihood		-468914.4		-1937016.4		-2901918.3		-2711186.0	
Number of Visits		205,727		861,493		1,292,806		1,182,540	
Number of Devices		16,692		67,570		96,771		91,510	
First Stage Partial R^2		10.6%		6.8%		6.2%		7.0%	
First Stage Partial F-stat		384.6		891.2		1160.8		1351.3	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.6: Dallas-Fort Worth-Arlington, TX Metro Area — Endo. Dist (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.583	(0.036)	-0.573	(0.031)	-0.286	(0.020)	-0.475	(0.035)
Density	β^{d2}	0.700	(0.059)	0.634	(0.036)	0.724	(0.034)	0.360	(0.022)
Fringe	ω	0.949	(0.088)	0.914	(0.049)	0.754	(0.046)	0.356	(0.049)
Control Function	ρ	0.349	(0.032)	0.306	(0.020)	-0.010	(0.016)	0.178	(0.018)
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		-0.176	(5.410)	2.993	(0.979)	1.076	(1.216)	2.901	(1.472)
Sam's Club		1.513	(2.133)	2.943	(1.745)	0.686	(2.754)	1.878	(0.753)
Bloomingdale's		-8.706	(4.471)	-3.317	(2.966)	-6.764	(1.829)	0.176	(1.704)
Dillard's		-5.300	(4.128)	-1.918	(1.892)	-3.786	(1.838)	2.104	(0.700)
JC Penney		-2.840	(3.017)	-1.982	(1.786)	-3.686	(1.563)	1.337	(0.836)
Kohl's		-4.475	(4.274)	0.098	(1.536)	-2.735	(2.373)	1.814	(1.106)
Macy's		-1.983	(4.882)	-0.757	(2.092)	-2.914	(1.069)	2.094	(0.868)
Neiman Marcus		-3.053	(4.805)	-0.908	(1.755)	-2.275	(2.869)	3.444	(2.426)
Nordstrom		-2.977	(5.352)	-1.382	(3.085)	-3.461	(2.774)	2.656	(1.563)
Saks Fifth Avenue		–	–	–	–	–	–	–	–
Sears		-7.847	(4.411)	-4.939	(3.305)	-6.964	(3.527)	-2.894	(2.621)
Burlington		3.402	(5.466)	3.088	(3.295)	0.681	(2.052)	1.380	(1.561)
Citi Trends		3.364	(4.623)	2.997	(0.980)	0.247	(3.130)	0.347	(2.210)
Five Below		1.138	(4.289)	0.887	(1.404)	-1.420	(2.124)	-0.920	(1.012)
Marshalls		3.058	(4.039)	3.026	(2.151)	0.803	(3.578)	1.582	(0.810)
Ross Dress for Less		3.444	(1.659)	3.257	(2.983)	1.281	(1.421)	1.661	(1.259)
T.J. Maxx		3.164	(4.864)	3.005	(3.380)	0.718	(1.556)	1.914	(1.027)
Big Lots		0.331	(1.876)	-0.062	(1.234)	-2.316	(0.805)	-1.452	(0.767)
Target		3.077	(3.364)	2.945	(2.463)	1.858	(1.269)	2.653	(1.051)
Walmart		6.058	(2.769)	5.567	(2.521)	4.466	(1.511)	3.608	(0.647)
99c Only		3.131	(3.850)	1.570	(0.973)	-2.485	(2.081)	-1.408	(0.805)
Dollar General		3.219	(2.262)	1.998	(2.305)	-0.121	(3.046)	-0.076	(0.959)
Dollar Tree		3.761	(5.618)	2.958	(0.874)	0.836	(1.152)	1.492	(0.868)
Family Dollar		3.444	(2.008)	2.591	(1.336)	-0.341	(1.131)	-0.240	(0.949)
Random Coefficients	σ_k								
Warehouse Stores		4.861	(0.915)	3.459	(0.922)	3.762	(0.804)	0.019	(0.586)
Traditional Stores		1.924	(0.519)	2.031	(0.207)	2.160	(0.237)	1.578	(0.435)
Discount Stores		0.000	(0.562)	1.353	(0.680)	2.337	(0.727)	1.690	(0.639)
Supercenters		0.146	(0.167)	0.121	(0.126)	0.850	(0.179)	0.000	(0.243)
Dollar Stores		3.684	(1.100)	2.170	(0.617)	2.879	(0.488)	1.587	(0.561)
Summary									
Log Likelihood		-464880.2		-2500527.7		-3063105.5		-2550883.1	
Number of Visits		246,951		1,264,309		1,525,077		1,184,965	
Number of Devices		20,453		91,652		105,444		92,991	
First Stage Partial R^2		12.0%		8.4%		6.8%		11.2%	
First Stage Partial F-stat		469.1		1464.9		1278.9		1875.5	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.7: Denver-Aurora-Lakewood, CO Metro Area — Endo. Dist (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.450	(0.143)	-0.515	(0.043)	-0.521	(0.048)	-0.655	(0.036)
Density	β^{d2}	1.382	(0.463)	1.570	(0.224)	1.361	(0.186)	1.914	(0.198)
Fringe	ω	1.763	(4.465)	1.887	(0.394)	1.944	(0.287)	2.616	(0.151)
Control Function	ρ	0.185	(0.103)	0.282	(0.033)	0.264	(0.031)	0.282	(0.023)
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		5.370	(3.782)	3.167	(1.307)	6.380	(0.781)	8.357	(1.411)
Sam's Club		5.123	(9.244)	2.295	(2.080)	5.388	(1.721)	6.209	(1.856)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		4.448	(12.309)	5.169	(1.344)	4.651	(1.468)	1.243	(1.489)
JC Penney		4.387	(3.700)	5.478	(1.060)	4.955	(0.912)	1.350	(1.422)
Kohl's		5.442	(3.721)	5.823	(1.193)	5.179	(1.349)	3.084	(1.432)
Macy's		4.611	(3.270)	5.230	(1.348)	4.212	(1.587)	1.283	(1.926)
Neiman Marcus		1.747	(15.555)	1.334	(2.875)	1.098	(2.350)	-0.730	(1.868)
Nordstrom		5.306	(3.675)	5.899	(2.554)	5.507	(0.951)	4.483	(2.239)
Saks Fifth Avenue		–	–	–	–	–	–	–	–
Sears		-25.383	(9.318)	2.271	(2.123)	3.172	(2.607)	-1.129	(4.508)
Burlington		5.838	(3.672)	5.608	(1.021)	5.586	(0.644)	7.185	(1.296)
Citi Trends		–	–	–	–	–	–	–	–
Five Below		3.037	(4.930)	2.238	(1.694)	2.390	(1.227)	3.734	(2.063)
Marshalls		5.074	(3.323)	5.653	(2.184)	5.858	(1.834)	6.021	(3.117)
Ross Dress for Less		5.996	(5.597)	5.878	(1.499)	5.940	(1.804)	6.430	(2.856)
T.J. Maxx		5.053	(6.222)	5.309	(1.977)	5.410	(2.004)	6.406	(4.118)
Big Lots		4.207	(3.956)	4.073	(1.288)	1.712	(1.289)	3.137	(0.932)
Target		6.684	(4.406)	6.597	(2.374)	5.654	(1.950)	7.787	(2.649)
Walmart		8.186	(12.000)	8.149	(2.751)	8.036	(2.961)	8.124	(4.578)
99c Only		–	–	–	–	–	–	–	–
Dollar General		4.089	(3.523)	3.020	(1.694)	3.208	(2.181)	0.919	(3.581)
Dollar Tree		6.778	(3.841)	6.318	(1.033)	6.759	(0.902)	5.831	(3.038)
Family Dollar		6.793	(3.683)	5.741	(1.808)	6.183	(1.676)	3.575	(1.908)
Random Coefficients	σ_k								
Warehouse Stores		1.122	(1.164)	0.000	(0.907)	1.439	(0.936)	4.187	(0.615)
Traditional Stores		1.530	(2.255)	1.084	(1.074)	2.680	(0.644)	2.127	(0.844)
Discount Stores		0.277	(1.604)	0.814	(0.575)	0.000	(0.802)	2.889	(0.842)
Supercenters		0.678	(1.598)	0.000	(0.587)	0.000	(0.300)	0.163	(0.241)
Dollar Stores		2.520	(1.726)	4.386	(0.812)	2.275	(0.566)	2.367	(0.336)
Summary									
Log Likelihood		-23848.6		-167204.0		-441725.0		-1260942.1	
Number of Visits		12,067		81,710		211,583		579,658	
Number of Devices		1,240		7,880		19,150		48,538	
First Stage Partial R^2		21.4%		19.8%		13.9%		14.9%	
First Stage Partial F-stat		73.8		392.7		587.6		1553.7	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.8: Detroit-Warren-Dearborn, MI Metro Area — Endo. Dist (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.219	(0.045)	-0.300	(0.028)	-0.496	(0.027)	-0.402	(0.030)
Density	β^{d2}	-0.222	(0.078)	-0.036	(0.041)	-0.001	(0.036)	0.322	(0.041)
Fringe	ω	0.550	(0.139)	0.592	(0.078)	0.959	(0.077)	0.004	(0.072)
Control Function	ρ	0.015	(0.038)	0.075	(0.019)	0.185	(0.023)	0.134	(0.016)
Chain Preferences									
BJ's Wholesale Club		-3.852	(2.085)	-2.246	(2.463)	-1.306	(2.011)	-2.376	(1.708)
Costco		-1.163	(1.252)	-0.491	(2.428)	1.510	(1.241)	1.373	(1.686)
Sam's Club		-1.088	(1.341)	-0.720	(1.328)	0.465	(1.972)	0.218	(1.804)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		–	–	–	–	–	–	–	–
JC Penney		-0.969	(0.800)	-0.497	(0.623)	-0.556	(0.833)	-2.230	(0.820)
Kohl's		-0.575	(1.532)	-0.133	(0.827)	0.153	(1.041)	-0.973	(0.925)
Macy's		-1.240	(1.629)	-0.660	(1.054)	-0.740	(1.355)	-0.250	(0.915)
Neiman Marcus		-3.519	(1.989)	-3.064	(1.711)	-2.874	(1.419)	-2.666	(1.302)
Nordstrom		-1.135	(2.113)	-0.898	(1.716)	-0.991	(1.881)	-0.755	(1.132)
Saks Fifth Avenue		-2.007	(2.155)	-1.388	(2.014)	-1.327	(1.577)	-1.145	(1.501)
Sears		-2.758	(2.460)	-2.224	(2.149)	-3.622	(2.240)	-3.786	(1.541)
Burlington		0.485	(2.285)	0.738	(0.827)	2.558	(1.200)	0.587	(1.409)
Citi Trends		-0.157	(0.927)	-0.057	(1.211)	1.212	(2.351)	-1.455	(1.665)
Five Below		-1.302	(0.927)	-1.272	(0.930)	-0.164	(0.842)	-2.727	(0.934)
Marshalls		-0.185	(1.321)	-0.032	(1.191)	1.449	(1.050)	-0.855	(1.154)
Ross Dress for Less		–	–	–	–	–	–	–	–
T.J. Maxx		-0.549	(1.984)	-0.231	(1.540)	1.487	(2.078)	0.053	(1.607)
Big Lots		-2.177	(1.493)	-1.033	(1.179)	-1.082	(1.107)	-4.807	(1.549)
Target		0.230	(2.151)	1.353	(1.575)	2.389	(1.837)	0.974	(1.596)
Walmart		1.472	(2.461)	2.082	(1.977)	2.703	(2.058)	-0.168	(1.418)
99c Only		–	–	–	–	–	–	–	–
Dollar General		-0.523	(0.895)	-0.325	(1.028)	-0.888	(1.441)	-4.105	(1.529)
Dollar Tree		1.026	(1.595)	1.190	(1.136)	1.527	(1.478)	-0.028	(1.120)
Family Dollar		0.210	(0.850)	0.308	(1.033)	-0.277	(1.256)	-2.187	(0.947)
Random Coefficients	σ_k								
Warehouse Stores		1.453	(1.084)	1.472	(0.574)	2.703	(0.572)	2.244	(0.703)
Traditional Stores		1.440	(0.911)	0.000	(0.643)	1.561	(0.432)	2.319	(0.513)
Discount Stores		0.986	(0.854)	0.737	(0.810)	2.126	(0.544)	2.114	(0.624)
Supercenters		0.000	(0.248)	0.000	(0.175)	0.000	(0.161)	0.387	(0.313)
Dollar Stores		2.186	(0.897)	2.254	(0.678)	2.752	(0.438)	1.781	(0.445)
Summary									
Log Likelihood		-264095.2		-1274894.2		-1773235.4		-1140656.4	
Number of Visits		114,880		568,898		813,913		514,811	
Number of Devices		9,783		44,575		59,254		40,336	
First Stage Partial R^2		18.5%		12.3%		9.4%		12.1%	
First Stage Partial F-stat		425.3		1132.1		1059.0		1019.1	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.9: Houston-The Woodlands-Sugar Land, TX Metro Area — Endo. Dist (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.485	(0.032)	-0.504	(0.027)	-0.433	(0.029)	-0.577	(0.048)
Density	β^{d2}	0.918	(0.064)	0.658	(0.047)	0.483	(0.045)	0.267	(0.052)
Fringe	ω	1.394	(0.072)	1.398	(0.045)	1.321	(0.050)	1.473	(0.067)
Control Function	ρ	0.259	(0.027)	0.248	(0.017)	0.141	(0.021)	0.212	(0.024)
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		-1.356	(2.662)	1.930	(1.047)	3.873	(1.929)	5.809	(2.102)
Sam's Club		-0.155	(3.094)	2.562	(2.092)	3.625	(3.070)	4.119	(2.057)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		-0.573	(2.938)	-0.214	(2.283)	1.785	(1.826)	1.183	(1.497)
JC Penney		0.161	(1.354)	-0.465	(2.059)	1.025	(3.050)	-1.346	(2.300)
Kohl's		0.069	(1.317)	0.715	(1.894)	1.111	(2.819)	1.672	(1.816)
Macy's		0.558	(3.331)	1.081	(2.149)	2.874	(2.302)	2.145	(2.019)
Neiman Marcus		0.485	(2.679)	1.288	(2.016)	1.930	(2.657)	3.136	(0.997)
Nordstrom		-0.812	(3.449)	-1.957	(3.180)	0.083	(3.544)	0.574	(2.465)
Saks Fifth Avenue		1.025	(2.613)	0.968	(2.567)	2.878	(1.878)	2.743	(1.713)
Sears		-0.417	(2.541)	-0.479	(1.907)	0.146	(3.339)	-0.464	(2.324)
Burlington		4.400	(3.084)	4.669	(0.710)	4.809	(1.033)	6.321	(1.426)
Citi Trends		2.988	(1.439)	3.262	(0.995)	3.202	(3.835)	3.977	(1.252)
Five Below		2.402	(2.810)	3.132	(1.722)	4.090	(2.120)	5.749	(2.247)
Marshalls		3.931	(1.721)	4.537	(2.517)	4.983	(2.977)	6.677	(1.917)
Ross Dress for Less		4.001	(2.170)	4.762	(2.983)	5.313	(4.186)	6.993	(1.879)
T.J. Maxx		3.114	(2.319)	3.605	(2.778)	4.153	(2.791)	5.564	(1.793)
Big Lots		0.302	(2.148)	1.918	(1.023)	1.864	(1.223)	2.402	(1.608)
Target		2.876	(2.525)	4.217	(2.891)	4.708	(3.419)	6.075	(1.794)
Walmart		6.839	(2.160)	6.771	(2.329)	6.513	(2.453)	6.921	(2.016)
99c Only		2.523	(0.948)	3.216	(0.622)	2.505	(0.594)	1.838	(0.543)
Dollar General		3.055	(1.001)	3.283	(1.231)	2.720	(2.504)	1.380	(2.396)
Dollar Tree		4.203	(1.372)	4.830	(1.331)	4.724	(1.752)	5.216	(1.425)
Family Dollar		3.401	(2.632)	3.715	(1.419)	3.278	(1.577)	2.402	(1.781)
Random Coefficients	σ_k								
Warehouse Stores		3.391	(0.905)	3.673	(0.701)	2.771	(0.908)	4.149	(0.980)
Traditional Stores		2.229	(0.412)	1.726	(0.248)	1.454	(0.269)	1.783	(0.348)
Discount Stores		1.433	(0.522)	1.215	(0.571)	1.409	(0.470)	2.487	(0.547)
Supercenters		0.964	(0.443)	1.060	(0.602)	0.174	(0.512)	0.000	(0.514)
Dollar Stores		5.047	(0.839)	3.697	(0.461)	2.524	(0.346)	2.859	(0.641)
Summary									
Log Likelihood		-626299.6		-2278790.6		-2383374.7		-1843484.8	
Number of Visits		300,006		1,042,665		1,078,704		788,704	
Number of Devices		25,023		75,329		74,979		62,243	
First Stage Partial R^2		14.2%		10.2%		6.3%		12.4%	
First Stage Partial F-stat		728.7		1606.8		943.7		1722.1	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.10: Miami-Fort Lauderdale-Pompano Beach, FL Metro Area — Endo. Dist (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.487	(0.064)	-0.560	(0.034)	-0.585	(0.028)	-0.606	(0.063)
Density	β^{d2}	0.465	(0.117)	0.104	(0.037)	-0.130	(0.029)	-0.068	(0.050)
Fringe	ω	1.120	(0.181)	0.810	(0.067)	1.028	(0.050)	1.133	(0.081)
Control Function	ρ	0.199	(0.047)	0.264	(0.024)	0.297	(0.019)	0.301	(0.045)
Chain Preferences									
BJ's Wholesale Club		2.833	(0.808)	2.639	(0.332)	3.775	(0.373)	3.281	(0.470)
Costco		3.002	(2.648)	2.854	(1.442)	4.289	(1.402)	4.125	(2.194)
Sam's Club		2.956	(2.643)	2.406	(1.715)	3.571	(0.830)	3.052	(1.282)
Bloomingdale's		-0.507	(2.242)	2.110	(0.789)	3.484	(0.605)	3.689	(0.308)
Dillard's		-7.123	(4.041)	1.187	(1.425)	0.470	(1.262)	-0.659	(1.742)
JC Penney		-1.906	(2.397)	-0.313	(0.829)	2.157	(0.701)	0.804	(1.108)
Kohl's		-4.815	(3.528)	0.200	(1.052)	0.997	(0.866)	0.161	(1.140)
Macy's		-2.295	(2.962)	0.931	(1.469)	2.255	(0.624)	1.751	(1.236)
Neiman Marcus		-6.797	(4.511)	-1.408	(1.708)	1.198	(1.227)	0.948	(1.293)
Nordstrom		-6.552	(4.218)	-1.582	(2.524)	0.356	(1.413)	1.107	(1.866)
Saks Fifth Avenue		-2.175	(2.907)	1.209	(1.395)	2.325	(0.983)	1.603	(1.727)
Sears		-1.552	(2.554)	-1.608	(1.723)	0.021	(1.273)	-0.539	(1.535)
Burlington		3.265	(0.803)	2.157	(0.508)	2.591	(0.638)	3.791	(0.603)
Citi Trends		2.672	(1.515)	2.411	(0.775)	2.937	(0.856)	4.150	(0.976)
Five Below		0.532	(2.424)	-0.607	(1.207)	-0.306	(1.366)	2.192	(1.548)
Marshalls		2.111	(3.051)	1.602	(1.121)	1.912	(1.018)	3.966	(1.768)
Ross Dress for Less		3.424	(2.176)	2.692	(2.456)	3.594	(0.867)	4.951	(1.667)
T.J. Maxx		2.470	(2.142)	1.789	(1.287)	2.395	(0.947)	4.442	(1.681)
Big Lots		-2.622	(1.699)	-1.283	(0.844)	0.944	(0.764)	2.139	(0.581)
Target		-0.611	(2.792)	0.307	(1.583)	2.743	(1.180)	4.416	(1.602)
Walmart		3.392	(2.648)	3.173	(1.744)	4.155	(1.017)	4.392	(1.567)
99c Only		–	–	–	–	–	–	–	–
Dollar General		0.142	(1.918)	-0.028	(1.880)	1.221	(1.405)	0.975	(1.703)
Dollar Tree		3.077	(1.225)	3.416	(1.405)	4.258	(1.198)	4.640	(1.228)
Family Dollar		1.911	(1.537)	2.262	(0.997)	2.730	(1.213)	2.468	(0.678)
Random Coefficients	σ_k								
Warehouse Stores		4.272	(1.544)	2.191	(0.810)	1.999	(0.805)	2.772	(0.644)
Traditional Stores		3.598	(0.939)	2.944	(0.388)	1.959	(0.317)	1.370	(0.383)
Discount Stores		2.479	(0.794)	1.776	(0.273)	1.712	(0.224)	1.932	(0.303)
Supercenters		0.806	(0.696)	1.490	(0.592)	1.747	(0.719)	0.078	(0.377)
Dollar Stores		0.000	(0.647)	0.857	(0.398)	0.000	(0.195)	1.523	(0.655)
Summary									
Log Likelihood		-238338.4		-1464492.8		-2254153.3		-3257684.3	
Number of Visits		99,832		602,570		908,939		1,299,438	
Number of Devices		7,744		38,650		56,260		84,592	
First Stage Partial R^2		20.6%		10.1%		9.8%		11.0%	
First Stage Partial F-stat		435.3		932.3		1268.0		2073.9	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.11: Minneapolis-St. Paul-Bloomington, MN-WI Metro Area — Endo. Dist (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.471	(0.126)	-0.618	(0.058)	-0.581	(0.032)	-0.753	(0.094)
Density	β^{d2}	0.213	(0.238)	0.058	(0.069)	0.026	(0.047)	-0.329	(0.287)
Fringe	ω	2.663	(4.430)	3.991	(0.468)	3.494	(0.087)	2.481	(0.138)
Control Function	ρ	0.253	(0.087)	0.388	(0.038)	0.334	(0.025)	0.491	(0.064)
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		7.059	(4.689)	8.373	(0.974)	7.399	(0.526)	7.274	(2.253)
Sam's Club		7.772	(5.121)	8.628	(1.480)	6.930	(2.562)	5.833	(2.396)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		–	–	–	–	–	–	–	–
JC Penney		5.370	(5.430)	7.033	(1.160)	3.832	(1.235)	0.083	(4.045)
Kohl's		6.372	(4.941)	7.392	(1.350)	4.949	(1.314)	2.051	(1.928)
Macy's		6.638	(6.067)	8.305	(1.232)	5.476	(2.389)	2.724	(3.123)
Neiman Marcus		–	–	–	–	–	–	–	–
Nordstrom		5.855	(5.009)	7.310	(1.771)	4.033	(2.261)	2.755	(2.679)
Saks Fifth Avenue		3.832	(5.633)	5.042	(1.375)	0.742	(2.011)	-2.399	(3.799)
Sears		–	–	–	–	–	–	–	–
Burlington		7.383	(4.908)	7.609	(1.297)	6.298	(0.823)	-1.903	(2.404)
Citi Trends		7.487	(5.248)	7.981	(1.194)	6.563	(1.883)	-4.922	(4.090)
Five Below		6.006	(5.110)	6.580	(0.929)	5.741	(1.529)	-2.698	(2.246)
Marshalls		6.928	(5.006)	7.389	(1.741)	6.335	(1.814)	-2.097	(2.369)
Ross Dress for Less		–	–	–	–	–	–	–	–
T.J. Maxx		5.686	(4.729)	6.697	(1.600)	6.167	(1.774)	-7.686	(3.539)
Big Lots		4.576	(4.904)	7.561	(2.186)	5.406	(2.446)	4.068	(3.031)
Target		8.686	(5.301)	10.591	(0.984)	9.280	(2.997)	8.196	(2.731)
Walmart		9.228	(4.661)	11.011	(1.087)	9.245	(2.054)	7.678	(2.944)
99c Only		–	–	–	–	–	–	–	–
Dollar General		5.661	(4.811)	6.851	(1.055)	5.349	(3.136)	2.161	(3.087)
Dollar Tree		7.721	(4.665)	8.747	(0.967)	7.089	(0.899)	4.920	(2.302)
Family Dollar		6.028	(4.736)	7.284	(0.970)	5.605	(1.002)	2.177	(2.566)
Random Coefficients	σ_k								
Warehouse Stores		1.809	(1.502)	2.213	(0.658)	3.044	(0.750)	4.574	(1.015)
Traditional Stores		0.812	(1.070)	0.176	(0.637)	0.057	(0.285)	0.000	(0.569)
Discount Stores		1.075	(0.908)	1.793	(0.447)	1.568	(0.266)	2.642	(1.028)
Supercenters		0.084	(1.441)	1.777	(0.678)	1.526	(0.592)	5.679	(1.369)
Dollar Stores		1.191	(1.395)	2.310	(0.545)	2.543	(0.308)	2.412	(0.713)
Summary									
Log Likelihood		-45638.8		-462223.3		-960519.9		-1002845.7	
Number of Visits		23,823		251,022		555,788		554,001	
Number of Devices		2,610		23,069		48,781		44,690	
First Stage Partial R^2		23.4%		15.5%		12.5%		10.1%	
First Stage Partial F-stat		148.9		715.1		1057.5		821.9	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.12: Philadelphia-Camden-Wilmington, PA-NJ-DE-MD Metro Area — Endo. Dist (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.391	(0.063)	-0.307	(0.023)	-0.350	(0.015)	-0.330	(0.014)
Density	β^{d2}	-0.010	(0.141)	-0.116	(0.046)	-0.166	(0.034)	-0.106	(0.030)
Fringe	ω	1.179	(0.175)	1.071	(0.057)	1.113	(0.038)	1.169	(0.033)
Control Function	ρ	0.060	(0.048)	0.023	(0.018)	0.052	(0.012)	0.003	(0.014)
Chain Preferences									
BJ's Wholesale Club		3.837	(0.983)	2.896	(1.102)	3.241	(1.821)	3.602	(0.506)
Costco		3.977	(3.398)	3.015	(1.012)	3.631	(1.855)	4.358	(1.756)
Sam's Club		3.851	(2.337)	3.001	(1.221)	3.239	(1.497)	3.363	(1.499)
Bloomingdale's		0.380	(2.230)	1.577	(0.663)	0.088	(1.551)	1.127	(1.766)
Dillard's		–	–	–	–	–	–	–	–
JC Penney		-0.934	(3.306)	1.343	(1.450)	0.441	(1.963)	0.727	(0.836)
Kohl's		-0.310	(2.565)	1.859	(0.679)	1.454	(0.877)	1.625	(1.216)
Macy's		-0.199	(3.244)	1.755	(1.813)	0.558	(1.245)	1.684	(1.444)
Neiman Marcus		-2.017	(3.135)	-0.093	(1.256)	-0.659	(1.398)	0.260	(1.522)
Nordstrom		-2.122	(2.599)	0.481	(1.365)	-0.664	(1.849)	1.841	(1.537)
Saks Fifth Avenue		-4.481	(3.451)	-1.982	(2.233)	-2.061	(1.458)	-0.873	(1.561)
Sears		-0.023	(2.474)	1.897	(1.353)	1.226	(1.748)	1.419	(1.851)
Burlington		3.612	(0.789)	2.883	(0.743)	2.850	(1.224)	3.073	(1.068)
Citi Trends		3.027	(0.900)	1.835	(1.139)	1.549	(0.668)	1.404	(1.008)
Five Below		2.446	(1.664)	1.269	(1.304)	1.304	(0.786)	1.861	(1.242)
Marshalls		4.117	(2.280)	2.933	(0.887)	3.209	(1.130)	3.473	(1.257)
Ross Dress for Less		3.702	(3.539)	2.813	(1.814)	2.902	(1.089)	2.676	(1.399)
T.J. Maxx		3.780	(3.353)	2.940	(1.983)	3.418	(1.416)	4.217	(2.044)
Big Lots		-1.744	(2.282)	1.219	(1.165)	1.896	(1.168)	1.301	(0.408)
Target		1.686	(3.968)	3.097	(1.715)	4.015	(1.347)	4.488	(1.833)
Walmart		4.249	(2.315)	4.273	(1.014)	4.521	(1.158)	4.285	(1.631)
99c Only		–	–	–	–	–	–	–	–
Dollar General		2.553	(1.058)	1.468	(0.527)	1.689	(0.284)	1.284	(1.316)
Dollar Tree		4.593	(1.578)	3.798	(0.492)	4.110	(0.442)	4.052	(1.305)
Family Dollar		3.275	(1.627)	2.086	(0.893)	1.719	(1.029)	0.815	(1.319)
Random Coefficients	σ_k								
Warehouse Stores		3.169	(1.522)	1.503	(0.755)	2.355	(0.443)	2.309	(0.254)
Traditional Stores		3.225	(0.933)	0.936	(0.235)	0.000	(0.401)	0.000	(0.078)
Discount Stores		1.375	(0.763)	1.311	(0.201)	1.195	(0.144)	1.313	(0.275)
Supercenters		0.000	(0.588)	0.000	(0.413)	0.000	(0.211)	0.000	(0.078)
Dollar Stores		0.275	(0.856)	0.161	(0.231)	0.406	(0.139)	0.000	(0.563)
Summary									
Log Likelihood		-105990.8		-952254.4		-1872160.0		-1927270.3	
Number of Visits		46,479		415,276		822,687		826,258	
Number of Devices		4,136		31,572		62,024		69,946	
First Stage Partial R^2		16.0%		8.1%		6.9%		7.6%	
First Stage Partial F-stat		147.4		506.1		801.0		1013.5	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.13: Phoenix-Mesa-Chandler, AZ Metro Area — Endo. Dist (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.544	(0.081)	-0.446	(0.073)	-0.389	(0.061)	-0.475	(0.030)
Density	β^{d2}	-0.343	(0.255)	-0.126	(0.091)	-0.233	(0.060)	-0.421	(0.047)
Fringe	ω	1.052	(0.216)	0.777	(0.142)	0.615	(0.114)	0.468	(0.133)
Control Function	ρ	0.308	(0.048)	0.260	(0.052)	0.145	(0.037)	0.233	(0.019)
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		3.032	(0.940)	4.453	(0.902)	3.999	(0.696)	5.359	(0.812)
Sam's Club		3.011	(2.463)	3.731	(2.093)	2.584	(1.904)	3.767	(2.381)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		-0.354	(1.064)	2.431	(1.027)	2.074	(0.829)	2.362	(0.831)
JC Penney		1.065	(1.663)	3.090	(1.164)	2.446	(0.777)	1.624	(1.036)
Kohl's		0.506	(2.158)	3.101	(1.757)	2.569	(1.185)	2.268	(0.942)
Macy's		2.438	(1.658)	3.218	(1.464)	2.751	(1.065)	3.259	(0.821)
Neiman Marcus		-0.764	(3.197)	0.811	(1.675)	0.018	(1.319)	1.533	(1.580)
Nordstrom		-0.209	(2.783)	2.218	(1.991)	1.608	(1.691)	2.957	(1.484)
Saks Fifth Avenue		-1.138	(2.960)	0.748	(2.402)	-0.035	(2.015)	1.121	(2.008)
Sears		-2.425	(3.302)	0.261	(1.767)	-0.187	(1.466)	-0.354	(1.921)
Burlington		-3.641	(1.432)	0.327	(1.424)	0.275	(1.145)	2.348	(0.672)
Citi Trends		–	–	–	–	–	–	–	–
Five Below		-5.770	(3.118)	-1.769	(1.661)	-1.624	(1.159)	1.383	(0.627)
Marshalls		-5.123	(3.031)	-0.154	(1.770)	0.305	(1.332)	3.413	(1.246)
Ross Dress for Less		1.933	(2.602)	2.692	(2.325)	2.470	(1.738)	4.436	(1.740)
T.J. Maxx		-4.657	(2.373)	1.622	(2.667)	1.944	(2.415)	3.525	(2.095)
Big Lots		1.336	(0.879)	0.158	(1.535)	0.265	(0.676)	2.208	(0.521)
Target		3.587	(2.707)	2.473	(2.442)	3.110	(2.545)	4.893	(1.968)
Walmart		5.945	(3.190)	4.968	(2.027)	5.001	(1.738)	5.379	(1.990)
99c Only		3.847	(2.526)	3.072	(0.457)	2.926	(0.346)	3.340	(0.352)
Dollar General		2.761	(0.665)	1.667	(0.775)	1.312	(0.810)	0.608	(1.412)
Dollar Tree		4.081	(1.521)	3.498	(0.616)	3.786	(0.783)	4.354	(1.364)
Family Dollar		3.060	(1.556)	2.376	(1.406)	1.736	(1.248)	1.100	(0.635)
Random Coefficients	σ_k								
Warehouse Stores		2.419	(1.076)	0.000	(1.217)	1.137	(1.073)	1.900	(0.541)
Traditional Stores		1.469	(1.338)	1.926	(0.872)	1.932	(0.497)	0.797	(0.642)
Discount Stores		0.000	(0.503)	0.000	(0.275)	0.000	(0.436)	0.554	(0.437)
Supercenters		4.670	(2.112)	2.143	(1.451)	2.097	(1.224)	0.000	(0.110)
Dollar Stores		2.306	(1.149)	0.000	(1.100)	1.669	(0.454)	1.246	(0.325)
Summary									
Log Likelihood		-93225.8		-571680.2		-816297.2		-659385.0	
Number of Visits		48,832		280,940		395,217		304,300	
Number of Devices		5,514		28,582		41,826		43,907	
First Stage Partial R^2		21.2%		19.6%		16.1%		14.5%	
First Stage Partial F-stat		246.6		1128.9		1182.2		863.1	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.14: Riverside-San Bernardino-Ontario, CA Metro Area — Endo. Dist (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.443	(0.063)	-0.418	(0.036)	-0.446	(0.019)	-0.387	(0.019)
Density	β^{d2}	-0.052	(0.126)	0.067	(0.051)	0.094	(0.028)	0.177	(0.023)
Fringe	ω	1.609	(0.189)	1.617	(0.081)	1.517	(0.047)	1.441	(0.051)
Control Function	ρ	0.199	(0.051)	0.215	(0.027)	0.228	(0.017)	0.160	(0.015)
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		2.051	(4.172)	4.440	(1.400)	4.822	(1.405)	5.966	(1.330)
Sam's Club		0.999	(1.996)	3.646	(1.497)	4.499	(0.884)	5.400	(1.335)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		–	–	–	–	–	–	–	–
JC Penney		-0.889	(1.956)	3.138	(1.292)	4.303	(1.212)	3.681	(0.922)
Kohl's		0.837	(1.928)	3.526	(1.228)	4.704	(1.367)	4.166	(0.497)
Macy's		-1.119	(5.435)	3.054	(1.107)	4.458	(1.196)	3.962	(0.603)
Neiman Marcus		-4.081	(7.938)	0.982	(1.970)	2.531	(1.491)	1.772	(1.247)
Nordstrom		0.761	(4.298)	3.516	(1.609)	4.948	(1.614)	4.209	(1.069)
Saks Fifth Avenue		-3.140	(6.319)	0.351	(1.266)	2.571	(0.484)	3.523	(1.061)
Sears		-1.832	(9.668)	1.555	(1.529)	2.488	(0.583)	2.345	(1.762)
Burlington		2.104	(1.010)	2.487	(0.625)	3.201	(0.611)	2.445	(0.524)
Citi Trends		0.739	(9.784)	0.981	(1.974)	1.380	(1.214)	0.659	(0.976)
Five Below		0.088	(1.324)	0.627	(1.167)	1.670	(1.425)	0.561	(1.353)
Marshalls		1.750	(1.648)	1.676	(1.271)	3.511	(0.565)	3.556	(0.931)
Ross Dress for Less		1.834	(2.381)	2.693	(1.305)	2.932	(0.775)	2.383	(1.143)
T.J. Maxx		0.971	(4.308)	2.343	(1.942)	3.074	(1.133)	2.876	(1.560)
Big Lots		2.672	(0.523)	2.859	(0.276)	3.255	(0.196)	3.035	(0.237)
Target		5.169	(4.709)	5.434	(1.466)	5.732	(1.079)	5.832	(1.513)
Walmart		6.199	(3.715)	6.154	(1.547)	6.200	(1.201)	6.017	(1.478)
99c Only		4.544	(0.431)	4.334	(0.322)	4.254	(0.243)	3.886	(0.248)
Dollar General		3.276	(1.631)	2.768	(0.917)	2.424	(1.516)	1.590	(1.614)
Dollar Tree		4.522	(1.587)	4.318	(1.137)	4.392	(1.133)	4.300	(1.331)
Family Dollar		3.018	(5.415)	2.702	(1.498)	2.416	(1.139)	1.983	(1.318)
Random Coefficients	σ_k								
Warehouse Stores		3.387	(1.634)	1.509	(0.963)	0.341	(0.285)	1.166	(0.366)
Traditional Stores		0.605	(0.692)	0.019	(0.226)	0.232	(0.146)	0.029	(0.104)
Discount Stores		0.495	(0.767)	0.784	(0.552)	1.006	(0.342)	1.164	(0.460)
Supercenters		2.357	(1.116)	2.060	(0.558)	1.570	(0.684)	1.989	(0.610)
Dollar Stores		3.422	(1.525)	1.991	(0.401)	2.001	(0.270)	0.652	(0.432)
Summary									
Log Likelihood		-78599.5		-565725.5		-1113461.5		-1748904.5	
Number of Visits		38,267		260,377		494,715		747,639	
Number of Devices		4,007		23,002		39,944		56,428	
First Stage Partial R^2		11.7%		10.0%		10.2%		10.0%	
First Stage Partial F-stat		81.0		420.8		789.3		1159.1	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.15: St. Louis, MO-IL Metro Area — Endo. Dist (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.428	(0.069)	-0.453	(0.054)	-0.545	(0.066)	-0.795	(0.034)
Density	β^{d2}	-0.339	(0.111)	-0.410	(0.054)	-0.459	(0.058)	-0.808	(0.084)
Fringe	ω	5.982	(5.033)	4.082	(1.248)	3.840	(0.263)	2.083	(0.096)
Control Function	ρ	0.198	(0.049)	0.226	(0.034)	0.301	(0.046)	0.550	(0.025)
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		7.717	(4.964)	5.612	(1.809)	6.830	(1.885)	1.340	(2.398)
Sam's Club		8.179	(3.648)	6.561	(2.988)	6.929	(4.071)	2.063	(2.925)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		0.454	(4.784)	3.494	(2.305)	0.147	(3.715)	1.537	(2.367)
JC Penney		2.412	(5.301)	5.029	(2.139)	2.993	(2.397)	0.704	(1.854)
Kohl's		3.013	(3.225)	5.420	(2.534)	3.453	(2.554)	1.918	(2.216)
Macy's		2.930	(5.130)	5.693	(2.240)	1.252	(3.442)	3.133	(1.841)
Neiman Marcus		-2.235	(5.674)	2.527	(2.723)	-0.217	(4.210)	-0.338	(3.122)
Nordstrom		1.790	(5.443)	4.597	(3.628)	2.022	(4.477)	2.886	(3.130)
Saks Fifth Avenue		-0.360	(5.151)	1.566	(3.579)	-0.440	(3.891)	-0.341	(3.354)
Sears		-4.396	(5.574)	2.144	(3.154)	-0.140	(3.674)	-1.603	(3.096)
Burlington		8.763	(4.748)	6.843	(2.025)	6.168	(0.622)	4.661	(1.395)
Citi Trends		7.390	(2.249)	5.766	(3.429)	4.850	(4.189)	2.869	(2.086)
Five Below		7.123	(2.993)	5.422	(2.044)	5.067	(2.316)	3.101	(1.536)
Marshalls		7.510	(2.873)	5.805	(2.638)	5.410	(2.468)	4.107	(2.388)
Ross Dress for Less		9.148	(3.458)	7.668	(3.085)	7.258	(3.510)	5.906	(2.799)
T.J. Maxx		9.279	(5.276)	7.804	(3.650)	7.511	(4.280)	6.436	(3.560)
Big Lots		8.146	(2.260)	6.275	(2.578)	5.377	(0.451)	4.893	(0.574)
Target		10.017	(4.617)	8.610	(3.722)	8.209	(4.813)	7.572	(3.137)
Walmart		11.278	(4.361)	9.646	(1.795)	8.870	(4.521)	7.785	(3.583)
99c Only		–	–	–	–	–	–	–	–
Dollar General		8.048	(2.458)	6.864	(1.359)	5.803	(2.504)	5.951	(2.293)
Dollar Tree		8.558	(4.361)	7.782	(1.482)	7.189	(2.096)	7.612	(2.417)
Family Dollar		8.162	(3.169)	7.153	(2.052)	5.707	(2.468)	6.346	(2.044)
Random Coefficients	σ_k								
Warehouse Stores		4.620	(1.119)	2.488	(0.808)	3.938	(0.787)	3.838	(0.553)
Traditional Stores		0.024	(0.693)	0.123	(0.504)	0.000	(0.606)	0.101	(0.585)
Discount Stores		1.835	(0.886)	1.086	(0.690)	1.371	(0.665)	0.000	(0.069)
Supercenters		0.218	(1.079)	0.330	(0.330)	0.000	(0.261)	1.242	(0.330)
Dollar Stores		2.329	(0.970)	2.694	(0.572)	2.141	(0.461)	6.000	(0.105)
Summary									
Log Likelihood		-193099.2		-885825.4		-1193639.8		-750068.5	
Number of Visits		111,263		511,689		640,355		364,876	
Number of Devices		10,446		40,353		45,028		25,214	
First Stage Partial R^2		15.4%		12.2%		11.1%		25.0%	
First Stage Partial F-stat		283.9		828.8		868.8		1545.0	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.16: San Diego-Chula Vista-Carlsbad, CA Metro Area — Endo. Dist (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.163	(0.071)	-0.275	(0.050)	-0.276	(0.050)	-0.268	(0.012)
Density	β^{d2}	-0.223	(0.399)	-0.114	(0.135)	-0.012	(0.109)	-0.029	(0.027)
Fringe	ω	0.413	(0.349)	1.076	(0.145)	0.914	(0.095)	0.970	(0.051)
Control Function	ρ	-0.007	(0.058)	0.085	(0.043)	0.115	(0.031)	0.047	(0.010)
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		0.492	(3.019)	3.237	(0.998)	2.830	(1.318)	2.554	(0.729)
Sam's Club		-1.552	(4.789)	1.460	(2.352)	0.940	(2.017)	-1.456	(1.029)
Bloomingdale's		1.571	(2.339)	3.621	(1.008)	3.246	(1.205)	3.607	(1.936)
Dillard's		–	–	–	–	–	–	–	–
JC Penney		0.311	(3.926)	2.425	(0.870)	1.960	(1.284)	2.015	(0.661)
Kohl's		0.153	(1.895)	2.346	(0.852)	1.914	(1.011)	2.326	(0.345)
Macy's		0.612	(2.098)	2.648	(0.987)	2.194	(1.039)	2.475	(0.437)
Neiman Marcus		-0.965	(1.956)	1.343	(1.339)	0.586	(1.258)	0.208	(1.883)
Nordstrom		0.171	(2.364)	2.170	(1.557)	1.739	(1.699)	2.379	(1.354)
Saks Fifth Avenue		-3.788	(4.631)	-1.479	(1.753)	-0.323	(2.021)	0.886	(2.043)
Sears		-2.861	(4.405)	-0.327	(1.736)	-0.655	(2.451)	-0.356	(1.779)
Burlington		0.099	(2.108)	1.872	(0.966)	1.331	(1.086)	1.263	(1.005)
Citi Trends		–	–	–	–	–	–	–	–
Five Below		-3.480	(8.089)	-1.522	(1.487)	-1.774	(1.744)	-2.010	(1.995)
Marshalls		-0.197	(3.405)	2.053	(1.285)	1.593	(1.159)	2.307	(0.907)
Ross Dress for Less		1.386	(3.104)	3.098	(2.725)	2.866	(1.588)	2.736	(1.042)
T.J. Maxx		-0.564	(3.033)	1.567	(2.641)	1.493	(1.586)	1.953	(1.869)
Big Lots		-0.729	(2.189)	0.526	(0.882)	1.065	(0.956)	1.043	(0.203)
Target		1.595	(3.192)	3.546	(1.728)	3.607	(1.821)	3.861	(1.902)
Walmart		2.700	(4.696)	4.256	(1.713)	4.097	(2.449)	3.973	(2.275)
99c Only		-1.989	(2.348)	2.903	(0.304)	2.445	(0.301)	2.140	(0.118)
Dollar General		–	–	–	–	–	–	–	–
Dollar Tree		-1.480	(5.037)	3.314	(1.858)	2.952	(1.884)	2.912	(1.560)
Family Dollar		-9.751	(7.103)	-0.790	(1.284)	-0.999	(1.347)	-1.552	(1.969)
Random Coefficients	σ_k								
Warehouse Stores		0.000	(1.456)	0.000	(0.899)	0.000	(1.069)	0.000	(0.401)
Traditional Stores		0.667	(1.771)	1.322	(0.921)	0.000	(1.058)	0.000	(0.133)
Discount Stores		4.078	(2.405)	0.310	(0.479)	0.000	(0.514)	0.000	(0.075)
Supercenters		0.491	(1.974)	0.245	(0.822)	0.024	(1.011)	0.003	(0.081)
Dollar Stores		1.833	(1.703)	1.013	(0.725)	1.399	(0.974)	2.934	(0.367)
Summary									
Log Likelihood		-40970.6		-201711.5		-427492.9		-1616735.1	
Number of Visits		17,995		88,803		185,858		714,861	
Number of Devices		1,608		6,487		12,894		54,179	
First Stage Partial R^2		31.8%		25.2%		22.4%		12.9%	
First Stage Partial F-stat		157.1		454.2		752.1		1505.7	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.17: San Francisco-Oakland-Fremont, CA Metro Area — Endo. Dist (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.298	(0.105)	-0.293	(0.055)	-0.405	(0.066)	-0.454	(0.029)
Density	β^{d2}	1.531	(0.540)	0.574	(0.153)	0.717	(0.150)	0.258	(0.037)
Fringe	ω	3.135	(1.531)	2.051	(0.377)	1.254	(0.215)	0.459	(0.047)
Control Function	ρ	0.012	(0.105)	0.092	(0.032)	0.211	(0.046)	0.227	(0.022)
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		2.911	(3.101)	4.526	(1.190)	3.238	(0.958)	2.160	(0.717)
Sam's Club		2.986	(4.545)	3.143	(1.333)	1.993	(2.007)	-0.911	(1.840)
Bloomingdale's		2.791	(2.789)	2.185	(1.341)	1.283	(1.370)	2.741	(1.642)
Dillard's		–	–	–	–	–	–	–	–
JC Penney		5.656	(4.241)	3.098	(1.254)	1.510	(0.986)	1.251	(0.708)
Kohl's		4.629	(2.713)	2.537	(1.134)	0.837	(0.998)	1.340	(0.796)
Macy's		5.652	(2.977)	3.556	(1.248)	1.715	(2.227)	2.070	(0.716)
Neiman Marcus		3.833	(3.375)	2.583	(1.512)	1.038	(1.771)	1.743	(1.349)
Nordstrom		5.970	(3.263)	2.851	(1.467)	1.111	(1.263)	1.867	(1.018)
Saks Fifth Avenue		3.153	(3.948)	1.507	(1.348)	-0.551	(1.753)	-0.132	(1.019)
Sears		3.259	(3.491)	1.716	(1.739)	-0.338	(2.612)	-0.298	(1.531)
Burlington		3.364	(3.218)	3.046	(0.979)	2.737	(1.743)	2.244	(0.754)
Citi Trends		2.690	(6.384)	1.977	(1.140)	1.645	(1.393)	0.144	(1.283)
Five Below		–	–	–	–	–	–	–	–
Marshalls		1.918	(3.350)	1.896	(1.346)	1.994	(1.071)	1.174	(0.802)
Ross Dress for Less		4.968	(3.410)	3.762	(1.814)	3.369	(1.330)	2.250	(1.407)
T.J. Maxx		1.469	(4.366)	2.016	(1.630)	2.163	(1.285)	1.747	(1.660)
Big Lots		-1.569	(4.495)	2.104	(1.498)	1.673	(1.783)	0.044	(1.081)
Target		5.070	(3.460)	4.933	(1.794)	3.832	(1.140)	3.152	(1.523)
Walmart		4.870	(5.503)	5.268	(1.960)	4.406	(1.637)	3.078	(2.029)
99c Only		-1.834	(3.960)	3.007	(1.047)	0.254	(1.885)	1.688	(0.621)
Dollar General		-3.574	(7.670)	0.112	(2.145)	-2.245	(2.096)	-1.585	(1.531)
Dollar Tree		1.273	(2.934)	3.380	(1.755)	1.882	(0.685)	2.216	(0.971)
Family Dollar		–	–	–	–	–	–	–	–
Random Coefficients	σ_k								
Warehouse Stores		0.000	(1.201)	1.031	(0.962)	1.995	(1.151)	0.851	(0.521)
Traditional Stores		3.629	(2.110)	0.110	(0.863)	0.000	(0.636)	0.073	(0.149)
Discount Stores		6.000	(1.455)	1.727	(1.091)	2.556	(0.782)	0.103	(0.176)
Supercenters		2.368	(1.288)	1.599	(1.039)	0.000	(0.834)	0.000	(0.618)
Dollar Stores		6.000	(0.375)	1.572	(1.080)	2.412	(0.918)	3.529	(0.367)
Summary									
Log Likelihood		-19572.2		-114977.7		-203300.6		-1817238.6	
Number of Visits		8,646		50,335		88,163		803,110	
Number of Devices		1,025		4,930		7,726		68,205	
First Stage Partial R^2		34.8%		23.7%		23.0%		14.0%	
First Stage Partial F-stat		96.6		252.8		375.8		1803.0	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.18: Seattle-Tacoma-Bellevue, WA Metro Area — Endo. Dist (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.362	(0.132)	-0.352	(0.034)	-0.321	(0.020)	-0.558	(0.025)
Density	β^{d2}	-0.332	(0.262)	-0.176	(0.115)	-0.246	(0.055)	0.079	(0.029)
Fringe	ω	0.925	(0.518)	0.824	(0.127)	0.913	(0.058)	0.932	(0.037)
Control Function	ρ	0.154	(0.092)	0.146	(0.032)	0.138	(0.020)	0.300	(0.018)
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		3.060	(1.520)	2.086	(1.368)	2.593	(1.954)	2.230	(0.532)
Sam's Club		–	–	–	–	–	–	–	–
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		–	–	–	–	–	–	–	–
JC Penney		-5.032	(3.052)	0.726	(1.182)	-0.616	(2.166)	-0.479	(0.978)
Kohl's		-6.449	(3.542)	0.520	(1.270)	-1.102	(0.747)	-0.877	(1.288)
Macy's		-3.541	(2.353)	0.882	(1.215)	-0.879	(0.697)	0.165	(1.070)
Neiman Marcus		–	–	–	–	–	–	–	–
Nordstrom		-5.173	(3.322)	0.892	(1.164)	-0.505	(0.797)	1.276	(0.870)
Saks Fifth Avenue		–	–	–	–	–	–	–	–
Sears		-6.535	(5.423)	-0.261	(2.231)	-2.426	(0.981)	-2.607	(2.571)
Burlington		1.201	(7.412)	0.782	(0.741)	0.669	(0.827)	2.017	(0.390)
Citi Trends		–	–	–	–	–	–	–	–
Five Below		–	–	–	–	–	–	–	–
Marshalls		0.551	(4.441)	-0.079	(0.894)	0.249	(0.785)	1.747	(0.641)
Ross Dress for Less		1.805	(3.689)	1.274	(1.299)	1.182	(0.895)	2.458	(0.941)
T.J. Maxx		0.872	(3.904)	0.202	(1.568)	0.397	(0.976)	1.634	(1.278)
Big Lots		0.887	(1.292)	0.866	(0.472)	0.285	(0.432)	1.279	(0.160)
Target		2.481	(2.341)	1.871	(1.041)	1.955	(2.167)	3.194	(0.939)
Walmart		3.800	(3.492)	3.011	(2.298)	2.895	(1.456)	3.387	(1.985)
99c Only		–	–	–	–	–	–	–	–
Dollar General		–	–	–	–	–	–	–	–
Dollar Tree		1.414	(1.642)	-0.864	(1.228)	-3.372	(1.178)	1.690	(1.126)
Family Dollar		–	–	–	–	–	–	–	–
Random Coefficients	σ_k								
Warehouse Stores		4.934	(2.078)	0.252	(1.009)	2.031	(0.569)	2.579	(0.344)
Traditional Stores		0.030	(1.557)	0.218	(0.336)	0.426	(0.122)	0.662	(0.269)
Discount Stores		2.814	(2.039)	4.048	(1.093)	6.000	(0.644)	1.904	(0.636)
Supercenters		0.235	(1.849)	0.167	(0.235)	0.000	(0.452)	0.064	(0.052)
Dollar Stores		0.000	(1.781)	1.468	(1.317)	0.807	(0.346)	4.524	(0.347)
Summary									
Log Likelihood		-24384.4		-149391.8		-433002.3		-1706081.8	
Number of Visits		12,453		77,469		223,113		861,409	
Number of Devices		1,303		6,703		16,137		64,033	
First Stage Partial R^2		18.1%		13.1%		12.8%		13.2%	
First Stage Partial F-stat		65.9		216.2		504.8		2018.8	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.19: Tampa-St. Petersburg-Clearwater, FL Metro Area — Endo. Dist (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.142	(0.043)	-0.235	(0.021)	-0.241	(0.018)	-0.431	(0.031)
Density	β^{d2}	0.866	(0.090)	0.763	(0.053)	0.825	(0.036)	0.710	(0.050)
Fringe	ω	0.601	(0.128)	1.106	(0.072)	1.375	(0.059)	2.146	(0.105)
Control Function	ρ	-0.099	(0.044)	-0.048	(0.022)	-0.052	(0.016)	0.136	(0.021)
Chain Preferences									
BJ's Wholesale Club		0.185	(2.773)	1.719	(0.434)	2.423	(0.540)	5.335	(0.810)
Costco		0.285	(2.938)	2.259	(1.782)	3.035	(1.645)	6.579	(2.073)
Sam's Club		1.193	(3.100)	2.708	(2.610)	3.315	(2.518)	5.890	(3.072)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		-4.346	(3.506)	-3.959	(1.968)	-3.625	(2.036)	0.344	(1.523)
JC Penney		-2.684	(2.388)	-3.043	(2.443)	-3.223	(2.151)	-1.785	(2.059)
Kohl's		-3.343	(3.428)	-1.616	(1.831)	-1.237	(1.671)	1.375	(1.448)
Macy's		-2.447	(3.718)	-2.104	(2.114)	-1.894	(2.189)	1.041	(2.211)
Neiman Marcus		-5.137	(4.576)	-5.754	(3.334)	-6.012	(3.528)	-1.443	(3.320)
Nordstrom		-3.638	(3.229)	-4.884	(2.959)	-4.910	(3.201)	-0.009	(2.500)
Saks Fifth Avenue		–	–	–	–	–	–	–	–
Sears		-6.423	(4.778)	-5.837	(3.304)	-6.349	(3.580)	-3.187	(3.398)
Burlington		0.014	(3.886)	1.476	(1.182)	2.066	(1.656)	4.737	(1.492)
Citi Trends		-0.325	(3.895)	0.492	(0.988)	0.299	(1.535)	2.982	(1.736)
Five Below		-3.166	(2.317)	-2.053	(2.075)	-1.200	(1.756)	0.949	(1.441)
Marshalls		-0.170	(3.258)	1.215	(2.608)	1.936	(2.654)	4.547	(2.152)
Ross Dress for Less		0.091	(4.456)	1.468	(2.000)	2.232	(2.268)	5.018	(2.572)
T.J. Maxx		-0.516	(3.617)	0.865	(2.270)	1.631	(2.746)	4.938	(2.372)
Big Lots		-2.973	(1.736)	-2.322	(0.620)	-0.815	(0.438)	3.154	(0.478)
Target		-0.554	(2.699)	0.206	(2.581)	1.986	(2.739)	5.302	(2.385)
Walmart		2.558	(2.893)	3.680	(2.446)	4.108	(3.097)	5.948	(2.626)
99c Only		–	–	–	–	–	–	–	–
Dollar General		1.203	(0.602)	-0.425	(1.346)	-0.033	(1.711)	-0.946	(1.931)
Dollar Tree		1.625	(2.404)	1.374	(1.401)	2.056	(1.563)	3.200	(1.460)
Family Dollar		1.184	(1.722)	-0.676	(1.561)	-0.153	(1.528)	-0.597	(1.216)
Random Coefficients	σ_k								
Warehouse Stores		2.560	(1.674)	3.260	(1.305)	3.543	(0.853)	3.761	(0.652)
Traditional Stores		2.375	(0.958)	2.768	(0.342)	2.208	(0.238)	1.750	(0.692)
Discount Stores		0.000	(0.792)	2.823	(0.373)	2.613	(0.275)	3.899	(0.475)
Supercenters		0.000	(0.582)	0.247	(0.328)	0.175	(0.266)	0.000	(0.312)
Dollar Stores		0.379	(0.679)	0.000	(0.495)	0.000	(0.523)	0.000	(0.726)
Summary									
Log Likelihood		-138062.6		-969245.5		-1416054.9		-949616.4	
Number of Visits		67,770		456,269		642,900		403,343	
Number of Devices		5,978		33,858		43,222		29,075	
First Stage Partial R^2		10.7%		8.7%		7.6%		13.3%	
First Stage Partial F-stat		119.4		547.0		625.2		850.9	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.20: Washington-Arlington-Alexandria, DC-VA-MD-WV Metro Area — Endo. Dist (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.601	(0.089)	-0.744	(0.036)	-0.934	(0.034)	-0.724	(0.037)
Density	β^{d2}	0.904	(0.304)	0.237	(0.050)	0.015	(0.035)	0.319	(0.025)
Fringe	ω	3.829	(5.100)	2.229	(0.224)	2.134	(0.054)	1.930	(0.047)
Control Function	ρ	0.287	(0.072)	0.465	(0.028)	0.611	(0.028)	0.287	(0.025)
Chain Preferences									
BJ's Wholesale Club		3.552	(7.712)	5.569	(0.964)	3.495	(1.899)	3.961	(1.896)
Costco		4.848	(7.733)	6.289	(0.828)	4.441	(1.281)	6.224	(0.629)
Sam's Club		3.760	(8.184)	6.008	(1.350)	2.934	(1.936)	3.334	(1.959)
Bloomingdale's		7.380	(7.541)	8.679	(1.143)	9.728	(1.319)	7.288	(1.830)
Dillard's		–	–	–	–	–	–	–	–
JC Penney		5.748	(6.609)	5.979	(0.628)	7.172	(0.961)	4.310	(0.727)
Kohl's		7.234	(6.367)	6.715	(1.058)	7.398	(0.861)	4.336	(0.853)
Macy's		7.207	(7.185)	7.096	(0.681)	7.956	(0.688)	5.284	(0.909)
Neiman Marcus		6.335	(8.320)	7.182	(1.434)	7.705	(0.586)	5.774	(0.928)
Nordstrom		6.502	(6.972)	6.813	(1.133)	7.321	(0.810)	5.397	(1.346)
Saks Fifth Avenue		3.989	(7.162)	5.696	(1.207)	7.329	(1.674)	4.977	(1.735)
Sears		3.311	(7.626)	4.252	(1.679)	5.207	(1.774)	2.025	(1.762)
Burlington		7.867	(6.995)	6.889	(1.039)	7.715	(1.221)	7.056	(0.559)
Citi Trends		8.356	(7.329)	7.318	(1.530)	8.422	(1.830)	7.659	(2.264)
Five Below		5.911	(7.316)	5.207	(0.558)	6.044	(0.903)	5.626	(0.957)
Marshalls		7.864	(7.012)	6.709	(0.784)	7.047	(0.554)	6.333	(0.616)
Ross Dress for Less		7.835	(7.345)	6.364	(1.081)	7.012	(0.794)	6.117	(1.643)
T.J. Maxx		7.778	(8.010)	6.910	(1.527)	7.766	(1.634)	6.876	(1.633)
Big Lots		5.034	(7.100)	5.164	(0.757)	4.558	(1.169)	5.214	(0.774)
Target		7.748	(8.301)	7.127	(1.178)	7.278	(1.243)	7.077	(1.375)
Walmart		9.408	(7.529)	8.240	(1.043)	8.463	(1.448)	7.077	(1.870)
99c Only		–	–	–	–	–	–	–	–
Dollar General		6.818	(7.619)	6.742	(1.125)	6.685	(1.374)	5.047	(0.770)
Dollar Tree		7.927	(7.359)	7.325	(1.272)	7.376	(0.801)	6.526	(0.727)
Family Dollar		8.051	(7.499)	7.159	(0.585)	6.859	(1.969)	4.964	(0.993)
Random Coefficients	σ_k								
Warehouse Stores		1.477	(1.354)	0.000	(0.355)	0.000	(0.345)	2.418	(0.548)
Traditional Stores		2.060	(0.935)	1.222	(0.309)	2.036	(0.208)	2.145	(0.184)
Discount Stores		1.629	(0.868)	0.000	(0.308)	1.503	(0.312)	1.865	(0.441)
Supercenters		0.210	(1.109)	0.000	(0.264)	0.114	(0.170)	0.080	(0.111)
Dollar Stores		3.978	(1.164)	1.989	(0.531)	4.410	(0.578)	3.470	(0.315)
Summary									
Log Likelihood		-45427.3		-302646.9		-741369.1		-2161376.3	
Number of Visits		20,202		135,194		328,955		928,953	
Number of Devices		2,310		13,760		31,978		94,399	
First Stage Partial R^2		19.5%		12.8%		10.0%		8.8%	
First Stage Partial F-stat		94.5		310.2		520.1		1410.5	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.21: Atlanta-Sandy Springs-Alpharetta, GA Metro Area — Exogenous Distance

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.236	(0.018)	-0.222	(0.013)	-0.247	(0.014)	-0.292	(0.018)
Density	β^{d2}	0.172	(0.064)	0.195	(0.032)	0.179	(0.025)	-0.062	(0.024)
Fringe	ω	0.914	(0.109)	0.787	(0.042)	0.925	(0.039)	0.880	(0.033)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		-0.104	(1.454)	-0.288	(2.574)	-0.503	(1.100)	-0.951	(0.881)
Costco		0.168	(1.745)	0.151	(1.663)	0.417	(3.108)	1.383	(1.155)
Sam's Club		0.776	(4.623)	0.829	(2.321)	0.441	(3.047)	0.064	(2.478)
Bloomingdale's		-2.412	(5.861)	-1.953	(2.185)	-3.384	(2.172)	0.208	(2.206)
Dillard's		-2.515	(5.362)	-0.608	(1.384)	-2.831	(2.833)	-0.310	(0.937)
JC Penney		-1.444	(1.500)	-0.368	(1.376)	-2.358	(1.626)	-0.565	(1.048)
Kohl's		-1.453	(2.040)	0.052	(1.533)	-2.020	(1.408)	0.582	(1.439)
Macy's		0.085	(2.234)	0.377	(1.316)	-2.551	(1.797)	0.894	(1.532)
Neiman Marcus		-3.489	(3.780)	-1.407	(2.022)	-2.557	(2.008)	0.015	(2.987)
Nordstrom		-1.896	(3.605)	-1.253	(2.719)	-2.737	(2.855)	0.322	(1.838)
Saks Fifth Avenue		-0.988	(4.276)	0.329	(2.325)	-1.604	(2.730)	1.791	(4.346)
Sears		-6.860	(5.486)	-4.293	(2.853)	-7.495	(2.924)	-6.409	(2.509)
Burlington		-0.563	(1.592)	0.768	(1.315)	0.713	(1.008)	0.481	(1.147)
Citi Trends		0.270	(1.731)	1.147	(1.188)	1.266	(1.563)	1.037	(0.540)
Five Below		-3.535	(1.718)	-1.714	(1.465)	-1.364	(1.976)	-1.403	(0.733)
Marshalls		-1.962	(3.758)	-0.163	(2.496)	0.586	(1.563)	1.765	(1.250)
Ross Dress for Less		-0.389	(6.970)	0.944	(2.814)	1.293	(2.211)	1.711	(1.263)
T.J. Maxx		-1.806	(4.461)	0.307	(2.854)	0.863	(2.549)	1.398	(2.196)
Big Lots		-7.411	(2.699)	-2.960	(1.006)	-1.415	(0.644)	0.059	(0.343)
Target		-3.464	(5.220)	-0.657	(2.785)	0.786	(2.420)	2.676	(2.394)
Walmart		2.987	(5.582)	3.118	(2.925)	2.995	(2.225)	3.075	(1.401)
99c Only		–	–	–	–	–	–	–	–
Dollar General		1.505	(1.965)	1.173	(1.629)	1.079	(1.472)	0.399	(0.675)
Dollar Tree		1.965	(1.739)	1.755	(1.698)	1.896	(1.671)	2.263	(0.844)
Family Dollar		1.412	(1.941)	0.979	(1.973)	0.738	(1.843)	0.074	(1.092)
Random Coefficients	σ_k								
Warehouse Stores		2.110	(0.850)	1.134	(1.078)	2.889	(0.998)	1.543	(0.935)
Traditional Stores		4.598	(0.954)	2.481	(0.319)	1.908	(0.322)	0.000	(0.483)
Discount Stores		0.014	(0.208)	0.000	(0.109)	0.310	(0.213)	0.000	(0.432)
Supercenters		2.174	(0.814)	0.516	(0.789)	0.000	(0.633)	0.000	(0.104)
Dollar Stores		1.756	(0.979)	1.679	(0.861)	2.005	(0.611)	2.359	(0.258)
Summary									
Log Likelihood		-183348.7		-1447032.3		-2834182.4		-2375778.3	
Number of Visits		93,187		710,037		1,356,299		1,081,661	
Number of Devices		9,257		58,953		101,608		88,523	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.22: Boston-Cambridge-Newton, MA-NH Metro Area — Exogenous Distance

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.436	(0.131)	-0.301	(0.040)	-0.265	(0.019)	-0.330	(0.018)
Density	β^{d2}	0.122	(1.129)	0.337	(0.137)	0.378	(0.079)	0.822	(0.063)
Fringe	ω	0.550	(11.240)	1.214	(0.132)	1.391	(0.075)	0.982	(0.041)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		2.571	(5.309)	2.761	(1.062)	2.800	(0.735)	2.983	(0.622)
Costco		-0.108	(5.120)	2.075	(1.338)	2.299	(0.789)	3.017	(0.883)
Sam's Club		-30.485	(16.283)	-42.717	(16.144)	-3.462	(2.925)	-4.440	(13.641)
Bloomingdale's		-0.055	(6.333)	-0.386	(1.541)	0.804	(2.383)	1.359	(0.702)
Dillard's		–	–	–	–	–	–	–	–
JC Penney		1.951	(5.130)	-0.628	(8.580)	1.131	(1.067)	-0.253	(3.174)
Kohl's		0.595	(5.352)	-0.863	(2.188)	1.400	(1.186)	0.681	(1.520)
Macy's		2.979	(5.254)	0.172	(1.920)	1.507	(1.103)	0.800	(1.312)
Neiman Marcus		1.620	(4.975)	-0.552	(2.533)	1.361	(1.699)	0.062	(1.525)
Nordstrom		0.496	(5.299)	-2.352	(3.139)	0.339	(2.055)	0.463	(1.685)
Saks Fifth Avenue		1.059	(5.561)	-1.468	(2.886)	0.469	(2.355)	-0.228	(1.939)
Sears		1.393	(5.162)	-1.788	(2.981)	0.798	(1.620)	-1.287	(2.254)
Burlington		3.947	(5.014)	2.694	(1.381)	1.902	(0.705)	2.207	(0.702)
Citi Trends		3.634	(20.228)	2.042	(4.418)	1.452	(11.509)	0.784	(6.984)
Five Below		2.466	(5.048)	2.027	(2.247)	1.690	(0.966)	2.992	(1.973)
Marshalls		4.660	(5.050)	3.075	(2.346)	2.939	(1.482)	3.042	(1.339)
Ross Dress for Less		–	–	–	–	–	–	–	–
T.J. Maxx		4.605	(5.715)	2.482	(3.118)	2.377	(1.805)	3.087	(1.631)
Big Lots		0.566	(4.171)	1.433	(0.826)	2.075	(0.781)	1.652	(0.878)
Target		4.407	(5.787)	3.464	(4.332)	3.982	(1.700)	4.181	(2.528)
Walmart		5.796	(6.088)	4.440	(5.033)	4.411	(2.458)	4.076	(3.107)
99c Only		–	–	–	–	–	–	–	–
Dollar General		2.316	(5.489)	1.097	(4.787)	1.512	(0.884)	1.655	(3.141)
Dollar Tree		4.173	(6.345)	3.202	(2.788)	3.411	(2.274)	3.715	(1.274)
Family Dollar		3.242	(4.923)	2.662	(2.670)	2.807	(2.267)	2.257	(1.767)
Random Coefficients	σ_k								
Warehouse Stores		2.560	(1.590)	3.175	(0.921)	1.972	(0.435)	2.748	(0.327)
Traditional Stores		1.408	(1.298)	1.228	(0.602)	0.000	(0.413)	0.386	(0.464)
Discount Stores		1.793	(1.258)	1.215	(0.668)	0.615	(0.478)	0.000	(0.371)
Supercenters		0.259	(1.599)	0.132	(0.552)	0.704	(0.364)	0.384	(0.324)
Dollar Stores		3.292	(1.457)	1.606	(0.983)	1.458	(0.786)	1.546	(0.420)
Summary									
Log Likelihood		-17458.1		-164741.4		-489246.8		-1494876.2	
Number of Visits		8,440		78,649		232,927		655,870	
Number of Devices		1,028		8,203		23,474		73,247	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.23: Chicago-Naperville-Elgin, IL-IN-WI Metro Area — Exogenous Distance

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.306	(0.035)	-0.305	(0.016)	-0.275	(0.020)	-0.312	(0.021)
Density	β^{d2}	0.275	(0.062)	-0.005	(0.026)	0.021	(0.022)	-0.044	(0.022)
Fringe	ω	0.203	(0.116)	0.397	(0.043)	0.565	(0.032)	0.395	(0.034)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		0.650	(0.816)	0.583	(0.769)	1.744	(1.172)	1.673	(1.211)
Sam's Club		0.643	(2.731)	-0.012	(4.151)	1.064	(3.225)	-0.042	(3.187)
Bloomingdale's		-4.268	(3.664)	-3.200	(3.491)	-3.678	(2.195)	-2.083	(1.484)
Dillard's		–	–	–	–	–	–	–	–
JC Penney		-3.087	(1.114)	-2.845	(1.795)	-3.146	(1.732)	-1.880	(0.980)
Kohl's		-2.784	(1.826)	-2.227	(2.223)	-1.503	(3.285)	-0.945	(1.203)
Macy's		-4.922	(2.483)	-4.379	(3.647)	-1.645	(2.419)	-1.396	(1.828)
Neiman Marcus		-7.524	(2.645)	-6.920	(4.755)	-5.611	(3.226)	-2.509	(1.774)
Nordstrom		-5.083	(2.425)	-4.505	(3.567)	-3.656	(4.092)	-1.129	(2.338)
Saks Fifth Avenue		-7.977	(2.625)	-7.683	(4.454)	-7.225	(4.093)	-4.574	(2.891)
Sears		-8.331	(3.353)	-6.266	(3.364)	-4.201	(3.362)	-3.697	(2.274)
Burlington		1.071	(1.268)	0.563	(2.231)	0.691	(0.664)	0.338	(0.992)
Citi Trends		0.941	(0.544)	0.520	(0.399)	0.567	(0.714)	-0.452	(2.028)
Five Below		-1.503	(1.695)	-1.951	(2.433)	-1.511	(1.519)	-2.173	(0.898)
Marshalls		0.432	(1.701)	-0.006	(2.655)	0.123	(3.151)	-0.261	(1.489)
Ross Dress for Less		1.401	(3.201)	1.122	(3.798)	1.287	(3.756)	1.034	(2.978)
T.J. Maxx		0.410	(2.537)	0.156	(4.381)	1.018	(3.830)	1.205	(2.939)
Big Lots		-3.663	(1.872)	-2.047	(1.574)	-1.338	(1.065)	-2.094	(0.861)
Target		0.489	(2.356)	1.507	(3.992)	2.397	(4.382)	2.312	(2.492)
Walmart		2.745	(3.802)	2.742	(3.356)	2.837	(2.943)	2.135	(2.488)
99c Only		–	–	–	–	–	–	–	–
Dollar General		0.342	(0.962)	0.639	(1.015)	0.508	(1.713)	-0.954	(1.462)
Dollar Tree		1.848	(1.014)	1.943	(1.844)	1.898	(1.857)	1.226	(1.405)
Family Dollar		1.330	(1.619)	1.287	(2.209)	0.760	(1.717)	-0.665	(1.254)
Random Coefficients	σ_k								
Warehouse Stores		3.503	(1.050)	3.470	(0.727)	3.085	(0.546)	2.513	(0.390)
Traditional Stores		2.437	(0.650)	1.504	(0.231)	0.076	(0.526)	0.226	(0.542)
Discount Stores		1.287	(0.568)	0.439	(0.436)	0.000	(0.526)	0.974	(0.576)
Supercenters		0.906	(0.745)	1.074	(0.470)	0.000	(0.193)	0.144	(0.225)
Dollar Stores		1.725	(1.160)	2.020	(0.593)	1.071	(0.513)	1.535	(0.307)
Summary									
Log Likelihood		-469236.0		-1938391.7		-2906175.6		-2715417.3	
Number of Visits		205,727		861,493		1,292,806		1,182,540	
Number of Devices		16,692		67,570		96,771		91,510	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.24: Dallas-Fort Worth-Arlington, TX Metro Area — Exogenous Distance

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.252	(0.019)	-0.286	(0.015)	-0.296	(0.015)	-0.312	(0.020)
Density	β^{d2}	0.850	(0.069)	0.668	(0.043)	0.724	(0.035)	0.357	(0.024)
Fringe	ω	0.793	(0.096)	0.785	(0.048)	0.760	(0.046)	0.202	(0.039)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		-1.720	(5.526)	1.114	(1.061)	1.144	(1.223)	1.934	(1.681)
Sam's Club		0.144	(2.299)	1.377	(1.981)	0.744	(2.778)	1.048	(0.769)
Bloomingdale's		-8.987	(4.621)	-5.747	(3.253)	-6.694	(1.835)	-0.939	(1.820)
Dillard's		-5.510	(4.220)	-4.194	(2.168)	-3.725	(1.865)	0.962	(0.723)
JC Penney		-3.628	(2.939)	-4.174	(1.996)	-3.627	(1.577)	0.257	(0.912)
Kohl's		-4.953	(4.418)	-1.811	(1.826)	-2.682	(2.290)	0.906	(1.216)
Macy's		-3.105	(4.761)	-2.913	(2.394)	-2.852	(1.065)	0.976	(0.897)
Neiman Marcus		-3.998	(4.743)	-3.460	(2.084)	-2.205	(2.911)	2.388	(2.593)
Nordstrom		-4.091	(5.374)	-3.914	(3.510)	-3.389	(2.804)	1.484	(1.697)
Saks Fifth Avenue		–	–	–	–	–	–	–	–
Sears		-8.442	(4.557)	-7.483	(3.750)	-6.895	(3.561)	-4.107	(2.698)
Burlington		1.137	(5.655)	1.325	(3.796)	0.736	(2.014)	0.262	(1.658)
Citi Trends		1.478	(4.584)	1.301	(1.074)	0.309	(3.033)	-1.047	(2.333)
Five Below		-1.088	(4.424)	-0.855	(1.666)	-1.367	(2.142)	-1.956	(1.053)
Marshalls		0.987	(4.133)	1.222	(2.534)	0.860	(3.498)	0.519	(0.910)
Ross Dress for Less		1.527	(1.731)	1.745	(3.674)	1.328	(1.439)	0.659	(1.285)
T.J. Maxx		0.804	(4.778)	1.237	(3.860)	0.769	(1.569)	0.900	(1.120)
Big Lots		-1.779	(2.071)	-1.693	(1.354)	-2.257	(0.803)	-2.801	(0.848)
Target		1.019	(3.219)	1.373	(2.722)	1.907	(1.279)	1.702	(1.096)
Walmart		4.570	(2.857)	4.438	(2.838)	4.504	(1.466)	2.824	(0.712)
99c Only		1.172	(3.877)	-0.108	(1.099)	-2.431	(2.017)	-2.968	(0.836)
Dollar General		1.938	(2.540)	0.882	(2.877)	-0.085	(2.957)	-1.262	(1.037)
Dollar Tree		2.197	(5.595)	1.674	(1.054)	0.876	(1.137)	0.437	(1.011)
Family Dollar		2.125	(1.946)	1.327	(1.571)	-0.294	(1.129)	-1.747	(1.081)
Random Coefficients	σ_k								
Warehouse Stores		4.061	(1.090)	3.635	(1.091)	3.762	(0.793)	0.028	(0.593)
Traditional Stores		1.997	(0.551)	2.135	(0.221)	2.157	(0.234)	1.766	(0.439)
Discount Stores		0.000	(0.711)	1.402	(0.704)	2.341	(0.720)	1.888	(0.629)
Supercenters		0.120	(0.231)	0.068	(0.148)	0.856	(0.177)	0.000	(0.242)
Dollar Stores		3.189	(1.017)	2.139	(0.618)	2.876	(0.460)	1.424	(0.523)
Summary									
Log Likelihood		-465887.1		-2504063.1		-3063108.9		-2552924.8	
Number of Visits		246,951		1,264,309		1,525,077		1,184,965	
Number of Devices		20,453		91,652		105,444		92,991	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.25: Denver-Aurora-Lakewood, CO Metro Area — Exogenous Distance

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.285	(0.099)	-0.325	(0.037)	-0.286	(0.037)	-0.407	(0.037)
Density	β^{d2}	1.291	(0.460)	1.911	(0.304)	1.252	(0.264)	2.160	(0.201)
Fringe	ω	1.407	(4.260)	1.885	(0.423)	1.937	(0.306)	2.479	(0.153)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		4.726	(3.170)	4.120	(1.330)	5.880	(0.938)	6.953	(1.521)
Sam's Club		4.483	(9.706)	3.486	(1.929)	5.016	(1.806)	4.676	(2.087)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		2.938	(16.160)	1.897	(1.661)	4.315	(2.114)	-0.479	(2.011)
JC Penney		3.076	(3.482)	3.379	(1.285)	4.744	(1.152)	-0.120	(1.489)
Kohl's		4.077	(3.204)	3.250	(1.618)	5.311	(1.886)	1.885	(1.518)
Macy's		3.207	(2.806)	1.660	(1.889)	4.450	(1.743)	-0.309	(2.041)
Neiman Marcus		0.455	(15.640)	0.172	(3.302)	1.083	(2.477)	-2.570	(2.016)
Nordstrom		3.910	(3.081)	3.159	(3.084)	4.908	(0.999)	2.731	(2.434)
Saks Fifth Avenue		–	–	–	–	–	–	–	–
Sears		-33.522	(8.394)	-0.723	(2.547)	1.630	(2.954)	-2.695	(4.981)
Burlington		4.085	(3.148)	4.465	(1.003)	4.435	(0.709)	5.748	(1.371)
Citi Trends		–	–	–	–	–	–	–	–
Five Below		1.415	(4.738)	0.892	(1.528)	1.270	(1.301)	1.806	(2.087)
Marshalls		3.407	(2.796)	3.969	(2.411)	4.669	(1.980)	4.391	(3.283)
Ross Dress for Less		4.593	(5.051)	4.994	(1.404)	5.097	(2.125)	5.028	(3.094)
T.J. Maxx		3.480	(5.683)	3.996	(2.187)	4.312	(2.293)	5.029	(4.445)
Big Lots		2.614	(3.574)	0.116	(1.827)	0.023	(1.518)	1.412	(0.985)
Target		5.360	(3.805)	4.413	(2.854)	4.761	(2.060)	6.714	(2.824)
Walmart		7.008	(10.803)	7.466	(3.492)	7.415	(3.488)	6.965	(5.123)
99c Only		–	–	–	–	–	–	–	–
Dollar General		2.541	(3.082)	0.828	(1.977)	0.735	(2.424)	-1.975	(4.083)
Dollar Tree		5.553	(3.368)	5.156	(1.160)	5.368	(1.021)	4.120	(3.491)
Family Dollar		5.528	(3.291)	4.398	(1.820)	4.218	(1.563)	0.729	(2.979)
Random Coefficients	σ_k								
Warehouse Stores		0.986	(1.171)	1.859	(1.137)	0.000	(1.343)	4.263	(0.663)
Traditional Stores		1.632	(2.151)	2.861	(1.207)	2.897	(0.759)	2.310	(0.732)
Discount Stores		0.407	(1.680)	1.670	(0.824)	1.631	(0.719)	3.393	(1.059)
Supercenters		0.858	(1.526)	0.200	(0.502)	0.000	(0.250)	0.191	(0.273)
Dollar Stores		1.814	(1.744)	3.147	(1.008)	1.762	(0.909)	2.573	(0.357)
Summary									
Log Likelihood		-23889.0		-167643.9		-442445.6		-1262084.9	
Number of Visits		12,067		81,710		211,583		579,658	
Number of Devices		1,240		7,880		19,150		48,538	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.26: Detroit-Warren-Dearborn, MI Metro Area — Exogenous Distance

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.206	(0.035)	-0.246	(0.030)	-0.332	(0.023)	-0.285	(0.022)
Density	β^{d2}	-0.218	(0.078)	-0.034	(0.040)	0.044	(0.035)	0.330	(0.039)
Fringe	ω	0.539	(0.135)	0.557	(0.084)	0.748	(0.075)	-0.155	(0.062)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		-3.888	(2.100)	-2.714	(2.460)	-2.679	(2.043)	-3.732	(1.759)
Costco		-1.214	(1.222)	-0.928	(2.403)	0.321	(1.229)	0.378	(1.738)
Sam's Club		-1.136	(1.315)	-1.125	(1.324)	-0.727	(1.983)	-0.899	(1.867)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		–	–	–	–	–	–	–	–
JC Penney		-1.012	(0.790)	-0.996	(0.626)	-1.976	(0.833)	-3.463	(0.893)
Kohl's		-0.608	(1.581)	-0.597	(0.850)	-1.116	(1.065)	-1.925	(0.934)
Macy's		-1.268	(1.650)	-1.258	(1.068)	-2.368	(1.395)	-1.359	(0.909)
Neiman Marcus		-3.588	(2.022)	-3.702	(1.760)	-4.747	(1.448)	-3.939	(1.386)
Nordstrom		-1.206	(2.095)	-1.426	(1.729)	-2.781	(1.963)	-1.968	(1.174)
Saks Fifth Avenue		-2.069	(2.147)	-2.089	(2.015)	-3.181	(1.617)	-2.311	(1.545)
Sears		-2.809	(2.447)	-2.900	(2.172)	-5.436	(2.255)	-5.095	(1.631)
Burlington		0.393	(2.277)	0.383	(0.807)	1.259	(1.165)	-0.482	(1.451)
Citi Trends		-0.243	(0.881)	-0.416	(1.190)	-0.236	(2.317)	-2.622	(1.622)
Five Below		-1.392	(0.855)	-1.593	(0.898)	-1.337	(0.839)	-3.584	(0.902)
Marshalls		-0.280	(1.326)	-0.394	(1.169)	0.171	(1.046)	-1.787	(1.194)
Ross Dress for Less		–	–	–	–	–	–	–	–
T.J. Maxx		-0.639	(2.017)	-0.564	(1.551)	0.264	(2.049)	-0.804	(1.702)
Big Lots		-2.266	(1.430)	-1.787	(1.180)	-2.851	(1.069)	-6.897	(1.708)
Target		0.136	(2.202)	0.701	(1.647)	0.970	(1.860)	-0.082	(1.637)
Walmart		1.384	(2.506)	1.458	(2.013)	1.358	(2.029)	-1.507	(1.414)
99c Only		–	–	–	–	–	–	–	–
Dollar General		-0.600	(0.843)	-0.800	(1.025)	-2.070	(1.423)	-5.108	(1.604)
Dollar Tree		0.953	(1.548)	0.797	(1.167)	0.473	(1.500)	-0.782	(1.141)
Family Dollar		0.137	(0.773)	-0.175	(1.007)	-1.535	(1.234)	-3.216	(0.931)
Random Coefficients	σ_k								
Warehouse Stores		1.405	(1.091)	1.600	(0.607)	2.821	(0.568)	2.416	(0.650)
Traditional Stores		1.448	(0.917)	0.999	(0.647)	1.911	(0.411)	2.816	(0.532)
Discount Stores		1.000	(0.814)	1.010	(0.774)	2.209	(0.517)	2.137	(0.628)
Supercenters		0.000	(0.259)	0.000	(0.170)	0.000	(0.156)	0.401	(0.286)
Dollar Stores		2.156	(0.914)	2.313	(0.685)	2.705	(0.426)	1.939	(0.435)
Summary									
Log Likelihood		-264097.1		-1275076.2		-1774056.4		-1140942.8	
Number of Visits		114,880		568,898		813,913		514,811	
Number of Devices		9,783		44,575		59,254		40,336	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.27: Houston-The Woodlands-Sugar Land, TX Metro Area — Exogenous Distance

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.244	(0.017)	-0.267	(0.017)	-0.299	(0.020)	-0.380	(0.032)
Density	β^{d2}	0.911	(0.074)	0.658	(0.050)	0.497	(0.044)	0.256	(0.052)
Fringe	ω	1.311	(0.077)	1.324	(0.045)	1.277	(0.049)	1.359	(0.062)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		0.244	(2.456)	1.237	(1.353)	3.266	(1.967)	4.565	(2.077)
Sam's Club		1.175	(2.661)	1.933	(2.302)	3.040	(3.160)	2.792	(2.174)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		-2.055	(2.717)	-1.611	(2.450)	0.933	(1.965)	-0.064	(1.576)
JC Penney		-1.153	(1.196)	-1.590	(2.209)	0.270	(3.119)	-2.412	(2.334)
Kohl's		-1.163	(1.230)	-0.346	(1.930)	0.467	(2.870)	0.725	(1.775)
Macy's		-0.841	(2.964)	-0.279	(2.344)	2.008	(2.352)	0.920	(2.074)
Neiman Marcus		-1.390	(2.619)	-0.383	(2.296)	1.009	(2.776)	1.914	(1.063)
Nordstrom		-2.445	(3.104)	-3.336	(3.459)	-0.811	(3.696)	-0.661	(2.546)
Saks Fifth Avenue		-0.821	(2.609)	-0.658	(3.039)	1.997	(1.950)	1.520	(1.848)
Sears		-1.851	(2.431)	-1.827	(2.097)	-0.678	(3.456)	-1.671	(2.473)
Burlington		2.857	(2.589)	3.342	(0.682)	4.005	(1.013)	5.076	(1.396)
Citi Trends		1.731	(1.357)	2.091	(1.095)	2.354	(3.955)	2.451	(1.297)
Five Below		0.862	(2.466)	1.938	(1.945)	3.320	(2.122)	4.576	(2.272)
Marshalls		2.351	(1.567)	3.268	(2.893)	4.213	(3.027)	5.486	(1.997)
Ross Dress for Less		2.671	(1.896)	3.629	(3.172)	4.625	(4.319)	5.897	(1.936)
T.J. Maxx		1.491	(1.998)	2.325	(3.028)	3.441	(2.913)	4.576	(1.969)
Big Lots		-0.795	(1.907)	0.645	(1.021)	1.063	(1.229)	1.123	(1.609)
Target		1.675	(2.121)	3.039	(3.157)	4.054	(3.561)	5.149	(1.979)
Walmart		5.719	(1.898)	5.838	(2.683)	6.020	(2.548)	6.097	(2.180)
99c Only		1.121	(0.839)	1.961	(0.618)	1.653	(0.500)	0.384	(0.568)
Dollar General		2.009	(0.766)	2.304	(1.286)	2.075	(2.584)	0.191	(2.494)
Dollar Tree		2.910	(1.170)	3.751	(1.359)	4.131	(1.728)	4.223	(1.508)
Family Dollar		2.391	(1.952)	2.746	(1.509)	2.557	(1.622)	0.943	(1.840)
Random Coefficients	σ_k								
Warehouse Stores		3.235	(0.949)	3.552	(0.779)	2.777	(0.916)	4.132	(0.991)
Traditional Stores		2.048	(0.457)	1.723	(0.256)	1.538	(0.271)	1.868	(0.350)
Discount Stores		1.617	(0.567)	1.284	(0.601)	1.455	(0.362)	2.554	(0.549)
Supercenters		1.070	(0.531)	0.949	(0.586)	0.175	(0.503)	0.000	(0.507)
Dollar Stores		3.119	(0.751)	3.140	(0.433)	2.383	(0.392)	2.977	(0.609)
Summary									
Log Likelihood		-627182.1		-2281545.6		-2384031.1		-1844548.1	
Number of Visits		300,006		1,042,665		1,078,704		788,704	
Number of Devices		25,023		75,329		74,979		62,243	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.28: Miami-Fort Lauderdale-Pompano Beach, FL Metro Area — Exogenous Distance

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.312	(0.033)	-0.314	(0.014)	-0.304	(0.015)	-0.290	(0.021)
Density	β^{d2}	0.523	(0.126)	0.161	(0.045)	-0.121	(0.032)	-0.294	(0.025)
Fringe	ω	1.020	(0.165)	0.725	(0.064)	0.831	(0.049)	0.801	(0.050)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		1.741	(0.703)	1.506	(0.282)	2.196	(0.366)	1.601	(0.438)
Costco		1.893	(2.602)	1.650	(1.450)	2.511	(1.529)	2.340	(1.732)
Sam's Club		1.653	(2.703)	1.060	(1.593)	1.702	(1.000)	0.998	(1.044)
Bloomingdale's		-2.369	(2.372)	0.426	(0.878)	1.824	(0.526)	3.304	(0.615)
Dillard's		-9.206	(4.483)	-0.349	(1.309)	-0.752	(1.445)	0.796	(1.843)
JC Penney		-3.579	(2.454)	-1.529	(0.864)	0.901	(0.799)	1.302	(0.866)
Kohl's		-6.653	(3.682)	-1.099	(1.089)	-0.093	(0.850)	1.318	(0.795)
Macy's		-3.995	(3.191)	-0.373	(1.418)	1.066	(0.737)	2.259	(0.620)
Neiman Marcus		-8.973	(4.765)	-3.046	(1.889)	-0.418	(1.326)	1.397	(0.922)
Nordstrom		-8.441	(4.424)	-2.987	(2.553)	-0.788	(1.560)	1.909	(1.350)
Saks Fifth Avenue		-3.965	(2.977)	-0.388	(1.479)	0.665	(0.988)	2.248	(1.241)
Sears		-2.329	(2.532)	-2.757	(1.729)	-1.127	(1.212)	-0.008	(1.067)
Burlington		2.262	(0.684)	0.911	(0.489)	1.243	(0.595)	1.740	(0.505)
Citi Trends		1.652	(1.293)	1.092	(0.741)	1.383	(0.913)	1.695	(0.910)
Five Below		-0.659	(2.621)	-1.908	(1.282)	-1.485	(1.219)	0.214	(0.985)
Marshalls		1.170	(3.323)	0.444	(1.115)	0.642	(1.204)	2.124	(1.154)
Ross Dress for Less		2.499	(2.319)	1.583	(2.373)	2.288	(0.970)	3.120	(1.086)
T.J. Maxx		1.424	(2.346)	0.440	(1.380)	0.999	(1.050)	2.585	(1.309)
Big Lots		-4.299	(1.963)	-3.184	(0.988)	-0.971	(0.816)	0.187	(0.732)
Target		-2.110	(2.906)	-1.437	(1.676)	1.003	(1.224)	2.791	(1.274)
Walmart		2.402	(2.823)	2.063	(1.769)	2.760	(1.132)	2.880	(1.022)
99c Only		–	–	–	–	–	–	–	–
Dollar General		-0.685	(1.859)	-1.197	(1.920)	-0.392	(1.526)	-0.584	(1.763)
Dollar Tree		2.321	(1.359)	2.461	(1.473)	2.973	(1.315)	3.283	(1.291)
Family Dollar		1.238	(1.789)	1.251	(1.067)	1.244	(1.246)	0.668	(0.623)
Random Coefficients	σ_k								
Warehouse Stores		4.532	(1.565)	2.108	(0.808)	1.556	(0.787)	0.000	(0.894)
Traditional Stores		3.934	(0.991)	3.306	(0.407)	2.157	(0.322)	1.188	(0.339)
Discount Stores		2.457	(0.801)	1.833	(0.275)	1.757	(0.275)	1.507	(0.285)
Supercenters		0.769	(0.666)	1.473	(0.568)	1.556	(0.708)	0.440	(0.383)
Dollar Stores		0.000	(0.504)	0.560	(0.282)	0.000	(0.159)	1.208	(0.472)
Summary									
Log Likelihood		-238620.3		-1466085.2		-2258087.3		-3262824.4	
Number of Visits		99,832		602,570		908,939		1,299,438	
Number of Devices		7,744		38,650		56,260		84,592	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.29: Minneapolis-St. Paul-Bloomington, MN-WI Metro Area — Exogenous Distance

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.244	(0.081)	-0.263	(0.039)	-0.258	(0.027)	-0.252	(0.056)
Density	β^{d2}	0.179	(0.218)	0.229	(0.093)	0.074	(0.049)	-0.184	(0.301)
Fringe	ω	2.780	(4.265)	3.856	(0.525)	3.179	(0.108)	2.110	(0.191)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		6.172	(4.578)	6.690	(1.302)	5.911	(0.618)	4.875	(2.312)
Sam's Club		6.743	(5.453)	6.956	(1.834)	5.514	(2.935)	3.900	(2.343)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		–	–	–	–	–	–	–	–
JC Penney		5.827	(5.189)	4.566	(2.141)	1.504	(1.409)	0.208	(4.262)
Kohl's		6.587	(5.235)	5.374	(1.952)	3.179	(1.713)	1.938	(2.846)
Macy's		7.002	(6.544)	5.864	(2.109)	3.133	(2.661)	1.949	(3.247)
Neiman Marcus		–	–	–	–	–	–	–	–
Nordstrom		6.525	(5.100)	4.719	(2.181)	1.399	(2.712)	1.940	(2.625)
Saks Fifth Avenue		4.064	(5.824)	1.905	(2.278)	-1.937	(2.504)	-1.518	(4.271)
Sears		–	–	–	–	–	–	–	–
Burlington		6.387	(5.007)	7.038	(1.746)	4.872	(1.016)	2.782	(2.617)
Citi Trends		6.677	(5.243)	7.317	(1.397)	4.928	(2.309)	2.465	(3.742)
Five Below		4.847	(5.472)	5.767	(1.617)	4.302	(1.909)	2.586	(2.321)
Marshalls		5.941	(5.392)	6.801	(3.189)	4.784	(2.075)	3.100	(1.889)
Ross Dress for Less		–	–	–	–	–	–	–	–
T.J. Maxx		4.837	(4.997)	6.344	(2.115)	4.750	(2.067)	2.242	(2.813)
Big Lots		3.657	(4.915)	5.519	(3.037)	3.381	(2.590)	0.237	(2.262)
Target		8.087	(5.819)	9.182	(1.133)	7.826	(3.760)	6.045	(2.598)
Walmart		8.397	(4.862)	9.336	(1.312)	7.601	(2.460)	5.146	(2.922)
99c Only		–	–	–	–	–	–	–	–
Dollar General		4.380	(4.838)	5.096	(1.358)	4.047	(3.377)	0.127	(3.283)
Dollar Tree		6.857	(4.603)	7.441	(0.934)	5.999	(1.040)	3.372	(2.459)
Family Dollar		4.716	(4.576)	5.559	(1.843)	4.240	(1.158)	0.418	(3.834)
Random Coefficients	σ_k								
Warehouse Stores		0.000	(1.745)	2.376	(1.191)	3.074	(0.908)	2.731	(1.080)
Traditional Stores		0.767	(1.158)	0.605	(0.625)	0.135	(0.524)	0.720	(0.740)
Discount Stores		1.482	(0.890)	1.731	(0.397)	1.093	(0.374)	1.966	(1.460)
Supercenters		0.209	(1.352)	0.000	(0.716)	0.966	(0.610)	1.091	(1.612)
Dollar Stores		1.117	(1.516)	2.015	(0.751)	1.920	(0.496)	1.437	(0.874)
Summary									
Log Likelihood		-45833.8		-464805.6		-963494.4		-1005571.8	
Number of Visits		23,823		251,022		555,788		554,001	
Number of Devices		2,610		23,069		48,781		44,690	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.30: Philadelphia-Camden-Wilmington, PA-NJ-DE-MD Metro Area — Exogenous Distance

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.339	(0.047)	-0.285	(0.014)	-0.300	(0.010)	-0.327	(0.006)
Density	β^{d2}	0.012	(0.131)	-0.110	(0.045)	-0.157	(0.034)	-0.107	(0.029)
Fringe	ω	1.141	(0.220)	1.056	(0.055)	1.070	(0.038)	1.167	(0.032)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		3.497	(0.904)	2.765	(1.100)	2.930	(1.857)	3.586	(0.496)
Costco		3.619	(3.210)	2.873	(1.005)	3.296	(1.893)	4.341	(1.751)
Sam's Club		3.485	(2.243)	2.867	(1.208)	2.937	(1.535)	3.345	(1.494)
Bloomingdale's		0.169	(1.962)	1.429	(0.650)	-0.277	(1.582)	1.108	(1.761)
Dillard's		–	–	–	–	–	–	–	–
JC Penney		-1.077	(3.113)	1.232	(1.421)	0.139	(1.999)	0.708	(0.824)
Kohl's		-0.418	(2.248)	1.762	(0.671)	1.208	(0.899)	1.611	(1.211)
Macy's		-0.305	(2.838)	1.648	(1.806)	0.277	(1.263)	1.668	(1.455)
Neiman Marcus		-2.098	(3.399)	-0.204	(1.252)	-0.974	(1.422)	0.241	(1.520)
Nordstrom		-2.246	(2.391)	0.363	(1.335)	-0.966	(1.879)	1.822	(1.543)
Saks Fifth Avenue		-4.609	(3.194)	-2.135	(2.244)	-2.447	(1.497)	-0.892	(1.559)
Sears		-0.234	(2.340)	1.764	(1.358)	0.904	(1.781)	1.401	(1.852)
Burlington		3.265	(0.754)	2.755	(0.740)	2.543	(1.246)	3.057	(1.068)
Citi Trends		2.692	(0.912)	1.695	(1.118)	1.176	(0.666)	1.384	(1.008)
Five Below		2.089	(1.513)	1.138	(1.293)	1.005	(0.793)	1.846	(1.230)
Marshalls		3.765	(2.078)	2.808	(0.881)	2.909	(1.158)	3.458	(1.255)
Ross Dress for Less		3.367	(3.166)	2.689	(1.808)	2.592	(1.105)	2.660	(1.392)
T.J. Maxx		3.420	(3.163)	2.806	(1.979)	3.100	(1.430)	4.202	(2.050)
Big Lots		-2.093	(2.287)	1.064	(1.182)	1.574	(1.202)	1.284	(0.402)
Target		1.397	(3.536)	2.969	(1.709)	3.745	(1.367)	4.474	(1.833)
Walmart		3.988	(2.175)	4.164	(1.002)	4.266	(1.164)	4.271	(1.633)
99c Only		–	–	–	–	–	–	–	–
Dollar General		2.257	(1.010)	1.348	(0.518)	1.402	(0.292)	1.268	(1.319)
Dollar Tree		4.305	(1.513)	3.695	(0.482)	3.866	(0.441)	4.039	(1.304)
Family Dollar		2.996	(1.550)	1.973	(0.888)	1.424	(1.079)	0.797	(1.320)
Random Coefficients	σ_k								
Warehouse Stores		3.045	(1.407)	1.481	(0.768)	2.326	(0.446)	2.309	(0.254)
Traditional Stores		3.220	(0.944)	0.958	(0.231)	0.000	(0.428)	0.000	(0.078)
Discount Stores		1.443	(0.849)	1.326	(0.200)	1.203	(0.143)	1.312	(0.270)
Supercenters		0.000	(0.633)	0.000	(0.410)	0.000	(0.214)	0.000	(0.079)
Dollar Stores		0.224	(0.788)	0.174	(0.194)	0.383	(0.138)	0.000	(0.562)
Summary									
Log Likelihood		-106002.9		-952267.6		-1872276.1		-1927270.6	
Number of Visits		46,479		415,276		822,687		826,258	
Number of Devices		4,136		31,572		62,024		69,946	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.31: Phoenix-Mesa-Chandler, AZ Metro Area — Exogenous Distance

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.250	(0.048)	-0.226	(0.021)	-0.248	(0.026)	-0.274	(0.024)
Density	β^{d2}	-0.309	(0.259)	-0.085	(0.076)	-0.227	(0.059)	-0.507	(0.053)
Fringe	ω	0.883	(0.180)	0.697	(0.112)	0.545	(0.100)	0.243	(0.131)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		1.724	(1.054)	2.489	(0.721)	3.254	(0.634)	4.103	(0.891)
Sam's Club		1.540	(2.481)	1.263	(1.740)	1.797	(1.797)	2.378	(2.890)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		-1.178	(0.880)	1.077	(0.520)	1.800	(0.744)	-0.260	(1.100)
JC Penney		0.001	(1.559)	1.708	(0.599)	2.201	(0.704)	-1.084	(1.447)
Kohl's		-0.160	(1.876)	2.007	(1.150)	2.697	(0.943)	0.026	(1.228)
Macy's		0.824	(1.916)	1.707	(1.426)	2.195	(1.126)	0.948	(1.053)
Neiman Marcus		-2.406	(3.294)	-0.963	(1.155)	-0.105	(1.088)	-1.538	(2.155)
Nordstrom		-1.490	(2.350)	0.693	(1.607)	1.423	(1.629)	0.480	(1.905)
Saks Fifth Avenue		-2.503	(2.752)	-0.771	(1.597)	-0.455	(1.686)	-0.998	(2.413)
Sears		-3.402	(3.410)	-1.077	(1.650)	-0.647	(1.462)	-3.318	(2.420)
Burlington		-3.148	(1.228)	-0.916	(1.120)	-0.548	(1.110)	0.994	(0.734)
Citi Trends		–	–	–	–	–	–	–	–
Five Below		-5.459	(3.161)	-3.423	(1.635)	-2.492	(1.224)	0.052	(0.663)
Marshalls		-4.348	(2.799)	-1.607	(1.184)	-0.559	(1.182)	2.128	(1.496)
Ross Dress for Less		1.393	(2.277)	1.505	(1.513)	1.747	(1.437)	3.208	(2.053)
T.J. Maxx		-4.152	(2.179)	0.393	(2.587)	1.093	(2.384)	2.260	(2.545)
Big Lots		0.316	(0.982)	-1.002	(1.399)	-0.245	(0.659)	0.648	(0.591)
Target		2.439	(2.471)	1.406	(2.477)	2.522	(2.574)	3.695	(2.458)
Walmart		4.684	(2.423)	4.211	(1.566)	4.472	(1.593)	4.240	(2.417)
99c Only		2.421	(2.477)	2.156	(0.307)	2.327	(0.269)	1.816	(0.391)
Dollar General		1.311	(0.614)	0.590	(0.795)	0.534	(0.817)	-1.357	(1.638)
Dollar Tree		2.755	(2.013)	2.653	(0.526)	3.214	(0.820)	3.108	(1.638)
Family Dollar		1.934	(1.576)	1.449	(1.638)	0.963	(1.264)	-0.812	(0.759)
Random Coefficients	σ_k								
Warehouse Stores		1.900	(1.048)	0.000	(0.706)	0.041	(0.925)	2.637	(0.650)
Traditional Stores		1.119	(1.157)	2.044	(0.777)	1.846	(0.483)	1.146	(0.515)
Discount Stores		0.047	(0.610)	0.016	(0.388)	0.000	(0.470)	0.962	(0.556)
Supercenters		3.529	(1.939)	2.206	(0.899)	2.074	(1.082)	0.000	(0.323)
Dollar Stores		1.841	(1.301)	1.654	(0.810)	1.653	(0.388)	1.275	(0.341)
Summary									
Log Likelihood		-93514.0		-572953.3		-816638.9		-660147.7	
Number of Visits		48,832		280,940		395,217		304,300	
Number of Devices		5,514		28,582		41,826		43,907	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.32: Riverside-San Bernardino-Ontario, CA Metro Area — Exogenous Distance

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.247	(0.047)	-0.214	(0.015)	-0.228	(0.006)	-0.236	(0.006)
Density	β^{d2}	-0.171	(0.127)	-0.042	(0.050)	0.014	(0.026)	0.163	(0.021)
Fringe	ω	1.528	(0.221)	1.560	(0.081)	1.456	(0.045)	1.399	(0.050)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		2.472	(3.745)	3.696	(1.090)	3.937	(1.182)	5.313	(1.295)
Sam's Club		1.657	(1.850)	2.862	(1.476)	3.486	(0.916)	4.746	(1.387)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		–	–	–	–	–	–	–	–
JC Penney		-1.197	(1.880)	1.951	(1.129)	3.229	(1.146)	2.748	(0.841)
Kohl's		0.304	(1.802)	2.358	(1.003)	3.691	(1.103)	3.477	(0.433)
Macy's		-1.423	(4.901)	1.775	(1.148)	3.306	(0.915)	2.992	(0.509)
Neiman Marcus		-4.663	(10.716)	-0.671	(1.963)	1.086	(1.617)	0.658	(1.352)
Nordstrom		0.242	(4.818)	2.164	(1.462)	3.784	(1.694)	3.355	(1.074)
Saks Fifth Avenue		-3.511	(6.168)	-0.979	(1.425)	1.194	(0.375)	2.537	(0.901)
Sears		-2.310	(11.169)	0.179	(1.533)	1.293	(0.362)	1.238	(1.885)
Burlington		1.656	(0.932)	2.056	(0.637)	2.986	(0.477)	2.221	(0.509)
Citi Trends		0.777	(9.790)	0.857	(2.167)	1.632	(1.192)	0.397	(0.781)
Five Below		-0.042	(1.358)	0.412	(1.326)	1.599	(1.429)	0.417	(1.220)
Marshalls		1.412	(1.578)	1.543	(1.109)	3.547	(0.431)	3.261	(1.011)
Ross Dress for Less		1.660	(2.261)	2.445	(1.367)	3.411	(0.560)	2.392	(0.968)
T.J. Maxx		0.674	(3.801)	1.834	(1.978)	3.021	(1.119)	2.655	(1.665)
Big Lots		1.820	(0.519)	1.969	(0.255)	2.282	(0.176)	2.308	(0.226)
Target		4.306	(4.244)	4.569	(1.420)	4.847	(1.166)	5.243	(1.642)
Walmart		5.369	(3.627)	5.361	(1.482)	5.370	(1.088)	5.373	(1.590)
99c Only		3.795	(0.422)	3.501	(0.324)	3.317	(0.243)	3.094	(0.268)
Dollar General		2.486	(1.409)	1.790	(1.132)	1.326	(1.571)	0.389	(1.901)
Dollar Tree		3.854	(1.455)	3.582	(1.082)	3.570	(1.326)	3.625	(1.368)
Family Dollar		2.199	(4.344)	1.790	(1.272)	1.354	(1.203)	0.802	(1.296)
Random Coefficients	σ_k								
Warehouse Stores		3.004	(1.518)	1.624	(1.050)	0.000	(0.299)	1.215	(0.448)
Traditional Stores		0.560	(0.816)	0.000	(0.199)	0.087	(0.085)	0.040	(0.115)
Discount Stores		0.543	(0.890)	0.927	(0.454)	1.151	(0.238)	1.351	(0.374)
Supercenters		1.916	(1.112)	1.574	(0.699)	0.000	(0.443)	1.529	(0.547)
Dollar Stores		2.236	(1.518)	1.583	(0.392)	1.684	(0.271)	0.243	(0.313)
Summary									
Log Likelihood		-78674.5		-566448.7		-1115381.7		-1750108.6	
Number of Visits		38,267		260,377		494,715		747,639	
Number of Devices		4,007		23,002		39,944		56,428	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.33: St. Louis, MO-IL Metro Area — Exogenous Distance

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.244	(0.054)	-0.241	(0.025)	-0.242	(0.030)	-0.259	(0.034)
Density	β^{d2}	-0.388	(0.115)	-0.433	(0.049)	-0.468	(0.060)	-0.508	(0.097)
Fringe	ω	5.741	(6.006)	3.826	(1.747)	3.453	(0.254)	1.861	(0.108)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		7.024	(4.876)	4.478	(2.325)	6.306	(2.136)	3.136	(1.507)
Sam's Club		7.600	(3.421)	5.463	(3.142)	6.564	(3.447)	3.519	(2.217)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		0.167	(4.558)	2.948	(2.733)	0.418	(2.723)	3.070	(1.370)
JC Penney		1.995	(5.031)	4.325	(2.331)	2.444	(1.700)	3.444	(1.121)
Kohl's		2.584	(3.272)	4.790	(2.589)	3.232	(2.092)	4.099	(1.143)
Macy's		2.386	(5.072)	4.827	(2.506)	1.107	(2.655)	4.066	(1.095)
Neiman Marcus		-2.824	(5.661)	1.638	(2.949)	-0.476	(3.720)	2.743	(1.821)
Nordstrom		1.276	(5.450)	3.733	(3.556)	1.764	(3.776)	4.353	(1.886)
Saks Fifth Avenue		-0.892	(5.335)	0.801	(3.577)	-0.703	(3.103)	3.013	(1.892)
Sears		-4.402	(5.546)	1.443	(3.242)	-0.577	(3.292)	0.860	(2.372)
Burlington		7.554	(4.545)	5.529	(2.435)	4.225	(0.880)	2.076	(0.999)
Citi Trends		6.412	(2.258)	4.449	(3.479)	2.625	(3.524)	-0.588	(2.280)
Five Below		6.002	(3.067)	4.283	(2.277)	3.500	(1.705)	1.371	(1.060)
Marshalls		6.389	(3.019)	4.675	(2.867)	3.729	(2.076)	1.940	(1.592)
Ross Dress for Less		8.077	(3.402)	6.506	(3.251)	5.620	(2.914)	3.720	(1.982)
T.J. Maxx		7.977	(5.362)	6.497	(3.705)	5.824	(3.557)	4.166	(2.354)
Big Lots		7.077	(2.126)	5.119	(2.715)	3.676	(0.415)	1.620	(0.641)
Target		8.981	(4.547)	7.615	(3.746)	6.894	(3.842)	5.346	(2.268)
Walmart		10.381	(3.959)	8.750	(2.270)	7.609	(3.922)	5.616	(2.504)
99c Only		–	–	–	–	–	–	–	–
Dollar General		7.281	(2.576)	6.094	(1.937)	4.395	(2.015)	2.325	(1.822)
Dollar Tree		7.746	(4.462)	6.937	(2.035)	5.885	(1.867)	5.128	(1.923)
Family Dollar		7.432	(3.075)	6.241	(2.397)	3.986	(2.268)	2.149	(1.013)
Random Coefficients	σ_k								
Warehouse Stores		4.218	(1.134)	2.134	(0.692)	3.017	(0.854)	0.103	(0.701)
Traditional Stores		0.092	(0.862)	0.073	(0.462)	0.000	(0.615)	0.000	(0.745)
Discount Stores		1.895	(1.041)	1.069	(0.667)	1.360	(0.476)	1.108	(0.607)
Supercenters		0.257	(1.125)	0.355	(0.598)	0.000	(0.592)	0.230	(0.686)
Dollar Stores		1.855	(0.969)	2.593	(0.512)	0.000	(0.786)	2.309	(0.651)
Summary									
Log Likelihood		-193389.6		-887509.8		-1195961.1		-755989.7	
Number of Visits		111,263		511,689		640,355		364,876	
Number of Devices		10,446		40,353		45,028		25,214	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.34: San Diego-Chula Vista-Carlsbad, CA Metro Area — Exogenous Distance

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.168	(0.062)	-0.211	(0.025)	-0.175	(0.024)	-0.226	(0.005)
Density	β^{d2}	-0.220	(0.374)	-0.160	(0.139)	-0.053	(0.097)	-0.028	(0.026)
Fringe	ω	0.410	(0.347)	1.085	(0.130)	0.903	(0.087)	0.947	(0.051)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		0.517	(3.048)	2.894	(1.025)	2.531	(1.283)	2.320	(0.756)
Sam's Club		-1.517	(5.144)	1.056	(2.182)	0.667	(1.847)	-1.808	(1.046)
Bloomingdale's		1.585	(2.316)	3.323	(0.985)	2.655	(1.276)	3.321	(1.952)
Dillard's		–	–	–	–	–	–	–	–
JC Penney		0.320	(3.927)	2.182	(0.719)	1.498	(1.376)	1.759	(0.652)
Kohl's		0.166	(1.891)	2.121	(0.682)	1.515	(0.875)	2.122	(0.285)
Macy's		0.625	(2.073)	2.406	(0.797)	1.742	(0.771)	2.221	(0.384)
Neiman Marcus		-0.949	(1.999)	1.042	(1.172)	-0.041	(1.112)	-0.074	(1.908)
Nordstrom		0.187	(2.381)	1.909	(1.527)	1.243	(1.514)	2.108	(1.367)
Saks Fifth Avenue		-3.772	(5.017)	-1.810	(1.633)	-0.957	(1.803)	0.616	(2.048)
Sears		-2.840	(4.276)	-0.677	(1.651)	-1.276	(2.278)	-0.626	(1.821)
Burlington		0.105	(2.106)	1.613	(0.994)	0.907	(1.373)	1.005	(1.020)
Citi Trends		–	–	–	–	–	–	–	–
Five Below		-3.478	(7.705)	-1.769	(1.505)	-2.217	(1.704)	-2.297	(2.048)
Marshalls		-0.194	(3.488)	1.776	(1.188)	1.133	(1.176)	2.086	(0.921)
Ross Dress for Less		1.392	(3.031)	2.894	(2.483)	2.508	(1.461)	2.543	(1.049)
T.J. Maxx		-0.552	(3.093)	1.304	(2.561)	0.994	(1.592)	1.733	(1.902)
Big Lots		-0.704	(1.913)	-0.112	(0.975)	0.694	(1.007)	0.822	(0.198)
Target		1.616	(3.213)	3.140	(1.709)	3.237	(1.661)	3.673	(1.920)
Walmart		2.714	(4.955)	3.933	(1.678)	3.756	(2.334)	3.780	(2.299)
99c Only		-2.004	(2.338)	2.709	(0.326)	2.135	(0.311)	1.940	(0.108)
Dollar General		–	–	–	–	–	–	–	–
Dollar Tree		-1.493	(5.008)	3.132	(1.921)	2.654	(1.864)	2.735	(1.599)
Family Dollar		-9.788	(7.252)	-1.052	(1.348)	-1.421	(1.521)	-1.846	(2.021)
Random Coefficients	σ_k								
Warehouse Stores		0.000	(1.430)	0.000	(0.590)	0.000	(0.713)	0.000	(0.222)
Traditional Stores		0.645	(1.638)	1.667	(0.862)	0.000	(0.913)	0.000	(0.074)
Discount Stores		4.097	(2.381)	0.388	(0.466)	0.000	(0.436)	0.000	(0.031)
Supercenters		0.505	(1.921)	0.320	(0.789)	0.017	(1.029)	0.002	(0.075)
Dollar Stores		1.821	(1.664)	1.188	(0.710)	1.277	(0.905)	2.962	(0.351)
Summary									
Log Likelihood		-40970.7		-201777.5		-427753.3		-1616852.9	
Number of Visits		17,995		88,803		185,858		714,861	
Number of Devices		1,608		6,487		12,894		54,179	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.35: San Francisco-Oakland-Fremont, CA Metro Area — Exogenous Distance

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.289	(0.066)	-0.217	(0.046)	-0.221	(0.048)	-0.241	(0.010)
Density	β^{d2}	1.536	(0.505)	0.562	(0.187)	0.675	(0.197)	0.178	(0.032)
Fringe	ω	3.136	(1.538)	2.093	(0.396)	1.306	(0.257)	0.597	(0.047)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		2.885	(3.004)	4.209	(1.184)	2.631	(1.191)	1.552	(0.644)
Sam's Club		2.944	(4.602)	2.737	(1.323)	1.336	(2.077)	-1.618	(1.888)
Bloomingdale's		2.730	(2.703)	1.762	(1.336)	0.745	(1.472)	2.118	(1.633)
Dillard's		–	–	–	–	–	–	–	–
JC Penney		5.610	(4.078)	2.761	(1.406)	1.040	(1.022)	0.824	(0.629)
Kohl's		4.584	(2.679)	2.264	(1.162)	0.482	(1.000)	0.948	(0.733)
Macy's		5.597	(2.981)	3.220	(1.276)	1.176	(2.472)	1.598	(0.765)
Neiman Marcus		3.775	(3.404)	2.136	(1.430)	0.464	(1.830)	1.180	(1.472)
Nordstrom		5.917	(3.184)	2.499	(1.516)	0.628	(1.190)	1.485	(0.876)
Saks Fifth Avenue		3.097	(3.821)	1.060	(1.293)	-1.097	(1.618)	-0.703	(1.045)
Sears		3.225	(3.504)	1.472	(1.701)	-0.574	(2.595)	-0.655	(1.399)
Burlington		3.310	(3.144)	2.699	(1.186)	2.056	(1.818)	1.427	(0.728)
Citi Trends		2.645	(6.232)	1.558	(1.142)	0.882	(1.422)	-0.606	(1.337)
Five Below		–	–	–	–	–	–	–	–
Marshalls		1.855	(3.303)	1.492	(1.423)	1.136	(1.158)	0.528	(0.796)
Ross Dress for Less		4.931	(3.389)	3.495	(1.889)	2.809	(1.184)	1.703	(1.345)
T.J. Maxx		1.409	(4.337)	1.647	(1.589)	1.485	(1.490)	1.114	(1.682)
Big Lots		-1.764	(4.330)	1.798	(1.528)	0.945	(1.686)	-0.691	(1.142)
Target		4.997	(3.285)	4.755	(1.839)	3.310	(1.239)	2.669	(1.460)
Walmart		4.767	(5.282)	5.029	(2.031)	3.799	(1.509)	2.395	(2.011)
99c Only		-1.859	(3.770)	2.830	(1.114)	-0.815	(2.140)	0.925	(0.620)
Dollar General		-3.607	(8.834)	-0.012	(2.161)	-3.355	(1.996)	-2.488	(1.707)
Dollar Tree		1.259	(2.931)	3.254	(1.794)	1.090	(0.985)	1.719	(0.940)
Family Dollar		–	–	–	–	–	–	–	–
Random Coefficients	σ_k								
Warehouse Stores		0.000	(1.175)	1.048	(0.991)	1.719	(1.189)	0.000	(0.591)
Traditional Stores		3.690	(1.854)	0.090	(1.063)	0.000	(1.018)	0.092	(0.255)
Discount Stores		6.000	(1.288)	1.694	(1.229)	2.858	(0.985)	0.132	(0.175)
Supercenters		2.378	(1.189)	1.694	(1.117)	0.000	(1.064)	0.000	(0.603)
Dollar Stores		6.000	(0.385)	1.717	(1.022)	2.327	(0.992)	3.405	(0.308)
Summary									
Log Likelihood		-19572.3		-115035.2		-203739.7		-1819957.9	
Number of Visits		8,646		50,335		88,163		803,110	
Number of Devices		1,025		4,930		7,726		68,205	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.36: Seattle-Tacoma-Bellevue, WA Metro Area — Exogenous Distance

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.227	(0.081)	-0.228	(0.027)	-0.201	(0.008)	-0.288	(0.006)
Density	β^{d2}	-0.464	(0.231)	-0.288	(0.111)	-0.353	(0.050)	-0.138	(0.028)
Fringe	ω	0.899	(0.470)	0.740	(0.129)	0.826	(0.056)	0.747	(0.025)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		2.403	(1.444)	1.048	(1.366)	1.781	(1.925)	0.272	(0.482)
Sam's Club		–	–	–	–	–	–	–	–
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		–	–	–	–	–	–	–	–
JC Penney		-3.281	(2.372)	-0.016	(1.386)	-1.103	(2.217)	-2.609	(1.101)
Kohl's		-4.299	(3.038)	-0.275	(1.546)	-1.496	(0.768)	-2.755	(1.427)
Macy's		-2.058	(2.177)	0.112	(1.555)	-1.284	(0.700)	-2.060	(1.370)
Neiman Marcus		–	–	–	–	–	–	–	–
Nordstrom		-3.315	(2.833)	0.148	(1.406)	-0.978	(0.801)	-0.702	(1.122)
Saks Fifth Avenue		–	–	–	–	–	–	–	–
Sears		-4.773	(4.458)	-1.133	(2.709)	-2.785	(1.015)	-5.169	(3.264)
Burlington		0.563	(6.140)	-0.010	(0.790)	-0.134	(0.790)	0.117	(0.324)
Citi Trends		–	–	–	–	–	–	–	–
Five Below		–	–	–	–	–	–	–	–
Marshalls		-0.110	(3.970)	-0.841	(1.096)	-0.501	(0.773)	0.069	(0.743)
Ross Dress for Less		1.280	(3.164)	0.632	(1.619)	0.539	(0.890)	0.915	(1.099)
T.J. Maxx		0.114	(3.168)	-0.609	(1.753)	-0.370	(1.039)	-0.015	(1.477)
Big Lots		0.159	(1.246)	0.136	(0.499)	-0.396	(0.405)	-0.257	(0.107)
Target		1.885	(2.217)	1.217	(1.313)	1.350	(2.135)	1.824	(1.166)
Walmart		3.194	(2.965)	2.378	(2.684)	2.294	(1.483)	1.939	(2.488)
99c Only		–	–	–	–	–	–	–	–
Dollar General		–	–	–	–	–	–	–	–
Dollar Tree		0.550	(1.453)	-2.063	(1.113)	-3.953	(1.166)	-0.301	(1.015)
Family Dollar		–	–	–	–	–	–	–	–
Random Coefficients	σ_k								
Warehouse Stores		3.535	(2.012)	0.000	(1.128)	1.784	(0.644)	2.714	(0.286)
Traditional Stores		0.000	(1.522)	0.104	(0.443)	0.331	(0.094)	0.320	(0.151)
Discount Stores		3.265	(1.747)	4.653	(0.881)	6.000	(0.496)	2.449	(0.223)
Supercenters		0.189	(1.790)	0.000	(0.417)	0.000	(0.413)	0.000	(0.059)
Dollar Stores		0.000	(1.841)	1.896	(1.310)	1.061	(0.384)	5.181	(0.085)
Summary									
Log Likelihood		-24416.6		-149536.8		-433330.8		-1710596.0	
Number of Visits		12,453		77,469		223,113		861,409	
Number of Devices		1,303		6,703		16,137		64,033	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.37: Tampa-St. Petersburg-Clearwater, FL Metro Area — Exogenous Distance

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.237	(0.019)	-0.279	(0.013)	-0.291	(0.010)	-0.306	(0.017)
Density	β^{d2}	0.835	(0.091)	0.761	(0.053)	0.817	(0.036)	0.708	(0.044)
Fringe	ω	0.638	(0.116)	1.126	(0.073)	1.426	(0.057)	1.993	(0.094)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		0.840	(2.629)	2.005	(0.423)	2.782	(0.545)	4.365	(0.779)
Costco		0.958	(2.756)	2.567	(1.817)	3.431	(1.637)	5.468	(1.994)
Sam's Club		1.740	(2.897)	2.948	(2.689)	3.635	(2.520)	4.955	(3.142)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		-2.960	(3.386)	-3.660	(1.925)	-3.227	(1.984)	-0.581	(1.588)
JC Penney		-1.496	(2.275)	-2.732	(2.413)	-2.813	(2.119)	-2.640	(2.034)
Kohl's		-2.015	(3.267)	-1.317	(1.807)	-0.849	(1.643)	0.476	(1.400)
Macy's		-1.286	(3.675)	-1.804	(2.070)	-1.504	(2.160)	0.136	(2.242)
Neiman Marcus		-3.841	(4.361)	-5.429	(3.296)	-5.572	(3.490)	-2.383	(3.360)
Nordstrom		-2.505	(3.104)	-4.563	(2.910)	-4.492	(3.165)	-0.949	(2.505)
Saks Fifth Avenue		–	–	–	–	–	–	–	–
Sears		-5.195	(4.672)	-5.536	(3.326)	-5.888	(3.554)	-4.327	(3.435)
Burlington		0.628	(3.805)	1.755	(1.175)	2.438	(1.648)	3.702	(1.454)
Citi Trends		0.149	(3.749)	0.750	(0.970)	0.684	(1.538)	1.875	(1.738)
Five Below		-2.576	(2.222)	-1.806	(2.072)	-0.879	(1.740)	0.010	(1.449)
Marshalls		0.350	(3.163)	1.446	(2.624)	2.246	(2.634)	3.668	(2.159)
Ross Dress for Less		0.613	(4.279)	1.703	(1.984)	2.550	(2.237)	4.115	(2.612)
T.J. Maxx		0.060	(3.442)	1.101	(2.222)	1.955	(2.712)	4.053	(2.451)
Big Lots		-2.978	(1.762)	-2.068	(0.619)	-0.461	(0.408)	2.045	(0.369)
Target		-0.404	(2.558)	0.448	(2.552)	2.307	(2.706)	4.372	(2.431)
Walmart		2.877	(2.723)	3.860	(2.426)	4.370	(3.067)	5.170	(2.682)
99c Only		–	–	–	–	–	–	–	–
Dollar General		1.550	(0.551)	-0.215	(1.313)	0.139	(1.684)	-1.884	(1.979)
Dollar Tree		2.029	(2.313)	1.579	(1.406)	2.275	(1.551)	2.382	(1.545)
Family Dollar		1.574	(1.584)	-0.439	(1.565)	0.072	(1.519)	-1.684	(1.231)
Random Coefficients	σ_k								
Warehouse Stores		2.211	(1.633)	3.239	(1.284)	3.521	(0.835)	3.729	(0.675)
Traditional Stores		2.683	(0.938)	2.752	(0.335)	2.186	(0.237)	1.902	(0.488)
Discount Stores		0.000	(0.699)	2.794	(0.370)	2.673	(0.271)	3.943	(0.465)
Supercenters		0.000	(0.575)	0.240	(0.325)	0.182	(0.270)	0.000	(0.285)
Dollar Stores		0.354	(0.635)	0.000	(0.494)	0.000	(0.519)	0.000	(0.669)
Summary									
Log Likelihood		-138096.7		-969277.4		-1416104.9		-949943.1	
Number of Visits		67,770		456,269		642,900		403,343	
Number of Devices		5,978		33,858		43,222		29,075	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table B.38: Washington-Arlington-Alexandria, DC-VA-MD-WV Metro Area — Exogenous Distance

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.357	(0.093)	-0.334	(0.026)	-0.365	(0.009)	-0.450	(0.018)
Density	β^{d2}	0.811	(0.321)	0.330	(0.059)	0.240	(0.030)	0.317	(0.022)
Fringe	ω	3.904	(5.259)	2.351	(0.247)	2.238	(0.058)	1.909	(0.046)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		2.889	(7.928)	3.878	(1.169)	2.694	(1.281)	2.640	(1.764)
Costco		4.434	(7.932)	4.718	(0.950)	3.710	(0.835)	4.917	(0.605)
Sam's Club		3.141	(8.497)	4.459	(1.348)	2.404	(1.470)	2.057	(1.891)
Bloomingdale's		5.840	(8.003)	6.409	(1.316)	6.896	(0.954)	5.744	(1.654)
Dillard's		–	–	–	–	–	–	–	–
JC Penney		4.788	(6.764)	4.060	(0.649)	4.358	(1.056)	3.056	(0.719)
Kohl's		6.070	(6.427)	4.987	(0.856)	5.025	(0.853)	3.344	(0.785)
Macy's		6.163	(7.405)	5.188	(0.673)	5.243	(0.630)	4.116	(0.731)
Neiman Marcus		4.915	(8.535)	5.146	(1.396)	5.091	(0.523)	4.442	(0.896)
Nordstrom		5.490	(7.195)	4.556	(1.067)	4.330	(0.577)	4.151	(1.282)
Saks Fifth Avenue		3.119	(7.331)	3.593	(1.182)	4.419	(1.193)	3.568	(1.625)
Sears		1.998	(7.514)	2.169	(1.562)	2.597	(1.362)	0.825	(1.672)
Burlington		6.666	(7.214)	5.079	(1.124)	5.149	(0.624)	5.526	(0.514)
Citi Trends		7.256	(7.546)	5.391	(1.570)	5.377	(1.425)	6.040	(2.028)
Five Below		4.736	(7.635)	3.309	(0.561)	3.547	(1.066)	4.168	(0.902)
Marshalls		6.741	(7.147)	4.773	(0.704)	4.318	(0.527)	4.951	(0.582)
Ross Dress for Less		6.878	(7.467)	4.746	(1.194)	4.633	(0.625)	4.825	(1.571)
T.J. Maxx		6.581	(7.907)	4.997	(1.504)	5.005	(1.274)	5.430	(1.531)
Big Lots		3.540	(7.406)	2.783	(0.899)	1.560	(1.223)	3.566	(0.756)
Target		6.533	(8.074)	5.357	(1.191)	4.943	(1.100)	5.864	(1.308)
Walmart		8.312	(7.840)	6.463	(0.884)	6.056	(1.222)	5.703	(1.764)
99c Only		–	–	–	–	–	–	–	–
Dollar General		5.251	(7.888)	4.500	(1.262)	3.701	(1.184)	3.503	(0.839)
Dollar Tree		6.882	(7.590)	5.854	(1.136)	5.322	(0.820)	5.504	(0.840)
Family Dollar		7.087	(7.786)	5.494	(0.739)	4.299	(1.483)	3.466	(1.079)
Random Coefficients	σ_k								
Warehouse Stores		1.336	(1.410)	0.000	(0.350)	0.000	(0.209)	2.189	(0.681)
Traditional Stores		2.227	(0.960)	1.502	(0.327)	2.182	(0.174)	2.206	(0.183)
Discount Stores		1.899	(0.948)	0.812	(0.409)	1.677	(0.357)	1.764	(0.442)
Supercenters		0.388	(1.229)	0.000	(0.367)	0.036	(0.108)	0.075	(0.130)
Dollar Stores		3.585	(1.162)	1.806	(0.494)	3.056	(0.339)	3.331	(0.310)
Summary									
Log Likelihood		-45592.8		-305748.0		-748582.3		-2164957.8	
Number of Visits		20,202		135,194		328,955		928,953	
Number of Devices		2,310		13,760		31,978		94,399	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

C Time as Endogenous Variable

C.1 Aggregate Summaries

Table C.1: Summary of Demand Estimates, Time Endogenous (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.165	(0.009)	-0.179	(0.005)	-0.170	(0.004)	-0.173	(0.004)
Density	β^{d2}	0.353	(0.090)	0.234	(0.020)	0.195	(0.015)	0.109	(0.016)
Fringe	ω	1.428	(0.708)	1.240	(0.050)	1.155	(0.024)	0.925	(0.018)
Control Function	ρ	0.070	(0.007)	0.089	(0.004)	0.080	(0.003)	0.077	(0.002)
Chain Preferences									
BJ's Wholesale Club		2.542	(1.331)	3.070	(0.543)	2.745	(0.566)	3.040	(0.438)
Costco		3.158	(0.823)	3.667	(0.307)	3.924	(0.462)	4.199	(0.395)
Sam's Club		1.337	(1.340)	1.064	(1.014)	3.017	(0.714)	2.480	(0.736)
Bloomingdale's		0.025	(1.329)	1.250	(0.766)	0.462	(0.700)	2.473	(0.546)
Dillard's		-1.615	(1.645)	0.369	(0.662)	-0.181	(0.859)	1.463	(0.517)
JC Penney		1.245	(0.729)	1.805	(0.502)	1.195	(0.457)	1.145	(0.436)
Kohl's		1.076	(0.712)	2.229	(0.382)	1.747	(0.512)	2.226	(0.334)
Macy's		1.483	(0.873)	2.136	(0.507)	1.719	(0.499)	2.459	(0.383)
Neiman Marcus		-0.995	(1.222)	0.242	(0.677)	-0.102	(0.708)	1.462	(0.490)
Nordstrom		0.370	(0.940)	1.071	(0.679)	0.652	(0.668)	2.279	(0.449)
Saks Fifth Avenue		-0.632	(1.187)	0.523	(0.723)	0.316	(0.719)	1.372	(0.637)
Sears		-3.047	(1.185)	-0.518	(0.620)	-0.937	(0.731)	-0.573	(0.537)
Burlington		3.724	(0.802)	3.435	(0.407)	3.229	(0.317)	2.682	(0.312)
Citi Trends		3.728	(1.481)	3.273	(0.415)	2.971	(0.813)	1.421	(0.582)
Five Below		1.696	(0.862)	1.523	(0.403)	1.495	(0.422)	1.166	(0.401)
Marshalls		3.225	(0.748)	3.001	(0.436)	3.010	(0.586)	2.651	(0.334)
Ross Dress for Less		4.130	(0.930)	3.754	(0.696)	3.797	(0.756)	3.768	(0.410)
T.J. Maxx		3.136	(0.929)	3.069	(0.642)	3.317	(0.646)	2.830	(0.516)
Big Lots		-0.015	(0.778)	1.109	(0.416)	0.921	(0.295)	1.121	(0.298)
Target		3.254	(0.882)	3.826	(0.610)	4.022	(0.713)	4.649	(0.451)
Walmart		5.740	(1.085)	5.663	(0.601)	5.284	(0.590)	4.778	(0.471)
99c Only		1.835	(0.969)	2.821	(0.563)	0.894	(0.501)	0.859	(0.347)
Dollar General		2.383	(0.873)	2.492	(0.428)	2.045	(0.505)	1.085	(0.450)
Dollar Tree		3.952	(0.734)	4.086	(0.349)	3.746	(0.442)	3.780	(0.336)
Family Dollar		3.138	(0.775)	3.312	(0.379)	2.599	(0.455)	1.557	(0.405)
Random Coefficients	σ_k								
Warehouse Stores		1.858	(0.297)	1.735	(0.198)	1.557	(0.179)	1.825	(0.152)
Traditional Stores		2.335	(0.331)	1.797	(0.221)	2.067	(0.191)	1.816	(0.186)
Discount Stores		0.663	(0.267)	0.772	(0.161)	0.487	(0.148)	0.708	(0.150)
Supercenters		2.168	(0.287)	1.709	(0.147)	1.520	(0.115)	1.096	(0.137)
Dollar Stores		1.927	(0.230)	1.277	(0.144)	1.409	(0.127)	1.355	(0.127)
Summary									
Number of Visits		1,476,820		7,737,705		11,797,999		13,796,397	
Number of Devices		130,157		605,128		886,500		1,132,056	
Avg. First Stage Partial R^2		15.6%		11.9%		10.2%		10.5%	
Avg. First Stage Partial F-stat		186.3		677.1		837.7		1266.9	

Table C.2: Summary of Demand Estimates, Time Exogenous

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.101	(0.007)	-0.099	(0.003)	-0.095	(0.002)	-0.101	(0.002)
Density	β^{d2}	0.351	(0.072)	0.252	(0.021)	0.191	(0.015)	0.133	(0.015)
Fringe	ω	1.395	(0.778)	1.240	(0.065)	1.152	(0.024)	0.895	(0.017)
Chain Preferences									
BJ's Wholesale Club		1.825	(1.592)	2.018	(0.513)	1.750	(0.535)	1.886	(0.411)
Costco		2.283	(0.943)	2.422	(0.313)	2.908	(0.447)	3.186	(0.410)
Sam's Club		0.478	(1.479)	0.263	(0.950)	2.023	(0.680)	1.452	(0.909)
Bloomingdale's		-0.996	(1.471)	-0.126	(0.792)	-0.517	(0.644)	1.548	(0.549)
Dillard's		-2.798	(1.777)	-1.165	(0.699)	-0.562	(0.792)	0.627	(0.542)
JC Penney		0.432	(0.806)	0.437	(0.572)	0.330	(0.434)	0.268	(0.438)
Kohl's		0.314	(0.836)	1.023	(0.377)	0.952	(0.486)	1.421	(0.336)
Macy's		0.614	(0.968)	0.729	(0.516)	0.800	(0.492)	1.516	(0.359)
Neiman Marcus		-1.924	(1.374)	-1.153	(0.687)	-0.927	(0.669)	0.536	(0.478)
Nordstrom		-0.470	(1.036)	-0.395	(0.699)	-0.235	(0.643)	1.360	(0.444)
Saks Fifth Avenue		-1.442	(1.250)	-0.935	(0.725)	-0.862	(0.703)	0.472	(0.647)
Sears		-3.286	(1.311)	-1.876	(0.630)	-1.789	(0.708)	-1.567	(0.564)
Burlington		2.685	(0.898)	2.160	(0.408)	2.080	(0.309)	1.449	(0.324)
Citi Trends		2.792	(1.760)	2.057	(0.428)	1.730	(0.914)	0.011	(0.635)
Five Below		0.543	(1.020)	0.161	(0.421)	0.425	(0.404)	-0.001	(0.386)
Marshalls		2.199	(0.843)	1.753	(0.445)	1.875	(0.551)	1.518	(0.315)
Ross Dress for Less		3.099	(1.080)	2.551	(0.674)	2.656	(0.706)	2.567	(0.434)
T.J. Maxx		2.056	(0.980)	1.826	(0.662)	2.170	(0.616)	1.692	(0.523)
Big Lots		-1.124	(0.867)	-0.440	(0.428)	-0.270	(0.312)	-0.298	(0.314)
Target		2.242	(0.960)	2.510	(0.627)	2.990	(0.688)	3.565	(0.462)
Walmart		4.840	(1.079)	4.581	(0.593)	4.322	(0.562)	3.660	(0.477)
99c Only		0.683	(1.047)	1.738	(0.572)	-0.073	(0.501)	0.209	(0.343)
Dollar General		1.502	(0.991)	1.233	(0.439)	0.574	(0.505)	-0.360	(0.504)
Dollar Tree		3.069	(0.818)	3.010	(0.362)	2.642	(0.421)	2.649	(0.362)
Family Dollar		2.317	(0.878)	2.112	(0.384)	1.408	(0.427)	0.001	(0.422)
Random Coefficients	σ_k								
Warehouse Stores		1.642	(0.302)	1.725	(0.199)	1.359	(0.177)	1.628	(0.152)
Traditional Stores		2.041	(0.351)	1.847	(0.230)	1.821	(0.187)	1.409	(0.195)
Discount Stores		0.641	(0.265)	0.785	(0.147)	0.453	(0.140)	0.632	(0.147)
Supercenters		2.181	(0.291)	1.902	(0.147)	1.561	(0.118)	1.260	(0.129)
Dollar Stores		1.974	(0.239)	1.479	(0.138)	1.640	(0.119)	1.495	(0.136)
Summary									
Number of Visits		1,476,820		7,737,705		11,797,999		13,796,397	
Number of Devices		130,157		605,128		886,500		1,132,056	

C.2 CBSA-Specific Parameter Estimates

Table C.3: Atlanta-Sandy Springs-Alpharetta, GA Metro Area — Endo. Time (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.157	(0.016)	-0.202	(0.014)	-0.196	(0.017)	-0.220	(0.016)
Density	β^{d2}	0.027	(0.057)	0.025	(0.026)	0.037	(0.021)	-0.338	(0.023)
Fringe	ω	0.688	(0.109)	0.450	(0.033)	0.543	(0.027)	0.520	(0.023)
Control Function	ρ	0.096	(0.015)	0.142	(0.013)	0.128	(0.015)	0.143	(0.012)
Chain Preferences									
BJ's Wholesale Club		2.290	(1.219)	2.214	(2.639)	1.506	(1.536)	0.878	(0.909)
Costco		2.638	(1.559)	2.648	(1.817)	2.358	(3.994)	3.063	(1.316)
Sam's Club		3.069	(5.602)	3.147	(2.505)	2.405	(4.080)	1.824	(2.454)
Bloomingdale's		-0.417	(4.846)	-0.589	(2.158)	-4.338	(2.716)	0.977	(2.297)
Dillard's		-0.780	(5.218)	0.570	(1.515)	-3.511	(3.579)	-0.082	(1.292)
JC Penney		0.330	(1.437)	0.500	(1.472)	-3.079	(2.365)	0.078	(1.245)
Kohl's		0.279	(1.802)	0.761	(1.662)	-2.774	(2.477)	1.731	(1.600)
Macy's		1.702	(2.112)	1.939	(1.383)	-3.104	(2.989)	1.895	(1.744)
Neiman Marcus		-1.599	(3.550)	-0.116	(2.039)	-2.915	(2.417)	1.022	(3.337)
Nordstrom		0.050	(3.435)	-0.108	(2.793)	-3.187	(3.718)	1.132	(2.072)
Saks Fifth Avenue		1.497	(5.033)	2.480	(2.439)	-1.225	(3.266)	3.742	(4.424)
Sears		-4.822	(5.040)	-2.812	(2.982)	-8.506	(3.770)	-5.356	(2.686)
Burlington		1.127	(1.187)	2.687	(1.388)	2.442	(1.330)	2.467	(1.158)
Citi Trends		1.821	(1.311)	3.020	(1.189)	3.041	(2.228)	3.308	(0.718)
Five Below		-1.601	(1.536)	0.104	(1.538)	0.216	(2.421)	0.538	(0.862)
Marshalls		-0.019	(3.374)	1.768	(2.689)	2.315	(2.176)	3.663	(1.446)
Ross Dress for Less		1.459	(5.499)	2.985	(2.889)	3.099	(2.786)	3.816	(1.329)
T.J. Maxx		0.032	(4.741)	2.258	(2.773)	2.652	(3.583)	3.467	(2.329)
Big Lots		-6.322	(2.976)	-0.627	(0.971)	0.302	(0.710)	1.656	(0.418)
Target		-2.315	(5.409)	1.593	(2.765)	2.454	(3.319)	4.280	(2.421)
Walmart		4.021	(6.047)	4.711	(2.910)	4.336	(3.120)	4.517	(1.329)
99c Only		–	–	–	–	–	–	–	–
Dollar General		2.539	(1.745)	2.733	(1.659)	2.472	(2.333)	2.078	(0.767)
Dollar Tree		3.106	(1.360)	3.429	(1.604)	3.284	(2.302)	3.911	(0.976)
Family Dollar		2.481	(1.652)	2.607	(1.871)	2.253	(2.393)	2.045	(1.113)
Random Coefficients	σ_k								
Warehouse Stores		1.843	(0.921)	1.898	(0.910)	4.264	(1.127)	2.312	(0.740)
Traditional Stores		4.642	(0.948)	2.274	(0.278)	1.914	(0.266)	0.946	(0.435)
Discount Stores		0.000	(0.395)	0.000	(0.102)	0.294	(0.225)	0.000	(0.621)
Supercenters		1.916	(0.728)	0.796	(0.662)	0.000	(0.544)	0.000	(0.092)
Dollar Stores		0.780	(0.457)	1.328	(0.744)	1.745	(0.877)	2.499	(0.335)
Summary									
Log Likelihood		-184198.4		-1452234.8		-2848053.3		-2395659.9	
Number of Visits		93,187		710,037		1,356,299		1,081,661	
Number of Devices		9,257		58,953		101,608		88,523	
First Stage Partial R^2		10.5%		7.9%		6.0%		12.2%	
First Stage Partial F-stat		160.9		700.4		897.4		1832.4	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.4: Boston-Cambridge-Newton, MA-NH Metro Area — Endo. Time (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.143	(0.074)	-0.173	(0.030)	-0.117	(0.019)	-0.152	(0.024)
Density	β^{d2}	-0.085	(1.414)	0.020	(0.124)	0.273	(0.089)	0.716	(0.106)
Fringe	ω	0.583	(11.097)	1.119	(0.128)	1.309	(0.088)	0.932	(0.078)
Control Function	ρ	0.015	(0.070)	0.069	(0.016)	0.021	(0.010)	0.033	(0.009)
Chain Preferences									
BJ's Wholesale Club		3.765	(4.952)	4.135	(0.849)	3.273	(0.710)	4.520	(0.672)
Costco		1.382	(4.991)	3.495	(0.967)	2.748	(0.842)	4.789	(0.881)
Sam's Club		-31.419	(15.963)	-38.503	(15.247)	-3.023	(2.604)	-2.392	(10.465)
Bloomingdale's		3.300	(5.866)	1.726	(1.157)	1.447	(2.427)	2.221	(0.756)
Dillard's		–	–	–	–	–	–	–	–
JC Penney		4.231	(4.920)	1.025	(7.060)	1.491	(1.130)	0.158	(3.046)
Kohl's		3.714	(4.783)	0.721	(2.019)	1.813	(1.268)	1.092	(1.486)
Macy's		5.129	(4.822)	1.818	(1.508)	1.913	(1.208)	1.345	(1.215)
Neiman Marcus		4.039	(4.610)	0.969	(2.191)	1.668	(1.754)	0.248	(1.722)
Nordstrom		3.674	(4.696)	-0.261	(2.791)	0.802	(2.076)	1.016	(1.788)
Saks Fifth Avenue		3.678	(5.304)	-0.048	(2.325)	0.734	(2.686)	0.022	(2.138)
Sears		3.693	(4.653)	-0.265	(2.795)	1.085	(1.638)	-1.105	(2.145)
Burlington		4.163	(4.499)	4.043	(1.065)	2.461	(0.676)	2.381	(0.994)
Citi Trends		3.946	(16.287)	3.409	(4.153)	2.114	(8.608)	1.030	(5.503)
Five Below		2.807	(5.059)	3.487	(2.083)	2.311	(0.992)	3.277	(1.846)
Marshalls		4.977	(4.736)	4.307	(1.956)	3.457	(1.470)	3.247	(1.367)
Ross Dress for Less		–	–	–	–	–	–	–	–
T.J. Maxx		4.868	(5.058)	3.743	(2.483)	2.911	(1.651)	3.270	(1.700)
Big Lots		1.754	(4.397)	2.767	(0.824)	2.519	(0.906)	1.977	(1.457)
Target		5.372	(5.267)	4.847	(3.624)	4.588	(1.688)	4.796	(2.330)
Walmart		6.196	(5.700)	5.619	(5.764)	4.915	(2.569)	4.654	(3.283)
99c Only		–	–	–	–	–	–	–	–
Dollar General		0.598	(5.137)	2.024	(4.378)	2.037	(0.858)	2.616	(2.387)
Dollar Tree		3.515	(5.887)	4.083	(1.952)	3.887	(2.078)	4.476	(1.501)
Family Dollar		1.828	(4.836)	3.475	(2.724)	3.299	(1.655)	3.117	(2.093)
Random Coefficients	σ_k								
Warehouse Stores		0.375	(1.705)	2.983	(0.962)	2.071	(0.629)	3.033	(0.664)
Traditional Stores		0.000	(1.335)	1.086	(0.583)	0.000	(0.545)	1.100	(0.571)
Discount Stores		3.012	(1.164)	1.469	(0.756)	0.586	(0.535)	0.000	(0.524)
Supercenters		0.481	(1.623)	0.291	(0.635)	0.727	(0.637)	1.432	(0.942)
Dollar Stores		2.430	(1.553)	1.593	(0.851)	1.557	(0.898)	0.000	(0.901)
Summary									
Log Likelihood		-17679.8		-164873.9		-491230.3		-1502350.4	
Number of Visits		8,440		78,649		232,927		655,870	
Number of Devices		1,028		8,203		23,474		73,247	
First Stage Partial R^2		25.6%		14.4%		11.1%		13.3%	
First Stage Partial F-stat		61.9		203.4		412.2		1754.3	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.5: Chicago-Naperville-Elgin, IL-IN-WI Metro Area — Endo. Time (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.116	(0.015)	-0.163	(0.008)	-0.187	(0.011)	-0.200	(0.015)
Density	β^{d2}	0.285	(0.060)	0.075	(0.025)	0.077	(0.031)	-0.060	(0.019)
Fringe	ω	0.056	(0.117)	0.148	(0.040)	0.279	(0.030)	-0.014	(0.028)
Control Function	ρ	0.031	(0.010)	0.068	(0.006)	0.103	(0.007)	0.126	(0.010)
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		1.366	(1.049)	1.068	(0.848)	3.470	(1.024)	3.219	(1.015)
Sam's Club		1.336	(3.080)	0.527	(3.736)	3.038	(3.296)	2.356	(1.338)
Bloomingdale's		-3.854	(3.400)	-2.568	(2.777)	-3.610	(2.737)	0.667	(0.658)
Dillard's		–	–	–	–	–	–	–	–
JC Penney		-2.139	(1.154)	-1.680	(1.467)	-2.401	(1.944)	0.979	(1.039)
Kohl's		-1.636	(1.631)	-1.065	(1.748)	-0.996	(3.460)	1.632	(0.663)
Macy's		-3.883	(2.270)	-3.231	(2.929)	-0.465	(2.533)	1.820	(0.889)
Neiman Marcus		-6.151	(2.646)	-5.286	(4.024)	-4.999	(3.673)	1.065	(0.796)
Nordstrom		-4.061	(2.456)	-3.450	(3.212)	-3.431	(4.049)	1.673	(0.957)
Saks Fifth Avenue		-7.484	(2.435)	-6.720	(3.791)	-6.588	(4.005)	-0.715	(1.255)
Sears		-6.862	(3.252)	-4.973	(2.936)	-3.353	(3.258)	-0.238	(1.144)
Burlington		1.656	(1.548)	1.356	(2.134)	1.815	(0.533)	1.644	(0.892)
Citi Trends		1.688	(0.553)	1.452	(0.425)	1.830	(0.742)	1.147	(0.876)
Five Below		-0.918	(1.319)	-1.179	(1.817)	-0.566	(1.652)	-0.983	(1.292)
Marshalls		0.818	(1.446)	0.723	(2.096)	1.094	(3.418)	0.866	(0.775)
Ross Dress for Less		2.049	(3.101)	1.865	(3.111)	2.192	(4.329)	2.125	(1.321)
T.J. Maxx		0.793	(2.244)	0.930	(3.849)	2.244	(3.936)	2.293	(1.433)
Big Lots		-4.446	(3.002)	-2.540	(2.367)	-0.945	(1.685)	-0.693	(1.073)
Target		0.090	(2.265)	1.536	(3.446)	2.863	(4.511)	3.159	(1.201)
Walmart		2.886	(3.864)	3.323	(2.746)	3.641	(3.109)	3.241	(1.128)
99c Only		–	–	–	–	–	–	–	–
Dollar General		0.850	(1.019)	1.505	(0.988)	1.936	(1.708)	1.207	(1.011)
Dollar Tree		2.297	(1.195)	2.678	(1.447)	2.928	(2.003)	2.561	(0.927)
Family Dollar		1.735	(1.432)	2.081	(1.783)	2.150	(1.927)	1.423	(1.291)
Random Coefficients	σ_k								
Warehouse Stores		3.097	(1.078)	3.305	(0.618)	3.501	(0.706)	1.151	(0.717)
Traditional Stores		2.955	(0.836)	2.333	(0.347)	1.455	(0.333)	0.000	(0.577)
Discount Stores		1.051	(0.755)	0.288	(0.397)	0.000	(0.423)	0.060	(0.188)
Supercenters		0.265	(0.612)	1.057	(0.350)	0.653	(0.317)	0.089	(0.365)
Dollar Stores		1.284	(1.309)	2.358	(0.818)	0.000	(0.959)	0.654	(0.563)
Summary									
Log Likelihood		-472979.8		-1954069.8		-2930015.0		-2736778.7	
Number of Visits		205,727		861,493		1,292,806		1,182,540	
Number of Devices		16,692		67,570		96,771		91,510	
First Stage Partial R^2		14.5%		9.0%		7.7%		8.5%	
First Stage Partial F-stat		551.7		1219.3		1464.1		1661.5	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.6: Dallas-Fort Worth-Arlington, TX Metro Area — Endo. Time (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.219	(0.019)	-0.179	(0.015)	-0.072	(0.007)	-0.154	(0.014)
Density	β^{d2}	0.700	(0.066)	0.619	(0.041)	0.651	(0.039)	0.257	(0.024)
Fringe	ω	0.942	(0.097)	0.687	(0.055)	0.623	(0.045)	-0.026	(0.034)
Control Function	ρ	0.136	(0.016)	0.087	(0.009)	-0.031	(0.006)	0.039	(0.007)
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		4.419	(4.374)	1.814	(0.988)	0.504	(1.956)	1.654	(1.686)
Sam's Club		5.155	(1.734)	2.188	(1.773)	0.316	(2.168)	0.530	(0.852)
Bloomingdale's		-5.877	(3.127)	-3.979	(3.051)	-5.803	(1.054)	-0.437	(1.771)
Dillard's		-2.909	(3.387)	-2.557	(1.622)	-2.829	(1.465)	1.342	(0.744)
JC Penney		-0.888	(2.363)	-2.025	(1.574)	-2.993	(1.177)	0.675	(1.095)
Kohl's		-2.262	(2.971)	-0.212	(1.033)	-1.969	(1.156)	1.310	(1.260)
Macy's		-1.184	(3.178)	-1.426	(1.619)	-2.404	(0.957)	1.412	(0.949)
Neiman Marcus		-1.145	(4.080)	-1.828	(1.622)	-1.803	(2.701)	2.789	(2.533)
Nordstrom		-1.109	(4.225)	-2.029	(2.866)	-2.887	(2.163)	1.995	(1.657)
Saks Fifth Avenue		–	–	–	–	–	–	–	–
Sears		-5.856	(4.166)	-5.712	(3.151)	-6.301	(3.016)	-3.697	(2.705)
Burlington		3.829	(3.562)	2.568	(2.136)	0.194	(1.227)	0.854	(1.654)
Citi Trends		3.879	(2.841)	2.393	(0.967)	-0.357	(1.455)	-0.524	(2.310)
Five Below		1.547	(3.521)	0.218	(1.122)	-1.896	(1.744)	-1.491	(1.015)
Marshalls		3.621	(2.413)	2.420	(1.057)	0.283	(2.500)	1.063	(1.050)
Ross Dress for Less		3.826	(1.346)	2.705	(1.833)	0.885	(1.073)	1.091	(1.154)
T.J. Maxx		3.286	(3.454)	2.232	(2.535)	0.175	(1.359)	1.352	(1.216)
Big Lots		-0.098	(3.467)	-1.731	(2.222)	-4.125	(1.217)	-2.852	(0.771)
Target		3.070	(2.000)	1.747	(2.421)	0.975	(1.071)	2.002	(1.361)
Walmart		6.829	(2.086)	5.471	(2.249)	4.269	(0.854)	3.200	(0.675)
99c Only		0.940	(2.855)	0.307	(1.778)	-4.650	(1.261)	-3.653	(0.930)
Dollar General		2.469	(4.137)	1.219	(1.227)	-1.195	(1.464)	-1.429	(0.926)
Dollar Tree		3.064	(3.799)	2.230	(0.785)	-0.176	(0.937)	0.300	(0.863)
Family Dollar		2.583	(1.759)	1.794	(1.057)	-1.729	(0.895)	-2.166	(1.065)
Random Coefficients	σ_k								
Warehouse Stores		3.984	(1.136)	3.379	(1.030)	3.114	(0.819)	0.000	(0.569)
Traditional Stores		2.361	(0.377)	2.717	(0.481)	2.811	(0.455)	2.021	(0.399)
Discount Stores		2.350	(0.704)	1.854	(0.726)	3.036	(0.614)	2.454	(0.439)
Supercenters		0.000	(0.281)	0.387	(0.300)	0.852	(0.271)	0.000	(0.375)
Dollar Stores		0.000	(1.212)	2.461	(0.921)	2.894	(0.683)	2.284	(0.728)
Summary									
Log Likelihood		-468468.4		-2525379.7		-3085435.5		-2567197.8	
Number of Visits		246,951		1,264,309		1,525,077		1,184,965	
Number of Devices		20,453		91,652		105,444		92,991	
First Stage Partial R^2		9.5%		10.4%		9.2%		10.4%	
First Stage Partial F-stat		360.9		1846.4		1788.0		1730.8	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.7: Denver-Aurora-Lakewood, CO Metro Area — Endo. Time (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.168	(0.059)	-0.244	(0.023)	-0.200	(0.021)	-0.258	(0.012)
Density	β^{d2}	1.162	(0.480)	1.623	(0.212)	1.146	(0.162)	1.514	(0.185)
Fringe	ω	2.590	(4.449)	2.117	(0.360)	1.867	(0.294)	2.273	(0.138)
Control Function	ρ	0.078	(0.041)	0.131	(0.017)	0.087	(0.014)	0.135	(0.011)
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		7.354	(3.275)	6.152	(1.214)	7.273	(0.838)	9.019	(1.368)
Sam's Club		7.288	(9.182)	5.651	(1.776)	6.523	(1.810)	7.123	(1.803)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		6.500	(11.433)	4.548	(1.146)	5.027	(1.312)	2.408	(1.600)
JC Penney		6.457	(3.428)	5.867	(0.936)	5.595	(0.811)	2.559	(1.397)
Kohl's		7.609	(3.737)	5.846	(1.197)	5.868	(1.221)	4.413	(1.410)
Macy's		6.729	(2.842)	4.348	(1.526)	4.713	(1.470)	2.441	(1.932)
Neiman Marcus		4.220	(15.086)	3.585	(2.854)	2.109	(2.228)	0.811	(1.744)
Nordstrom		7.381	(3.422)	5.947	(2.680)	5.992	(0.927)	5.531	(2.097)
Saks Fifth Avenue		–	–	–	–	–	–	–	–
Sears		-44.566	(10.609)	2.217	(2.237)	3.836	(2.441)	0.356	(4.352)
Burlington		7.569	(3.544)	7.194	(1.081)	5.866	(0.735)	7.721	(1.195)
Citi Trends		–	–	–	–	–	–	–	–
Five Below		4.950	(4.455)	3.885	(1.407)	2.920	(1.269)	4.198	(1.867)
Marshalls		6.816	(2.968)	6.690	(2.167)	6.127	(1.554)	6.905	(3.066)
Ross Dress for Less		8.054	(4.989)	7.578	(1.340)	6.507	(1.732)	7.150	(2.650)
T.J. Maxx		6.934	(6.393)	6.583	(1.973)	5.585	(1.923)	7.109	(3.959)
Big Lots		6.500	(3.709)	2.199	(1.869)	1.353	(1.390)	4.223	(0.982)
Target		8.887	(3.959)	6.561	(2.519)	5.961	(1.951)	8.621	(2.507)
Walmart		10.376	(13.178)	9.723	(2.981)	8.731	(2.807)	9.004	(4.455)
99c Only		–	–	–	–	–	–	–	–
Dollar General		6.319	(3.205)	4.069	(1.674)	3.024	(2.187)	2.202	(3.555)
Dollar Tree		8.892	(3.568)	7.598	(0.988)	6.904	(0.891)	6.739	(2.852)
Family Dollar		8.864	(3.144)	6.912	(1.642)	5.973	(1.516)	4.315	(2.126)
Random Coefficients	σ_k								
Warehouse Stores		1.020	(1.261)	1.897	(0.719)	1.369	(0.757)	3.789	(0.558)
Traditional Stores		1.370	(2.159)	3.186	(1.257)	3.147	(0.636)	1.874	(0.873)
Discount Stores		0.248	(1.600)	1.499	(0.765)	1.416	(0.746)	2.731	(0.827)
Supercenters		0.842	(1.818)	0.136	(0.681)	0.511	(0.447)	0.146	(0.281)
Dollar Stores		2.412	(1.529)	3.459	(0.836)	1.773	(0.711)	2.072	(0.386)
Summary									
Log Likelihood		-23886.4		-167236.5		-441627.3		-1264585.3	
Number of Visits		12,067		81,710		211,583		579,658	
Number of Devices		1,240		7,880		19,150		48,538	
First Stage Partial R^2		21.6%		19.8%		16.5%		12.4%	
First Stage Partial F-stat		74.8		392.3		715.4		1252.0	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.8: Detroit-Warren-Dearborn, MI Metro Area — Endo. Time (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.092	(0.021)	-0.105	(0.012)	-0.132	(0.008)	-0.127	(0.011)
Density	β^{d2}	-0.095	(0.090)	0.109	(0.049)	0.206	(0.038)	0.393	(0.047)
Fringe	ω	0.497	(0.146)	0.516	(0.079)	0.760	(0.065)	-0.209	(0.061)
Control Function	ρ	0.015	(0.015)	0.016	(0.012)	-0.000	(0.016)	0.021	(0.008)
Chain Preferences									
BJ's Wholesale Club		-3.233	(2.691)	-1.085	(1.689)	-1.801	(2.010)	-2.243	(1.470)
Costco		-0.751	(1.382)	0.487	(2.390)	1.066	(2.624)	1.209	(1.887)
Sam's Club		-0.703	(2.028)	0.246	(1.520)	0.151	(2.541)	0.181	(2.353)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		–	–	–	–	–	–	–	–
JC Penney		-1.189	(1.632)	-0.726	(1.049)	-2.075	(1.358)	-4.445	(1.264)
Kohl's		-0.780	(3.397)	-0.297	(1.587)	-1.146	(1.501)	-2.386	(1.324)
Macy's		-1.631	(3.248)	-1.016	(1.872)	-2.645	(2.223)	-1.789	(1.102)
Neiman Marcus		-3.678	(3.331)	-3.264	(2.161)	-5.196	(1.990)	-4.989	(1.979)
Nordstrom		-1.289	(3.364)	-1.108	(2.291)	-3.071	(2.463)	-2.607	(1.624)
Saks Fifth Avenue		-2.291	(3.555)	-1.736	(2.458)	-3.475	(1.984)	-2.532	(1.989)
Sears		-3.135	(4.032)	-2.604	(2.978)	-6.074	(3.024)	-6.025	(2.089)
Burlington		0.577	(2.327)	0.609	(0.782)	1.647	(1.829)	0.056	(1.670)
Citi Trends		0.057	(1.042)	-0.082	(1.166)	0.194	(3.297)	-1.868	(1.951)
Five Below		-1.192	(1.182)	-1.332	(1.144)	-0.904	(1.404)	-2.954	(0.917)
Marshalls		-0.044	(2.592)	-0.096	(1.467)	0.583	(1.460)	-1.099	(1.418)
Ross Dress for Less		–	–	–	–	–	–	–	–
T.J. Maxx		-0.414	(3.775)	-0.280	(1.896)	0.713	(2.801)	-0.227	(1.937)
Big Lots		-1.753	(1.637)	-1.349	(1.592)	-3.140	(1.676)	-6.700	(1.786)
Target		0.483	(4.057)	0.986	(1.880)	1.074	(2.516)	0.318	(1.861)
Walmart		1.747	(4.338)	1.784	(2.329)	1.474	(2.928)	-1.116	(1.642)
99c Only		–	–	–	–	–	–	–	–
Dollar General		-0.592	(1.078)	-0.673	(1.215)	-3.094	(2.818)	-5.716	(1.894)
Dollar Tree		1.055	(1.848)	0.996	(1.506)	0.156	(2.130)	-0.691	(1.161)
Family Dollar		0.191	(1.112)	-0.036	(1.190)	-2.513	(2.093)	-3.530	(1.032)
Random Coefficients	σ_k								
Warehouse Stores		1.732	(1.812)	1.614	(1.355)	3.197	(0.865)	3.264	(0.533)
Traditional Stores		1.294	(1.164)	0.964	(0.937)	2.306	(0.654)	2.978	(0.643)
Discount Stores		1.257	(0.962)	1.200	(0.809)	3.110	(0.806)	2.666	(0.537)
Supercenters		0.000	(0.330)	0.000	(0.178)	0.000	(0.180)	0.321	(0.376)
Dollar Stores		2.031	(1.199)	1.423	(1.078)	2.415	(0.917)	1.342	(0.608)
Summary									
Log Likelihood		-264881.6		-1279173.3		-1782828.0		-1143958.1	
Number of Visits		114,880		568,898		813,913		514,811	
Number of Devices		9,783		44,575		59,254		40,336	
First Stage Partial R^2		12.5%		12.0%		11.6%		10.1%	
First Stage Partial F-stat		270.1		1100.2		1331.9		834.8	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.9: Houston-The Woodlands-Sugar Land, TX Metro Area — Endo. Time (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.172	(0.010)	-0.188	(0.017)	-0.123	(0.015)	-0.128	(0.020)
Density	β^{d2}	0.982	(0.064)	0.771	(0.070)	0.542	(0.070)	0.328	(0.073)
Fringe	ω	1.344	(0.074)	1.353	(0.053)	1.308	(0.062)	1.329	(0.110)
Control Function	ρ	0.095	(0.009)	0.100	(0.011)	0.033	(0.008)	0.031	(0.009)
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		-2.489	(2.778)	2.165	(0.989)	3.559	(1.993)	4.262	(2.121)
Sam's Club		-0.336	(2.804)	3.481	(1.870)	3.654	(3.141)	2.721	(2.168)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		-1.067	(3.561)	-0.112	(2.191)	1.269	(2.140)	0.004	(1.899)
JC Penney		0.048	(1.283)	-0.081	(1.966)	0.490	(3.201)	-2.507	(2.956)
Kohl's		-0.244	(1.294)	0.990	(1.849)	0.736	(3.281)	0.934	(1.813)
Macy's		0.178	(3.813)	1.242	(2.047)	2.395	(2.678)	1.048	(2.208)
Neiman Marcus		-0.632	(2.810)	1.095	(2.138)	1.014	(3.132)	1.915	(1.238)
Nordstrom		-1.601	(3.722)	-2.210	(3.287)	-0.741	(3.885)	-0.705	(2.635)
Saks Fifth Avenue		0.118	(2.745)	0.767	(2.379)	2.237	(2.374)	1.553	(1.877)
Sears		-0.586	(2.780)	0.083	(1.722)	-0.215	(3.630)	-1.238	(2.612)
Burlington		4.594	(2.824)	5.050	(0.665)	4.551	(0.974)	5.337	(1.319)
Citi Trends		3.473	(1.643)	3.860	(0.865)	2.993	(4.399)	2.639	(1.282)
Five Below		2.717	(3.246)	3.536	(1.352)	3.794	(2.091)	4.781	(2.064)
Marshalls		4.134	(1.769)	4.864	(2.148)	4.586	(3.350)	5.545	(1.817)
Ross Dress for Less		4.355	(1.914)	5.248	(2.761)	5.180	(5.152)	6.071	(1.920)
T.J. Maxx		3.349	(2.440)	4.085	(2.747)	4.011	(3.034)	4.875	(2.028)
Big Lots		-0.121	(2.513)	2.141	(1.101)	1.556	(1.355)	1.689	(1.990)
Target		2.514	(2.358)	4.251	(2.818)	4.515	(3.713)	5.434	(2.000)
Walmart		7.249	(2.327)	7.426	(2.480)	6.664	(2.655)	6.442	(2.262)
99c Only		3.218	(1.165)	3.790	(0.696)	2.183	(0.543)	1.147	(0.885)
Dollar General		3.738	(1.012)	3.804	(1.013)	2.530	(3.195)	1.016	(2.856)
Dollar Tree		4.698	(1.501)	5.274	(1.122)	4.680	(1.752)	4.704	(1.523)
Family Dollar		4.128	(2.531)	4.170	(1.100)	3.040	(1.598)	1.566	(1.739)
Random Coefficients	σ_k								
Warehouse Stores		3.657	(1.073)	3.886	(0.934)	3.038	(1.214)	4.219	(1.292)
Traditional Stores		2.643	(0.430)	2.134	(0.330)	1.733	(0.403)	1.781	(0.783)
Discount Stores		1.245	(0.527)	1.421	(0.576)	1.652	(0.383)	2.345	(0.821)
Supercenters		0.910	(0.450)	1.134	(0.618)	0.638	(0.590)	0.000	(0.834)
Dollar Stores		5.543	(0.874)	3.634	(0.480)	2.588	(0.457)	3.304	(0.838)
Summary									
Log Likelihood		-627924.7		-2285568.4		-2400101.2		-1868795.6	
Number of Visits		300,006		1,042,665		1,078,704		788,704	
Number of Devices		25,023		75,329		74,979		62,243	
First Stage Partial R^2		8.7%		6.9%		7.0%		11.3%	
First Stage Partial F-stat		422.2		1050.8		1056.7		1556.9	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.10: Miami-Fort Lauderdale-Pompano Beach, FL Metro Area — Endo. Time (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.241	(0.020)	-0.197	(0.010)	-0.188	(0.005)	-0.162	(0.006)
Density	β^{d2}	0.396	(0.097)	0.037	(0.034)	-0.091	(0.024)	-0.168	(0.017)
Fringe	ω	0.987	(0.141)	0.639	(0.061)	0.890	(0.046)	0.934	(0.044)
Control Function	ρ	0.115	(0.017)	0.095	(0.009)	0.104	(0.005)	0.081	(0.005)
Chain Preferences									
BJ's Wholesale Club		3.861	(1.076)	2.988	(0.415)	3.923	(0.349)	3.477	(0.383)
Costco		4.289	(3.643)	3.254	(1.676)	4.402	(1.276)	4.232	(1.737)
Sam's Club		4.170	(2.451)	2.769	(2.024)	3.610	(0.734)	3.110	(0.823)
Bloomingdale's		-0.186	(2.136)	3.406	(1.208)	4.110	(0.317)	4.889	(0.667)
Dillard's		-7.075	(3.878)	1.809	(1.612)	2.195	(1.184)	2.450	(1.531)
JC Penney		-1.687	(2.331)	2.616	(0.947)	3.115	(0.470)	2.865	(0.510)
Kohl's		-4.803	(3.443)	2.068	(1.310)	2.563	(0.769)	3.006	(0.469)
Macy's		-1.985	(2.743)	2.863	(1.870)	3.419	(0.627)	3.827	(0.522)
Neiman Marcus		-6.605	(4.288)	1.286	(1.898)	2.058	(1.092)	2.906	(0.884)
Nordstrom		-6.880	(4.271)	1.296	(3.025)	1.999	(1.218)	3.447	(0.853)
Saks Fifth Avenue		-1.964	(2.784)	2.687	(1.599)	3.053	(0.850)	3.821	(0.993)
Sears		-0.634	(2.230)	0.564	(1.868)	1.208	(1.090)	1.553	(1.044)
Burlington		4.239	(1.161)	3.101	(0.646)	3.751	(0.495)	3.388	(0.514)
Citi Trends		3.791	(2.336)	3.312	(1.051)	4.160	(0.995)	3.572	(0.944)
Five Below		1.634	(2.067)	0.956	(0.836)	2.034	(0.707)	2.025	(0.556)
Marshalls		2.928	(2.833)	2.480	(1.594)	3.418	(0.764)	3.675	(0.710)
Ross Dress for Less		4.332	(2.065)	3.686	(3.292)	4.679	(1.146)	4.693	(0.769)
T.J. Maxx		3.403	(2.103)	2.846	(1.472)	3.829	(0.995)	4.271	(1.057)
Big Lots		-2.339	(1.690)	-0.385	(0.893)	1.464	(0.938)	2.600	(0.523)
Target		-0.369	(2.924)	1.089	(1.933)	3.221	(0.991)	4.661	(1.144)
Walmart		4.189	(2.370)	3.635	(1.931)	4.498	(0.813)	4.786	(0.840)
99c Only		–	–	–	–	–	–	–	–
Dollar General		-0.363	(2.755)	0.170	(2.207)	1.770	(1.343)	1.416	(1.610)
Dollar Tree		3.444	(1.581)	3.654	(1.624)	4.696	(1.005)	4.902	(1.167)
Family Dollar		1.839	(1.653)	2.436	(1.022)	3.235	(0.644)	2.689	(0.527)
Random Coefficients	σ_k								
Warehouse Stores		4.705	(1.558)	0.160	(1.035)	0.885	(0.526)	0.000	(0.321)
Traditional Stores		4.063	(0.851)	2.430	(0.395)	1.637	(0.396)	0.004	(0.412)
Discount Stores		3.384	(0.750)	1.672	(0.220)	1.274	(0.254)	1.216	(0.304)
Supercenters		0.844	(0.591)	0.000	(0.338)	0.000	(0.163)	0.101	(0.063)
Dollar Stores		0.000	(0.426)	0.394	(0.391)	0.000	(0.084)	0.926	(0.430)
Summary									
Log Likelihood		-238190.1		-1468635.0		-2270394.0		-3287591.9	
Number of Visits		99,832		602,570		908,939		1,299,438	
Number of Devices		7,744		38,650		56,260		84,592	
First Stage Partial R^2		16.5%		12.1%		12.0%		13.3%	
First Stage Partial F-stat		331.0		1144.4		1585.7		2571.3	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.11: Minneapolis-St. Paul-Bloomington, MN-WI Metro Area — Endo. Time (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.221	(0.064)	-0.370	(0.036)	-0.297	(0.031)	-0.178	(0.028)
Density	β^{d2}	0.381	(0.267)	0.200	(0.083)	0.026	(0.069)	-0.420	(0.264)
Fringe	ω	2.578	(3.746)	4.060	(0.677)	3.165	(0.123)	2.182	(0.162)
Control Function	ρ	0.117	(0.045)	0.250	(0.024)	0.198	(0.021)	0.072	(0.013)
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		8.336	(3.877)	10.427	(1.057)	8.523	(0.869)	6.716	(3.766)
Sam's Club		8.708	(4.285)	10.681	(1.774)	7.932	(1.903)	5.644	(3.188)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		–	–	–	–	–	–	–	–
JC Penney		7.002	(4.991)	9.435	(1.584)	6.093	(1.063)	1.724	(4.577)
Kohl's		7.667	(4.042)	9.187	(1.603)	6.742	(1.190)	3.251	(3.926)
Macy's		8.207	(5.471)	10.744	(1.662)	7.456	(1.532)	3.543	(4.579)
Neiman Marcus		–	–	–	–	–	–	–	–
Nordstrom		7.009	(3.914)	8.832	(2.103)	5.857	(1.657)	3.360	(3.013)
Saks Fifth Avenue		5.047	(4.740)	6.331	(1.701)	3.149	(1.928)	-0.507	(4.667)
Sears		–	–	–	–	–	–	–	–
Burlington		7.931	(4.182)	8.770	(1.715)	6.275	(0.767)	-4.698	(3.309)
Citi Trends		7.731	(4.516)	9.210	(1.601)	6.535	(1.639)	-8.214	(4.282)
Five Below		6.406	(4.094)	8.050	(1.414)	5.944	(1.237)	-4.784	(3.247)
Marshalls		7.467	(4.074)	8.864	(2.232)	6.588	(1.388)	-4.728	(3.322)
Ross Dress for Less		–	–	–	–	–	–	–	–
T.J. Maxx		6.110	(4.229)	7.827	(1.708)	6.417	(1.560)	-10.696	(5.109)
Big Lots		4.717	(4.004)	9.055	(2.409)	6.169	(1.607)	0.537	(2.954)
Target		9.269	(4.202)	12.481	(1.377)	10.096	(2.544)	7.196	(3.463)
Walmart		9.714	(3.952)	12.765	(1.714)	9.888	(1.919)	5.900	(3.419)
99c Only		–	–	–	–	–	–	–	–
Dollar General		5.859	(4.279)	8.456	(1.292)	7.011	(2.379)	-0.067	(3.952)
Dollar Tree		8.187	(3.779)	10.535	(1.324)	8.222	(1.001)	3.734	(3.256)
Family Dollar		6.535	(3.816)	9.068	(1.458)	6.995	(1.060)	0.352	(4.572)
Random Coefficients	σ_k								
Warehouse Stores		1.225	(1.517)	2.484	(0.800)	2.411	(0.791)	2.841	(1.266)
Traditional Stores		0.939	(1.103)	1.074	(0.635)	0.029	(0.580)	1.459	(0.670)
Discount Stores		1.278	(0.905)	2.110	(0.375)	1.158	(0.366)	2.834	(1.218)
Supercenters		0.074	(1.414)	2.262	(0.929)	1.971	(0.857)	6.000	(1.053)
Dollar Stores		0.129	(1.497)	2.337	(0.860)	2.160	(0.677)	0.000	(0.713)
Summary									
Log Likelihood		-45714.9		-464718.5		-966686.8		-1011307.2	
Number of Visits		23,823		251,022		555,788		554,001	
Number of Devices		2,610		23,069		48,781		44,690	
First Stage Partial R^2		19.2%		10.4%		7.3%		9.3%	
First Stage Partial F-stat		115.6		454.3		581.4		752.8	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.12: Philadelphia-Camden-Wilmington, PA-NJ-DE-MD Metro Area — Endo. Time (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.143	(0.029)	-0.120	(0.009)	-0.133	(0.006)	-0.168	(0.007)
Density	β^{d2}	0.112	(0.140)	-0.077	(0.043)	-0.179	(0.037)	-0.109	(0.032)
Fringe	ω	1.029	(0.213)	0.945	(0.059)	0.895	(0.039)	1.052	(0.036)
Control Function	ρ	0.017	(0.016)	0.015	(0.006)	0.024	(0.005)	0.053	(0.006)
Chain Preferences									
BJ's Wholesale Club		3.606	(1.009)	3.086	(0.969)	3.008	(1.855)	4.693	(0.508)
Costco		3.580	(3.045)	3.117	(0.824)	3.412	(1.912)	5.217	(1.695)
Sam's Club		3.589	(2.173)	3.032	(1.058)	3.009	(1.462)	4.410	(1.430)
Bloomingdale's		0.566	(1.799)	1.784	(0.577)	0.373	(1.514)	2.174	(1.701)
Dillard's		–	–	–	–	–	–	–	–
JC Penney		-0.303	(2.913)	1.769	(1.309)	0.718	(1.938)	1.755	(0.798)
Kohl's		0.472	(1.674)	2.364	(0.700)	1.783	(0.926)	2.630	(1.127)
Macy's		0.337	(2.305)	2.146	(1.604)	0.814	(1.236)	2.676	(1.359)
Neiman Marcus		-1.880	(2.904)	0.058	(1.142)	-0.460	(1.424)	1.071	(1.486)
Nordstrom		-1.529	(2.308)	0.834	(1.211)	-0.440	(1.802)	2.709	(1.458)
Saks Fifth Avenue		-3.829	(3.044)	-1.631	(2.142)	-1.963	(1.374)	0.186	(1.520)
Sears		0.968	(2.345)	2.547	(1.219)	1.656	(1.739)	2.677	(1.817)
Burlington		3.633	(0.777)	3.166	(0.686)	3.058	(1.157)	4.183	(1.031)
Citi Trends		2.983	(0.937)	2.008	(0.899)	1.607	(0.633)	2.586	(0.981)
Five Below		2.465	(1.464)	1.510	(1.105)	1.456	(0.772)	2.824	(1.161)
Marshalls		4.102	(1.880)	3.116	(0.907)	3.267	(1.176)	4.352	(1.243)
Ross Dress for Less		3.644	(2.852)	3.018	(1.624)	3.045	(1.069)	3.641	(1.409)
T.J. Maxx		3.809	(3.010)	3.110	(1.809)	3.498	(1.488)	5.084	(1.894)
Big Lots		-1.071	(2.205)	1.154	(1.162)	1.792	(1.222)	2.327	(0.367)
Target		2.147	(3.017)	3.144	(1.521)	4.022	(1.389)	5.420	(1.729)
Walmart		4.555	(2.054)	4.444	(1.051)	4.577	(1.276)	5.202	(1.544)
99c Only		–	–	–	–	–	–	–	–
Dollar General		2.623	(1.074)	1.629	(0.548)	1.569	(0.394)	1.975	(1.193)
Dollar Tree		4.648	(1.480)	3.998	(0.474)	4.134	(0.480)	4.847	(1.313)
Family Dollar		3.400	(1.549)	2.286	(0.844)	1.651	(1.135)	1.716	(1.285)
Random Coefficients	σ_k								
Warehouse Stores		2.857	(1.269)	1.328	(0.732)	2.239	(0.350)	2.278	(0.282)
Traditional Stores		2.909	(1.080)	1.189	(0.228)	0.600	(0.367)	0.000	(0.325)
Discount Stores		1.321	(1.006)	1.319	(0.203)	1.398	(0.132)	1.451	(0.171)
Supercenters		0.000	(0.944)	0.000	(0.482)	0.175	(0.219)	0.000	(0.067)
Dollar Stores		0.845	(0.965)	0.563	(0.446)	1.027	(0.349)	0.000	(0.644)
Summary									
Log Likelihood		-106080.8		-954727.8		-1880825.9		-1935192.5	
Number of Visits		46,479		415,276		822,687		826,258	
Number of Devices		4,136		31,572		62,024		69,946	
First Stage Partial R^2		18.3%		11.1%		7.4%		7.0%	
First Stage Partial F-stat		174.0		711.4		865.9		921.5	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.13: Phoenix-Mesa-Chandler, AZ Metro Area — Endo. Time (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.181	(0.035)	-0.175	(0.033)	-0.144	(0.033)	-0.135	(0.021)
Density	β^{d2}	-0.770	(0.207)	-0.301	(0.080)	-0.322	(0.086)	-0.452	(0.055)
Fringe	ω	0.694	(0.181)	0.631	(0.131)	0.435	(0.099)	0.434	(0.139)
Control Function	ρ	0.125	(0.028)	0.107	(0.026)	0.056	(0.022)	0.050	(0.013)
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		3.396	(1.017)	4.068	(0.831)	3.963	(0.810)	5.181	(0.864)
Sam's Club		3.163	(2.338)	3.133	(2.366)	2.602	(2.167)	3.613	(2.337)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		0.596	(1.012)	2.502	(1.339)	1.956	(1.107)	3.023	(1.053)
JC Penney		1.565	(1.626)	3.068	(1.410)	2.275	(1.089)	2.561	(1.286)
Kohl's		1.208	(2.042)	3.237	(1.547)	2.565	(1.422)	3.374	(1.107)
Macy's		2.574	(1.097)	3.364	(1.265)	2.668	(0.800)	3.702	(0.890)
Neiman Marcus		-0.221	(2.832)	1.053	(1.966)	0.027	(1.640)	2.505	(1.676)
Nordstrom		0.113	(2.580)	2.437	(1.868)	1.619	(2.078)	3.636	(1.457)
Saks Fifth Avenue		-0.338	(2.645)	1.455	(2.008)	0.263	(2.101)	1.906	(2.209)
Sears		-1.774	(2.708)	0.086	(1.648)	-0.491	(1.584)	-0.093	(1.952)
Burlington		2.303	(1.405)	1.514	(1.014)	0.834	(0.787)	2.153	(0.761)
Citi Trends		–	–	–	–	–	–	–	–
Five Below		0.219	(1.963)	-0.431	(1.292)	-0.956	(0.765)	0.866	(0.766)
Marshalls		1.928	(2.345)	1.136	(1.638)	0.871	(1.551)	3.099	(1.230)
Ross Dress for Less		4.757	(2.531)	3.600	(2.428)	2.897	(2.073)	4.217	(1.676)
T.J. Maxx		2.230	(2.304)	2.264	(2.353)	2.236	(2.569)	3.267	(2.069)
Big Lots		1.942	(0.908)	0.973	(1.204)	0.465	(0.728)	1.940	(0.490)
Target		3.971	(2.676)	3.180	(2.202)	3.209	(2.738)	4.754	(2.086)
Walmart		5.485	(2.738)	5.259	(1.718)	4.995	(1.915)	5.349	(1.980)
99c Only		3.253	(1.572)	3.177	(0.509)	2.869	(0.374)	3.036	(0.388)
Dollar General		2.336	(0.666)	1.769	(0.853)	1.249	(0.908)	0.173	(1.493)
Dollar Tree		3.826	(1.085)	3.779	(0.697)	3.821	(0.893)	4.119	(1.418)
Family Dollar		2.594	(2.032)	2.485	(1.082)	1.574	(0.820)	0.470	(0.744)
Random Coefficients	σ_k								
Warehouse Stores		1.700	(1.138)	0.000	(1.346)	1.091	(1.263)	0.961	(0.919)
Traditional Stores		0.320	(1.264)	1.414	(0.705)	1.770	(0.619)	0.889	(0.412)
Discount Stores		0.000	(0.626)	0.000	(0.399)	0.000	(0.692)	0.767	(0.638)
Supercenters		0.578	(1.359)	1.347	(1.246)	1.614	(1.020)	0.000	(0.254)
Dollar Stores		1.004	(1.169)	1.139	(1.075)	1.515	(0.534)	1.090	(0.348)
Summary									
Log Likelihood		-94055.0		-573787.2		-819225.2		-662410.9	
Number of Visits		48,832		280,940		395,217		304,300	
Number of Devices		5,514		28,582		41,826		43,907	
First Stage Partial R^2		14.8%		14.1%		11.1%		8.8%	
First Stage Partial F-stat		160.7		761.2		764.3		491.7	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.14: Riverside-San Bernardino-Ontario, CA Metro Area — Endo. Time (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.117	(0.032)	-0.149	(0.011)	-0.173	(0.017)	-0.086	(0.007)
Density	β^{d2}	0.110	(0.129)	0.292	(0.044)	0.343	(0.049)	0.199	(0.028)
Fringe	ω	1.866	(0.211)	1.747	(0.077)	1.512	(0.058)	1.395	(0.057)
Control Function	ρ	0.050	(0.025)	0.084	(0.010)	0.108	(0.015)	0.028	(0.006)
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		5.254	(4.090)	4.520	(0.839)	5.643	(1.193)	5.483	(1.481)
Sam's Club		4.692	(1.338)	3.353	(1.521)	5.059	(1.626)	4.868	(1.535)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		–	–	–	–	–	–	–	–
JC Penney		3.724	(1.241)	4.309	(1.029)	4.677	(2.506)	3.055	(0.957)
Kohl's		4.033	(1.242)	4.475	(0.990)	4.885	(1.711)	3.875	(0.591)
Macy's		3.650	(4.083)	4.323	(0.635)	4.753	(1.275)	3.399	(0.670)
Neiman Marcus		-0.371	(7.564)	1.638	(1.765)	2.017	(1.699)	0.732	(1.484)
Nordstrom		4.075	(4.154)	4.381	(1.245)	4.940	(1.904)	3.624	(1.277)
Saks Fifth Avenue		0.667	(5.791)	1.895	(0.632)	3.307	(1.289)	3.104	(1.142)
Sears		2.626	(9.683)	2.778	(1.399)	2.811	(1.632)	1.622	(1.964)
Burlington		3.948	(0.975)	4.047	(0.554)	4.424	(2.125)	2.154	(0.638)
Citi Trends		3.609	(9.112)	3.080	(1.686)	3.290	(2.025)	0.346	(1.069)
Five Below		2.619	(1.186)	2.441	(0.642)	2.984	(1.720)	0.424	(1.247)
Marshalls		3.739	(1.217)	3.740	(0.859)	4.844	(1.275)	3.270	(1.137)
Ross Dress for Less		3.913	(1.362)	4.096	(1.176)	4.570	(1.686)	2.415	(1.184)
T.J. Maxx		3.300	(3.488)	3.745	(1.695)	4.361	(1.412)	2.664	(1.799)
Big Lots		2.845	(0.709)	3.185	(0.312)	3.633	(0.470)	2.490	(0.272)
Target		5.310	(4.360)	5.781	(1.438)	6.133	(2.033)	5.488	(1.698)
Walmart		6.398	(3.368)	6.588	(1.728)	6.631	(1.677)	5.572	(1.763)
99c Only		4.562	(0.480)	4.665	(0.306)	4.648	(0.266)	3.799	(0.201)
Dollar General		3.380	(1.661)	3.077	(0.948)	2.879	(1.986)	1.102	(1.765)
Dollar Tree		4.604	(1.598)	4.716	(1.029)	4.833	(1.182)	4.339	(1.568)
Family Dollar		3.092	(3.800)	2.966	(1.048)	2.847	(1.920)	1.682	(1.397)
Random Coefficients	σ_k								
Warehouse Stores		0.000	(1.219)	0.455	(0.373)	0.000	(0.164)	0.949	(0.532)
Traditional Stores		0.039	(0.876)	0.160	(0.184)	0.071	(0.293)	0.009	(0.230)
Discount Stores		0.819	(0.829)	0.937	(0.453)	1.003	(0.442)	0.761	(0.279)
Supercenters		0.408	(0.929)	0.901	(0.660)	0.000	(1.608)	1.660	(0.641)
Dollar Stores		0.169	(1.791)	2.275	(0.768)	1.487	(0.547)	0.047	(0.235)
Summary									
Log Likelihood		-79298.0		-569874.4		-1124161.8		-1772792.2	
Number of Visits		38,267		260,377		494,715		747,639	
Number of Devices		4,007		23,002		39,944		56,428	
First Stage Partial R^2		11.1%		10.6%		9.5%		6.3%	
First Stage Partial F-stat		76.6		451.5		728.4		702.5	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.15: St. Louis, MO-IL Metro Area — Endo. Time (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.205	(0.033)	-0.198	(0.024)	-0.231	(0.020)	-0.338	(0.026)
Density	β^{d2}	-0.175	(0.124)	-0.315	(0.052)	-0.386	(0.050)	-0.605	(0.103)
Fringe	ω	6.241	(4.733)	3.723	(0.584)	3.704	(0.260)	2.201	(0.106)
Control Function	ρ	0.117	(0.026)	0.122	(0.015)	0.150	(0.012)	0.262	(0.021)
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		9.584	(5.551)	8.490	(1.625)	9.028	(2.524)	3.438	(2.354)
Sam's Club		10.201	(4.304)	9.212	(3.327)	9.282	(5.206)	3.703	(2.765)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		-1.761	(5.847)	2.024	(2.447)	-1.319	(4.757)	3.166	(2.340)
JC Penney		0.953	(6.655)	3.995	(2.562)	1.973	(2.744)	2.376	(1.846)
Kohl's		1.367	(3.594)	4.768	(3.001)	3.297	(3.408)	4.262	(1.972)
Macy's		1.515	(5.999)	4.798	(2.389)	-0.143	(4.003)	4.776	(1.587)
Neiman Marcus		-2.960	(6.286)	2.010	(3.546)	-0.781	(4.716)	2.619	(2.911)
Nordstrom		-0.328	(6.312)	3.147	(4.141)	0.699	(4.723)	4.316	(2.804)
Saks Fifth Avenue		-1.036	(6.411)	0.910	(4.245)	-1.039	(4.480)	2.391	(3.021)
Sears		-7.067	(6.441)	1.213	(3.523)	-0.846	(4.471)	0.425	(3.006)
Burlington		9.937	(5.611)	7.614	(2.426)	7.299	(0.856)	4.867	(1.240)
Citi Trends		8.964	(2.163)	6.675	(3.864)	5.966	(4.509)	4.018	(2.127)
Five Below		8.608	(3.240)	6.174	(2.117)	6.029	(2.903)	3.470	(1.552)
Marshalls		8.835	(3.110)	6.369	(2.864)	6.234	(3.416)	4.475	(2.180)
Ross Dress for Less		10.457	(4.119)	8.302	(3.570)	8.368	(4.027)	6.663	(2.695)
T.J. Maxx		10.621	(5.803)	8.445	(3.983)	8.509	(4.946)	7.222	(3.261)
Big Lots		9.508	(2.108)	6.871	(3.479)	6.122	(0.584)	6.512	(1.008)
Target		11.318	(5.626)	9.317	(3.947)	9.218	(5.633)	9.338	(2.753)
Walmart		12.812	(4.816)	10.526	(1.662)	10.083	(5.718)	9.898	(3.420)
99c Only		–	–	–	–	–	–	–	–
Dollar General		9.217	(2.577)	8.110	(0.569)	7.044	(3.858)	7.734	(2.287)
Dollar Tree		9.727	(5.931)	8.850	(0.820)	8.328	(2.488)	9.499	(2.511)
Family Dollar		9.323	(3.905)	8.295	(2.025)	7.001	(2.884)	8.129	(2.185)
Random Coefficients	σ_k								
Warehouse Stores		6.000	(0.768)	3.330	(0.852)	4.813	(0.683)	3.669	(0.745)
Traditional Stores		0.024	(0.791)	0.000	(0.532)	0.000	(0.530)	0.000	(0.675)
Discount Stores		1.906	(0.935)	0.000	(0.697)	1.221	(0.673)	0.000	(0.095)
Supercenters		0.158	(1.047)	0.420	(0.558)	0.000	(0.717)	2.170	(0.642)
Dollar Stores		1.976	(1.116)	0.833	(0.697)	0.000	(0.717)	6.000	(0.531)
Summary									
Log Likelihood		-193063.3		-889140.1		-1199275.9		-757726.1	
Number of Visits		111,263		511,689		640,355		364,876	
Number of Devices		10,446		40,353		45,028		25,214	
First Stage Partial R^2		10.0%		10.2%		10.5%		19.2%	
First Stage Partial F-stat		174.7		678.9		815.2		1098.9	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.16: San Diego-Chula Vista-Carlsbad, CA Metro Area — Endo. Time (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.076	(0.042)	-0.114	(0.032)	-0.122	(0.020)	-0.087	(0.007)
Density	β^{d2}	-0.340	(0.428)	-0.382	(0.186)	-0.140	(0.110)	-0.026	(0.040)
Fringe	ω	0.407	(0.322)	1.090	(0.173)	0.951	(0.096)	0.981	(0.060)
Control Function	ρ	0.002	(0.033)	0.042	(0.025)	0.064	(0.015)	0.034	(0.006)
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		0.270	(2.921)	3.978	(1.134)	3.628	(1.235)	3.969	(1.335)
Sam's Club		-1.826	(5.309)	2.619	(2.762)	2.077	(2.398)	1.258	(1.884)
Bloomingdale's		1.776	(2.387)	3.858	(2.267)	3.602	(1.897)	3.471	(1.878)
Dillard's		–	–	–	–	–	–	–	–
JC Penney		0.647	(4.031)	2.864	(1.341)	2.576	(2.024)	2.140	(1.002)
Kohl's		0.641	(1.849)	3.063	(1.249)	2.790	(1.402)	2.674	(0.700)
Macy's		0.898	(2.075)	3.145	(3.477)	2.848	(0.950)	2.615	(0.655)
Neiman Marcus		-0.656	(2.252)	1.776	(2.032)	1.076	(1.495)	0.180	(1.693)
Nordstrom		0.512	(2.448)	2.710	(2.058)	2.435	(1.843)	2.463	(1.444)
Saks Fifth Avenue		-3.666	(4.701)	-1.356	(2.748)	-0.047	(2.367)	0.901	(2.060)
Sears		-2.792	(4.257)	-0.274	(2.116)	-0.462	(2.505)	-0.482	(1.768)
Burlington		0.443	(2.290)	-1.017	(2.609)	0.419	(2.124)	1.305	(1.565)
Citi Trends		–	–	–	–	–	–	–	–
Five Below		-3.172	(7.415)	-3.977	(2.467)	-2.718	(2.428)	-2.162	(2.212)
Marshalls		0.199	(3.928)	0.174	(1.705)	0.333	(1.936)	2.425	(0.746)
Ross Dress for Less		1.786	(3.076)	1.194	(3.049)	2.593	(1.717)	2.986	(1.355)
T.J. Maxx		-0.235	(3.139)	-0.148	(3.184)	0.924	(1.871)	2.100	(2.139)
Big Lots		-0.601	(1.974)	0.973	(1.355)	1.680	(0.702)	1.246	(0.275)
Target		1.848	(3.571)	4.150	(2.454)	4.334	(1.984)	4.184	(2.030)
Walmart		3.018	(4.589)	4.812	(2.955)	4.818	(2.775)	4.301	(2.730)
99c Only		0.116	(2.121)	3.468	(0.450)	3.110	(0.291)	2.386	(0.193)
Dollar General		–	–	–	–	–	–	–	–
Dollar Tree		0.531	(4.527)	3.918	(2.206)	3.643	(1.931)	3.237	(1.967)
Family Dollar		-5.138	(6.707)	-0.424	(3.158)	-0.478	(2.490)	-1.477	(2.085)
Random Coefficients	σ_k								
Warehouse Stores		0.107	(1.461)	0.000	(1.001)	0.000	(0.719)	0.079	(0.215)
Traditional Stores		0.834	(1.747)	1.338	(1.162)	0.210	(0.887)	0.031	(0.208)
Discount Stores		2.464	(2.179)	0.000	(0.889)	0.000	(0.439)	0.000	(0.384)
Supercenters		0.287	(2.054)	2.723	(1.596)	1.712	(1.096)	0.302	(0.896)
Dollar Stores		2.305	(1.806)	0.635	(1.002)	1.298	(0.860)	1.219	(0.586)
Summary									
Log Likelihood		-40994.4		-202795.2		-429117.9		-1632569.7	
Number of Visits		17,995		88,803		185,858		714,861	
Number of Devices		1,608		6,487		12,894		54,179	
First Stage Partial R^2		23.2%		18.6%		15.9%		8.3%	
First Stage Partial F-stat		102.3		308.9		493.8		914.6	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.17: San Francisco-Oakland-Fremont, CA Metro Area — Endo. Time (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.131	(0.052)	-0.096	(0.031)	-0.172	(0.033)	-0.083	(0.016)
Density	β^{d2}	1.617	(0.488)	0.691	(0.221)	0.799	(0.146)	0.145	(0.073)
Fringe	ω	2.940	(1.089)	2.436	(0.466)	1.480	(0.291)	0.833	(0.079)
Control Function	ρ	-0.010	(0.051)	-0.006	(0.023)	0.097	(0.031)	0.012	(0.011)
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		3.087	(2.409)	4.269	(1.518)	4.241	(2.028)	1.974	(1.519)
Sam's Club		2.745	(4.032)	1.501	(1.853)	1.827	(4.398)	-2.546	(2.521)
Bloomingdale's		2.494	(2.207)	2.785	(1.678)	3.460	(2.439)	2.629	(2.528)
Dillard's		–	–	–	–	–	–	–	–
JC Penney		5.648	(4.125)	3.987	(1.846)	3.782	(1.164)	1.344	(1.274)
Kohl's		4.795	(2.052)	3.560	(1.554)	3.572	(1.326)	1.593	(1.337)
Macy's		5.451	(2.540)	4.232	(1.641)	3.907	(4.302)	2.115	(1.823)
Neiman Marcus		3.613	(3.099)	3.272	(2.255)	3.767	(2.906)	1.754	(2.201)
Nordstrom		5.767	(2.721)	3.758	(1.985)	3.699	(1.353)	2.060	(2.222)
Saks Fifth Avenue		3.021	(3.522)	2.261	(1.937)	2.229	(1.638)	-0.136	(2.313)
Sears		3.250	(3.059)	2.673	(1.531)	2.451	(4.352)	-0.097	(2.467)
Burlington		3.023	(2.682)	2.405	(3.384)	3.675	(2.345)	-1.205	(1.751)
Citi Trends		2.137	(6.022)	0.293	(1.331)	2.244	(2.081)	-3.760	(2.085)
Five Below		–	–	–	–	–	–	–	–
Marshalls		1.292	(2.961)	0.600	(1.952)	2.662	(1.910)	-3.309	(1.634)
Ross Dress for Less		4.807	(3.010)	3.540	(2.488)	4.342	(1.446)	0.030	(1.367)
T.J. Maxx		1.504	(4.543)	1.103	(1.964)	3.443	(1.824)	-1.822	(2.276)
Big Lots		-3.945	(4.759)	-0.571	(2.441)	-3.031	(1.412)	-1.884	(2.254)
Target		4.588	(2.995)	4.673	(2.232)	2.013	(1.624)	2.722	(2.285)
Walmart		3.931	(4.745)	4.678	(2.229)	3.027	(1.916)	2.001	(2.959)
99c Only		-1.664	(3.437)	2.711	(2.050)	0.434	(2.696)	1.328	(1.125)
Dollar General		-3.551	(7.625)	-1.753	(2.885)	-2.704	(1.916)	-2.226	(2.034)
Dollar Tree		1.502	(2.481)	3.204	(3.042)	2.630	(3.294)	2.285	(1.192)
Family Dollar		–	–	–	–	–	–	–	–
Random Coefficients	σ_k								
Warehouse Stores		0.000	(1.232)	0.492	(1.096)	0.000	(0.790)	0.000	(0.988)
Traditional Stores		4.574	(1.589)	2.476	(1.601)	4.480	(1.081)	2.116	(1.215)
Discount Stores		6.000	(1.468)	2.761	(1.586)	3.158	(1.327)	0.388	(0.329)
Supercenters		2.643	(1.095)	2.884	(1.213)	0.000	(1.174)	3.455	(1.589)
Dollar Stores		6.000	(0.317)	3.224	(1.474)	3.134	(1.223)	4.308	(0.749)
Summary									
Log Likelihood		-19683.6		-116111.0		-205663.3		-1844193.7	
Number of Visits		8,646		50,335		88,163		803,110	
Number of Devices		1,025		4,930		7,726		68,205	
First Stage Partial R^2		26.4%		18.2%		16.6%		9.8%	
First Stage Partial F-stat		65.4		181.3		250.3		1201.9	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.18: Seattle-Tacoma-Bellevue, WA Metro Area — Endo. Time (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.269	(0.070)	-0.201	(0.022)	-0.146	(0.010)	-0.216	(0.005)
Density	β^{d2}	-0.219	(0.290)	0.011	(0.108)	-0.178	(0.055)	0.096	(0.024)
Fringe	ω	1.236	(0.469)	0.854	(0.128)	0.835	(0.059)	0.895	(0.026)
Control Function	ρ	0.183	(0.067)	0.128	(0.020)	0.096	(0.011)	0.134	(0.005)
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		4.780	(1.719)	3.770	(1.562)	3.132	(2.036)	2.456	(0.355)
Sam's Club		–	–	–	–	–	–	–	–
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		–	–	–	–	–	–	–	–
JC Penney		-0.241	(2.485)	1.963	(0.496)	1.268	(1.526)	2.467	(0.428)
Kohl's		-1.086	(3.479)	1.532	(0.539)	0.925	(0.350)	2.040	(0.424)
Macy's		1.300	(2.331)	2.170	(0.580)	1.458	(0.398)	3.182	(0.358)
Neiman Marcus		–	–	–	–	–	–	–	–
Nordstrom		0.125	(3.185)	2.276	(0.618)	1.569	(0.809)	3.581	(0.534)
Saks Fifth Avenue		–	–	–	–	–	–	–	–
Sears		-1.304	(5.065)	1.116	(0.992)	0.114	(0.754)	2.104	(0.785)
Burlington		2.667	(7.124)	2.349	(0.832)	1.323	(0.794)	2.646	(0.450)
Citi Trends		–	–	–	–	–	–	–	–
Five Below		–	–	–	–	–	–	–	–
Marshalls		2.014	(4.560)	1.134	(0.754)	0.645	(0.484)	2.150	(0.549)
Ross Dress for Less		3.211	(3.651)	2.360	(0.758)	1.505	(0.587)	2.801	(0.532)
T.J. Maxx		2.558	(3.775)	1.317	(1.243)	0.754	(0.888)	2.002	(0.850)
Big Lots		3.558	(1.796)	2.060	(0.562)	0.741	(0.440)	1.823	(0.183)
Target		4.935	(2.400)	2.922	(0.878)	2.372	(1.249)	3.603	(0.725)
Walmart		6.318	(3.217)	4.113	(1.495)	3.278	(1.240)	3.897	(0.855)
99c Only		–	–	–	–	–	–	–	–
Dollar General		–	–	–	–	–	–	–	–
Dollar Tree		1.664	(1.903)	-1.819	(1.570)	-3.013	(1.746)	0.860	(0.437)
Family Dollar		–	–	–	–	–	–	–	–
Random Coefficients	σ_k								
Warehouse Stores		3.630	(2.142)	0.000	(0.391)	0.156	(0.199)	0.145	(0.408)
Traditional Stores		0.099	(1.505)	0.024	(0.423)	0.022	(0.068)	0.091	(0.086)
Discount Stores		5.271	(1.399)	6.000	(0.271)	6.000	(0.000)	3.101	(0.312)
Supercenters		1.548	(1.802)	0.000	(0.455)	0.110	(0.567)	0.000	(0.050)
Dollar Stores		1.832	(1.871)	0.000	(1.022)	0.000	(0.621)	4.607	(0.381)
Summary									
Log Likelihood		-24485.9		-149461.3		-435019.3		-1714052.3	
Number of Visits		12,453		77,469		223,113		861,409	
Number of Devices		1,303		6,703		16,137		64,033	
First Stage Partial R^2		8.2%		6.6%		8.1%		8.9%	
First Stage Partial F-stat		27.2		102.3		302.4		1305.0	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.19: Tampa-St. Petersburg-Clearwater, FL Metro Area — Endo. Time (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.090	(0.016)	-0.131	(0.012)	-0.142	(0.009)	-0.192	(0.020)
Density	β^{d2}	0.842	(0.093)	0.808	(0.074)	0.837	(0.050)	0.691	(0.050)
Fringe	ω	0.762	(0.130)	0.963	(0.075)	1.193	(0.055)	1.847	(0.106)
Control Function	ρ	-0.009	(0.016)	0.039	(0.010)	0.054	(0.008)	0.102	(0.015)
Chain Preferences									
BJ's Wholesale Club		1.019	(3.260)	2.436	(0.428)	3.279	(0.525)	6.120	(0.762)
Costco		1.226	(3.895)	3.167	(1.994)	4.038	(1.909)	7.281	(1.957)
Sam's Club		1.845	(3.840)	3.295	(2.663)	4.044	(2.771)	6.532	(2.898)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		-1.463	(3.790)	-3.534	(2.128)	-2.630	(2.132)	1.152	(1.498)
JC Penney		-0.252	(2.503)	-2.636	(2.833)	-2.377	(2.244)	-0.908	(2.085)
Kohl's		-0.358	(4.155)	-1.260	(2.004)	-0.532	(1.715)	1.867	(1.413)
Macy's		-0.130	(4.361)	-1.639	(2.165)	-0.981	(2.180)	1.866	(2.291)
Neiman Marcus		-2.431	(5.251)	-5.323	(3.372)	-5.061	(3.605)	-0.688	(3.342)
Nordstrom		-1.343	(3.831)	-4.634	(3.205)	-4.118	(3.266)	0.633	(2.374)
Saks Fifth Avenue		–	–	–	–	–	–	–	–
Sears		-3.699	(5.455)	-5.463	(3.481)	-5.329	(3.765)	-2.741	(3.639)
Burlington		1.106	(4.626)	2.198	(1.315)	2.918	(1.850)	5.259	(1.361)
Citi Trends		0.640	(4.905)	1.071	(1.100)	1.084	(1.682)	3.585	(1.910)
Five Below		-2.043	(2.512)	-1.414	(2.334)	-0.460	(1.909)	1.589	(1.632)
Marshalls		0.788	(3.827)	1.793	(2.742)	2.590	(2.926)	5.003	(2.044)
Ross Dress for Less		1.041	(5.538)	2.096	(2.094)	2.986	(2.311)	5.656	(2.500)
T.J. Maxx		0.563	(4.146)	1.530	(2.281)	2.404	(2.848)	5.677	(2.190)
Big Lots		-3.193	(1.778)	-2.335	(0.852)	0.297	(0.542)	3.115	(0.449)
Target		-0.229	(3.349)	0.426	(2.643)	2.928	(2.894)	5.431	(2.256)
Walmart		3.287	(3.420)	4.083	(2.450)	4.752	(3.228)	6.271	(2.664)
99c Only		–	–	–	–	–	–	–	–
Dollar General		1.168	(0.560)	0.862	(1.416)	1.692	(1.974)	0.751	(1.843)
Dollar Tree		1.771	(2.799)	2.334	(1.512)	3.222	(1.754)	4.371	(1.397)
Family Dollar		0.794	(1.857)	0.681	(1.694)	1.736	(1.684)	1.142	(1.378)
Random Coefficients	σ_k								
Warehouse Stores		1.636	(1.904)	3.354	(1.503)	3.471	(0.900)	3.761	(0.855)
Traditional Stores		3.093	(1.032)	3.072	(0.533)	1.952	(0.393)	2.316	(0.426)
Discount Stores		1.790	(0.773)	2.216	(0.422)	1.813	(0.287)	3.326	(0.592)
Supercenters		0.000	(0.597)	0.158	(0.464)	0.023	(0.392)	0.000	(0.359)
Dollar Stores		0.836	(0.694)	0.000	(0.460)	0.000	(0.342)	0.000	(0.901)
Summary									
Log Likelihood		-138194.3		-972982.0		-1422893.4		-955355.7	
Number of Visits		67,770		456,269		642,900		403,343	
Number of Devices		5,978		33,858		43,222		29,075	
First Stage Partial R^2		12.4%		9.3%		7.1%		11.0%	
First Stage Partial F-stat		141.5		593.4		581.7		687.0	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.20: Washington-Arlington-Alexandria, DC-VA-MD-WV Metro Area — Endo. Time (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.214	(0.045)	-0.258	(0.028)	-0.327	(0.012)	-0.272	(0.014)
Density	β^{d2}	0.909	(0.340)	0.194	(0.058)	0.014	(0.032)	0.287	(0.033)
Fringe	ω	3.742	(4.104)	2.158	(0.247)	1.895	(0.054)	1.773	(0.040)
Control Function	ρ	0.077	(0.034)	0.150	(0.020)	0.216	(0.010)	0.097	(0.011)
Chain Preferences									
BJ's Wholesale Club		4.270	(6.760)	6.327	(1.182)	4.991	(1.661)	4.020	(1.933)
Costco		5.747	(7.099)	7.160	(0.988)	6.017	(1.012)	6.610	(0.775)
Sam's Club		4.482	(7.370)	6.792	(1.367)	4.577	(1.768)	3.487	(2.141)
Bloomingdale's		7.686	(6.472)	9.451	(1.436)	10.431	(1.326)	7.563	(1.959)
Dillard's		–	–	–	–	–	–	–	–
JC Penney		5.890	(5.704)	6.421	(0.590)	7.531	(0.964)	4.863	(0.946)
Kohl's		7.223	(5.510)	7.346	(1.163)	8.137	(0.899)	4.969	(1.076)
Macy's		7.414	(6.213)	7.461	(0.701)	8.282	(0.700)	5.757	(1.384)
Neiman Marcus		6.035	(7.632)	7.244	(1.269)	7.766	(0.544)	5.879	(1.303)
Nordstrom		6.500	(6.129)	7.012	(1.082)	7.635	(0.655)	5.745	(1.616)
Saks Fifth Avenue		3.852	(6.584)	5.953	(1.220)	7.656	(1.415)	5.000	(2.034)
Sears		3.932	(6.625)	5.099	(1.635)	6.166	(1.568)	2.936	(1.927)
Burlington		7.848	(6.073)	7.422	(1.248)	8.256	(1.059)	7.716	(0.627)
Citi Trends		9.988	(6.392)	8.673	(1.384)	9.191	(1.711)	8.356	(2.528)
Five Below		5.886	(6.472)	5.611	(0.624)	6.600	(0.920)	6.256	(1.377)
Marshalls		7.875	(6.022)	7.186	(0.899)	7.474	(0.555)	6.989	(0.890)
Ross Dress for Less		8.078	(6.470)	7.000	(1.103)	7.550	(0.679)	6.737	(1.869)
T.J. Maxx		7.850	(7.049)	7.352	(1.585)	8.099	(1.472)	7.302	(1.878)
Big Lots		5.074	(6.229)	5.752	(0.841)	5.609	(1.239)	5.193	(0.835)
Target		7.963	(6.628)	7.736	(1.328)	7.979	(1.139)	7.508	(1.511)
Walmart		9.639	(6.635)	8.754	(0.935)	9.058	(1.343)	7.389	(2.041)
99c Only		–	–	–	–	–	–	–	–
Dollar General		6.381	(6.661)	6.969	(1.151)	7.618	(1.369)	5.855	(0.824)
Dollar Tree		8.153	(6.309)	7.986	(1.068)	8.515	(0.723)	7.371	(0.867)
Family Dollar		8.186	(6.608)	7.728	(0.681)	8.134	(1.807)	5.757	(1.272)
Random Coefficients	σ_k								
Warehouse Stores		1.632	(1.260)	0.000	(0.535)	0.002	(0.290)	2.533	(0.477)
Traditional Stores		2.330	(0.998)	1.162	(0.368)	1.742	(0.179)	2.601	(0.206)
Discount Stores		2.205	(0.922)	0.000	(0.394)	0.000	(0.261)	1.797	(0.260)
Supercenters		0.891	(1.271)	0.000	(0.684)	0.065	(0.131)	0.263	(0.120)
Dollar Stores		3.843	(1.214)	1.717	(0.469)	3.529	(0.357)	3.773	(0.351)
Summary									
Log Likelihood		-45585.8		-304555.9		-746125.1		-2173942.9	
Number of Visits		20,202		135,194		328,955		928,953	
Number of Devices		2,310		13,760		31,978		94,399	
First Stage Partial R^2		17.3%		11.9%		8.6%		9.5%	
First Stage Partial F-stat		81.5		287.3		442.9		1534.1	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.21: Atlanta-Sandy Springs-Alpharetta, GA Metro Area — Exogenous Time

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.066	(0.006)	-0.064	(0.003)	-0.071	(0.003)	-0.082	(0.006)
Density	β^{d2}	0.164	(0.058)	0.175	(0.026)	0.132	(0.020)	-0.158	(0.021)
Fringe	ω	0.763	(0.114)	0.567	(0.035)	0.661	(0.029)	0.600	(0.024)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		0.614	(1.281)	0.461	(2.294)	0.499	(1.452)	-0.501	(0.573)
Costco		0.899	(1.596)	0.926	(1.456)	1.441	(3.579)	1.463	(1.280)
Sam's Club		1.443	(4.696)	1.310	(2.146)	1.350	(3.805)	0.412	(2.303)
Bloomingdale's		-2.367	(5.471)	-2.765	(1.853)	-5.348	(2.517)	0.591	(2.176)
Dillard's		-2.316	(5.163)	-1.213	(1.359)	-4.392	(3.298)	0.571	(0.809)
JC Penney		-1.256	(1.528)	-1.060	(1.246)	-3.889	(2.142)	-0.050	(0.892)
Kohl's		-1.137	(1.891)	-0.559	(1.316)	-3.476	(1.939)	1.245	(1.295)
Macy's		0.043	(2.350)	-0.152	(1.212)	-4.147	(2.627)	1.475	(1.308)
Neiman Marcus		-3.467	(3.865)	-2.230	(1.758)	-4.263	(2.270)	0.136	(2.991)
Nordstrom		-1.958	(3.585)	-1.868	(2.332)	-4.299	(3.433)	1.030	(1.592)
Saks Fifth Avenue		-0.845	(4.011)	-0.255	(2.083)	-3.062	(3.129)	2.221	(4.537)
Sears		-6.679	(5.200)	-4.826	(2.610)	-9.443	(3.508)	-5.690	(2.665)
Burlington		-0.400	(1.308)	0.415	(1.148)	0.299	(1.240)	-0.040	(1.199)
Citi Trends		0.491	(1.300)	0.816	(1.055)	0.858	(2.159)	0.489	(0.817)
Five Below		-3.252	(1.701)	-2.127	(1.321)	-1.779	(2.229)	-1.918	(0.631)
Marshalls		-1.612	(3.411)	-0.544	(2.126)	0.177	(1.909)	1.302	(1.108)
Ross Dress for Less		-0.115	(7.139)	0.615	(2.554)	0.896	(2.679)	1.263	(1.469)
T.J. Maxx		-1.494	(4.500)	-0.072	(2.512)	0.471	(3.184)	0.990	(2.073)
Big Lots		-8.703	(2.907)	-3.398	(1.091)	-1.980	(0.813)	-0.936	(0.553)
Target		-4.491	(5.064)	-1.080	(2.284)	0.241	(2.964)	2.059	(2.386)
Walmart		2.723	(5.681)	2.831	(2.633)	2.612	(2.719)	2.508	(1.490)
99c Only		–	–	–	–	–	–	–	–
Dollar General		1.440	(1.921)	0.987	(1.439)	0.866	(2.109)	0.018	(1.007)
Dollar Tree		1.858	(1.464)	1.515	(1.516)	1.629	(2.061)	1.930	(1.312)
Family Dollar		1.352	(1.863)	0.757	(1.795)	0.449	(2.171)	-0.501	(1.147)
Random Coefficients	σ_k								
Warehouse Stores		1.763	(0.952)	1.333	(0.859)	3.528	(1.006)	0.000	(0.901)
Traditional Stores		5.018	(0.842)	2.558	(0.267)	2.042	(0.247)	0.998	(0.348)
Discount Stores		0.000	(0.458)	0.000	(0.123)	0.000	(0.266)	0.000	(0.509)
Supercenters		1.816	(0.775)	0.612	(0.800)	0.000	(0.656)	0.140	(0.085)
Dollar Stores		0.695	(0.406)	0.469	(0.230)	0.518	(0.347)	1.626	(0.391)
Summary									
Log Likelihood		-184408.5		-1455119.0		-2851246.8		-2402578.2	
Number of Visits		93,187		710,037		1,356,299		1,081,661	
Number of Devices		9,257		58,953		101,608		88,523	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.22: Boston-Cambridge-Newton, MA-NH Metro Area — Exogenous Time

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.133	(0.053)	-0.114	(0.018)	-0.097	(0.009)	-0.121	(0.015)
Density	β^{d2}	0.019	(1.075)	0.241	(0.133)	0.335	(0.084)	0.739	(0.106)
Fringe	ω	0.611	(11.158)	1.146	(0.138)	1.313	(0.078)	0.936	(0.075)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		3.323	(5.174)	2.811	(0.901)	3.007	(0.718)	4.023	(0.680)
Costco		0.773	(5.153)	1.996	(1.111)	2.450	(0.836)	4.205	(0.889)
Sam's Club		-32.664	(16.960)	-32.631	(13.442)	-3.298	(3.349)	-2.952	(13.643)
Bloomingdale's		3.115	(6.039)	0.490	(1.225)	0.927	(2.404)	1.739	(0.799)
Dillard's		–	–	–	–	–	–	–	–
JC Penney		4.077	(4.989)	-0.011	(8.576)	1.068	(1.105)	-0.164	(3.102)
Kohl's		3.566	(4.814)	-0.252	(1.949)	1.392	(1.235)	0.789	(1.451)
Macy's		4.999	(4.887)	0.771	(1.578)	1.497	(1.142)	0.976	(1.106)
Neiman Marcus		3.947	(4.677)	0.029	(2.270)	1.226	(1.739)	-0.073	(1.585)
Nordstrom		3.453	(4.720)	-1.548	(2.783)	0.301	(2.118)	0.641	(1.676)
Saks Fifth Avenue		3.575	(5.098)	-0.913	(2.442)	0.305	(2.379)	-0.250	(1.977)
Sears		3.567	(4.764)	-1.305	(2.646)	0.655	(1.663)	-1.361	(2.173)
Burlington		3.977	(4.537)	3.021	(1.251)	2.198	(0.689)	1.646	(0.979)
Citi Trends		3.797	(20.560)	2.480	(4.418)	1.857	(11.176)	0.183	(6.626)
Five Below		2.618	(5.004)	2.418	(2.091)	2.034	(0.956)	2.569	(2.022)
Marshalls		4.858	(4.843)	3.411	(1.955)	3.204	(1.499)	2.674	(1.257)
Ross Dress for Less		–	–	–	–	–	–	–	–
T.J. Maxx		4.734	(5.103)	2.858	(2.543)	2.685	(1.693)	2.677	(1.602)
Big Lots		1.584	(4.332)	1.781	(0.759)	2.166	(0.887)	1.437	(1.384)
Target		5.260	(5.658)	3.950	(4.156)	4.248	(1.775)	4.301	(2.572)
Walmart		6.077	(5.755)	4.833	(4.975)	4.641	(2.628)	4.174	(2.803)
99c Only		–	–	–	–	–	–	–	–
Dollar General		0.335	(5.363)	0.796	(4.881)	1.673	(0.897)	1.998	(3.237)
Dollar Tree		3.357	(6.165)	3.265	(2.280)	3.628	(2.385)	4.041	(1.465)
Family Dollar		1.659	(4.887)	2.608	(2.364)	3.010	(2.270)	2.574	(1.677)
Random Coefficients	σ_k								
Warehouse Stores		0.375	(1.739)	2.991	(0.928)	2.133	(0.518)	2.882	(0.575)
Traditional Stores		0.000	(1.461)	1.128	(0.660)	0.253	(0.506)	1.078	(0.581)
Discount Stores		3.079	(1.181)	1.637	(0.702)	0.614	(0.513)	0.000	(0.518)
Supercenters		0.492	(1.662)	0.092	(0.654)	0.565	(0.431)	1.535	(0.908)
Dollar Stores		2.697	(1.533)	2.005	(0.865)	1.506	(0.826)	0.000	(0.890)
Summary									
Log Likelihood		-17682.8		-165124.1		-491298.7		-1502840.7	
Number of Visits		8,440		78,649		232,927		655,870	
Number of Devices		1,028		8,203		23,474		73,247	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.23: Chicago-Naperville-Elgin, IL-IN-WI Metro Area — Exogenous Time

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.089	(0.011)	-0.099	(0.005)	-0.089	(0.006)	-0.083	(0.008)
Density	β^{d2}	0.298	(0.061)	0.066	(0.024)	0.082	(0.026)	0.022	(0.021)
Fringe	ω	0.044	(0.113)	0.180	(0.040)	0.339	(0.031)	0.082	(0.030)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		0.756	(1.060)	-0.148	(0.905)	1.963	(1.104)	1.278	(1.248)
Sam's Club		0.773	(2.772)	-0.714	(3.798)	1.347	(3.018)	-0.184	(1.859)
Bloomingdale's		-4.355	(3.344)	-3.477	(2.796)	-4.282	(2.392)	-0.673	(0.828)
Dillard's		–	–	–	–	–	–	–	–
JC Penney		-2.708	(1.196)	-2.630	(1.490)	-3.000	(1.792)	-0.366	(1.169)
Kohl's		-2.143	(1.574)	-1.882	(1.716)	-1.582	(3.260)	0.702	(0.837)
Macy's		-4.362	(2.259)	-4.179	(2.912)	-1.474	(2.440)	0.605	(0.888)
Neiman Marcus		-6.893	(2.695)	-6.554	(4.064)	-5.965	(3.445)	-0.506	(0.985)
Nordstrom		-4.662	(2.467)	-4.447	(3.319)	-4.024	(3.936)	0.379	(1.320)
Saks Fifth Avenue		-7.983	(2.398)	-7.668	(3.803)	-7.082	(3.900)	-2.189	(1.521)
Sears		-7.484	(3.281)	-5.998	(2.956)	-4.250	(3.181)	-1.866	(1.502)
Burlington		1.127	(1.450)	0.210	(2.110)	0.353	(0.602)	-0.296	(1.050)
Citi Trends		1.173	(0.527)	0.231	(0.455)	0.129	(0.761)	-1.276	(0.953)
Five Below		-1.497	(1.363)	-2.406	(1.840)	-1.946	(1.496)	-2.769	(1.099)
Marshalls		0.341	(1.401)	-0.378	(2.104)	-0.339	(3.109)	-0.958	(0.750)
Ross Dress for Less		1.538	(3.096)	0.788	(3.120)	0.847	(3.757)	0.423	(1.713)
T.J. Maxx		0.258	(2.189)	-0.322	(3.929)	0.796	(3.731)	0.561	(1.744)
Big Lots		-5.313	(3.143)	-3.748	(2.491)	-2.755	(1.826)	-3.120	(1.487)
Target		-0.534	(2.195)	0.583	(3.391)	1.618	(4.371)	1.668	(1.571)
Walmart		2.402	(3.855)	2.424	(2.766)	2.351	(2.957)	1.463	(1.318)
99c Only		–	–	–	–	–	–	–	–
Dollar General		0.400	(1.006)	0.655	(1.071)	0.417	(1.677)	-1.067	(1.362)
Dollar Tree		1.853	(1.156)	1.917	(1.525)	1.758	(1.887)	1.080	(1.211)
Family Dollar		1.316	(1.443)	1.234	(1.882)	0.594	(1.730)	-0.824	(1.177)
Random Coefficients	σ_k								
Warehouse Stores		3.100	(1.153)	3.217	(0.635)	2.987	(0.642)	0.000	(0.791)
Traditional Stores		3.102	(0.860)	2.450	(0.377)	1.558	(0.316)	0.893	(0.551)
Discount Stores		1.168	(0.742)	0.338	(0.423)	0.000	(0.440)	0.219	(0.515)
Supercenters		0.381	(0.631)	1.261	(0.433)	0.610	(0.319)	0.012	(0.319)
Dollar Stores		1.354	(1.322)	2.468	(0.834)	0.000	(0.888)	1.177	(0.486)
Summary									
Log Likelihood		-473052.6		-1955190.2		-2934341.4		-2743289.0	
Number of Visits		205,727		861,493		1,292,806		1,182,540	
Number of Devices		16,692		67,570		96,771		91,510	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.24: Dallas-Fort Worth-Arlington, TX Metro Area — Exogenous Time

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.091	(0.008)	-0.101	(0.009)	-0.101	(0.007)	-0.118	(0.009)
Density	β^{d2}	0.802	(0.083)	0.646	(0.051)	0.630	(0.037)	0.304	(0.023)
Fringe	ω	0.887	(0.091)	0.719	(0.054)	0.613	(0.045)	-0.038	(0.034)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		2.172	(4.945)	1.054	(1.016)	0.845	(1.915)	1.190	(1.853)
Sam's Club		3.034	(1.931)	1.429	(2.030)	0.596	(2.100)	0.118	(0.823)
Bloomingdale's		-8.476	(3.688)	-5.954	(3.391)	-5.149	(1.031)	-1.063	(1.830)
Dillard's		-5.222	(3.878)	-4.461	(2.003)	-2.267	(1.439)	0.755	(0.779)
JC Penney		-3.178	(2.303)	-3.808	(1.854)	-2.442	(1.141)	0.104	(1.225)
Kohl's		-4.575	(3.480)	-1.765	(1.306)	-1.484	(1.136)	0.806	(1.321)
Macy's		-3.422	(3.401)	-3.116	(1.949)	-1.863	(0.927)	0.824	(0.996)
Neiman Marcus		-3.530	(4.387)	-3.800	(2.010)	-1.238	(2.671)	2.246	(2.596)
Nordstrom		-3.576	(4.631)	-4.055	(3.264)	-2.250	(2.103)	1.368	(1.735)
Saks Fifth Avenue		–	–	–	–	–	–	–	–
Sears		-8.236	(4.620)	-7.661	(3.578)	-5.710	(2.944)	-4.317	(2.730)
Burlington		1.511	(4.198)	1.262	(2.403)	0.667	(1.178)	0.212	(1.689)
Citi Trends		1.907	(3.361)	1.250	(1.020)	0.138	(1.390)	-1.262	(2.358)
Five Below		-0.765	(3.979)	-1.017	(1.275)	-1.468	(1.717)	-2.067	(1.052)
Marshalls		1.411	(2.850)	1.163	(1.175)	0.742	(2.435)	0.453	(1.147)
Ross Dress for Less		1.885	(1.495)	1.653	(2.220)	1.261	(1.051)	0.522	(1.205)
T.J. Maxx		1.051	(3.941)	1.081	(2.742)	0.606	(1.327)	0.787	(1.330)
Big Lots		-2.333	(3.301)	-3.310	(2.373)	-3.568	(1.188)	-3.669	(0.835)
Target		0.999	(2.368)	0.438	(2.704)	1.367	(1.040)	1.446	(1.465)
Walmart		5.160	(2.411)	4.673	(2.569)	4.547	(0.826)	2.747	(0.718)
99c Only		-1.216	(3.223)	-1.357	(1.859)	-3.974	(1.225)	-4.561	(0.927)
Dollar General		1.005	(4.109)	0.058	(1.526)	-0.791	(1.435)	-2.105	(0.962)
Dollar Tree		1.348	(4.185)	1.061	(0.844)	0.228	(0.895)	-0.306	(0.962)
Family Dollar		1.095	(1.696)	0.553	(1.179)	-1.225	(0.872)	-3.013	(1.165)
Random Coefficients	σ_k								
Warehouse Stores		4.000	(1.265)	3.687	(1.156)	3.036	(0.819)	0.000	(0.550)
Traditional Stores		2.465	(0.483)	3.014	(0.540)	2.729	(0.441)	2.151	(0.402)
Discount Stores		2.371	(0.572)	2.171	(0.610)	2.950	(0.641)	2.556	(0.406)
Supercenters		0.000	(0.305)	0.505	(0.337)	0.822	(0.269)	0.000	(0.398)
Dollar Stores		0.000	(0.979)	2.180	(0.869)	2.959	(0.674)	2.173	(0.694)
Summary									
Log Likelihood		-469218.8		-2527018.3		-3085663.2		-2567765.7	
Number of Visits		246,951		1,264,309		1,525,077		1,184,965	
Number of Devices		20,453		91,652		105,444		92,991	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.25: Denver-Aurora-Lakewood, CO Metro Area — Exogenous Time

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.107	(0.035)	-0.136	(0.013)	-0.127	(0.013)	-0.140	(0.011)
Density	β^{d2}	1.227	(0.472)	1.823	(0.237)	1.211	(0.196)	1.941	(0.190)
Fringe	ω	2.172	(4.285)	2.026	(0.371)	1.866	(0.290)	2.426	(0.129)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		5.907	(3.399)	5.340	(1.196)	6.265	(0.927)	7.475	(1.537)
Sam's Club		5.748	(10.176)	4.967	(1.795)	5.515	(1.756)	5.438	(2.027)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		4.404	(14.699)	2.600	(1.391)	4.159	(1.645)	0.385	(2.268)
JC Penney		4.592	(3.602)	4.226	(1.074)	4.818	(0.857)	0.804	(1.456)
Kohl's		5.697	(3.863)	4.123	(1.398)	5.199	(1.457)	2.826	(1.456)
Macy's		4.748	(3.105)	2.408	(1.720)	3.998	(1.426)	0.473	(2.034)
Neiman Marcus		2.211	(15.507)	1.398	(3.157)	0.987	(2.350)	-1.641	(2.013)
Nordstrom		5.396	(3.434)	3.895	(3.173)	4.951	(0.976)	3.478	(2.329)
Saks Fifth Avenue		–	–	–	–	–	–	–	–
Sears		-27.433	(7.984)	0.205	(2.630)	2.555	(2.649)	-1.689	(4.998)
Burlington		5.570	(3.713)	5.230	(1.066)	4.771	(0.778)	6.055	(1.282)
Citi Trends		–	–	–	–	–	–	–	–
Five Below		2.894	(5.279)	1.778	(1.465)	1.698	(1.393)	2.108	(1.930)
Marshalls		4.800	(3.090)	4.607	(2.296)	4.920	(1.670)	4.902	(3.181)
Ross Dress for Less		6.225	(5.381)	5.894	(1.396)	5.536	(1.844)	5.438	(2.904)
T.J. Maxx		4.960	(5.719)	4.663	(2.072)	4.502	(2.103)	5.432	(4.326)
Big Lots		4.182	(3.757)	-1.688	(1.974)	-0.603	(1.463)	1.753	(1.068)
Target		7.017	(4.061)	4.093	(2.249)	4.728	(1.959)	7.145	(2.662)
Walmart		8.791	(10.594)	8.249	(3.403)	7.887	(3.092)	7.389	(5.044)
99c Only		–	–	–	–	–	–	–	–
Dollar General		4.425	(3.384)	1.881	(2.014)	1.347	(2.434)	-1.294	(4.219)
Dollar Tree		7.344	(3.892)	6.067	(1.077)	5.881	(0.922)	4.665	(3.444)
Family Dollar		7.300	(3.531)	5.333	(1.737)	4.725	(1.490)	1.060	(3.704)
Random Coefficients	σ_k								
Warehouse Stores		1.112	(1.160)	1.849	(0.818)	1.058	(1.018)	3.910	(0.653)
Traditional Stores		1.780	(1.922)	4.114	(0.926)	3.519	(0.644)	2.330	(0.554)
Discount Stores		0.261	(1.567)	1.664	(0.723)	1.674	(0.617)	3.316	(1.161)
Supercenters		1.042	(1.730)	0.174	(0.609)	0.468	(0.464)	0.163	(0.347)
Dollar Stores		2.231	(1.589)	2.767	(0.920)	1.807	(0.878)	2.193	(0.412)
Summary									
Log Likelihood		-23947.4		-167773.1		-442213.3		-1266623.0	
Number of Visits		12,067		81,710		211,583		579,658	
Number of Devices		1,240		7,880		19,150		48,538	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.26: Detroit-Warren-Dearborn, MI Metro Area — Exogenous Time

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.078	(0.018)	-0.092	(0.017)	-0.132	(0.017)	-0.108	(0.009)
Density	β^{d2}	-0.109	(0.093)	0.096	(0.051)	0.207	(0.036)	0.377	(0.045)
Fringe	ω	0.475	(0.141)	0.489	(0.094)	0.761	(0.107)	-0.254	(0.059)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		-3.407	(2.763)	-1.440	(1.659)	-1.794	(1.726)	-2.815	(1.498)
Costco		-0.935	(1.394)	0.177	(2.298)	1.071	(2.354)	0.799	(1.914)
Sam's Club		-0.868	(2.072)	-0.046	(1.460)	0.157	(2.009)	-0.274	(2.375)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		–	–	–	–	–	–	–	–
JC Penney		-1.391	(1.623)	-1.071	(0.943)	-2.069	(1.077)	-4.928	(1.296)
Kohl's		-0.978	(3.414)	-0.640	(1.420)	-1.140	(1.213)	-2.772	(1.332)
Macy's		-1.837	(3.251)	-1.431	(1.736)	-2.637	(1.770)	-2.247	(1.112)
Neiman Marcus		-3.982	(3.371)	-3.717	(2.051)	-5.187	(1.568)	-5.542	(2.026)
Nordstrom		-1.577	(3.390)	-1.518	(2.118)	-3.063	(2.133)	-3.106	(1.638)
Saks Fifth Avenue		-2.573	(3.592)	-2.199	(2.263)	-3.467	(1.812)	-3.042	(2.003)
Sears		-3.365	(4.091)	-3.032	(2.771)	-6.065	(2.577)	-6.534	(2.103)
Burlington		0.331	(2.328)	0.350	(0.756)	1.652	(1.658)	-0.391	(1.686)
Citi Trends		-0.192	(1.026)	-0.358	(1.102)	0.199	(2.647)	-2.379	(1.919)
Five Below		-1.433	(1.143)	-1.582	(1.019)	-0.900	(1.088)	-3.328	(0.904)
Marshalls		-0.307	(2.607)	-0.369	(1.322)	0.588	(1.227)	-1.516	(1.454)
Ross Dress for Less		–	–	–	–	–	–	–	–
T.J. Maxx		-0.660	(3.817)	-0.534	(1.810)	0.718	(2.213)	-0.613	(1.962)
Big Lots		-1.974	(1.677)	-1.671	(1.396)	-3.132	(1.283)	-7.561	(1.838)
Target		0.267	(4.118)	0.692	(1.901)	1.079	(1.989)	-0.139	(1.869)
Walmart		1.516	(4.411)	1.497	(2.225)	1.480	(2.310)	-1.681	(1.597)
99c Only		–	–	–	–	–	–	–	–
Dollar General		-0.786	(1.063)	-0.920	(1.138)	-3.088	(2.589)	-6.147	(1.919)
Dollar Tree		0.857	(1.816)	0.762	(1.434)	0.161	(1.796)	-1.024	(1.177)
Family Dollar		0.002	(1.106)	-0.285	(1.102)	-2.507	(1.716)	-3.950	(1.032)
Random Coefficients	σ_k								
Warehouse Stores		1.687	(1.847)	1.685	(1.273)	3.196	(0.864)	3.304	(0.528)
Traditional Stores		1.272	(1.212)	1.045	(0.883)	2.304	(0.608)	3.162	(0.635)
Discount Stores		1.255	(0.962)	1.234	(0.769)	3.108	(0.847)	2.664	(0.562)
Supercenters		0.000	(0.303)	0.000	(0.180)	0.000	(0.249)	0.301	(0.338)
Dollar Stores		1.965	(1.232)	1.455	(1.098)	2.414	(1.211)	1.397	(0.607)
Summary									
Log Likelihood		-264891.4		-1279228.5		-1782828.0		-1143994.8	
Number of Visits		114,880		568,898		813,913		514,811	
Number of Devices		9,783		44,575		59,254		40,336	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.27: Houston-The Woodlands-Sugar Land, TX Metro Area — Exogenous Time

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.083	(0.006)	-0.092	(0.008)	-0.092	(0.010)	-0.100	(0.014)
Density	β^{d2}	0.895	(0.069)	0.669	(0.065)	0.511	(0.068)	0.262	(0.062)
Fringe	ω	1.313	(0.082)	1.334	(0.053)	1.294	(0.060)	1.292	(0.099)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		-2.127	(2.864)	0.029	(1.426)	2.953	(2.013)	3.835	(2.172)
Sam's Club		-0.467	(2.989)	1.306	(2.070)	2.981	(3.073)	2.217	(2.228)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		-2.189	(3.457)	-1.878	(2.473)	1.122	(2.038)	-0.782	(2.006)
JC Penney		-1.077	(1.296)	-1.664	(2.439)	0.455	(3.120)	-3.281	(2.943)
Kohl's		-1.212	(1.271)	-0.450	(2.075)	0.706	(3.337)	0.277	(1.860)
Macy's		-0.970	(3.862)	-0.528	(2.411)	2.142	(2.716)	0.272	(2.285)
Neiman Marcus		-1.797	(2.955)	-0.547	(2.513)	0.843	(3.206)	1.248	(1.261)
Nordstrom		-2.740	(3.699)	-3.886	(3.627)	-0.762	(3.785)	-1.484	(2.719)
Saks Fifth Avenue		-1.114	(2.903)	-0.932	(3.036)	2.087	(2.457)	0.865	(1.960)
Sears		-1.821	(2.883)	-1.809	(1.988)	-0.350	(3.604)	-2.095	(2.715)
Burlington		3.034	(2.867)	3.536	(0.710)	4.000	(0.949)	4.801	(1.342)
Citi Trends		2.097	(1.498)	2.457	(1.061)	2.442	(4.447)	2.063	(1.373)
Five Below		1.146	(3.143)	2.187	(1.805)	3.301	(2.080)	4.307	(2.140)
Marshalls		2.554	(1.796)	3.462	(2.659)	4.109	(3.434)	5.107	(1.878)
Ross Dress for Less		2.952	(2.037)	3.907	(3.007)	4.712	(5.235)	5.640	(1.999)
T.J. Maxx		1.710	(2.503)	2.586	(3.115)	3.512	(3.057)	4.458	(2.126)
Big Lots		-1.015	(2.503)	0.585	(1.141)	0.912	(1.385)	1.145	(1.910)
Target		1.502	(2.481)	2.918	(3.108)	4.017	(3.714)	5.058	(2.117)
Walmart		5.959	(2.357)	6.168	(2.865)	6.250	(2.694)	6.058	(2.360)
99c Only		1.502	(0.921)	2.103	(0.594)	1.517	(0.520)	0.394	(0.886)
Dollar General		2.390	(0.953)	2.422	(1.074)	2.011	(3.271)	0.330	(3.005)
Dollar Tree		3.210	(1.474)	3.880	(1.088)	4.202	(1.761)	4.196	(1.588)
Family Dollar		2.798	(2.656)	2.844	(1.183)	2.491	(1.561)	0.832	(1.851)
Random Coefficients	σ_k								
Warehouse Stores		3.329	(1.285)	3.805	(1.264)	2.767	(1.243)	4.341	(1.246)
Traditional Stores		2.282	(0.480)	2.043	(0.337)	1.801	(0.402)	1.787	(0.686)
Discount Stores		1.533	(0.461)	1.515	(0.411)	1.694	(0.388)	2.435	(0.843)
Supercenters		0.976	(0.499)	0.947	(0.618)	0.568	(0.597)	0.000	(0.804)
Dollar Stores		4.446	(0.863)	3.943	(0.531)	2.654	(0.467)	3.265	(0.818)
Summary									
Log Likelihood		-628790.3		-2288452.5		-2400373.7		-1869023.7	
Number of Visits		300,006		1,042,665		1,078,704		788,704	
Number of Devices		25,023		75,329		74,979		62,243	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.28: Miami-Fort Lauderdale-Pompano Beach, FL Metro Area — Exogenous Time

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.139	(0.011)	-0.119	(0.004)	-0.094	(0.004)	-0.088	(0.003)
Density	β^{d2}	0.482	(0.111)	0.117	(0.037)	-0.106	(0.024)	-0.256	(0.016)
Fringe	ω	0.971	(0.150)	0.673	(0.062)	0.756	(0.048)	0.749	(0.045)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		2.274	(0.847)	1.835	(0.338)	2.239	(0.355)	2.272	(0.453)
Costco		2.538	(3.066)	2.003	(1.387)	2.535	(1.307)	3.034	(2.131)
Sam's Club		2.240	(2.470)	1.404	(1.605)	1.691	(0.818)	1.687	(0.814)
Bloomingdale's		-1.801	(2.189)	1.084	(0.887)	2.393	(0.236)	3.203	(0.625)
Dillard's		-8.634	(4.010)	0.202	(1.240)	0.488	(1.272)	0.807	(1.901)
JC Penney		-3.076	(2.305)	-0.246	(0.834)	1.594	(0.491)	1.327	(0.538)
Kohl's		-6.130	(3.481)	-0.121	(1.023)	1.063	(0.747)	1.384	(0.486)
Macy's		-3.396	(2.919)	0.542	(1.488)	1.949	(0.714)	2.282	(0.531)
Neiman Marcus		-8.231	(4.406)	-1.832	(1.580)	0.304	(1.082)	1.346	(0.874)
Nordstrom		-8.009	(4.234)	-1.766	(2.476)	0.512	(1.219)	1.877	(0.879)
Saks Fifth Avenue		-3.529	(2.753)	0.336	(1.329)	1.334	(0.823)	2.190	(0.984)
Sears		-1.546	(2.256)	-1.811	(1.645)	-0.305	(1.006)	-0.070	(1.024)
Burlington		2.651	(0.897)	1.552	(0.580)	2.088	(0.509)	1.867	(0.610)
Citi Trends		2.115	(1.805)	1.746	(0.939)	2.306	(1.097)	1.727	(1.219)
Five Below		-0.462	(2.245)	-0.983	(0.901)	0.229	(0.742)	0.479	(0.589)
Marshalls		1.399	(2.923)	1.067	(1.121)	1.768	(0.873)	2.266	(0.735)
Ross Dress for Less		2.886	(2.092)	2.222	(2.463)	3.055	(1.216)	3.264	(0.816)
T.J. Maxx		1.709	(2.243)	1.136	(1.386)	2.063	(1.066)	2.801	(1.058)
Big Lots		-4.188	(1.896)	-2.784	(1.102)	-0.957	(1.185)	0.853	(0.640)
Target		-1.948	(2.859)	-1.111	(1.790)	1.089	(1.064)	3.202	(1.169)
Walmart		2.883	(2.502)	2.412	(1.638)	2.803	(0.873)	3.342	(0.806)
99c Only		–	–	–	–	–	–	–	–
Dollar General		-1.392	(2.423)	-1.502	(1.716)	0.047	(1.459)	-0.586	(1.852)
Dollar Tree		2.336	(1.365)	2.606	(1.662)	3.229	(1.111)	3.395	(1.401)
Family Dollar		0.930	(1.497)	1.226	(1.003)	1.619	(0.676)	0.623	(0.593)
Random Coefficients	σ_k								
Warehouse Stores		4.529	(1.575)	1.619	(0.946)	0.290	(0.313)	0.000	(0.049)
Traditional Stores		4.166	(0.946)	3.249	(0.438)	2.094	(0.451)	0.547	(0.368)
Discount Stores		3.246	(0.787)	2.118	(0.231)	1.391	(0.331)	1.516	(0.328)
Supercenters		0.977	(0.584)	1.081	(0.406)	0.284	(0.252)	0.169	(0.080)
Dollar Stores		0.000	(0.320)	0.512	(0.254)	0.000	(0.068)	0.000	(0.426)
Summary									
Log Likelihood		-238639.2		-1470392.0		-2274353.1		-3292770.7	
Number of Visits		99,832		602,570		908,939		1,299,438	
Number of Devices		7,744		38,650		56,260		84,592	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.29: Minneapolis-St. Paul-Bloomington, MN-WI Metro Area — Exogenous Time

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.120	(0.042)	-0.120	(0.018)	-0.103	(0.017)	-0.112	(0.022)
Density	β^{d2}	0.257	(0.260)	0.278	(0.103)	-0.009	(0.064)	-0.368	(0.262)
Fringe	ω	2.767	(3.940)	3.778	(0.416)	2.990	(0.135)	2.128	(0.163)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		7.143	(4.729)	7.413	(1.246)	6.595	(1.029)	5.686	(3.559)
Sam's Club		7.502	(5.429)	7.637	(1.756)	6.226	(2.488)	4.754	(3.137)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		–	–	–	–	–	–	–	–
JC Penney		6.404	(5.263)	5.112	(2.239)	2.409	(1.388)	0.568	(4.748)
Kohl's		7.091	(5.046)	5.748	(1.815)	3.839	(1.767)	2.340	(3.914)
Macy's		7.585	(6.385)	6.350	(2.123)	3.809	(2.126)	2.363	(4.433)
Neiman Marcus		–	–	–	–	–	–	–	–
Nordstrom		6.781	(4.802)	4.922	(2.190)	2.219	(2.475)	2.237	(3.073)
Saks Fifth Avenue		4.385	(5.128)	2.080	(2.350)	-0.723	(2.602)	-1.674	(4.683)
Sears		–	–	–	–	–	–	–	–
Burlington		6.767	(5.004)	7.276	(1.733)	4.796	(1.149)	-5.669	(3.235)
Citi Trends		6.859	(5.425)	7.516	(1.338)	4.868	(2.235)	-9.379	(4.281)
Five Below		5.162	(5.159)	6.025	(1.646)	4.351	(1.802)	-5.830	(3.211)
Marshalls		6.302	(5.049)	7.089	(3.196)	4.738	(2.034)	-5.771	(3.102)
Ross Dress for Less		–	–	–	–	–	–	–	–
T.J. Maxx		5.142	(5.128)	6.631	(2.064)	4.782	(2.034)	-11.764	(5.140)
Big Lots		3.688	(4.916)	5.549	(3.007)	3.339	(2.170)	-0.680	(2.791)
Target		8.474	(5.148)	9.479	(1.000)	7.885	(3.473)	6.426	(3.181)
Walmart		8.739	(4.867)	9.543	(1.475)	7.569	(2.528)	5.086	(3.377)
99c Only		–	–	–	–	–	–	–	–
Dollar General		4.437	(5.058)	5.211	(1.271)	4.179	(3.032)	-0.901	(3.889)
Dollar Tree		7.102	(4.830)	7.661	(0.741)	6.046	(1.290)	3.086	(3.099)
Family Dollar		4.834	(4.649)	5.658	(1.712)	4.189	(1.414)	-0.522	(4.733)
Random Coefficients	σ_k								
Warehouse Stores		0.000	(1.680)	2.346	(1.154)	2.608	(1.035)	2.845	(1.406)
Traditional Stores		0.989	(1.186)	0.878	(0.569)	0.000	(0.462)	1.513	(0.525)
Discount Stores		1.736	(1.021)	1.893	(0.360)	1.123	(0.413)	2.712	(1.277)
Supercenters		0.365	(1.418)	0.000	(0.748)	0.944	(0.922)	6.000	(1.163)
Dollar Stores		0.386	(1.475)	1.616	(0.970)	0.937	(0.801)	0.000	(0.723)
Summary									
Log Likelihood		-45876.6		-467407.1		-970301.7		-1011779.1	
Number of Visits		23,823		251,022		555,788		554,001	
Number of Devices		2,610		23,069		48,781		44,690	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.30: Philadelphia-Camden-Wilmington, PA-NJ-DE-MD Metro Area — Exogenous Time

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.128	(0.026)	-0.106	(0.006)	-0.111	(0.004)	-0.117	(0.004)
Density	β^{d2}	0.112	(0.143)	-0.072	(0.042)	-0.165	(0.035)	-0.133	(0.032)
Fringe	ω	1.011	(0.261)	0.937	(0.058)	0.890	(0.038)	1.017	(0.035)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		3.367	(1.011)	2.848	(0.976)	2.656	(1.857)	3.711	(0.510)
Costco		3.332	(2.996)	2.867	(0.806)	3.032	(1.923)	4.257	(1.694)
Sam's Club		3.325	(2.142)	2.807	(1.053)	2.674	(1.485)	3.392	(1.459)
Bloomingdale's		0.388	(1.707)	1.521	(0.576)	-0.054	(1.522)	1.188	(1.728)
Dillard's		–	–	–	–	–	–	–	–
JC Penney		-0.484	(2.877)	1.542	(1.297)	0.362	(1.960)	0.782	(0.809)
Kohl's		0.305	(1.645)	2.150	(0.692)	1.459	(0.947)	1.848	(1.155)
Macy's		0.197	(2.091)	1.928	(1.603)	0.472	(1.230)	1.776	(1.368)
Neiman Marcus		-1.973	(2.793)	-0.152	(1.139)	-0.820	(1.428)	0.150	(1.441)
Nordstrom		-1.691	(2.237)	0.602	(1.202)	-0.807	(1.803)	1.734	(1.518)
Saks Fifth Avenue		-3.999	(2.923)	-1.920	(2.152)	-2.412	(1.392)	-0.786	(1.502)
Sears		0.695	(2.229)	2.255	(1.224)	1.224	(1.755)	1.662	(1.845)
Burlington		3.360	(0.770)	2.919	(0.683)	2.662	(1.184)	3.203	(1.046)
Citi Trends		2.726	(0.941)	1.757	(0.886)	1.146	(0.633)	1.429	(1.032)
Five Below		2.182	(1.439)	1.262	(1.102)	1.071	(0.775)	1.944	(1.219)
Marshalls		3.824	(1.829)	2.887	(0.907)	2.895	(1.206)	3.485	(1.270)
Ross Dress for Less		3.389	(2.759)	2.789	(1.622)	2.669	(1.066)	2.723	(1.434)
T.J. Maxx		3.518	(2.867)	2.866	(1.815)	3.115	(1.487)	4.220	(1.937)
Big Lots		-1.353	(2.234)	0.882	(1.160)	1.354	(1.252)	1.361	(0.359)
Target		1.902	(2.842)	2.908	(1.507)	3.656	(1.392)	4.581	(1.753)
Walmart		4.328	(2.009)	4.236	(1.039)	4.239	(1.289)	4.365	(1.594)
99c Only		–	–	–	–	–	–	–	–
Dollar General		2.379	(1.072)	1.403	(0.543)	1.203	(0.376)	1.105	(1.263)
Dollar Tree		4.411	(1.460)	3.801	(0.462)	3.827	(0.474)	4.062	(1.383)
Family Dollar		3.166	(1.528)	2.068	(0.833)	1.272	(1.160)	0.646	(1.360)
Random Coefficients	σ_k								
Warehouse Stores		2.788	(1.222)	1.304	(0.734)	2.211	(0.349)	2.229	(0.289)
Traditional Stores		2.907	(1.091)	1.211	(0.232)	0.689	(0.263)	0.000	(0.347)
Discount Stores		1.378	(1.081)	1.354	(0.201)	1.440	(0.126)	1.459	(0.159)
Supercenters		0.000	(0.977)	0.000	(0.480)	0.252	(0.231)	0.000	(0.073)
Dollar Stores		0.782	(0.946)	0.530	(0.413)	0.981	(0.303)	0.000	(0.663)
Summary									
Log Likelihood		-106087.6		-954765.3		-1880973.8		-1935879.4	
Number of Visits		46,479		415,276		822,687		826,258	
Number of Devices		4,136		31,572		62,024		69,946	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.31: Phoenix-Mesa-Chandler, AZ Metro Area — Endogeous Distance

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.064	(0.016)	-0.080	(0.008)	-0.090	(0.011)	-0.086	(0.012)
Density	β^{d2}	-0.580	(0.231)	-0.141	(0.078)	-0.252	(0.062)	-0.440	(0.057)
Fringe	ω	0.669	(0.183)	0.638	(0.114)	0.429	(0.098)	0.274	(0.137)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		2.201	(0.937)	2.330	(0.779)	3.188	(0.686)	4.216	(0.887)
Sam's Club		1.756	(2.348)	1.158	(1.704)	1.769	(1.827)	2.574	(2.475)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		0.332	(0.802)	1.021	(0.476)	1.568	(0.860)	1.959	(1.225)
JC Penney		1.153	(1.778)	1.589	(0.494)	1.951	(0.767)	1.634	(1.414)
Kohl's		1.254	(2.046)	1.986	(0.888)	2.476	(1.060)	2.445	(1.253)
Macy's		1.376	(1.518)	1.672	(1.171)	2.076	(0.846)	2.619	(1.013)
Neiman Marcus		-1.450	(3.045)	-1.047	(1.290)	-0.376	(1.209)	1.338	(1.925)
Nordstrom		-0.376	(2.472)	0.673	(1.647)	1.259	(1.779)	2.593	(1.640)
Saks Fifth Avenue		-1.545	(2.528)	-0.599	(1.455)	-0.440	(1.702)	0.773	(2.331)
Sears		-2.293	(2.964)	-1.233	(1.543)	-0.910	(1.449)	-1.207	(2.241)
Burlington		0.722	(1.521)	-0.203	(0.908)	-0.029	(0.825)	1.083	(0.746)
Citi Trends		–	–	–	–	–	–	–	–
Five Below		-1.668	(2.574)	-2.562	(1.495)	-1.874	(0.939)	-0.089	(0.696)
Marshalls		0.179	(2.364)	-0.808	(1.152)	-0.018	(1.280)	2.120	(1.251)
Ross Dress for Less		3.236	(2.690)	2.011	(1.391)	2.123	(1.505)	3.247	(1.816)
T.J. Maxx		0.205	(2.179)	0.544	(2.421)	1.313	(2.452)	2.263	(2.376)
Big Lots		0.529	(1.272)	-0.373	(1.213)	-0.098	(0.748)	1.097	(0.560)
Target		2.504	(2.566)	1.869	(2.274)	2.591	(2.595)	3.931	(2.369)
Walmart		4.204	(2.302)	4.288	(1.465)	4.446	(1.683)	4.503	(2.140)
99c Only		1.863	(1.938)	2.150	(0.346)	2.265	(0.330)	2.109	(0.389)
Dollar General		0.809	(0.585)	0.576	(0.838)	0.472	(0.900)	-0.918	(1.674)
Dollar Tree		2.372	(1.485)	2.725	(0.561)	3.204	(0.881)	3.285	(1.605)
Family Dollar		1.490	(2.100)	1.443	(1.286)	0.836	(0.877)	-0.632	(0.830)
Random Coefficients	σ_k								
Warehouse Stores		0.000	(1.098)	0.000	(0.560)	0.432	(0.988)	0.910	(1.003)
Traditional Stores		0.000	(1.189)	1.611	(0.688)	1.707	(0.569)	0.731	(0.506)
Discount Stores		0.000	(0.525)	0.076	(0.484)	0.000	(0.627)	0.711	(0.669)
Supercenters		0.000	(1.625)	1.680	(0.881)	1.636	(0.908)	0.000	(0.503)
Dollar Stores		0.000	(1.464)	1.709	(0.894)	1.577	(0.471)	1.079	(0.331)
Summary									
Log Likelihood		-94364.4		-574825.2		-819472.8		-662618.6	
Number of Visits		48,832		280,940		395,217		304,300	
Number of Devices		5,514		28,582		41,826		43,907	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.32: Riverside-San Bernardino-Ontario, CA Metro Area — Exogenous Time

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.069	(0.017)	-0.068	(0.004)	-0.071	(0.005)	-0.059	(0.003)
Density	β^{d2}	-0.037	(0.113)	0.056	(0.039)	0.062	(0.032)	0.161	(0.022)
Fringe	ω	1.810	(0.216)	1.671	(0.074)	1.460	(0.058)	1.387	(0.053)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		4.494	(3.456)	3.967	(0.932)	4.213	(1.282)	5.088	(1.440)
Sam's Club		3.966	(1.332)	3.032	(1.462)	3.652	(1.500)	4.478	(1.492)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		–	–	–	–	–	–	–	–
JC Penney		2.976	(1.406)	3.011	(0.881)	3.169	(2.034)	2.764	(0.924)
Kohl's		3.340	(1.189)	3.308	(0.901)	3.605	(1.586)	3.701	(0.518)
Macy's		2.893	(4.471)	2.999	(0.612)	3.222	(1.165)	3.169	(0.618)
Neiman Marcus		-1.057	(10.323)	0.391	(1.735)	0.630	(1.795)	0.499	(1.443)
Nordstrom		3.390	(4.266)	3.162	(1.196)	3.603	(1.982)	3.397	(1.208)
Saks Fifth Avenue		-0.185	(5.727)	0.284	(0.794)	1.134	(1.053)	2.739	(1.085)
Sears		1.719	(10.695)	1.226	(1.370)	1.162	(1.351)	1.339	(1.949)
Burlington		3.191	(0.879)	2.707	(0.446)	2.926	(1.847)	2.044	(0.593)
Citi Trends		2.938	(9.225)	1.792	(1.836)	1.692	(1.904)	0.173	(0.980)
Five Below		1.891	(1.304)	1.177	(0.761)	1.559	(1.642)	0.343	(1.228)
Marshalls		3.052	(1.064)	2.442	(0.803)	3.479	(0.996)	3.135	(1.122)
Ross Dress for Less		3.339	(1.239)	3.054	(1.142)	3.428	(1.475)	2.411	(1.087)
T.J. Maxx		2.464	(3.769)	2.379	(1.757)	2.930	(1.465)	2.545	(1.779)
Big Lots		2.244	(0.735)	2.130	(0.283)	2.296	(0.461)	2.124	(0.243)
Target		4.672	(4.601)	4.721	(1.410)	4.879	(1.807)	5.160	(1.689)
Walmart		5.771	(3.378)	5.571	(1.671)	5.405	(1.554)	5.233	(1.693)
99c Only		4.015	(0.455)	3.664	(0.307)	3.451	(0.316)	3.432	(0.160)
Dollar General		2.767	(1.264)	1.939	(1.022)	1.444	(2.102)	0.613	(1.818)
Dollar Tree		4.115	(1.512)	3.784	(1.060)	3.732	(1.274)	4.005	(1.569)
Family Dollar		2.507	(4.098)	1.924	(1.048)	1.514	(1.829)	1.191	(1.363)
Random Coefficients	σ_k								
Warehouse Stores		0.000	(1.116)	0.577	(0.517)	0.000	(0.179)	0.765	(0.368)
Traditional Stores		0.029	(0.948)	0.154	(0.192)	0.055	(0.277)	0.009	(0.117)
Discount Stores		0.816	(0.919)	1.006	(0.417)	1.048	(0.474)	0.818	(0.224)
Supercenters		0.511	(1.003)	1.047	(0.555)	0.000	(1.282)	1.418	(0.604)
Dollar Stores		0.033	(1.702)	1.435	(0.811)	1.275	(0.773)	0.034	(0.179)
Summary									
Log Likelihood		-79342.0		-570544.6		-1126495.7		-1772998.5	
Number of Visits		38,267		260,377		494,715		747,639	
Number of Devices		4,007		23,002		39,944		56,428	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.33: St. Louis, MO-IL Metro Area — Exogenous Time

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.093	(0.023)	-0.086	(0.011)	-0.093	(0.015)	-0.085	(0.013)
Density	β^{d2}	-0.322	(0.114)	-0.372	(0.055)	-0.487	(0.069)	-0.516	(0.095)
Fringe	ω	5.931	(5.261)	3.699	(1.245)	3.570	(0.277)	1.966	(0.145)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		8.563	(5.499)	6.168	(2.163)	6.718	(2.545)	4.117	(1.790)
Sam's Club		9.340	(4.098)	6.931	(3.266)	7.025	(3.956)	4.368	(2.070)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		-2.490	(5.681)	2.038	(2.692)	0.470	(3.456)	3.160	(1.393)
JC Penney		-0.071	(6.296)	3.591	(2.308)	2.445	(1.842)	3.548	(1.260)
Kohl's		0.478	(3.449)	4.250	(2.673)	3.528	(2.720)	4.475	(1.565)
Macy's		0.411	(5.856)	4.208	(2.419)	1.129	(2.921)	4.189	(1.257)
Neiman Marcus		-4.727	(6.210)	1.139	(3.265)	-0.063	(4.071)	3.116	(1.456)
Nordstrom		-1.200	(6.140)	2.788	(3.753)	1.689	(4.166)	4.408	(1.811)
Saks Fifth Avenue		-2.747	(6.283)	0.135	(3.971)	-0.304	(3.522)	3.372	(1.806)
Sears		-7.530	(6.210)	0.781	(3.434)	-0.369	(3.593)	1.045	(2.374)
Burlington		7.649	(5.509)	5.633	(2.441)	4.720	(1.431)	2.217	(1.251)
Citi Trends		6.770	(1.907)	4.606	(3.756)	3.077	(3.854)	-0.268	(2.546)
Five Below		6.242	(3.162)	4.413	(2.033)	3.960	(2.169)	1.699	(1.286)
Marshalls		6.607	(2.959)	4.717	(2.878)	4.114	(2.680)	2.268	(1.499)
Ross Dress for Less		8.285	(3.898)	6.548	(3.448)	6.089	(3.537)	4.032	(1.990)
T.J. Maxx		8.190	(5.776)	6.535	(3.992)	6.270	(4.357)	4.513	(2.146)
Big Lots		7.463	(1.675)	5.197	(3.064)	3.840	(0.577)	1.788	(0.926)
Target		9.362	(5.364)	7.769	(3.940)	7.207	(4.421)	5.644	(2.022)
Walmart		10.946	(4.383)	9.014	(2.118)	8.094	(4.520)	5.980	(2.408)
99c Only		–	–	–	–	–	–	–	–
Dollar General		7.642	(2.395)	6.431	(1.410)	4.772	(2.564)	1.817	(2.077)
Dollar Tree		8.127	(5.580)	7.204	(1.664)	6.255	(2.406)	5.193	(2.093)
Family Dollar		7.822	(3.707)	6.489	(2.305)	4.179	(2.727)	1.738	(1.276)
Random Coefficients	σ_k								
Warehouse Stores		5.461	(1.051)	2.573	(0.859)	3.164	(1.011)	0.149	(1.215)
Traditional Stores		0.199	(0.855)	0.074	(0.553)	0.613	(0.655)	0.000	(0.594)
Discount Stores		1.972	(0.948)	0.960	(0.701)	1.521	(0.675)	1.597	(0.518)
Supercenters		0.694	(1.090)	0.463	(0.815)	0.000	(1.118)	0.018	(0.909)
Dollar Stores		0.000	(1.264)	1.347	(0.780)	0.000	(0.875)	1.657	(0.829)
Summary									
Log Likelihood		-193471.8		-892034.0		-1202498.4		-762038.4	
Number of Visits		111,263		511,689		640,355		364,876	
Number of Devices		10,446		40,353		45,028		25,214	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.34: San Diego-Chula Vista-Carlsbad, CA Metro Area — Exogenous Time

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.074	(0.027)	-0.078	(0.013)	-0.062	(0.009)	-0.054	(0.004)
Density	β^{d2}	-0.339	(0.386)	-0.406	(0.184)	-0.196	(0.107)	-0.031	(0.041)
Fringe	ω	0.409	(0.322)	1.095	(0.144)	0.920	(0.084)	0.920	(0.061)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		0.228	(2.896)	3.420	(1.053)	2.943	(1.225)	3.400	(1.357)
Sam's Club		-1.891	(5.296)	1.945	(2.506)	1.353	(2.434)	0.573	(1.890)
Bloomingdale's		1.763	(2.471)	3.393	(2.359)	2.660	(2.233)	2.843	(1.905)
Dillard's		–	–	–	–	–	–	–	–
JC Penney		0.634	(4.129)	2.419	(1.299)	1.693	(2.167)	1.503	(1.017)
Kohl's		0.623	(1.892)	2.559	(1.136)	1.864	(1.458)	2.065	(0.702)
Macy's		0.883	(1.961)	2.696	(3.603)	1.973	(1.000)	1.979	(0.657)
Neiman Marcus		-0.673	(2.234)	1.258	(2.096)	0.034	(1.559)	-0.481	(1.720)
Nordstrom		0.495	(2.519)	2.237	(1.937)	1.507	(1.859)	1.822	(1.469)
Saks Fifth Avenue		-3.679	(5.494)	-1.832	(2.707)	-1.009	(2.476)	0.282	(2.098)
Sears		-2.807	(4.891)	-0.760	(2.056)	-1.375	(2.554)	-1.078	(1.792)
Burlington		0.431	(2.338)	-1.629	(2.597)	-0.846	(2.523)	0.684	(1.577)
Citi Trends		–	–	–	–	–	–	–	–
Five Below		-3.182	(7.659)	-4.523	(2.519)	-3.845	(2.623)	-2.810	(2.230)
Marshalls		0.187	(4.132)	-0.380	(1.578)	-1.067	(2.441)	1.839	(0.792)
Ross Dress for Less		1.773	(3.114)	0.667	(2.757)	1.519	(1.629)	2.423	(1.380)
T.J. Maxx		-0.251	(3.255)	-0.526	(3.053)	-0.335	(2.018)	1.517	(2.170)
Big Lots		-0.625	(1.877)	0.233	(1.247)	0.900	(0.788)	0.666	(0.288)
Target		1.825	(3.236)	3.577	(2.348)	3.495	(2.058)	3.620	(2.055)
Walmart		3.001	(5.057)	4.303	(2.829)	4.021	(2.850)	3.732	(2.735)
99c Only		0.119	(2.125)	3.106	(0.391)	2.398	(0.280)	1.839	(0.161)
Dollar General		–	–	–	–	–	–	–	–
Dollar Tree		0.532	(4.498)	3.557	(2.065)	2.936	(1.943)	2.709	(1.971)
Family Dollar		-5.123	(7.121)	-0.832	(3.185)	-1.260	(2.947)	-2.155	(2.152)
Random Coefficients	σ_k								
Warehouse Stores		0.109	(1.352)	0.000	(0.593)	0.000	(0.515)	0.091	(0.210)
Traditional Stores		0.850	(1.674)	1.599	(0.967)	0.263	(0.912)	0.024	(0.235)
Discount Stores		2.452	(2.203)	0.000	(0.682)	0.000	(0.369)	0.000	(0.318)
Supercenters		0.284	(2.036)	2.804	(1.575)	1.953	(1.057)	0.300	(0.913)
Dollar Stores		2.330	(1.745)	0.834	(0.902)	1.050	(0.838)	1.149	(0.581)
Summary									
Log Likelihood		-40994.4		-202845.7		-429375.7		-1632786.3	
Number of Visits		17,995		88,803		185,858		714,861	
Number of Devices		1,608		6,487		12,894		54,179	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.35: San Francisco-Oakland-Fremont, CA Metro Area — Exogenous Time

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.138	(0.032)	-0.102	(0.025)	-0.075	(0.018)	-0.071	(0.011)
Density	β^{d2}	1.609	(0.483)	0.693	(0.231)	0.752	(0.161)	0.138	(0.076)
Fringe	ω	2.937	(1.473)	2.432	(0.480)	1.374	(0.302)	0.836	(0.082)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		3.176	(2.851)	4.342	(1.526)	3.179	(1.839)	1.870	(1.480)
Sam's Club		2.821	(4.504)	1.572	(1.855)	1.450	(4.296)	-2.494	(2.369)
Bloomingdale's		2.624	(2.605)	2.874	(1.680)	1.845	(2.388)	2.440	(2.444)
Dillard's		–	–	–	–	–	–	–	–
JC Penney		5.759	(3.943)	4.058	(1.859)	2.320	(1.143)	1.173	(1.277)
Kohl's		4.919	(2.574)	3.632	(1.562)	2.009	(1.430)	1.415	(1.310)
Macy's		5.571	(2.982)	4.303	(1.635)	2.390	(4.491)	1.950	(1.773)
Neiman Marcus		3.747	(3.384)	3.367	(2.261)	1.957	(3.243)	1.538	(2.048)
Nordstrom		5.878	(3.013)	3.835	(2.041)	2.117	(1.426)	1.877	(2.149)
Saks Fifth Avenue		3.149	(3.575)	2.360	(1.949)	0.445	(1.440)	-0.354	(2.175)
Sears		3.349	(3.392)	2.735	(1.463)	1.104	(4.498)	-0.269	(2.400)
Burlington		3.151	(3.146)	2.509	(3.342)	2.207	(2.452)	-1.232	(1.667)
Citi Trends		2.234	(6.171)	0.414	(1.318)	0.931	(2.037)	-3.729	(1.888)
Five Below		–	–	–	–	–	–	–	–
Marshalls		1.433	(3.328)	0.710	(2.008)	1.151	(1.959)	-3.249	(1.587)
Ross Dress for Less		4.906	(3.316)	3.627	(2.537)	3.018	(1.407)	0.004	(1.369)
T.J. Maxx		1.670	(4.711)	1.229	(1.951)	1.794	(1.775)	-1.834	(2.187)
Big Lots		-3.630	(4.840)	-0.555	(2.434)	-1.133	(1.381)	-2.028	(2.280)
Target		4.738	(3.491)	4.713	(2.347)	2.361	(1.620)	2.568	(2.177)
Walmart		4.115	(5.206)	4.726	(2.322)	3.056	(1.911)	1.831	(2.818)
99c Only		-1.590	(3.738)	2.773	(2.075)	-3.860	(2.796)	1.164	(1.110)
Dollar General		-3.479	(9.361)	-1.691	(2.911)	-8.360	(2.185)	-2.396	(2.043)
Dollar Tree		1.571	(2.823)	3.261	(3.191)	-0.769	(2.781)	2.139	(1.168)
Family Dollar		–	–	–	–	–	–	–	–
Random Coefficients	σ_k								
Warehouse Stores		0.000	(1.252)	0.488	(1.159)	0.000	(0.942)	0.000	(1.009)
Traditional Stores		4.495	(1.389)	2.501	(1.623)	2.517	(1.359)	2.097	(1.244)
Discount Stores		6.000	(1.411)	2.756	(1.645)	5.014	(1.104)	0.392	(0.337)
Supercenters		2.625	(1.087)	2.853	(1.261)	0.000	(1.249)	3.335	(1.566)
Dollar Stores		6.000	(0.294)	3.215	(1.517)	2.278	(1.418)	4.151	(0.800)
Summary									
Log Likelihood		-19683.9		-116111.5		-205846.5		-1844222.5	
Number of Visits		8,646		50,335		88,163		803,110	
Number of Devices		1,025		4,930		7,726		68,205	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.36: Seattle-Tacoma-Bellevue, WA Metro Area — Endo. Time (Disc)

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.094	(0.027)	-0.086	(0.011)	-0.060	(0.005)	-0.097	(0.002)
Density	β^{d2}	-0.496	(0.224)	-0.279	(0.102)	-0.360	(0.049)	-0.097	(0.021)
Fringe	ω	1.049	(0.416)	0.688	(0.122)	0.720	(0.056)	0.677	(0.023)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		–	–	–	–	–	–	–	–
Costco		1.871	(1.344)	1.429	(1.490)	1.770	(2.046)	0.224	(0.517)
Sam's Club		–	–	–	–	–	–	–	–
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		–	–	–	–	–	–	–	–
JC Penney		-1.877	(2.038)	0.006	(0.646)	-0.267	(1.751)	0.169	(0.309)
Kohl's		-2.823	(3.140)	-0.343	(0.707)	-0.452	(0.320)	0.036	(0.398)
Macy's		-0.666	(2.022)	0.128	(0.772)	-0.140	(0.281)	0.809	(0.353)
Neiman Marcus		–	–	–	–	–	–	–	–
Nordstrom		-1.675	(2.746)	0.245	(0.720)	-0.067	(0.697)	1.295	(0.540)
Saks Fifth Avenue		–	–	–	–	–	–	–	–
Sears		-3.228	(4.436)	-1.146	(1.316)	-1.569	(0.757)	-0.481	(1.029)
Burlington		1.068	(6.311)	0.131	(0.791)	-0.359	(0.811)	0.095	(0.368)
Citi Trends		–	–	–	–	–	–	–	–
Five Below		–	–	–	–	–	–	–	–
Marshalls		0.304	(4.209)	-0.860	(0.968)	-0.811	(0.402)	-0.025	(0.621)
Ross Dress for Less		1.736	(3.425)	0.656	(0.963)	0.258	(0.562)	0.796	(0.577)
T.J. Maxx		0.561	(3.339)	-0.632	(1.408)	-0.696	(0.911)	-0.126	(0.915)
Big Lots		0.718	(1.268)	0.156	(0.540)	-0.636	(0.414)	-0.337	(0.117)
Target		2.451	(2.034)	1.244	(1.102)	1.130	(1.398)	1.717	(0.833)
Walmart		3.753	(2.832)	2.409	(1.831)	2.066	(1.231)	1.883	(1.076)
99c Only		–	–	–	–	–	–	–	–
Dollar General		–	–	–	–	–	–	–	–
Dollar Tree		-0.372	(1.547)	-3.404	(1.307)	-4.171	(1.576)	-1.848	(0.650)
Family Dollar		–	–	–	–	–	–	–	–
Random Coefficients	σ_k								
Warehouse Stores		3.028	(2.063)	0.000	(0.692)	0.312	(0.242)	0.098	(0.258)
Traditional Stores		0.002	(1.353)	0.120	(0.455)	0.022	(0.039)	0.086	(0.051)
Discount Stores		5.008	(1.366)	6.000	(0.239)	6.000	(0.000)	3.739	(0.336)
Supercenters		0.532	(1.567)	0.117	(0.514)	0.044	(0.239)	0.000	(0.051)
Dollar Stores		2.119	(1.754)	1.368	(1.088)	0.000	(0.793)	4.989	(0.290)
Summary									
Log Likelihood		-24549.5		-149844.1		-435899.3		-1720242.3	
Number of Visits		12,453		77,469		223,113		861,409	
Number of Devices		1,303		6,703		16,137		64,033	

Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.37: Tampa-St. Petersburg-Clearwater, FL Metro Area — Exogenous Time

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.096	(0.009)	-0.094	(0.005)	-0.091	(0.004)	-0.095	(0.005)
Density	β^{d2}	0.832	(0.094)	0.798	(0.070)	0.858	(0.049)	0.741	(0.047)
Fringe	ω	0.743	(0.125)	0.965	(0.074)	1.145	(0.055)	1.724	(0.088)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		1.162	(3.261)	1.808	(0.375)	2.312	(0.500)	4.034	(0.683)
Costco		1.376	(3.855)	2.457	(2.022)	2.958	(1.928)	4.999	(1.657)
Sam's Club		1.966	(3.761)	2.773	(2.725)	3.191	(2.851)	4.594	(2.814)
Bloomingdale's		–	–	–	–	–	–	–	–
Dillard's		0.324	(3.859)	-4.156	(2.125)	-3.702	(2.185)	-0.904	(1.535)
JC Penney		0.840	(2.520)	-3.239	(2.880)	-3.415	(2.316)	-2.885	(2.024)
Kohl's		0.730	(4.139)	-1.835	(2.041)	-1.476	(1.758)	0.019	(1.284)
Macy's		1.116	(4.383)	-2.246	(2.208)	-2.002	(2.248)	-0.148	(2.097)
Neiman Marcus		-1.211	(5.259)	-5.942	(3.426)	-6.154	(3.699)	-2.784	(3.298)
Nordstrom		-0.257	(3.813)	-5.225	(3.235)	-5.131	(3.285)	-1.365	(2.265)
Saks Fifth Avenue		–	–	–	–	–	–	–	–
Sears		-2.474	(5.476)	-6.051	(3.454)	-6.477	(3.780)	-5.054	(3.407)
Burlington		1.170	(4.658)	1.572	(1.290)	1.916	(1.858)	3.175	(1.205)
Citi Trends		0.681	(4.903)	0.521	(1.068)	0.085	(1.696)	1.331	(1.625)
Five Below		-1.976	(2.498)	-1.958	(2.371)	-1.315	(1.965)	-0.369	(1.454)
Marshalls		0.851	(3.844)	1.288	(2.833)	1.785	(2.947)	3.243	(1.679)
Ross Dress for Less		1.097	(5.518)	1.571	(2.108)	2.131	(2.342)	3.761	(2.321)
T.J. Maxx		0.628	(4.149)	0.983	(2.274)	1.520	(2.895)	3.752	(2.191)
Big Lots		-2.998	(1.824)	-2.836	(0.810)	-0.701	(0.513)	1.043	(0.426)
Target		-0.102	(3.308)	-0.090	(2.706)	2.019	(2.953)	3.656	(2.174)
Walmart		3.316	(3.396)	3.678	(2.471)	4.019	(3.260)	4.684	(2.430)
99c Only		–	–	–	–	–	–	–	–
Dollar General		1.359	(0.487)	0.213	(1.436)	0.908	(2.017)	-1.009	(1.762)
Dollar Tree		1.953	(2.838)	1.773	(1.546)	2.462	(1.797)	2.698	(1.470)
Family Dollar		1.078	(1.856)	-0.033	(1.714)	0.804	(1.700)	-0.886	(1.243)
Random Coefficients	σ_k								
Warehouse Stores		0.000	(1.924)	3.375	(1.539)	3.515	(0.982)	3.725	(0.830)
Traditional Stores		3.006	(1.046)	3.079	(0.472)	2.052	(0.340)	2.382	(0.341)
Discount Stores		1.556	(0.748)	2.413	(0.413)	1.865	(0.298)	3.295	(0.492)
Supercenters		0.000	(0.599)	0.200	(0.418)	0.055	(0.342)	0.000	(0.305)
Dollar Stores		0.731	(0.640)	0.000	(0.454)	0.000	(0.363)	0.000	(0.639)
Summary									
Log Likelihood		-138195.4		-973120.4		-1423244.8		-956346.0	
Number of Visits		67,770		456,269		642,900		403,343	
Number of Devices		5,978		33,858		43,222		29,075	

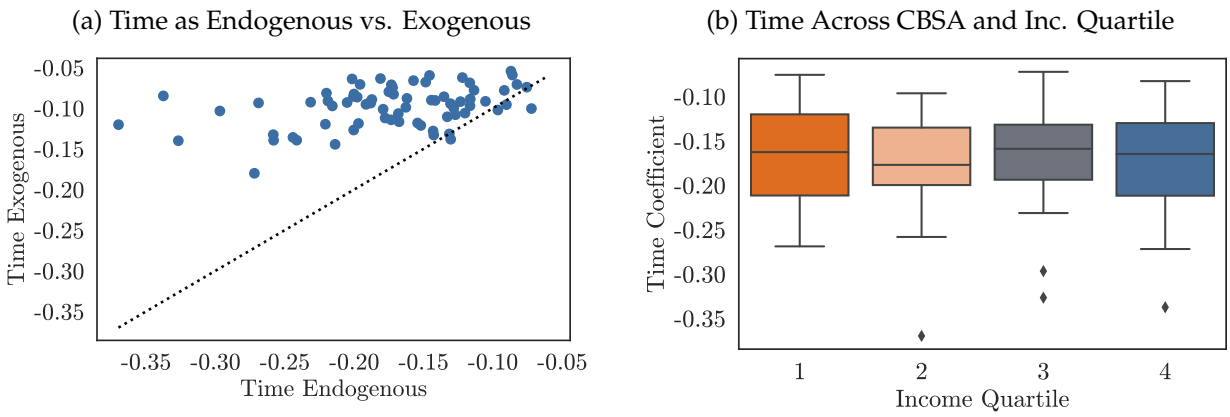
Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Table C.38: Washington-Arlington-Alexandria, DC-VA-MD-WV Metro Area — Exogenous Time

Income Quartile		Inc. 1	Inc. 1 SE	Inc. 2	Inc. 2 SE	Inc. 3	Inc. 3 SE	Inc 4.	Inc. 4 SE
Parameter									
Distance	β^{d1}	-0.145	(0.042)	-0.133	(0.008)	-0.140	(0.004)	-0.180	(0.007)
Density	β^{d2}	0.804	(0.390)	0.299	(0.051)	0.240	(0.031)	0.324	(0.028)
Fringe	ω	3.754	(4.957)	2.316	(0.255)	2.213	(0.055)	1.833	(0.043)
Control Function	ρ	–	–	–	–	–	–	–	–
Chain Preferences									
BJ's Wholesale Club		3.826	(7.762)	4.749	(1.156)	2.776	(1.567)	2.513	(1.888)
Costco		5.336	(8.034)	5.532	(0.882)	3.881	(0.995)	5.117	(0.796)
Sam's Club		4.069	(8.243)	5.142	(1.293)	2.348	(1.595)	1.895	(2.045)
Bloomingdale's		6.298	(7.665)	6.950	(1.313)	7.367	(1.042)	6.150	(1.918)
Dillard's		–	–	–	–	–	–	–	–
JC Penney		5.061	(6.697)	4.517	(0.627)	4.801	(1.001)	3.582	(0.781)
Kohl's		6.280	(6.536)	5.510	(0.865)	5.556	(0.844)	3.917	(0.895)
Macy's		6.475	(7.278)	5.617	(0.672)	5.683	(0.652)	4.610	(0.954)
Neiman Marcus		5.029	(8.607)	5.388	(1.315)	5.391	(0.544)	4.701	(1.081)
Nordstrom		5.700	(7.140)	4.914	(1.121)	4.711	(0.659)	4.571	(1.496)
Saks Fifth Avenue		3.201	(7.375)	3.929	(1.176)	4.716	(1.373)	3.774	(1.760)
Sears		2.699	(7.483)	2.832	(1.555)	3.189	(1.475)	1.567	(1.763)
Burlington		6.811	(7.091)	5.567	(1.123)	5.639	(0.894)	6.153	(0.566)
Citi Trends		8.528	(7.441)	6.408	(1.448)	6.110	(1.603)	6.806	(2.317)
Five Below		4.902	(7.452)	3.749	(0.562)	4.044	(1.072)	4.762	(1.069)
Marshalls		6.926	(7.113)	5.253	(0.850)	4.733	(0.550)	5.523	(0.712)
Ross Dress for Less		7.161	(7.299)	5.275	(1.151)	5.099	(0.689)	5.371	(1.775)
T.J. Maxx		6.839	(8.046)	5.471	(1.477)	5.426	(1.391)	5.902	(1.729)
Big Lots		4.035	(7.233)	3.005	(0.939)	1.584	(1.354)	3.586	(0.904)
Target		6.974	(8.330)	5.750	(1.206)	5.260	(1.198)	6.237	(1.451)
Walmart		8.661	(7.597)	6.858	(0.890)	6.404	(1.264)	6.006	(1.950)
99c Only		–	–	–	–	–	–	–	–
Dollar General		4.961	(7.613)	4.553	(1.302)	3.864	(1.284)	3.986	(0.961)
Dollar Tree		7.031	(7.355)	6.211	(1.035)	5.726	(0.906)	6.178	(0.970)
Family Dollar		7.155	(7.609)	5.744	(0.590)	4.558	(1.677)	4.115	(1.216)
Random Coefficients	σ_k								
Warehouse Stores		1.422	(1.497)	0.000	(0.361)	0.000	(0.365)	2.284	(0.544)
Traditional Stores		2.238	(1.085)	1.654	(0.294)	2.402	(0.198)	2.638	(0.210)
Discount Stores		2.378	(1.062)	1.178	(0.271)	1.835	(0.255)	1.779	(0.405)
Supercenters		0.786	(1.401)	0.000	(0.315)	0.009	(0.109)	0.253	(0.130)
Dollar Stores		3.333	(1.280)	1.517	(0.519)	3.302	(0.429)	3.808	(0.377)
Summary									
Log Likelihood		-45657.3		-306636.6		-752225.8		-2176652.5	
Number of Visits		20,202		135,194		328,955		928,953	
Number of Devices		2,310		13,760		31,978		94,399	

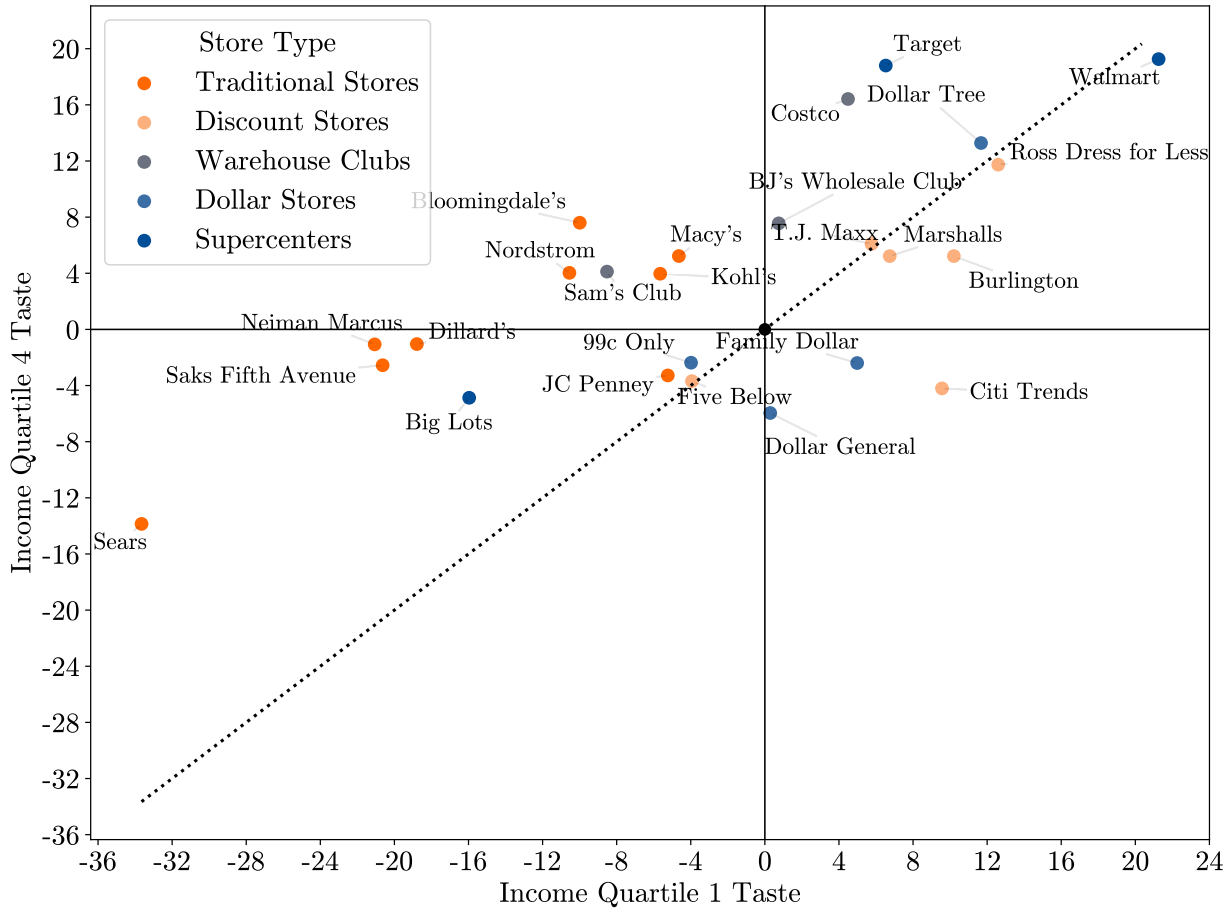
Note: Demand estimates using simulated maximum likelihood with 100 Halton draws per random coefficient. Standard errors computed using block bootstrap.

Figure C.1: Time Coefficients



Notes: These figures report the same information as Figure 7, except the endogenous variable is measured as travel times (in minutes) between Census block groups instead of distance (in miles).

Figure C.2: Distance Normalized Chain Taste Parameters with Time



Notes: This figure reports the same information as Figure 8, except the endogenous variable is measured as travel times (in minutes) between Census block groups instead of distance (in miles).