Impacts of Dollar Store Entry on Household Shopping Patterns and Nutrition

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PRELIMINARY AND INCOMPLETE, PLEASE DO NOT CITE OR CIRCULATE[1]

Abstract

This paper examines how household shopping trips, food expenditure, and nutrition are impacted by the entry of dollar stores. Dollar stores are a controversial and rapidly expanding food retailer with limited availability of perishable and nutritious food products. We use food retailer location data from Nielsen TDLinx and the IRI Consumer Panel dataset to document a large decrease in distance to the nearest dollar store relative to the nearest supermarket for households in my data. We also document that dollar store food expenditure is concentrated on less nutritious product groups and is small in magnitude but increasingly rapidly for low-income households. Using an event study approach, we find that when a dollar store enters a household's zip, households shift food expenditure to dollar stores from other food retail channels, with larger effects for low-income, low-access, and non-metro county households. I find that market share is taken from both high-quality and low-quality food retailers, and that new expenditure at dollar stores looks very similar to average expenditure at dollar stores. Households shift food spending away from perishable product groups with limited offerings at the dollar store like dairy and meat, but by a relatively small amount. We find small impacts of dollar store entry on nutrition, particularly for households living in low-access areas with no large food retailer in their zip code. These effects are about 0.03 standard deviations, or about 5% of the nutrition-income gap, and are driven by decreases in dark greens, legumes, protein, and healthy fat and increases in refined grain. This suggests that household store choice could have an important role in food access and nutrition.

1 Introduction

Much focus has been spent by researchers and policymakers alike on the differences in household nutrition by income. What a household consumes is recognized as an important determinant for a wide range of health outcomes including obesity, which in turn can directly effect broader economic outcomes. There is clear evidence that lower-income households purchase and consume less healthful food, sometimes referred to as "nutritional inequality".[2]

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[1]Disclaimers: (1) The findings and conclusions in this publication are those of the authors and should not be construed to represent any official USDA or U.S. Government determination or policy. (2) The analysis, findings, and conclusions expressed in this report should not be attributed to NielsenIQ TDLinx. (3) The analysis, findings, and conclusions expressed in this report should not be attributed to IRI.

[2]See Allcott et al. (2019) for a description and summary.

While the issue of nutritional inequality is clear, the causes of it are not well understood. Households of different incomes have different preferences, but also face different food retail environments. Low-income households are more likely to live in areas with poor access to stores selling healthy food at reasonable prices, often referred to as "food deserts" or "low-access areas".[3] However, low-access could be either a cause or a consequence of household behavior. Past research has worked to disentangle the role of household preferences and the retail environment on the nutrition of household grocery purchases. Notably, Allcott et al. (2019) finds a limited role for the retail environment on nutrition. They provide reduced form evidence from both supermarket[4] entry and household moves that show changes in the retail environment have limited impacts on nutrition. This is supported by the fact that households purchase upwards of 80% of their groceries at supermarkets and often travel significant distances to shop, even for low-access and low-income households.[5] Households substituting between different supermarket stores likely face less variation in product offerings and prices compared to substitution with other food retailer channels, making effects on nutrition unlikely.

These research findings contrast with widespread beliefs about the impact of dollar stores.[6] A common narrative is that dollar stores target low-income and low-access areas, undercut and drive out local grocery stores, and worsen access to healthy food, which exacerbates the differences in nutrition between high and low-income households.[7] As of 2022, 25 cities have moved to restrict or otherwise regulate the entry of new dollar stores, including large cities like Cleveland, Forth Worth, Oklahoma City, and New Orleans.[8] This reflects a broader concern about the impacts of dollar stores that are rapidly expanding across the United States and targeting low-income households as their main customer.[9] However, this overlooks the potential benefits that dollar stores may be providing customers by serving areas other food retailers do not. In this paper we measure the impact of dollar store entry between 2008 and 2018 on household food purchasing trips, food purchases, and nutrition to see if the dollar store is an exception to the rule that the retail environment has a limited on nutrition.

While dollar stores are not new, they have steadily entered the food retail space over the last two decades by expanding their food product offerings, starting to offer perishable food products, and starting to accept federal food assistance benefits via the SNAP program.[10] For many households, dollar stores represent a new type of food retailer in a household's choice set that varies significantly from supermarkets. There are several possible explanations for why

[3] See Bitler and Haider (2011) for a summary.

[4] Supermarket here refers to large grocers (including supermarkets), mass merchandisers, and wholesale club stores.

[5] 2009 National Household Travel Survey.

[6] While dollar stores may not have a single defining feature, they are a set of small format discount stores with low price points and a wide range of product offerings. Over 90% of dollar stores are part of the national brands Dollar General, Family Dollar, and Dollar Tree.

[7] See Planet Money "Episode 909: Dollar Stores vs. Lettuce" (https://www.npr.org/sections/money/2019/04/26/717665452/episode-909-dollar-stores-vs-lettuce), work by the Institute of Self Reliance (https://ilsr.org/dollar-stores-factsheet/), and "As Dollar Stores Proliferate, Some Communities Push Back" on Civil eats (https://civileats.com/2022/04/13/dollar-stores/).

[8] See Chenarides et al. (2021) and https://civileats.com/2022/04/13/dollar-stores/.

[9] Dollar stores acknowledge that they target low-income or fixed-income households. See https://www.wsj.com/articles/how-dollar-general-became-rural-americas-store-of-choice-1512401992 as one example.

[10] Byrne et al. (2022) discusses retail chain SNAP expansion, including dollar stores.

dollar stores could have a larger impacts on nutrition than other store types. First, the number of dollar store entries nationwide is incredibly large, making "procompetitive effects" possible;[11] dollar stores could cause existing food retailers to change their prices or exit. Second, dollar stores carry mainly shelf stable food products and a limited assortment of generally healthier perishable products like fresh produce, meat, and dairy. This means that if dollar stores offer more competitive prices than existing retailers, that would change the relative price of unhealthy food more than healthy food. Third, store choice involving an option with limited variety could play an important role in household nutrition. Households face a fixed cost of shopping trips, making it not possible to take advantage of all the appealing characteristics of every store in every period. This may put households in a position where they need to choose between a marginal trip to the grocery store or the dollar store. Households are trading off the attractive characteristics of the dollar store like store distance and non-food product variety with its lack of nutritious and perishable product offerings. In this situation, a household's ability to smooth consumption of products only available at the grocery store may be limited by the perishability of the goods themselves or other explanations like budget constraints. This could lead to changes in nutritional consumption, and highlights a possible role of store choice in nutrition and food access. Dollar stores highlight that if low-income and high-income households living in the same zip code make different store choice decisions - possibly for reasons unrelated to nutrition preferences like access to a car, budget constraints, or preferences for non-food items - households could face very different prices and variety, and may not take full advantage of the best characteristics of different store types. My approach focuses on measuring the effect of a particular dollar store entry on nearby households, and is unable to measure procompetitive effects. For the remaining explanations and those not considered here, we do not attempt to disentangle these mechanisms, but instead look at reduced form evidence of changes in household behavior.

We start with data on household grocery trips and food expenditure from the IRI Consumer Panel of about 60,000 households per year from 2008-2018. We aggregate this data into quarterly measures of household trips and expenditure by store type and product group. We also use the Purchase to Place Crosswalk (PPC) from Carlson et al. (2019) to calculate measures of nutrition including Health Eating Index (HEI) scores for this household purchase data. We then combine this data with detailed food retail store location and entry data from Nielsen TDLinx. For descriptive evidence, We show that the number of dollar stores from the three largest dollar store chains has increased from about 18,000 stores in 2008 to over 32,000 stores in 2018. This has shifted the distribution of distance to the nearest dollar store for households dramatically while the distance to the nearest supermarket remains unchanged. This trend is even stronger in low-access areas. We then show that the share of household food expenditure spent at dollar stores has increased, in particular doubling from 1.5 to 3 percentage points for low-income

[11] See Atkin, Faber, and Gonzalez-Navarro (2018) for a more in-depth discussion.

households. Lastly we show that purchases at dollar stores are more to be from non-perishable, unhealthy product categories; they are less likely to be fruits, vegetables, dairy, or meat products and more likely to be snacks, desserts, and sugary beverages.

We use an event study approach to measure the impact of a single dollar store entry event on households living in the zip code of entry. We use quarterly household spending data to isolate sharp changes in behavior near the store entry event that are plausbily uncorrelated with long-term changes in household demand or the retail environment. We look at within-household variation controlling for county-quarter specific shocks, and focus on several household subsets of interest including low-income and low-access households. However, while 30% of households experienced a single dollar store entry in their zip code between 2008 and 2016, about 20% experienced more than one dollar store entry. This motivates the use of a cumulative entry regression framework to quantify the effect of multiple dollar store entries, which is included in the appendix. This imposes fewer data restrictions but is likely contaminated by confounding long-term trends. Hence, at this stage the results of this cumulative framework are included in the appendix to highlight that impacts may be even larger than measured in my event study approach.[12]

We find that dollar stores as a store category increase their market share when a new dollar store enters by 0.15 percentage points across all households. We find significant heterogeneity along several dimensions, including for low-income (0.26 p.p), low-access (0.63 p.p.), and non-metro households (0.34 p.p). This is consistent with qualitative evidence and descriptions of corporate strategy that dollar stores are used particularly by low-income households in rural areas, and that dollar stores entering in low-access areas have less competition. This contrasts with the case of supermarket entry in Allcott et al. (2019) where new stores were found to take market share from other supermarkets, leading to no increase in overall supermarket market share. We also find that the results for dollar store trip share are even larger than expenditure share, reflecting that households make smaller, more frequent purchases at dollar stores. We don't find a single alternative food retailer type that dollar stores are taking market share from, but that the effects are not driven by substitution from only similar "low-quality" food retailers like drug stores, convenience stores, and other smaller dollar store chains.

We then look at what types of food households are purchasing more of at dollar stores and if there are changes in expenditure allocated to food product categories, particularly those with less variety at dollar stores. We find evidence of switching from generally perishable dairy and meat categories towards pre-packaged meals and in other cases snacks and desserts, but of a small magnitude. Last, we look at measures of nutrition with much more granular information than these broad product categories. We find some weak evidence of decreases in nutrition via the HEI score. In particular, low-access households experience a decrease in HEI score of 0.03 standard deviations, or about 5% of the nutrition-income gap. Breaking apart the HEI score

[12] In the future, we seek to improve this approach to have more plausibly causal estimates.

into its nutrition components, we find that this is driven by less dark greens and beans, protein, and good fat plus more refined grain, which is consistent with lower quality of vegetables, less meat, and more unhealthy shelf-stable products being purchased at the dollar store.

This paper contributes to several literatures, including the impacts of changes in the retail environment through entry of nearby food retailers like fast food restaurants, supermarkets, and supercenters (Davis and Carpenter (2009), Currie et al. (2010), Dunn (2010), Anderson and Matsa (2011), Courtemanche and Carden (2011), Allcott et al. (2019), Courtemanche, Carden, et al. (2019)) or using households that move across retail environments (Hut (2020),Allcott et al. (2019)). It also relates to the large literature measuring the effects of store entry including household welfare, particularly of Walmart (Hausman and Leibtag (2007), Jia (2008), Holmes (2011), Ellickson and Grieco (2013), Atkin, Faber, and Gonzalez-Navarro (2018)). It also contributes to a growing literature on dollar stores including their impact on BMI (Drichoutis et al. (2015)), where they enter and how they interact with other stores (Chenarides et al. (2021)), and their prices and product offerings (Coughenour, Bungum, and Regalado (2018)). It contributes to a broader literature that attempts to understand the economic causes of obesity, poor household nutrition, and nutritional inequality and how these can be shaped by policy (Ludwig et al. (2011), Dubois, Griffith, and Nevo (2014), Lichtman-Sadot (2016), Hut and Oster (2018), Griffith, Hinke, and Smith (2018), AlÃ©-Chilet and Moshary (2020), Sadoff, Samek, and Sprenger (2020), Hastings, Kessler, and Shapiro (2021)). We contribute to these literatures by focusing on dollar stores as a new entering store type, offering some of the first evidence from household level expenditure data of the way dollar stores impact household purchasing decisions and nutrition. We also highlight the possible role of store choice (and factors external to the food retail environment that influence it) as an important factor for understanding the relationship between the retail environment and food access, nutrition, and nutritional inequality that has not often been considered seriously in past research.

The rest of the paper proceeds as follows. Section 2 describes and summarizes the data. Section 3 outlines the empirical method and Section 4 presents the results. Finally, Section 5 concludes.

2 Data and Stylized Facts

2.1 IRI Consumer Panel

The IRI Consumer Panel ("IRI") data is the source of household grocery expenditure and demographics.[13] The IRI data is a nationally representative sample of households across the United States that agree to document their trips and food purchases at the UPC code level using a barcode scanner. I use product departments in the IRI data to categorize food products as perishable or non-perishable and product descriptions to categorize food products into eight

[13]The data does not include information on non-food purchases, but contains the total amount spent on food and non-food purchases for each trip. I only focus on food expenditure.

product categories.[14] In addition to UPC-level and product information, expenditure is recorded separately for all store chains. I first categorize dollar stores as stores that are part of the three national leading dollar store brands. I then categorize stores into grocery stores, mass merchandisers and supercenters,[15] warehouse and club stores,[16] and an "other" category. The other category includes dollar stores not part of the three leading brands, drug stores, convenience stores, and miscellaneous stores. I refer to grocery stores, mass merchandisers, and wholesale / club stores as "high-quality" stores to reflect that in general they have a wide variety of all food product categories. I refer to dollar stors and stores in the other category as "low-quality" stores reflecting their smaller size and often limited availability or perishable items. The IRI data does not include non-food-at-home purchase at restaurants.

The panel includes about 60,000 households each year from 2008-2019. In addition, IRI records demographic characteristics of the household on an annual basis. This includes income, age of household members, education, zip code, working status, and occupation. I define low-income households as those with on average less than $30,000 in income. Because the sample of households exposed to dollar store entry is already not nationally representative, I do not include IRI sample weights for my analysis. In addition to the standard sample restriction imposed by IRI,[17] I require households to have at least $100 of food expenditure per quarter.

Nonpackaged groceries like some produce and meat products that are paid per weight are only recorded for a subset of households and not considered in this analysis. Allcott et al. (2019) found that these products represented a nontrivial share of household purchases but does not vary statistically by income. Dollar stores do not have nonpackaged goods, so omission of these categories could lead to changes in purchases on produce and meat categories to be underestimated.

2.2 Retail Establishments

I obtain information about the location and entry of retail establishments from Nielsen TDLinx, which is an annual census of food-at-home retailers.[18] Nielsen TDLinx also includes the date of store entry, which I utilize at the quarterly level. From this I can see information about the store brand, what chain and ownership it belongs to, where the store is located, and the date it entered. I use the to find the quarter the first dollar store entered a given zip during my data period between 2008 and 2016. I also use this data to determine the number of stores in a household's zip code and distance to the nearest store across the food retailer categories highlighted in the IRI data.

[14] These eight categories are produce (fresh and non-fresh), juice, dairy, meat, sugary beverages, meals, snacks and desserts, and all other products. See Appendix Section **??** for a description of these categories.

[15] Discount/Mass Merchandisers includes brands like Walmart, Target, and K-Mart, plus their supercenter locations.

[16] Warehouse/Club Stores includes brands like Costco, Sam's Club, and BJ's.

[17] IRI requires households to have a recorded purchase in 11 out of 13 4-week periods during the year and a certain amount of annual expenditure that varies with households size. These requirements are not specifically based on food expenditure.

[18] This includes grocery stores, supermarkets, mass merchandisers, drug stores, dollar stores, specialty food stores, wholesale stores, club stores, and convenience stores, but does not include restaurants.

2.3 Nutrition Measures

For nutrition measures I utilize the 2015 Purchase to Plate Crosswalk (PPC) described in Carlson et al. (2019), an updated version of the crosswalk used in Allcott et al. (2019). This links UPC codes in the IRI data to one of several thousand product types for which nutrition data is available in the USDA Food Patterns Equivalents Database (FPED) and Food Patterns Equivalents Ingredient Database (FPID). These measures of nutrition reflect average characteristics for these product groups, making this measure of nutrition good at measuring changes in nutrition from substitution across these product groups but not within these groups.[19] The 2015 PPC was designed to match 95% of household panel sales in 2015. This means that match rates for other years will not be as high since UPC codes turn over, products are reformulated, or for other reasons. I find that in early and late years of my sample that these match rates are above 80% for all years 2010 and after, and hit a low of about 65-70% coverage in 2008.[20]

From this data I construct Healthy Eating Index (HEI) Scores,[21] a standard and widely used measure of nutrition in the United States (Guenther, Reedy, and Krebs-Smith (2008), Krebs-Smith et al. (2018)). The HEI Score is on a scale between 0 and 100 where 100 is the best (most nutritious) score. The HEI score is a combination of 9 good and 4 bad dietary components each assigned a maximum score that is part of the 100 points.[22] Most of these components are density measures calculated either as the number of servings per 1,000 kilocalories or as a share of energy.[23] Examples of these include the servings of fruit, vegetables, or whole grain per 1,000 kilocalories purchased. Points for each component are rewarded linearly based on these density measures and capped below at 0 points and above at the maximum score, hence the HEI score is nonlinear in its component scores. I also consider a linearized version of the HEI score that removes these caps. In Figure 1, I summarize average HEI scores across the income distribution for households in my panel in 2015 to show the nutrition-income relationship documented in Allcott et al. (2019). With the exception of households with no income,[24] there is a strong positive correlation between income and better nutrition of purchases. The difference in HEI scores between the lowest income and highest income households is about 6. Given that the standard deviation of HEI scores is about 10, this is a difference of 0.6 standard deviations.[25]

[19] For example, barbeque sauce is mapped to either barbeque sauce or low-sodium barbeque sauce, which have average nutrition characteristics of products within those groups. For more detail, see Carlson et al. (2019).

[20] See Appendix Figure 1.

[21] Specifically, I calculate 2015 HEI scores based on the 2015-2020 Daily Guidelines for Americans. The method of calculating HEI scores is updated over time. See Krebs-Smith et al. (2018).

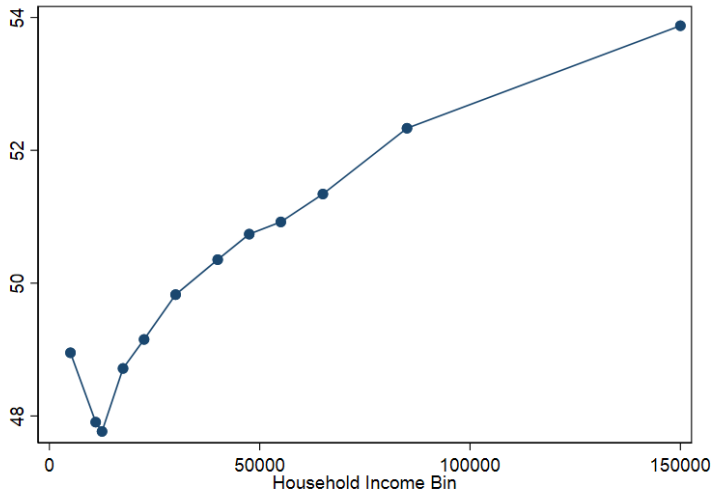
[22] The positive components are total fruits, whole fruits, total vegetables, dark greens and beans, whole grains, dairy, total protein foods, seafood and plant proteins, and fatty acids. The negative (moderation) components are refined grains, sodium, added sugars, and saturated fats.

[23] See https://epi.grants.cancer.gov/hei/developing.html for more details.

[24] Households with no income and with very low-income are not comparable. Households with no income likely include the temporary unemployed, those in school, and those that are retired. Households with no income in one year often have incomes in other years, and have significantly different levels of education, meaning they should not be necessarily considered low in socioeconomic status.

[25] The difference in linearized HEI score is is similar at about 10 points and has a standard deviation of about 20, or about 0.5 standard deviations.

Figure 1: Average Healthy Eating Index (HEI) Score By Household Income



Notes: Data for households in the IRI Consumer Panel in the year 2015. Household income is in dollars. HEI score is on the y-axis and is on a scale from 0-100 where 100 is the best (most nutritious) score. IRI household income is binned and the midpoints of each bin are plotted.

2.4 Proliferation of Dollar Stores and Household Purchase Patterns

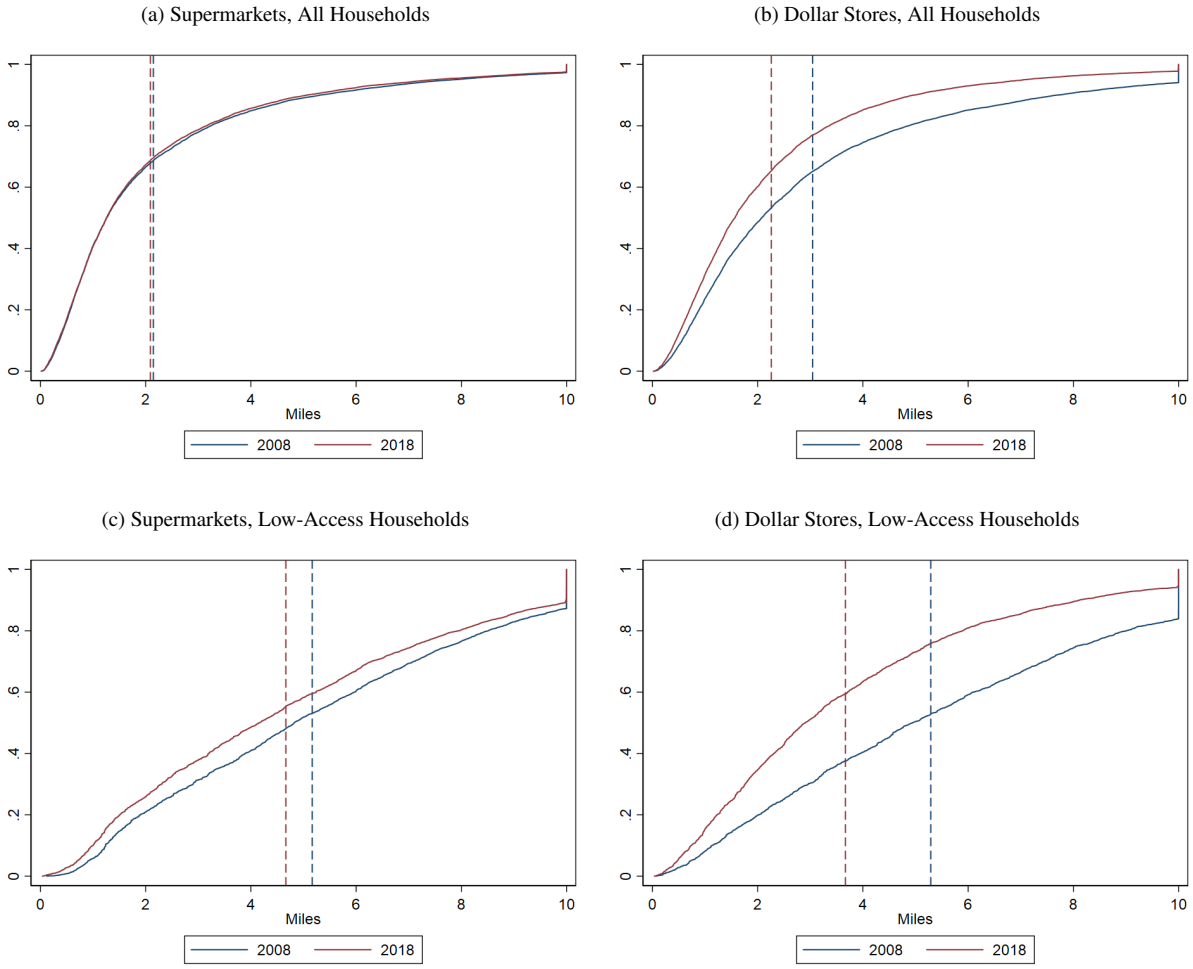
During the time period I consider, the number of dollar stores across the United States increased dramatically. In Appendix Figure 1. I show that the number of dollar stores increased from about 18,000 in 2006 to over 32,000 in 2018, surpassing the number of supermarkets. Over this time period the aggregate number of supermarkets, small grocers, mass merchandisers, small grocers, and drug stores remained relatively unchanged. In addition to the increasing the number of stores, dollar stores also changed their food offerings and accessibility during this period. In particular, Byrne et al. (2022) documents that the majority of store locations for two of the three dollar store chains became eligible for the Supplemental Nutrition Assistance Program (SNAP) between 2008 and 2012. This required dollar stores to increase their food product offerings to meet SNAP retailer requirements[26] and allowed these stores to start accepting SNAP benefits as payment from households participating in the federal food assistance program. Dollar stores have continuously been investing in expanding their refrigeration and freezer capacity and fresh product sourcing, particularly towards the end and after my data period.

These new dollar stores increased household proximity to a new store type. In Figure 2 I compare the distance to the nearest dollar store or supermarket for households in the IRI data in 2008 and 2018, with means denoted by the vertical lines. Here I define supermarket to include large grocers, mass merchansiders, supercenters, wholesalers, and club stores. Consistent with no net increase in supermarkets over this time period, the distribution of distance to the nearest supermarket remains mostly unchanged between 2008 and 2018 with a mean distance of about

[26]To be a SNAP-eligible store, a store must offer products in four product categories: grain, dairy, meat, and vegetable. At least two of these cateogires must include fresh offerings.

2 miles and a median of about 1.4 miles. Due to the large influx of new dollar stores over this period, there is a significant shift in the distribution of the distance to the nearest dollar store, with the average distance decreasing from about 3 miles to about 2.3 miles. I also show that these patterns are even stronger for households in low-access areas, defined as zip codes with no supermarket in 2007 prior to the start of my data. Low-Access households are closer to a supermarket in 2018, but by less than a mile on average. However, the median distance to a dollar store decreases from over 5 miles to 3 miles between 2008 to 2018. Over this time frame in low-access areas, dollar stores went from being farther or a similar distance to supermarkets to being significantly closer for most households.

Figure 2: CDF for Distance to the Nearest Store for IRI Households: 2008 versus 2018

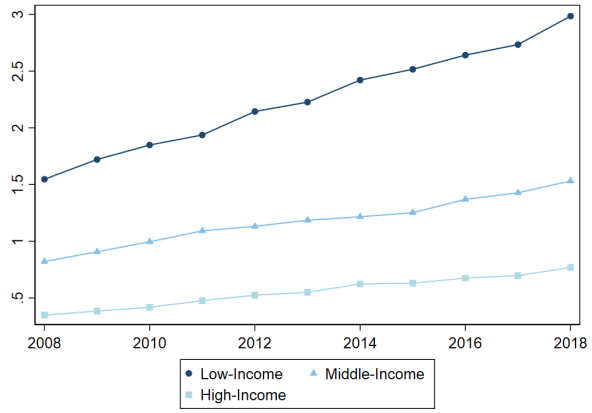


Note: Each figures shows the cumulative distribution function for distance to the nearest dollar store or nearest supermarket store for IRI households, either for all IRI households or households living in low-access areas. Vertical lines mark the average distance. Low access areas are defined as not having a supermarket in their zip code in 2007 before the start of the IRI data.

2.5 Household Purchase Patterns and Nutrition

Households purchase food for consumption at home at several different channels of food retailers. Appendix Figure 2 shows how household trips and expenditure in the IRI data are split across these channels across the income distribution for the year 2015.[27] Grocery stores have about 50% of all trips and 60% of all expenditures. Mass merchandisers and supercenters have about 20% and warehouse and club stores have between 5% to 15% depending on household income. This is consistent with Allcott et al. (2019), which finds that over 80% of food purchases are made at "supermarkets", which includes large grocery stores, mass merchandisers, supercenters, warehouse, and club stores. This holds for high and low-income households, and even for households in low-access areas defined as zip codes with no supermarket at the beginning of the data period. Dollar store trip and expenditure share is a relatively small component of the total, but is more prevalent for low-income households and is growing steadily over time. Figure 3 shows the average share of household expenditure spent at dollar stores between 2008 and 2018. In 2008, the average low-income IRI household spent 1.5% of their at-home food spending at dollar stores. This share doubled to 3.0% of all food spending by 2018 with a standard deviation of 8.5%. The share spent at dollar stores and its increase over time are less prominent for middle and high-income households.

Figure 3: Dollar Store Expenditure Share (percentage points): 2008 to 2018



Note: This figure plots the share of food expenditure spent at dollar stores in percentage points. Low-income households have average income across years of less than $30,000, and high-income households have income above $70,000.

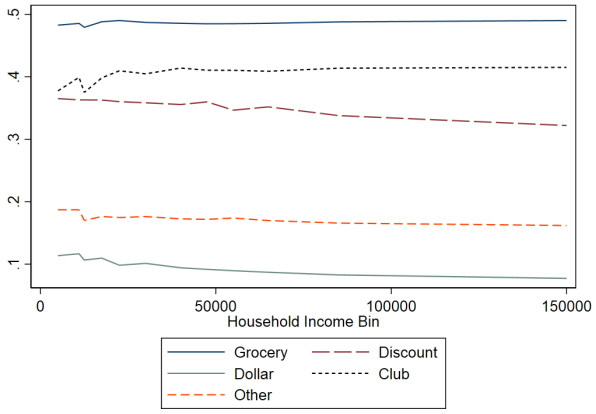
Many store characteristics vary across these channels and particularly for dollar stores. In particular, dollar stores have limited product offerings for perishable food products. They tend to have limited refrigeration and freezer capacity, limiting their selection of dairy and meat products. In the majority of cases they have no fresh produce. This is reflected in the way households utilize dollar stores compared to other channel types. In Figure 4 I show the share of all expenditure at a channel type that is spent on certain product categories. Figure 4a shows the

[27] Trips here are defined as any trip where food was purchased.

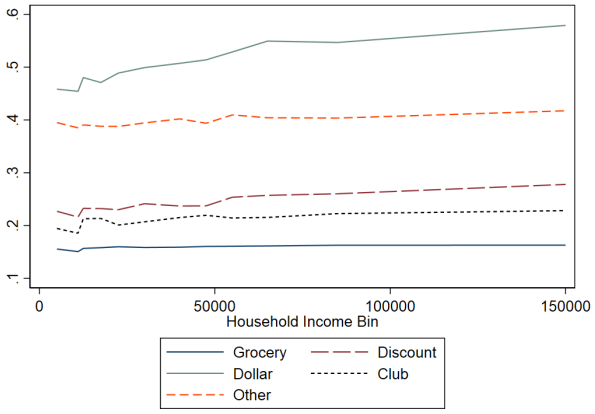
percent of a household's expenditure spent on perishable (non-dry) grocery products. Perishable products are products generally along the edge of a grocery store, including fresh produce, meat, dairy, and frozen items in the year 2015. They are generally more perishable and often require coolers for refrigeration, making them harder to stock. The first notable takeaway is that the amount of spending on non-dry products is relatively similar across incomes within a store type, i.e. the lines are relatively flat. The second notable takeaway is that regardless of income, households buy more non-dry products at grocery stores and less at dollar stores. In Figure 4b we see largely the opposite pattern for snack and dessert items. Households regardless of income are more likely to buy products like snacks, crackers chips, cookies, and desserts at dollar stores, making up 45-55% of all spending at dollar stores. This compares to only 15% of purchases at grocery stores and 25% of purchases at mass merchandisers. This highlights that purchases made at dollar stores are fundamentally different than at other stores and are done from a more limited product variety of many key grocery categories. However, it should be noted that low-income households buy slightly more non-dry products and slightly less snack and dessert foods at dollar stores, meaning that they use these stores more closely to traditional food retailers than high-income households.

Figure 4: Average Share of Household Spending By Store Channel and Household Income

(a) Share Spent on Non-Dry Food Products (%)



(b) Share Spent on Snack and Dessert Products (%)



Notes: Figures plot the share of food spending done at a particular store channel that is spent on a certain product category. On this plot the y-axis value 0.5 means 50% of food spending at that chanel is spent on a certain product group. This is an average across households in the IRI Consumer Panel in the year 2015. Perishable product expenditure represent about 40-50% of overall households expenditure and snack and dessert products about 15-25%, large components of household expenditure.

3 Empirical Methods

I focus on dollar store entry as a source of quasi-exogneous variation in a household's grocery retail environment in order to measure substitution across grocery retail types and the elasticity of healthy grocery demand. I start by considering event studies related to dollar store entry. I then look at the cumulative impact of dollar store entry over time.

3.1 Event Study Estimation Strategy

I use an event study framework to measure the within-household effect of dollar store entry on grocery food purchases and other outcomes. The entry of dollar stores may be related to a variety of confounding factors like long-term changes in household demand. This event study relies on the suddeness of the store entry being unlikely to line up exactly with these longer term confounders. I leverage quarterly level data on household expenditure and store entry to look at changes in spending close to the store entry event.

I consider the impact of entries within a household's zip. Zip codes are a convenient unit for analysis because they often change in size as population density changes, allowing a store entry within a zip code to be a reasonable measure for a shock to the local retail environment of a household for both urban, suburban, and rural zip codes. For each household i, I identify the first dollar store entry in their zip (z) between 2009 and 2016.[28] Event time (q) is defined relative to the quarter of that dollar store's entry. I require households to have a 3 years of quarterly data in the same zip for 5 quarters prior to entry and 6 quarters after entry.[29] I define B_{izt} as an indicator variable for a particular household-year (it) observation meeting these event study criterion. In my data, about 14,000 households experience a dollar store entry in their zip code between 2009 and 2016 that meets these data requirements. I run the following household-quarter regression in the IRI data:

$$Y_{izt} = \sum_{q} B_{izt}\tau_q + \gamma X_{it} + \mu_{d(z)t} + \phi_i + \epsilon_{izt} \tag{1}$$

The outcome variable Y_{izt} will be a variety of trip, expenditure, and nutrition measures. In each event-time quarter relative to the store entry at $q = 0$, I estimate an event-time coefficient τ_q. These coefficients are estimated only for household-quarters where $B_{izt} = 1$, meaning that they meet the event-study criteria above. I bin event time outside of 5 quarters prior and 6 quarters post. I include all household-quarter data in my regression to improve the precision of household covariates and help in the estimation of fixed effects. I include time-varying household characteristics like household size and income as household covariates in X_{it}. The fixed effect $\mu_{d(z)t}$ is a county-quarter fixed effect to control for time and location specific shocks. Then ϕ_i is a household fixed effect to isolate within-household variation, and exclude movers from the event study sample. Standard errors are clustered by zip. I represent these event study results in figures but also in tables by replacing time-varying coefficients with a post indicator. In these tables I maintain the same data requirements and proximity to the event at $q = 0$ for my estimation such that results are largely consistent with the event study plot.[30] I estimate this

[28] My data existing from 2008 through 2018 limits the entries I can consider based on my chosen event time window.

[29] I do not require that no other dollar entry occured during the event study window. Event study plots for the average number of dollar stores does not seem to indicate this is a huge issue, but is a check I should do.

[30] For skewed measures with many zeroes like expenditure (in $) at dollar stores, I should estimate Equation 1 using Poisson Pseudo Maximum Likelihood (PPML) as discussed in Silva and Tenreyro (2006), but have not for this draft due to large run-time issues and limited time frame. Past results comparing versions with linear regression and PPML have not shown important differences in trends.

regression for my entire sample and a variety of subsets, in each case estimating the equation with only data from that household subset.[31] I find that the year of the first post-2009 dollar store entry for households are well spread across my data from 2009 through 2016, as attested to by the pattern of entry in Appendix Figure 3.

There are several important concerns with this estimation strategy. First, it compares ever-treated households to other ever-treated households. Recent work has shown issues with this type of staggered difference in difference approach for comparing not-yet treated households to already treated households, especially in the presence of heterogeneous treatment effects.[32] This will likely be an issue in these results, especially if household preferences lead to nutritional responses to dollar store entry to increase over time. Furthermore, households shop outside of their zip code, so control households may be treated prior to receiving a dollar store in their zip code. This could be a particular concern if dollar stores expand in a cluster pattern within a county, for which there is evidence could occur.[33] Lastly, I do not use sample weights, meaning my household panel is not representative and is skewed towards higher incomes. As mentioned in the data section, there are issues with measures of nonpackaged goods and nutrition data matching that could also introduce issues or lead bias in my results. This also cannot speak to substitution from food-at-home purchases to food-away-from-home purchases at restaurants.

3.2 Cumulative Entry Estimation Strategy

While the event study framework utilizes sudden changes very close to the entry event for identification, it imposes strict data requirements and doesn't address the impact of multiple entries, which is particularly important for dollar stores. In Appendix Figure 3 I show that by 2018 about 50% of households experienced a dollar store entry in their zip code and about 20% experienced more than one. Therefore, I can complement the event study framework with a regression strategy similar to Allcott et al. (2019) to consider the impact of cumulative dollar store entry since the start of my data in 2008. This framework imposes significantly less data requirements than my event study analysis, but is more vulnerable to identification challenges associated with other long-term changes unrelated to but correlated with dollar store entry. I have not pursued ways to address these identification challenges yet, and therefore describe this method and include some select results from it in the appendix.[34]

[31] This makes it harder to estimate county-quarter fixed effects in smaller samples. However, including other household types to estimate my fixed effects may lead to inappropriate comparisons across household groups within a county. For characteristics that vary within a zip code, I could for robustness try a specification that includes zip-quarter fixed effects.

[32] See Goodman-Bacon (2021), Callaway and SantâAnna (2021), and Sun and Abraham (2021).

[33] Figures of expansion patterns from TDLinx not included.

[34] See Appendix Section B for a description of the method.

3.3 Household Subsets and Summary Statistics

I focus on the impact of dollar stores on all households and also on several possibly relevant subsets of households. This includes low-income, low-access, non-metro, first entry, and high poverty zip households. Low-income households have average income across all years they appear in the data below $30,000. Dollar stores are believed to target low-income households as their main customer, and I showed that low-income households shop more at dollar stores than higher-income households. Low-access households do not have a supermarket in their zip code in 2007, the year prior to the start of my household panel data.[35] Low-access households, also referred to as households living in "food deserts", have been a particular concern for policy-makers and in past research. Non-metro households are those that live in a non-metro county.[36] Dollar stores are often believed to be more prevalent in rural areas. First entry households are those that live in zip codes where the first dollar store entry in my data period (2009-2018) is the first dollar store to enter their zip code. It is reasonable to expect the first dollar store to enter a household's zip may have a larger impact than subsequent entries. I also define high-poverty zip households as those living in a zip code whose poverty rate from the 2007-2011 ACS is one standard deviation above average in the IRI data.

In Table 1 I show the number of households in my regression specifications for each subset and how the different subsets of households overlap. The number of households is the number of households that are part of my event study regression specifications discussed in the next section.[37] In my data overall there are 128,000 households, which reflects that the panel of 60,000 households per year is unbalanced. Some households stay in the data a long time and others do not. However, of these households only 14,000 experience a dollar store entry, have balanced data around the first dollar store entry event in their zip, and have enough other households in their county to estimate county fixed effects. Overall the subsets seem relatively distinct. One exception is that most dollar store entries into low-access areas are the first entry in that zip, which makes sense to the extent these areas have fewer stores in general.

[35] This is an arguably crude measure of low-access, but is easily implementable and follows the approach used in Allcott et al. (2019) to identify "food deserts".

[36] Data from the USDA 2003 Rural Urban Continuum Codes.

[37] This differs from the subsets of households in my data because of the balanced data and county fixed effects estimation requirements.

Table 1: IRI Household Subsets

	All	Low-Income	Low Access	First Entry	Non-Metro
	(1)	(2)	(3)	(4)	(5)
Low-Income	0.22	1.00	0.21	0.18	0.31
Low Access	0.07	0.07	1.00	0.19	0.14
First Entry	0.28	0.23	0.72	1.00	0.25
Non-Metro	0.15	0.20	0.27	0.14	1.00
Households	128374	27159	15621	118911	15643
Event Study Households	14007	2983	966	3904	2091

Note: the bottom two rows of the table show the number of households used to estimate regressions of each household population and the number of those households with data satisfying the event study data requirements used to estimate the event study coefficients of interest. The other rows show the percent of each household group that belong to the other household subsets.

4 Results

4.1 Impact on Household Store Spending and Trip Patterns

4.1.1 Dollar Store Expenditure and Trip Share

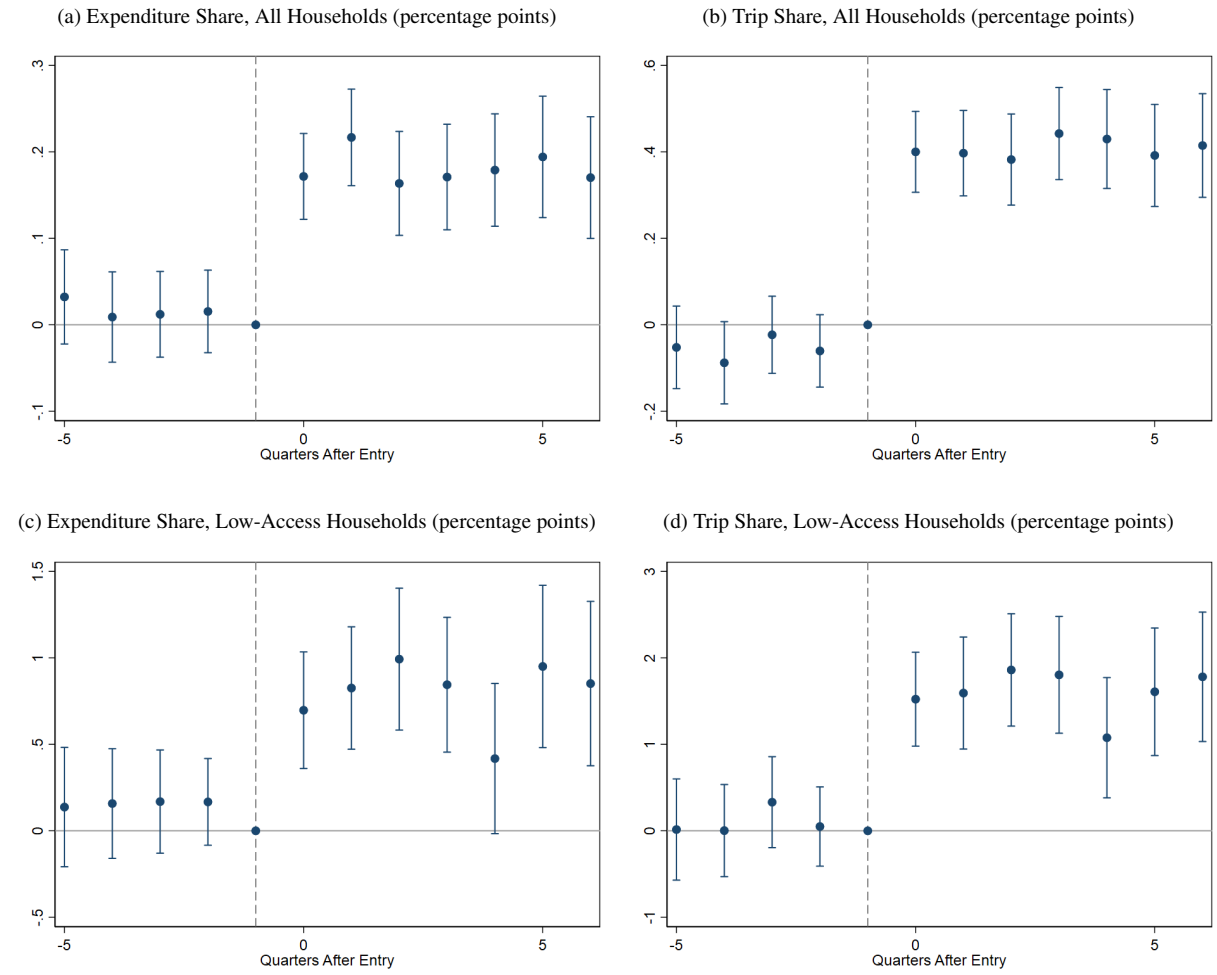
First, I look to see if dollar store entry leads to increased channel expenditure share for dollar stores.[38] If dollar stores only steal expenditure from other dollar stores, there should be no effect on channel level expenditure share. Allcott et al. (2019) found that supermarket entry doesn't change expenditure share at supermarkets for this reason. If dollar stores shift expenditure from other store channels (i.e. store types), then this should increase channel expenditure share and show a positive effect.

In Subfigures 5a and 5b, I show that across all households in my data dollar store expenditure share increases by about 0.2 percentage points and trip share increases by 0.4 percentage points after dollar store entry.[39] These figures show no notable pre-trends and the increases in share are persistent after dollar store entry. Again, this contrasts with findings for supermarket entry in Allcott et al. (2019), which is intuitive for a store channel with small overall market share. In Subfigures 5c and 5d I show the same result for the subset of low-access households. The effects are noisier due to a much smaller sample size but much larger in magnitude, showing expenditure share and trip share increases of about 0.6 and 1.4 percentage points. This suggests that in areas with less immediate competition from large food retailers, the impact of dollar store entry is larger.

[38] Dollar stores are defined as stores that are part of the three largest dollar store chains, which account for over 90% of stores.

[39] Trips must have at least one food item purchased to be included in this IRI data, but a general measure of trips is also available.

Figure 5: Impact of Dollar Store Entry on Dollar Store Expenditure Share and Trip Share



Note: The y-axis shows the change in dollar store expenditure share or dollar store trip share in percentage points. The x-axis shows event time where the dollar store enters at q=0. Error bars show 95% confidence intervals. Estimates are normalized relative to q=-1.

I summarize these results across all of my household subsets of interest in Table 2. Consistent with the event study plots, I find that there is an impact for dollar stores for households overall. These effects are small in magnitude, but are large percentage increases compared to sample mean. In addition, it is worth remembering that over 50% of households in my unweighted but otherwise nationally representative data experience an entry in their zip code, so the effects are incredibly widespread. There are also larger effects for low-income, low-access, first entry, and non-metro households. This matches intuition that dollar stores are more appealing to low-income households, the first dollar store in a zip should have a larger impact than subsequent entries, and that dollar stores are more popular in non-urban areas. Low access households are the smallest subset and have the largest measured effect. It is worth noting that more than half of households already have a dollar store in their zip code.[40] This means that even when dollar stores are present in a household's zip, an additional store continues to increase dollar store

[40]Compare the number of balanced households used in the event study in Column (1) versus Column (4).

channel market share.

Table 2: Impact of Dollar Store Entry on Dollar Store Expenditure Share

	All	Low Income	Low Access	First Dollar Entry	Non-Metro County
	(1)	(2)	(3)	(4)	(5)
Post Entry	0.157***	0.256***	0.632***	0.368***	0.336***
	(0.021)	(0.067)	(0.146)	(0.042)	(0.099)
Dep. var. mean	1.24	2.16	2.35	.97	2.24
Dep. var. std. dev.	4.08	5.53	6.41	3.6	6.02
R-Squared	0.643	0.691	0.73	0.657	0.686
Observations	2,339,419	461,903	261,318	1,977,839	276,237
Households	128386	27161	15622	118923	15644
Balanced Households	14007	2983	966	3904	2091

Note: Each column shows the impact of dollar store entry on dollar store expenditure share for a different group of households using household-quarter level IRI data for 2008 through 2018. The "All" subset contains all households in the data. Low-Income in column 2 includes households with average income below $30,000. Low-Access in Column (3) are households with no supermarket in their zip code in 2007 prior to the start of the data. The "First Entry" subset are households whose entry event is the first dollar store to enter their zip code. Lastly, Column (5) contains households living in non-metro (rural) counties. The estimation mirrors the event study specification except that coefficients are not estimated for each event time quarter but for pre and post entry within the balanced event window. The first and second row of the table below the estimated coefficients show the dependent variable mean and standard deviation. All specifications include household and county*quarter fixed effects. Unbalanced households are included in the regression for the estimation of fixed effects, but not in estimating the coefficient of interest. Robust standard errors clustered at the zip level are in parentheses.

From this point on I focus my discussions and tables on low-access households, but include results for all households and the other subsets in the Appendix. Furthermore, it is important to focus on low-income households to the extent they are a more policy relevant population. I show in Appendix Table 1 that within low-income households, there is significant heterogeneity in effects in the household subsets above and also by zip poverty that are worth further exploration. I also include results from the cumulative entry specification for expenditure share and trip share in Appendix Tables 2 and 3. These show larger but roughly consistent effects on expenditure share for the first entry after 2008, and in most cases put the effect of two or more entries after 2008 is twice the size of the event study estimates. This highlights that the effects of dollar store entry for many households may be much larger.

In in Table 3 I break down changes in dollar store expenditure and trip share for low-access households into changes in dollar store expenditure and trips and changes in total expenditure and trips.[41] On average, these households in low-access areas are spending about $660 per quarter on food and making 23 trips. There is no notable effect on total expenditure or total trips when dollar stores enter, while dollar store expenditure increases by $5 per quarter and trips by about half a trip per quarter. This indicates that for low-access households, market share is being taken from other store channels. This is consistent for results for all households (Appendix Table 4). For the other subsets, I find similar strong increases in expenditure at dollar stores, but also some weak evidence that total expenditure or trips may change as well by small amounts.

[41] Tables for all households and other subsets are included in the appendix. Event study plots are also included in the appendix.

Table 3: Breakdown of Impacts on Expenditure Share and Trip Share, Low-Access Households

	Expenditure			Trips		
	(1) Dollar Store Exp.	(2) Total Exp.	(3) Exp. Share	(4) Dollar Store Trips	(5) Total Trips	(6) Trip Share
Post Entry	5.112***	-0.651	0.632***	0.568***	0.084	1.414***
	(0.871)	(6.525)	(0.146)	(0.093)	(0.211)	(0.223)
Dep. var. mean	13.49	661.9	2.35	2.08	23.13	6.32
Dep. var. std. dev.	39.73	348.48	6.41	4.79	12.07	11.17
R-Squared	0.755	0.75	0.73	0.778	0.776	0.761
Observations	261,318	261,318	261,318	261,318	261,318	261,318
Households	15622	15622	15622	15622	15622	15622
Balanced Households	966	966	966	966	966	966

Note: Each column shows the impact of dollar store entry on a different dependent variable for low-access households using household-quarter level IRI data for 2008 through 2018. The dependent variable in Columns (1) and (4) are the amount spent at dollar stores and the number of trips made to dollar stores per quarter. Columns (2) and (5) are the total amount spent on food and the total trips made with a food purchase per quarter. Columns (3) and (6) are dollar store expenditure share and dollar store trip share, which is the share of expenditure or trips made to dollar stores of the total. Robust standard errors clustered at the zip level are in parentheses.

4.1.2 Expenditure At Other Retailers

I investigate if there is a particular food retail channel from which dollar stores are taking market share. This could be informative to understand what retailers are most substitutable with dollar stores and could be negatively impacted by dollar store entry, but also to understand the expected nutrition effects of dollar store entry. Dollar stores could be taking expenditure from "high-quality" channels like supermarkets (large groceries, mass merchandisers, wholesale /club store) and grocers or from other "low-quality" channels like drug stores, convenience stores, or other dollar stores. On average, households of all incomes purchase much less nutritious food products at low-quality stores than high quality stores, as seen in Figure 4. If marginal changes in purchases match the average composition of the purchases in each channel, the nutrition effects of shifts from high or low-quality stores to dollar stores could be quite different.

I divide all other food retailers into four store categories; grocery, mass merchandiser, wholesale/club, and other stores.[42] The results for expenditure share are presented for low-access households in Table 4. The results show a large but imprecise increase in grocery store market share that coincides with dollar store entry. Expenditure share reduces for all other channels including mass merchandisers, club stores, and other food retailers. This paints a very ambiguous picture.[43] Results for trip share for low-access households show most trip substitution occuring with other retailers, which is intuitive in an area with no supermarkets nearby. Estimates for all households and other household subsets show very different effects (see Appendix Table 8 through Table 16). For example, first entry and non-metro households are substituting trips mostly from high quality retailers (Columns (2) to (5)) including grocery stores, while low-

[42] Grocery stores include small grocers and supermarkets. Mass merchandisers and supercenters include stores like Walmart/Walmart Supercenter and Target/Target Supercenter. Wholesale and club stores include stores like Costco, Sam's Club, and BJ's. Other stores include drug stores, convenience stores, dollar stores not part of the 3 main brands, and miscellaneous.

[43] Dollar stores can be located as standalone stores but also in shopping plazas, which often put them in closer proximity to a grocery stores than large mass merchandisers and wholesale/club stores that do not exist in shopping plazas. This could lead to either increase or decrease in grocery store utilization.

income households are mainly switching from mass merchandisers and other stores (Columns (3) and (5)). Even though for low-income and low-access households there is more substitution from low-quality retailers, large amounts of trip and expenditure substitution is coming from high-quality retailers across many of the subsets.

Table 4: Changes in Expenditure Share at Other Retailers, Low-Access Households (in percentage points)

	Dollar	Grocery	Mass Merch	Club	Other
	(1)	(2)	(3)	(4)	(5)
Post Entry	0.632***	0.711	-0.434	-0.438*	-0.471**
	(0.146)	(0.489)	(0.469)	(0.254)	(0.234)
Dep. var. mean	2.35	55.95	27.03	8.17	6.49
Dep. var. std. dev.	6.41	31.03	29.1	15.26	12.96
R-Squared	0.73	0.821	0.839	0.791	0.719
Observations	261,318	261,318	261,318	261,318	261,318
Households	15622	15622	15622	15622	15622
Balanced Households	966	966	966	966	966

Note: Each column shows the impact of dollar store entry on a different dependent variable for low-access households using household-quarter level IRI data for 2008 through 2018. The dependent variable in each column is the share of household expenditure spent at that store type, and each column uses the same sample. The estimated coefficients across Columns (1) through (5) should add up to zero. Look in Appendix Section A or the data section for definitions of store types. Robust standard errors clustered at the zip level are in parentheses.

4.2 Changes in Product Composition of Household Expenditure

I have shown that households are switching trips and food expenditure from other food retailer channels to dollar stores. In particular, trips and expenditure shifted from high-quality retailers to dollar stores will be spent in a very different store environment. On average, about 50% of spending at dollar stores is on snacks and dessert products, while for other high-quality retailers the average is less than 30% (see Figure 4). However, the impact of this store choice on nutrition is ambiguous, especially given the relatively small share that dollar store represent for most household food expenditures.

One option is that households' marginal expenditure at each store could be very similar to average expenditure at those stores. This would be the case where households purchase a fixed offering at each store and vary the products they purchase only through store choice. This would lead households to consume less nutritious products. A second option is that households' marginal expenditure at dollar stores could be spent in the same manner as it was in the previous store. This would mean marginal expenditure would be more nutritious than average dollar store spending but lead to no nutritional impact. A third option is that households only shift their unhealthy, non-perishable spending to the dollar store while not increasing total expenditure on these products at all, leading to very unhealthy marginal expenditure but also no nutritional impact. I attempt to provide evidence of how marginal purchases at dollar stores are spent and how overall composition of food purchases changes.

I break down food expenditure in two ways. First I focus on perishable products, Perishable (or non-dry) products are food departments where products are not shelf stable. This includes products that require refrigeration or being frozen and fresh produce, and are generally the products found on the outside wall of a grocery store. Dollar store have much more limited

perishable sections and limited cooling capacity than grocery stores. Second, I break down all expenditure into 8 semi-arbitrary categories by product aisle in the IRI data. These categories are produce, juice, dairy, meat, snack and dessert products, sugary beverages, meals, and other.[44] In addition to expenditure on these categories, I construct measures of the share of overall food expenditure allocated to each group (across all retailers). This measure gives an indication of how households allocate spending across broad groups. Both measures confound quantity and price effects, but results from prior sections show that total expenditure is not changing.

4.2.1 Marginal Purchases at Dollar Stores

First I break down dollar store expenditure (in dollars) by product category. In total, expenditure at dollar stores increased by about $5 for low-access households. In Table 5 I break down what product categories that expenditure increase went to and compare it to what we know about average purchases at dollar stores, which is shown in the sample means in the table. Low access households increase expenditure on almost all categories at the dollar store, and the composition seems to represent overall dollar store expenditure quite well. Of the average $13.5 spent at dollar stores, $7.8 is spent on snacks, desserts, and sugary beverages, about 60%, which lines up with Figure 4.[45] This lines up with about 50% of marginal expenditure being spent on these categories.[46] This general finding is consistent across all households and the other household subsets.

Table 5: Increase in Dollar Store Expenditure by Product Group, Low-Access Households (in $)

	(1) Produce	(2) Juice	(3) Dairy	(4) Snack / Dessert	(5) Sugary Bev.	(6) Meat	(7) Meals	(8) Other
Post Entry	0.150***	0.040	0.534***	1.916***	0.572***	0.221***	0.638***	1.041***
	(0.047)	(0.048)	(0.105)	(0.356)	(0.207)	(0.060)	(0.122)	(0.239)
Dep. var. mean	.39	.32	.75	6	1.79	.26	1.27	2.7
Dep. var. std. dev.	2.02	1.95	3.84	16.83	11.63	2.04	5.14	10.12
R-Squared	0.513	0.529	0.68	0.699	0.688	0.54	0.591	0.68
Observations	261,318	261,318	261,318	261,318	261,318	261,318	261,318	261,318
Households	15622	15622	15622	15622	15622	15622	15622	15622
Balanced Households	966	966	966	966	966	966	966	966

Note: Each column shows the impact of dollar store entry on a different dependent variable for low-access households using household-quarter level IRI data for 2008 through 2018. The dependent variable in each column is the quarterly dollar expenditure on a given product category by a household (in $), and each column uses the same sample. The estimated coefficients across Columns (1) through (5) should add up to the change in dollar store expenditure for low-access households which is about $5. Robust standard errors clustered at the zip level are in parentheses.

4.2.2 Overall Product Composition Effects

Next I look at the overall change in expenditure share for different product groups across all retailers. First I start by looking at the share of expenditure spent on perishable goods.[47] Table 6 starts by showing if dollar store entry decreases overall expenditure share on perishable product

[44] Many of these groups contain both perishable and nonperishable products. Most groups are self-explanatory, but the meal category contains things that are meals or used to create meals like frozen dinners, pasta, pasta sauce, and ramen noodles that don't fit into other categories. The other category is a catch-all for all other products.

[45] Sugary beverage share is about 10% of dollar store spending.

[46] (1.916+0.572)/5=0.5

[47] For context, a shift of 0.2 percentage points on $600 spent per quarter is about $1.2 per quarter.

categories. There are decreases in expenditure share on perishable products, but the magnitudes are quite small and often not significant.

Table 6: Impact of Dollar Store Entry on Share of Overall Expenditure Spent on Perishable Products (in percentage points)

	All	Low Income	Low Access	First Dollar Entry	Non-Metro County
	(1)	(2)	(3)	(4)	(5)
Post Entry	-0.101**	-0.231*	-0.170	-0.047	-0.218
	(0.050)	(0.123)	(0.220)	(0.096)	(0.149)
Dep. var. mean	43.84	43.36	43.22	44.22	42.73
Dep. var. std. dev.	10.92	11.38	10.54	11.07	10.83
R-Squared	0.57	0.624	0.633	0.574	0.616
Observations	2,339,419	461,903	261,318	1,977,839	276,237
Households	128386	27161	15622	118923	15644
Balanced Households	14007	2983	966	3904	2091

Note: Each column shows the impact of dollar store entry on the share of total expenditure spent on perishable products (in percentage points) for a different group of households using household-quarter level IRI data for 2008 through 2018. The "All" subset contains all households in the data. Low-Income in Column (2) includes households with average income below $30,000. Low-Access in Column (3) are households with no supermarket in their zip code in 2007 prior to the start of the data. The "First Entry" subset are households whose entry event is the first dollar store to enter their zip code. Lastly, Column (5) contains households living in non-metro (rural) counties. Robust standard errors clustered at the zip level are in parentheses.

Second, I show changes in expenditure allocation to different product groups for low-access households in in Table 7. These are allocations across the whole household budget, not at a particular store type. There are decreases in expenditure on meat and statistically insignificant increases for snacks/desserts and sugary beverages. For all households and low-income households, there are stronger patterns of expenditure share shifting from dairy and meat products to the "meals" category (Appendix Table 21). For first entry households there are no effects, and for non-metro households there are increases in snack/dessert expenditure share. The evidence here varies across different groups, but highlights that there is often decreases in perishable categories dairy and meat and increases in either meals or snack/dessert products.[48]

Overall, the magnitudes of these shifts are all below 0.3 percentage points, or below $2 per household per quarter. This lines up with a back of the envelope calculation of what you would be expected if marginal expenditure from each store was similar to the average.[49] It is worth noting that to the extent perishable categories contain more nonpackaged products (like random weight product or deli meat/cheese), these estimates will be underestimated.[50]

[48]The shift from dairy and meat to meals could reflect buying less individual perishable ingredients and instead buying more prepackaged meal products like frozen pizzas and macaroni and cheese.

[49]Total spending is $660. Before dollar store entry there is $13 spent at dollar stores and $647 spent on other stores. After dollar store entry we assume that $18 is spent on dollar stores and $642 is spent at other stores. If other stores have characteristics of grocery stores where 50% of spending is spent on non-dry goods, while 10% of dollar store spending is is spent on dry goods, one would expect to see a decrease in non-dry product expenditure share of 0.3 percentage points.

[50]This is because dollar stores have no nonpackaged products, and hence if households stop buying nonpackaged goods, there will be no measured effect. To the extent households shift nonpackaged goods like random weight apples or chicken for packaged goods like frozen produce or hot dogs at a dollar store, the impact on expenditure share would appear positive. A small sample of households recording these nonpackaged purchases can be used to explore the possibility of such effects.

Table 7: Impact of Dollar Store Entry on Product Expenditure Shares, Low-Access Households (percentage points)

	(1) Produce	(2) Juice	(3) Dairy	(4) Snack / Dessert	(5) Sugary Bev.	(6) Meat	(7) Meals	(8) Other
Post Entry	-0.038	-0.101	0.078	0.207	0.117	-0.253*	0.105	-0.114
	(0.118)	(0.075)	(0.124)	(0.184)	(0.102)	(0.131)	(0.150)	(0.182)
Dep. var. mean	9.7	3.01	14.14	24.04	5.49	9.05	12.85	21.72
Dep. var. std. dev.	5.94	3.41	6.48	8.97	5.82	5.82	7.28	8.09
R-Squared	0.656	0.617	0.671	0.653	0.72	0.587	0.625	0.572
Observations	261,318	261,318	261,318	261,318	261,318	261,318	261,318	261,318
Households	15622	15622	15622	15622	15622	15622	15622	15622
Balanced Households	966	966	966	966	966	966	966	966

Note: Each column shows the impact of dollar store entry on a different dependent variable for low-access households using household-quarter level IRI data for 2008 through 2018. The dependent variable in each column is the share of total expenditure spent on a given product category by a household (in percentage points), and each column uses the same sample. The estimated coefficients across Columns (1) through (8) should add up 0. Robust standard errors clustered at the zip level are in parentheses.

4.3 Impact on Nutrition

While we find limited evidence of substitution between perishable and non-perishable products and across product groups, this only looks at broad allocations of expenditure to product groups motivated by a lack of or more limited availability at dollar stores. There is still plenty of scope for within product category substitutions to impact nutrition, especially for categories like snacks and desserts that have a wide range of nutritional quality of products. I calculate HEI scores of household purchases across all retailers. This measure is not impacted by price changes like expenditure share measures. To address concerns with decaying data match rates in years outside of 2015, in Appendix Tables 25 and 26 I look for differential changes in overall calories, share of expenditure matched to the nutrition data, and cost per kilocalorie with respect to dollar entry as robustness checks.

First I provide the results for the impact of dollar store entry on Healthy Eating Index (HEI) scores for all households and the various subsets. I provide one table with a traditional HEI score in Table 8 and a linearized version of the HEI score in 9. I see some evidence of changes in both HEI score measures for low-access households, in both cases of about 0.03 standard deviations, or about 5% of the gap between high and low-income households. This is a small but seemingly sensible amount for the impact of a single dollar store entry. Notably, in the linear specification there is also an impact for all households but a relatively well-measured 0 for low-income households. There are also noisy decreases for first entry and non-metro households. See Appendix Figure 8 to see event study plots for HEI score.

Table 8: Impact on Healthy Eating Index (HEI) Scores and Nutrition Measures

	All	Low Income	Low Access	First Dollar Entry	Non-Metro County
	(1)	(2)	(3)	(4)	(5)
Post Entry	-0.049	0.053	-0.319*	-0.095	-0.088
	(0.044)	(0.103)	(0.188)	(0.084)	(0.125)
Dep. var. mean	52.06	50.42	50.45	52.39	50.58
Dep. var. std. dev.	11.01	11.02	10.75	11.1	10.76
R-Squared	0.583	0.624	0.635	0.586	0.611
Observations	2,339,419	461,903	261,318	1,977,839	276,237
Households	128386	27161	15622	118923	15644
Balanced Households	14007	2983	966	3904	2091

Note: Each column shows the impact of dollar store entry on Healthy Eating Index Score (higher is more nutritious) for a different group of households using household-quarter level IRI data for 2008 through 2018. The "All" subset contains all households in the data. Low-Income in Column (2) includes households with average income below $30,000. Low-Access in Column (3) are households with no supermarket in their zip code in 2007 prior to the start of the data. The "First Entry" subset are households whose entry event is the first dollar store to enter their zip code. Lastly, Column (5) contains households living in non-metro (rural) counties. Robust standard errors clustered at the zip level are in parentheses.

Table 9: Impact on Linearized Healthy Eating Index (HEI) Scores and Nutrition Measures

	All	Low Income	Low Access	First Dollar Entry	Non-Metro County
	(1)	(2)	(3)	(4)	(5)
Post Entry	-0.182**	-0.023	-0.713*	-0.189	-0.259
	(0.090)	(0.210)	(0.396)	(0.169)	(0.270)
Dep. var. mean	53.52	50.97	51.1	54.47	50.78
Dep. var. std. dev.	20.12	20.1	19.46	20.33	19.43
R-Squared	0.456	0.508	0.521	0.461	0.491
Observations	2,339,419	461,903	261,318	1,977,839	276,237
Households	128386	27161	15622	118923	15644
Balanced Households	14007	2983	966	3904	2091

Note: Each column shows the impact of dollar store entry on the Linearized Healthy Eating Index Score (higher is more nutritious) for a different group of households using household-quarter level IRI data for 2008 through 2018. The "All" subset contains all households in the data. Low-Income in Column (2) includes households with average income below $30,000. Low-Access in Column (3) are households with no supermarket in their zip code in 2007 prior to the start of the data. The "First Entry" subset are households whose entry event is the first dollar store to enter their zip code. Lastly, Column (5) contains households living in non-metro (rural) counties. Robust standard errors clustered at the zip level are in parentheses.

Given the patterns in product substitution in the previous section, this result seems somewhat surprising. To understand why HEI may be changing for low-access households, We look at how dollar store entry impacts each of the 13 components that factor in HEI score, each of which is normalized.[51] Generally these are nutrition density measures (i.e. amounts per calorie purchased) or measures as a percent of energy. Table 10 includes positive nutrition characteristics where a higher amount is better for nutrition and Table 11 includes moderating factors where a higher amount is worse for nutrition. There are three positive components that show decreases of about 0.03 to 0.04 standard deviations; dark greens and beans, protein, and the fat ratio. We see that in Column (1) total vegetable servings did not change, but the amount of dark green vegetable and legume servings did, hence this is consistent with no overall effect in produce expenditure share. In Column (7) we see a decrease in total ounces of protein per kilocalorie, which makes sense if households are reducing meat purchases as seen in Table 7. Lastly, we see a decrease in the fat ratio in Column (9), which is the ratio of "good fats" to "bad fats",[52] which likely has significant variation within product category. There is a positive

[51] Variation in mean and standard deviation across sample leads to means and standard deviations that vary from 0 and 1, respectively.

[52] The numerator contains polyunsaturated and monounsaturated fatty acids (PUFA and MUFAS) while the denominator contains saturated fats.

impact on servings of dairy products of a similar magnitude that mitigates nutrition effects. For moderating components, there is an increase in the servings of refined grain servings being purchased, even as whole grain servings remain constant. Refined grains are associated with the snacks category, but also bread products and other items not broken out in my expenditure category groups.

Table 10: Impact of Dollar Store Entry on Healthy Eating Index (HEI) Components (normalized), Low-Access Households

	(1) Vegetable	(2) Green/Bean	(3) Fruit	(4) Whole Fruit	(5) Whole Grain	(6) Dairy	(7) Protein	(8) Sea/Plant	(9) Fat Ratio
Post Entry	0.013	-0.030*	-0.005	-0.005	0.002	0.026*	-0.039**	-0.022	-0.027*
	(0.018)	(0.018)	(0.017)	(0.016)	(0.018)	(0.016)	(0.018)	(0.018)	(0.016)
Dep. var. mean	-.05	-.08	-.1	-.09	-.1	-.07	-.05	-.05	0
Dep. var. std. dev.	.81	.73	.75	.77	.81	.87	.86	.84	.84
R-Squared	0.584	0.525	0.631	0.599	0.59	0.626	0.551	0.541	0.521
Observations	261,318	261,318	261,318	261,318	261,318	261,318	261,318	261,318	261,318
Households	15622	15622	15622	15622	15622	15622	15622	15622	15622
Balanced Households	966	966	966	966	966	966	966	966	966

Note: Each column is a nutrition density measure (servings per calorie) that positive contributes to better nutrition (higher is good). Each variable is normalized to be interpreted in standard deviation changes. Vegetable refers to total servuings of vegetable while Green/Bean refers to dark greens and legumes specifically. Fruit in Column (3) refers to total servings of fruit. The fat ratio is the ratio between good fats (monounsaturated fatty acids and polyunsaturated fatty acids) and bad fats (saturated fat).

Table 11: Impact of Dollar Store Entry on Healthy Eating Index (HEI) Components (normalized), Low-Access Households

	(1) Sodium	(2) Refined Grain	(3) Added Sugar	(4) Saturated Fat
Post Entry	0.011	0.037**	0.016	0.017
	(0.019)	(0.018)	(0.021)	(0.017)
Dep. var. mean	-.04	-.01	.1	-.04
Dep. var. std. dev.	.78	.89	.96	.9
R-Squared	0.34	0.52	0.555	0.596
Observations	261,318	261,318	261,318	261,318
Households	15622	15622	15622	15622
Balanced Households	966	966	966	966

Note: Each column is a nutrition density measure (servings per calorie or percent of energy) that negatively contributes to better nutrition (higher is worse). Each variable is normalized to be interpreted in standard deviation changes.

4.4 Mechanisms and Descriptive Changes in the Retail Environment

While a dollar store entry is plausibly uncorrelated with sudden changes in demand of an individual household, dollar store entry is not random and could be correlated a variety of other phenomena. Dollar store entry could coincide with the entry of other stores that are all targeting areas of high demand or clustering in shopping centers, or dollar store entry could be a response to or a cause of nearby store exit. While it would be unlikely to see these changes line up exactly with dollar store entry, they could impact these results calculated over a three-year window. This section seeks to explore if anything else is changing when a dollar store enters other than dollar store entry that could be contributing to the estimated effects. Specifically, we look at the patterns in entry of dollar stores, small grocery stores, and supermarkets to see how

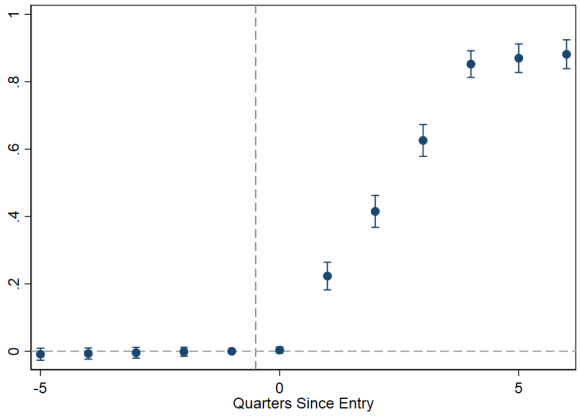
these correlate with dollar store entry we have defined.[53]

In Figure 6 we show the event study for the relationship between dollar store entry and the number of dollar stores, small grocery stores, and supermarkets. In Subfigure 6a the number of dollar stores increases from 0 to close to 1 mechanically for both high and low-income households. In the Nielsen TDLinx data the number of stores is measured at an annual frequency while date of entry is measured at the quarterly level, hence this effect takes four quarters to phase in. It does not appear that there are many cases where multiple dollar stores open in a zip code at the same time, and there is only a small amount of net addition of dollar stores in the year and a half after a new one enters. In Subfigures 6b and 6c we look at changes in number of small grocery stores and supermarkets (defined as large grocery, supercenters, and wholesale/club stores). This provides evidence that when dollar stores enter, the impacts on the number of small grocery stores and supermarkets in the short run are small overall given that households have on average over 3 supermarkets per zip code. This suggests that when considering a dollar store entry, the main factor changing for households in the short term is the entry of the dollar store and not a change in the presence of other stores.

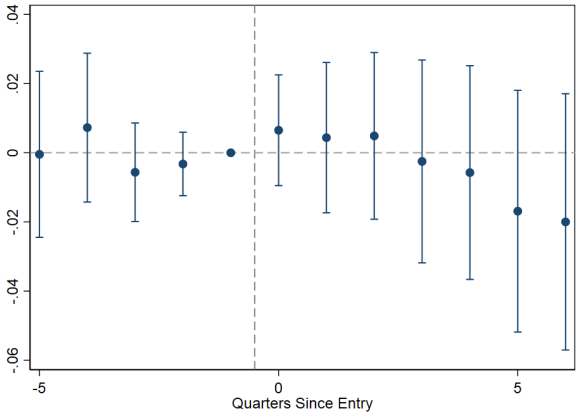
[53] We intend to look at distance to the nearest store by channel and other store characteristics but have not yet done so.

Figure 6: Impact of Dollar Store Entry on the Number of Stores, Low-Access Households

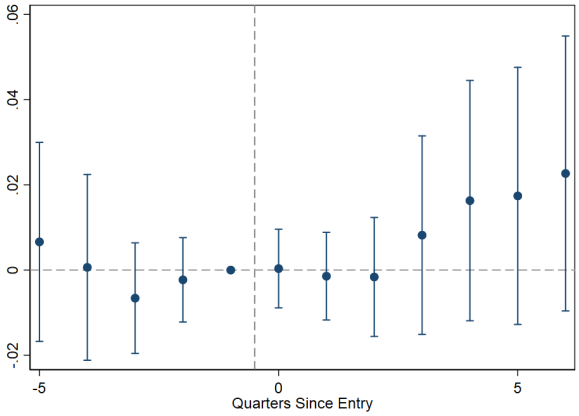
(a) Number of Dollar Stores



(b) Number of Small Grocery Stores



(c) Number of Supermarkets



Note: The y-axis shows the change in the number of stores. The x-axis shows event time where the dollar store enters at q=0. Error bars show 95% confidence intervals. Estimates are normalized relative to q=-1.

5 Conclusion

We measure the impact of dollar store entry on household store choice, product expenditure decisions, and nutrition. We find evidence that dollar stores take market share from other stores and change the composition of a household's overall food purchases. The magnitude of these effects are larger for certain household groups, including low-income households, low-access households, households experiencing their first dollar entry, and households living in non-metro areas. Furthermore, we find some evidence that dollar stores impact nutrition, particularly for low-access households that experience the largest expenditure shifts to dollar stores. We find these effects despite the fact that dollar store expenditure represents a small fraction of most household's overall food expenditure and trips.

Further work should consider ways to break down the mechanisms driving these household store choices and product choice decisions by looking at distances, prices, and other important factors. Further work should also try to quantify the benefits of dollar stores. The shift in expenditure to dollar stores and their close proximity to many households indicates that these stores could have welfare benefits, particularly for households of interest that are low-income or living in low-access areas. This work also has no ability of quantifying any procompetitive effects of dollar stores, which could also have significant benefits or harm to households by changing prices or driving out other store options with greater product variety.

This work occurs against a backdrop where thousands of dollar stores enter every year, local governments are regulating the entry of new dollar stores, and dollar stores chains are making aggresive expansions of food distribution capabilities and product offerings to compete more directly with bigger grocery retailers. Understanding the way in which households use dollar stores to shop will be important in understanding the consequences of these changes to the grocery retail sector on nutrition, food access, and consumer welfare.

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A Acronyms and Definitions

- Dollar Store: a store that is part of the national brands Dollar General, Dollar Tree, and Family Dollar. This includes over 90% of stores in the general defintion of dollar stores. Dollar stores have low price points, small store formats, and a wide variety of products.
- First Entry Households: households whose first dollar store entry during the 2009-2018 data period is also the first dollar store to enter their zip code
- HEI Score: Healthy Eating Index score, which is a measure of nutrition from 0 to 100 where 100 is the most nutritious score. The measure is a weighted average of 13 nutrient components, 9 good components and 4 moderating components.
- High-Quality Stores: grocery food retailers and supermarkets (large grocery stores, mass merchandisers, and wholesale/club stores) that are large stores with good product variety especially for perishable and nutritious food categories like produce, meat, and dairy
- Grocery Store: traditional food retailers that specialize in the sale of food and have a broad set of food product offerings. This includes small grocers through large supermarkets
- Low-Quality Stores: small, non-grocery food retailers that have limited product selection. These include convenience stores, drug stores, and dollar stores. Often their selection does not include important product categories like fresh produce and meat and otherwise a limited selection of perishable and healthy foods.
- Mass Merchandiser: large discount retailers that are not traditional grocery stores. These include chains like Walmart, Target, K-Mart, etc.
- Not Dry Products: equivalent to perishable products, see definition below
- Other Store: includes drug stores, convenience stores, other dollar stores (not Dollar General, Dollar Tree, or Family Dollar), and miscellaneous food retailers
- Perishable Products: products that are not shelf stable and either go bad relatively quickly or require refrigeration. This includes meat, dairy, and fresh produce, refrigerated and frozen products, and many other products that often exist in the produce section or coolers along the outside walls of a traditional grocery store.
- Produce: fruits and vegetables, can include fresh produce and shelf stable varieties like frozen and canned
- Store Channel: a particular type of food retailer. The first categorization of store channels in this paper for IRI household trips and expenditure data are dollar store, grocery store, mass merchandiser, wholesale / club store, and other, where other is composed of other dolalr stores not part of the three large national chains, drug stores, convenience stores, and miscellaneous uncategorized. For the TDLinx store data, in some cases grocery stores are divided into small grocery stores and large grocery stores.
- Supermarket: refers to a combination of large grocery stores (including what are commonly referred to as "supermarkets"), mass merchandisers (including supercenters), and wholesale / club stores. This follows the categorization made in Allcott et al. (2019).
- Wholesale / Club Store: stores that often have membership fees and are more likely to sell products in bulk. These include chains like Costco, Sam's Club, and BJ's

B Cumulative Entry Estimation Strategy

While the event study framework utilizes sudden changes very close to the entry event for identification, it imposes strict data requirements and doesn't address the impact of multiple entries, which is particularly important for dollar stores. Therefore, we complement the event study framework with a regression strategy similar to Allcott et al. (2019) to consider the impact of cumulative dollar store entry (D_{zt}) since the start of my data in 2008. This framework imposes significantly less data requirements than my event study analysis but is more vulnerable to identification challenges associated with other long-term changes unrelated to but correlated with dollar store entry. We again allow the effect of dollar store entry to be different amongst high and low-income households. We do not distinguish whether a dollar store entry occurring after 2008 is the first dollar store entry in that zip code or not, but we do allow the effect of the first entry since 2008 ($[D = 1]_{zt}$) and later entries ($[D \geq 2]_{zt}$) to vary. In Appendix Figure 3we show that about 50% of households experienced a dollar store entry in their zip code and about 20% experienced more than one. For household i in quarter t and zip z,we estimate the following

$$\begin{aligned} Y_{izt} = \tau_1[D_{zt} = 1]LowInc_i + \tau_2[D_{zt} \geq 2]LowInc_i \\ + \lambda_1[D_{zt} = 1] + \lambda_2[D_{zt} \geq 2] + \gamma X_{it} + \mu_{d(z)t} + \phi_{iz} + \epsilon_{izt} \end{aligned} \tag{2}$$

In this regression, τ_1 and τ_2 represent the differential impact of dollar store entry between low-income households and high income households, and $\tau_1 + \lambda_1$ and $\tau_2 + \lambda_2$ represents the overall impact of dollar stores on low-income households. The covariates and fixed effects in this regression are similar to the event study, except that a household-zip fixed effect ϕ_{iz} is included to control for households that move across zip codes during the study period.

We also perform this analysis for a subset of households that have less access to grocery retail stores. We define a "food desert" sample as households with no supermarket in their zip code in 2007. Dollar stores are expected to be more competitive in areas with fewer nearby store substitutes. About 15% of households in the data fall into this categorization.

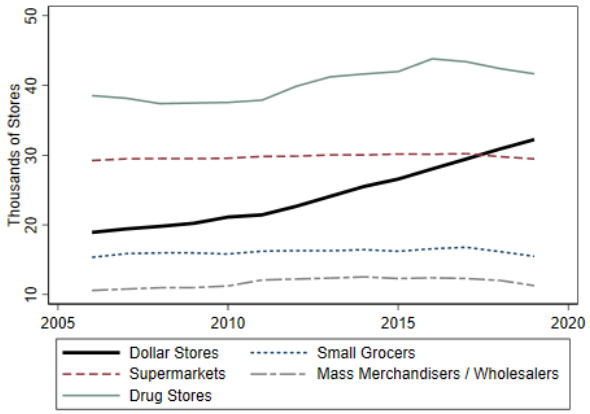
C Data Appendix

D Appendix Figures and Tables

D.1 Appendix Figures

D.1.1 Summary Figures

Figure 1: Number of Food Stores by Channel

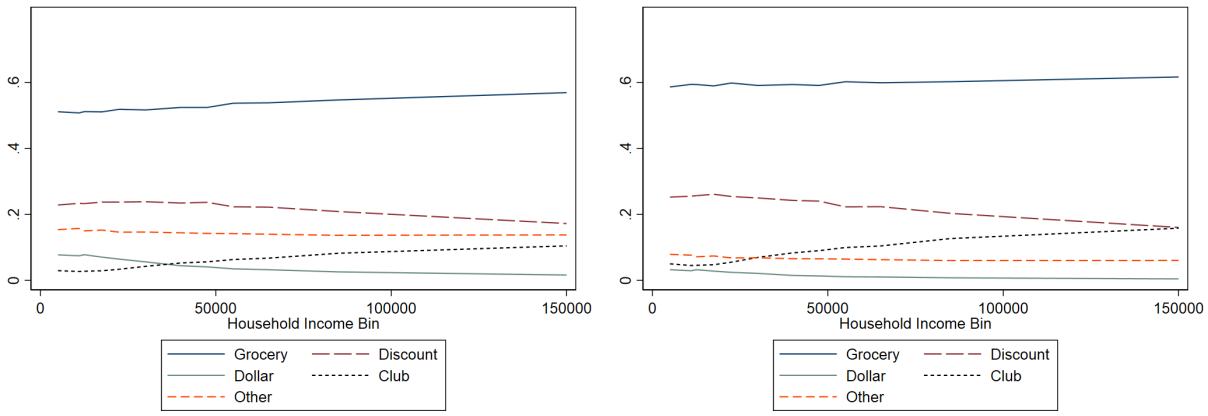


Notes: Data from Nielsen TDLinx.

Figure 2: Channel Trip and Expenditure Share by Store Channel and Household Income (%)

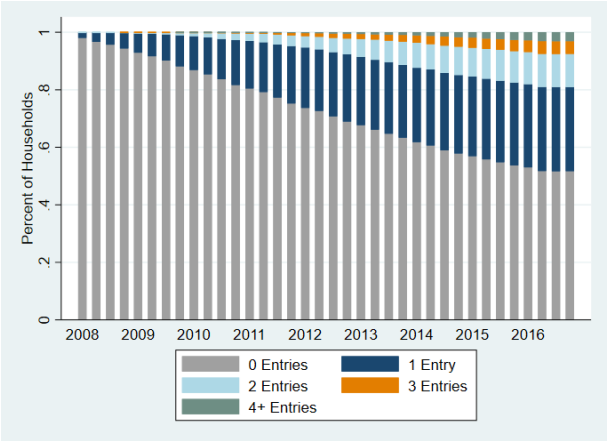
(a) Trip Share

(b) Expenditure Share



Notes: Data for households in the IRI Consumer Panel in the year 2015. Here 0.6 means 60% of household trips or expenditure share. Trips are all trips with at least one food item categorized in IRI data. Expenditure is for food purchases at food-at-home retailers.

Figure 3: Percent of Households by Number of Dollar Store Entries Since 2008

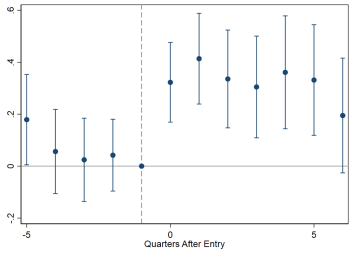


Notes: Data for households in the IRI Consumer Panel in the year 2015. Shows the percent of households in the data in a given quarter whose zip code has experienced a certain number of dollar store entries since 2008. In 2008, over 50% of households already had a dollar store in their zip code.

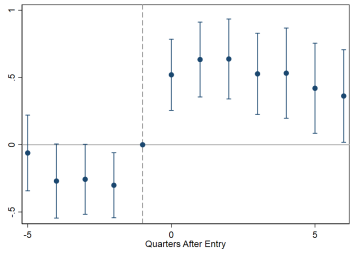
D.1.2 Expenditure and Trip Share

Figure 4: Impact of Dollar Store Entry on Dollar Store Expenditure Share and Trip Share

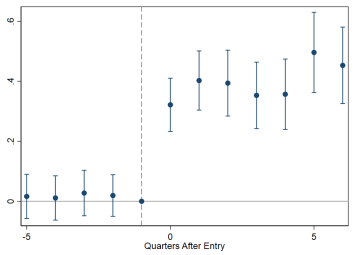
(a) Expenditure Share, Low-Income Households (percentage points)



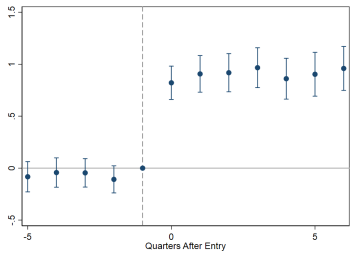
(b) Trip Share, Low-Income Households (percentage points)



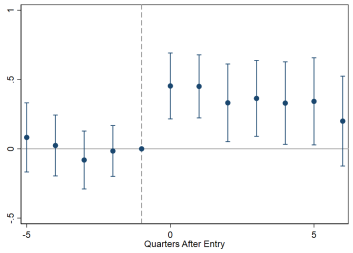
(c) Expenditure Share, First Entry Households (percentage points)



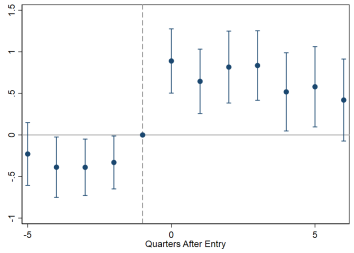
(d) Trip Share, First Entry Households (percentage points)



(e) Expenditure Share, Non-Metro Households (percentage points)



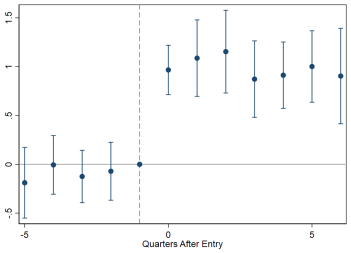
(f) Trip Share, Non-Metro Households (percentage points)



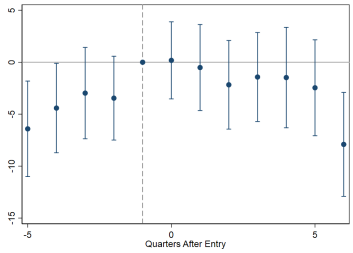
Note:

Figure 5: Impact of Dollar Store Entry on Dollar Store Expenditure and Total Expenditure

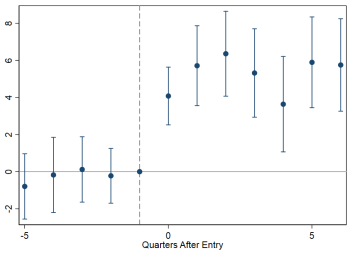
(a) Expenditure, All Households (percentage points)



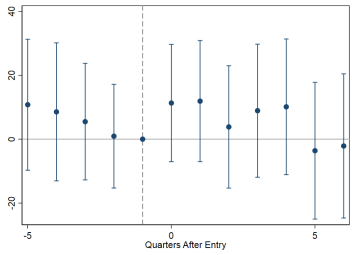
(b) Total Expenditure, All Households (percentage points)



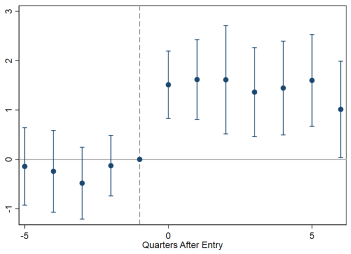
(c) Expenditure, Low-Access Households (percentage points)



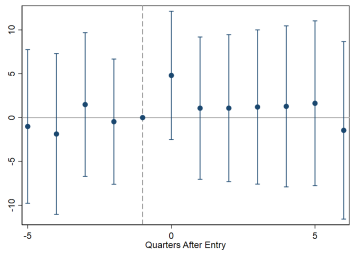
(d) Total Expenditure, Low-Access Households (percentage points)



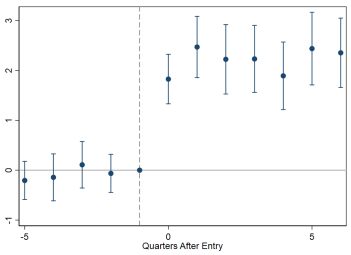
(e) Expenditure, Low-Income Households (percentage points)



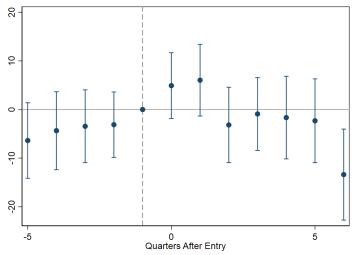
(f) Total Expenditure, Low-Income Households (percentage points)



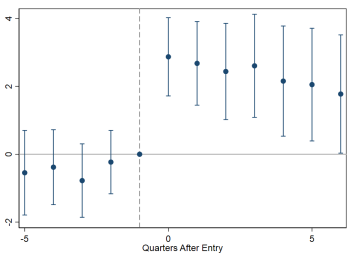
(g) Expenditure, First Entry Households (percentage points)



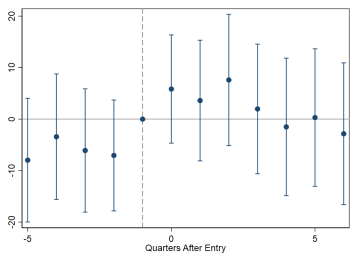
(h) Total Expenditure, First Entry Households (percentage points)



(i) Expenditure, Non-Metro Households (percentage points)



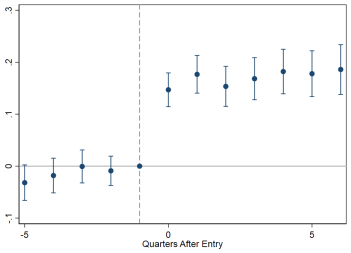
(j) Total Expenditure, Non-Metro Households (percentage points)



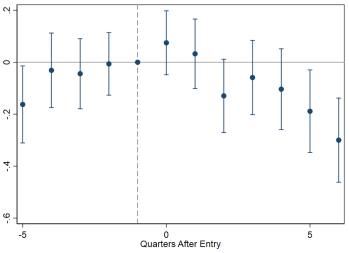
Note:

Figure 6: Impact of Dollar Store Entry on Dollar Store Trips and Total Trips

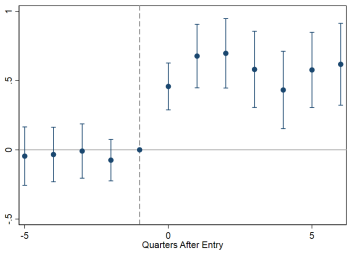
(a) Trips, All Households (percentage points)



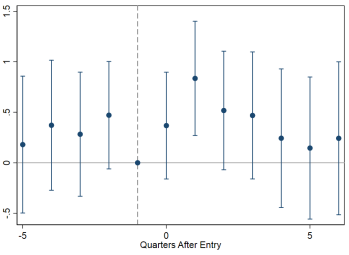
(b) Total Trips, All Households (percentage points)



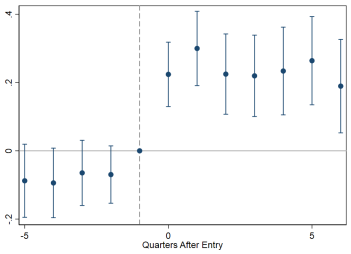
(c) Trips, Low-Access Households (percentage points)



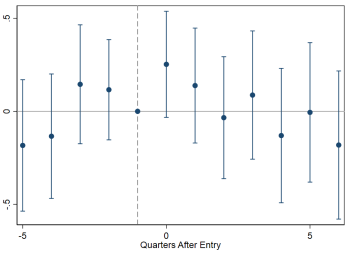
(d) Total Trips, Low-Access Households (percentage points)



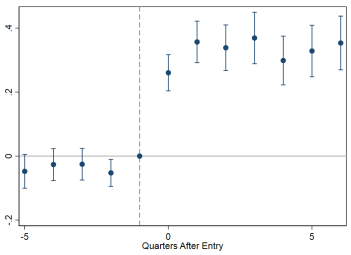
(e) Trips, Low-Income Households (percentage points)



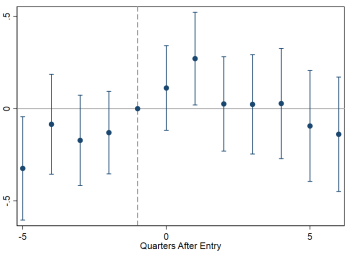
(f) Total Trips, Low-Income Households (percentage points)



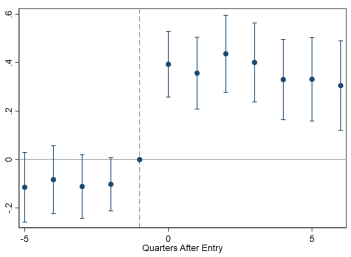
(g) Trips, First Entry Households (percentage points)



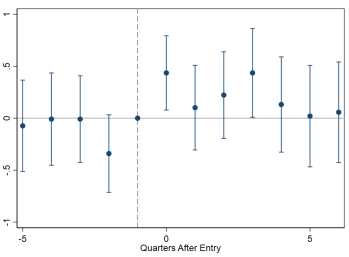
(h) Total Trips, First Entry Households (percentage points)



(i) Trips, Non-Metro Households (percentage points)



(j) Total Trips, Non-Metro Households (percentage points)

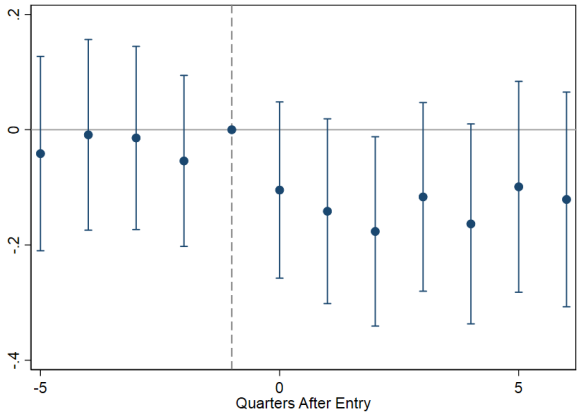


Note:

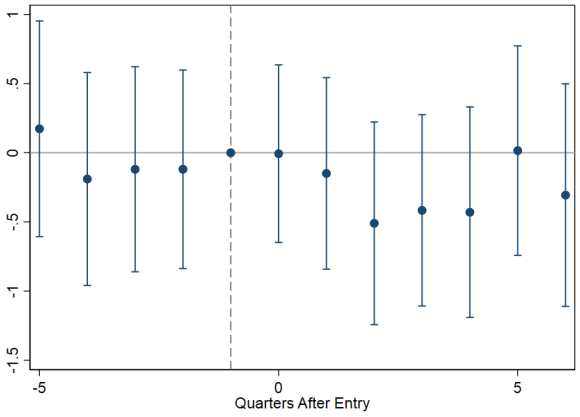
D.1.3 Product Composition

Figure 7: Impact of Dollar Store Entry on Perishable Product Expenditure Share (Across All Retailers)

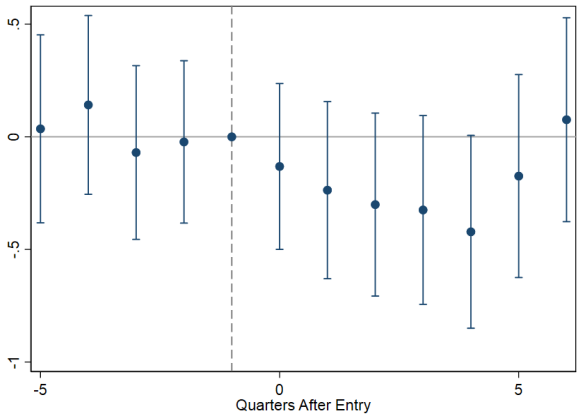
(a) All Households



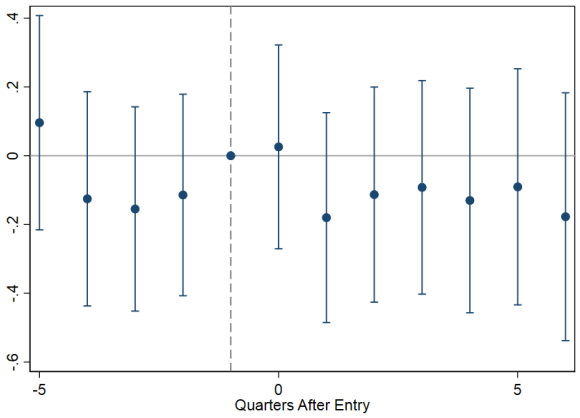
(b) Low-Access Households



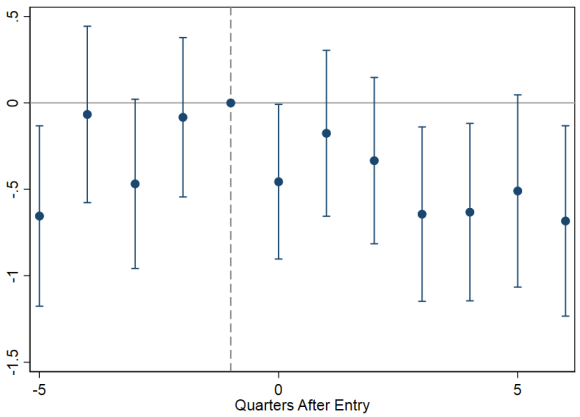
(c) Low-Income Households



(d) First Entry Households



(e) Non-Metro Households

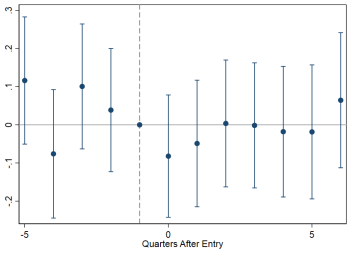


Note: Perishable product expenditure share is the percent of all food expenditure spent on perishable products. This is for the entire set of household expenditure, not for a particular store type.

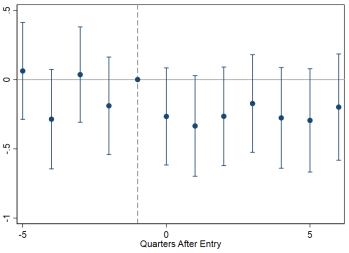
D.1.4 Nutrition

Figure 8: Impact of Dollar Store Entry on HEI Score and Linearized HEI Score

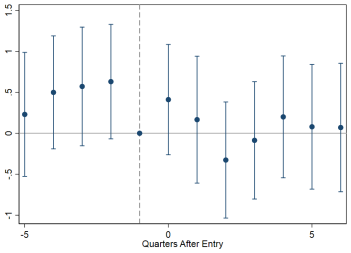
(a) HEI Score, All Households



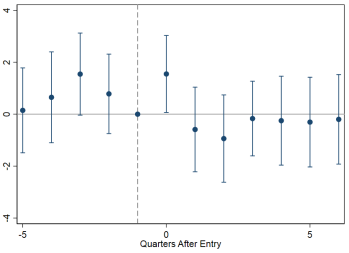
(b) Linear HEI Score, All Households



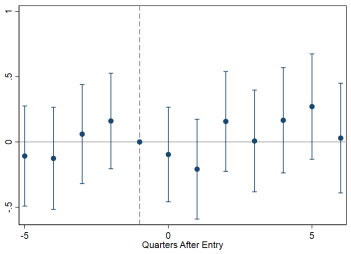
(c) HEI Score, Low-Access Households



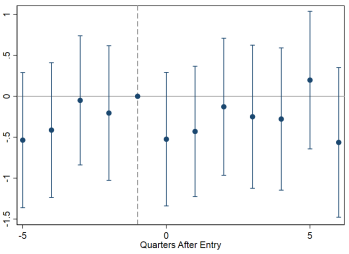
(d) Linear HEI Score, Low-Access Households



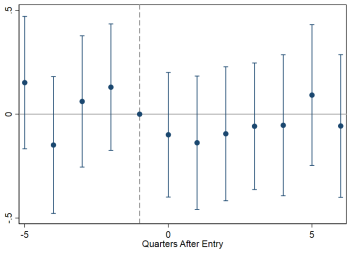
(e) HEI Score, Low-Income Households



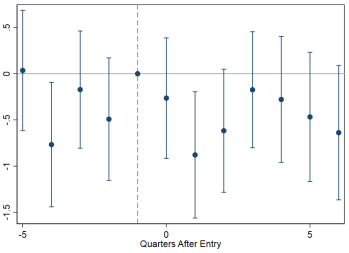
(f) Linear HEI Score, Low-Income Households



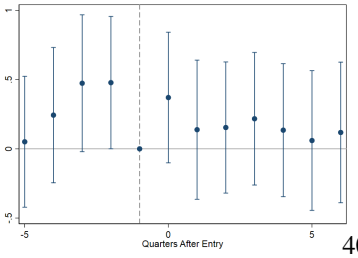
(g) HEI Score, First Entry Households



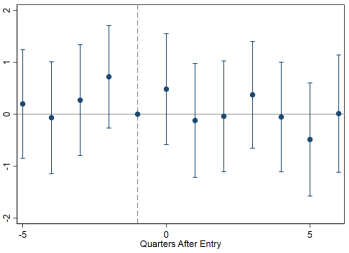
(h) Linear HEI Score, First Entry Households



(i) HEI Score, Non-Metro Households



(j) Linear HEI Score, Non-Metro Households

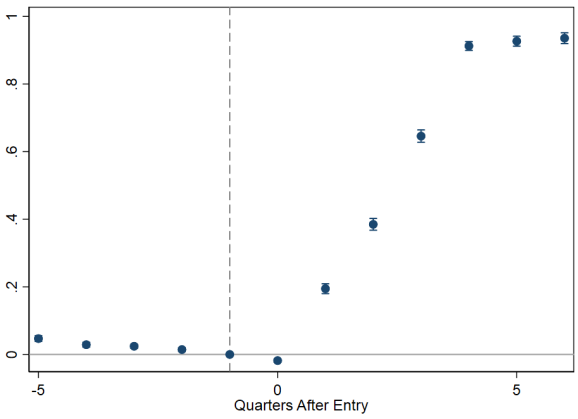


Note:

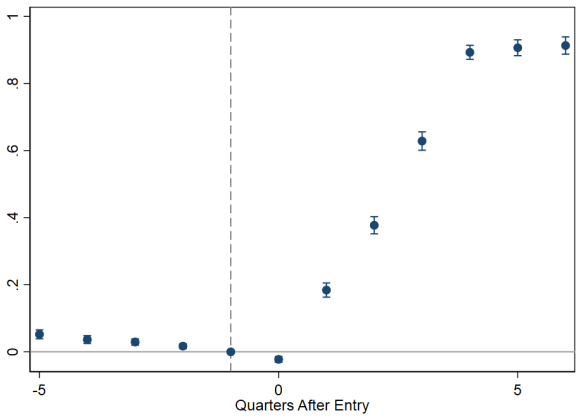
D.1.5 Mechanisms and Store Entry

Figure 9: Impact of Dollar Store Entry on the Number of Dollar Stores

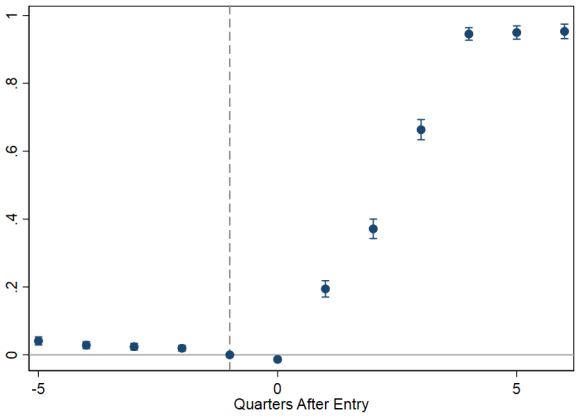
(a) All Households



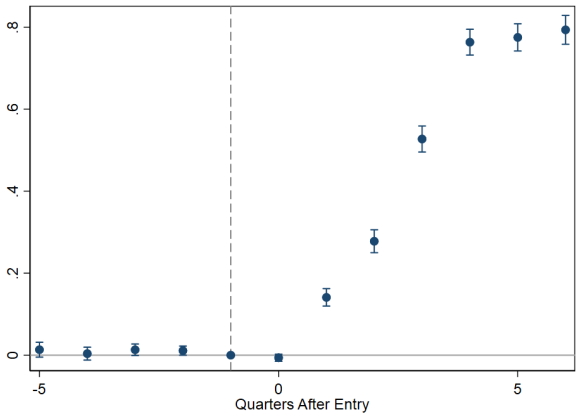
(b) Low-Income Households



(c) First Entry Households



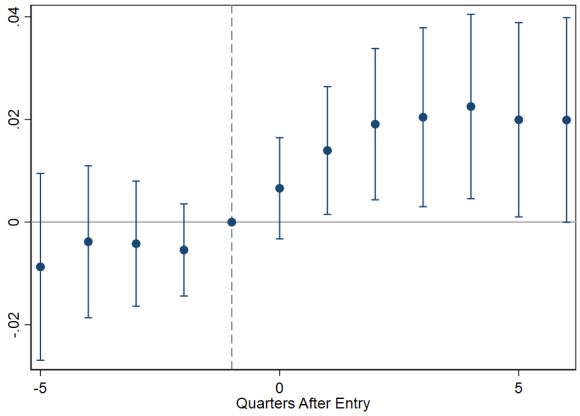
(d) Non-Metro Households



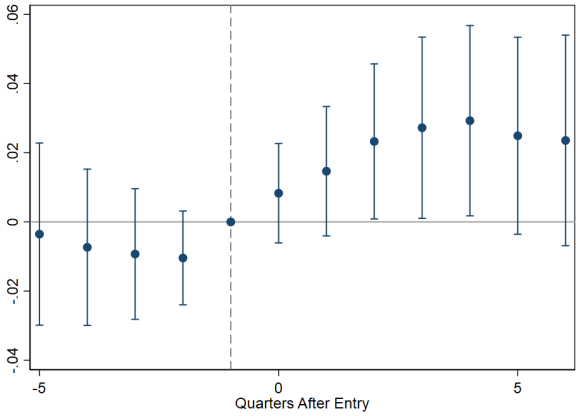
Note:

Figure 10: Impact of Dollar Store Entry on the Number of Small Grocery Stores

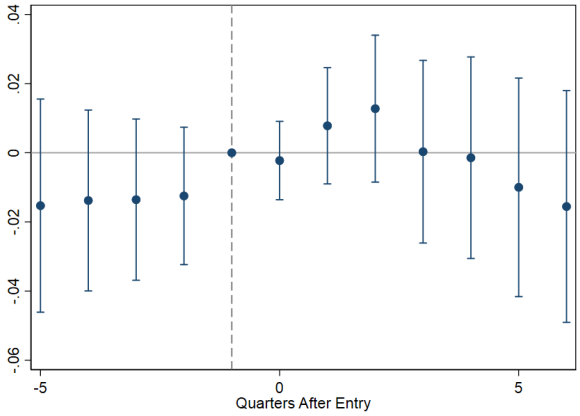
(a) All Households



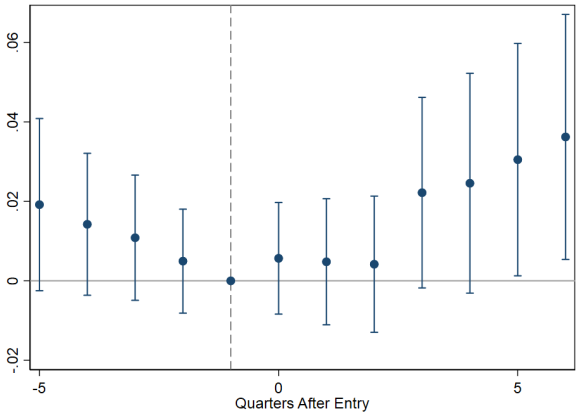
(b) Low-Income Households



(c) First Entry Households



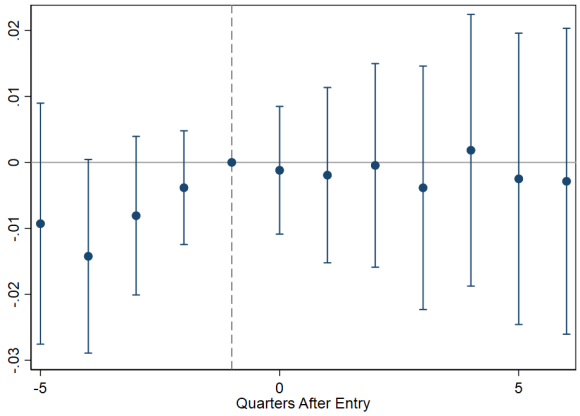
(d) Non-Metro Households



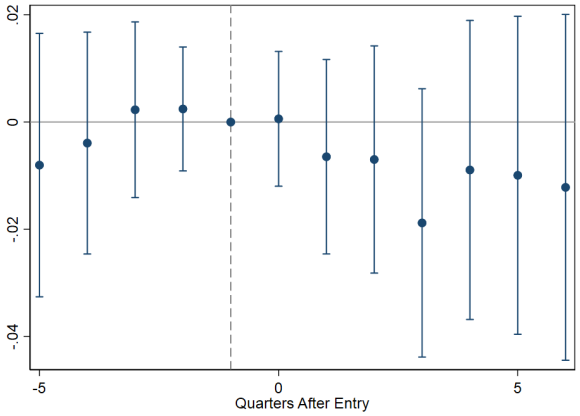
Note:

Figure 11: Impact of Dollar Store Entry on the Number of Supermarkets

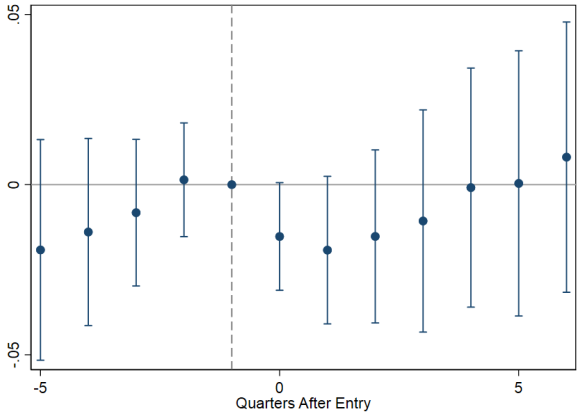
(a) All Households



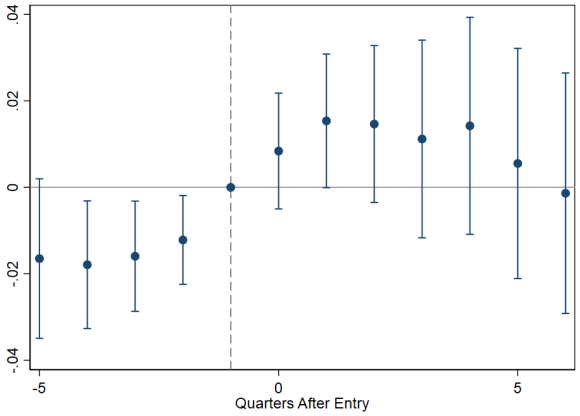
(b) Low-Income Households



(c) First Entry Households



(d) Non-Metro Households



Note:

D.2 Appendix Tables

D.2.1 Expenditure and Trip Share

Table 1: Impact of Dollar Store Entry on Expenditure Share: Heterogeneity Within Low-Income Households

	(1)	(2)	(3)	(4)	(5)	(6)
		First Entry	Low-Access	High Poverty Zip	Large Hhold	Has Vehicle
Post Entry	0.256***	0.137*	0.205***	0.148**	0.254***	0.380***
	(0.067)	(0.078)	(0.067)	(0.075)	(0.072)	(0.143)
Post x Heterogeneity		0.510***	0.750**	0.400**	0.017	-0.133
		(0.153)	(0.338)	(0.161)	(0.178)	(0.173)
Dependent variable mean	2.16	2.16	2.16	2.16	2.16	2.14
Dependent variable standard deviation	5.53	5.53	5.53	5.53	5.53	5.41
R-Squared	0.691	0.691	0.691	0.691	0.691	0.675
Observations	461,903	461,903	461,903	461,903	461,903	271,167
Households	27161	27161	27161	27161	27161	11883
Balanced Households	2983	2983	2983	2983	2983	2025
Balanced, Low-Income Households	2983	2983	2983	2983	2983	2025
Balanced, Heterogeneity Households		674	206	779	471	1309
Balanced, Low-Income, Heterogeneity Hholds		674	206	779	471	1309

Note:

Table 2: Cumulative Entry Model: Impact of Dollar Store Entry on Expenditure Share

	(1)	(2)	(3)	(4)	(5)
	All	Low Income	Low Access	First Dollar Entry	Non-Metro County
First Entry	0.223***	0.337***	0.736***	0.360***	0.528***
	(0.022)	(0.066)	(0.128)	(0.040)	(0.104)
Two or More Entries	0.391***	0.546***	1.313***	0.573***	0.381**
	(0.041)	(0.127)	(0.365)	(0.074)	(0.192)
Dep. Var. Mean	1.29	2.35	1.74	.8300000000000001	2.34
Dep. Var. Standard Deviation	4.65	6.61	5.71	3.57	6.45
Household*Zip, County*Quarter FE	Yes	Yes	Yes	Yes	Yes
Household Income and Size FE	Yes	Yes	Yes	Yes	Yes
Household, Zip Clustering	Yes	Yes	Yes	Yes	Yes
R-Squared	0.66	0.704	0.744	0.651	0.711
Observations	2,515,429	498,662	292,753	918,772	407,144
Households	138833	29682	17740	52847	23508
Low-Income Households	30484	29682	3984	9753	7277

Note:

Table 3: Cumulative Entry Model: Impact of Dollar Store Entry on Trip Share

	(1)	(2)	(3)	(4)	(5)
	All	Low Income	Low Access	First Dollar Entry	Non-Metro County
First Entry	0.567***	0.763***	1.612***	0.871***	1.210***
	(0.036)	(0.103)	(0.216)	(0.065)	(0.164)
Two or More Entries	0.901***	1.017***	2.681***	1.360***	1.154***
	(0.064)	(0.183)	(0.496)	(0.131)	(0.287)
Dep. Var. Mean	3.55	5.83	4.68	2.38	5.98
Dep. Var. Standard Deviation	8.07	10.6	9.710000000000001	6.49	10.58
Household*Zip, County*Quarter FE	Yes	Yes	Yes	Yes	Yes
Household Income and Size FE	Yes	Yes	Yes	Yes	Yes
Household, Zip Clustering	Yes	Yes	Yes	Yes	Yes
R-Squared	0.7	0.744	0.769	0.697	0.746
Observations	2,515,429	498,662	292,753	918,772	407,144
Households	138833	29682	17740	52847	23508
Low-Income Households	30484	29682	3984	9753	7277

Note:

Table 4: Breakdown of Expenditure Share and Trip Share Changes, All Households

	Expenditure			Trips		
	(1)	(2)	(3)	(4)	(5)	(6)
	Dollar Store Exp.	Total Exp.	Exp. Share	Dollar Store Trips	Total Trips	Trip Share
Post Entry	0.969***	0.269	0.157***	0.163***	-0.077	0.417***
	(0.117)	(1.403)	(0.021)	(0.015)	(0.048)	(0.036)
Dependent variable mean	6.58	644.91	1.24	1.26	24.84	3.73
Dependent variable standard deviation	26.74	366.17	4.08	3.09	13.2	7.81
R-Squared	0.642	0.719	0.643	0.709	0.742	0.688
Observations	2,339,419	2,339,419	2,339,419	2,339,419	2,339,419	2,339,419
Households	128386	128386	128386	128386	128386	128386
Balanced Households	14007	14007	14007	14007	14007	14007

Note:

Table 5: Breakdown of Expenditure Share and Trip Share Changes, Low-Income Households

	Expenditure			Trips		
	(1)	(2)	(3)	(4)	(5)	(6)
	Dollar Store Exp.	Total Exp.	Exp. Share	Dollar Store Trips	Total Trips	Trip Share
Post Entry	1.512***	1.245	0.256***	0.274***	-0.011	0.658***
	(0.288)	(3.083)	(0.067)	(0.043)	(0.111)	(0.102)
Dependent variable mean	9.96	536.86	2.16	2.05	25.2	6
Dependent variable standard deviation	26.72	306.68	5.53	4.17	13.77	10.09
R-Squared	0.694	0.728	0.691	0.751	0.773	0.733
Observations	461,903	461,903	461,903	461,903	461,903	461,903
Households	27161	27161	27161	27161	27161	27161
Balanced Households	2983	2983	2983	2983	2983	2983

Note:

Table 6: Breakdown of Expenditure Share and Trip Share Changes, First Entry Households

	Expenditure			Trips		
	(1)	(2)	(3)	(4)	(5)	(6)
	Dollar Store Exp.	Total Exp.	Exp. Share	Dollar Store Trips	Total Trips	Trip Share
Post Entry	2.174***	1.574	0.368***	0.345***	0.155*	0.927***
	(0.258)	(2.628)	(0.042)	(0.029)	(0.090)	(0.071)
Dependent variable mean	5.31	660.86	.97	.96	24.77	2.86
Dependent variable standard deviation	21.05	367.31	3.6	2.68	13.29	6.97
R-Squared	0.665	0.722	0.657	0.718	0.745	0.697
Observations	1,977,839	1,977,839	1,977,839	1,977,839	1,977,839	1,977,839
Households	118923	118923	118923	118923	118923	118923
Balanced Households	3904	3904	3904	3904	3904	3904

Note:

Table 7: Breakdown of Expenditure Share and Trip Share Changes, Non-Metro Households

	Expenditure			Trips		
	(1)	(2)	(3)	(4)	(5)	(6)
	Dollar Store Exp.	Total Exp.	Exp. Share	Dollar Store Trips	Total Trips	Trip Share
Post Entry	2.467***	5.696	0.336***	0.400***	0.188	0.884***
	(0.524)	(3.877)	(0.099)	(0.059)	(0.139)	(0.151)
Dependent variable mean	11.61	635.55	2.24	2.03	24.87	6.07
Dependent variable standard deviation	32.02	334.86	6.02	3.88	13.09	10.33
R-Squared	0.71	0.737	0.686	0.743	0.771	0.728
Observations	276,237	276,237	276,237	276,237	276,237	276,237
Households	15644	15644	15644	15644	15644	15644
Balanced Households	2091	2091	2091	2091	2091	2091

Note:

D.2.2 Expenditure at Other Retailers

Table 8: Changes in Expenditure Share at Other Retailers, All Households (in percentage points)

	Dollar	Grocery	Mass Merch	Club	Other
	(1)	(2)	(3)	(4)	(5)
Post Entry	0.157***	-0.099	0.020	-0.060	-0.018
	(0.021)	(0.104)	(0.091)	(0.056)	(0.054)
Dep. var. mean	1.24	61.18	21.22	9.5	6.86
Dep. var. std. dev.	4.08	30.09	26.92	16.88	12.68
R-Squared	0.643	0.778	0.801	0.765	0.672
Observations	2,339,419	2,339,419	2,339,419	2,339,419	2,339,419
Households	128386	128386	128386	128386	128386
Balanced Households	14007	14007	14007	14007	14007

Note: Food category expenditure share is calculated across all household food expenditure at all retail types.

Table 9: Changes in Expenditure Share at Other Retailers, Low-Income Households (in percentage points)

	Dollar	Grocery	Mass Merch	Club	Other
	(1)	(2)	(3)	(4)	(5)
Post Entry	0.256***	0.182	-0.264	0.020	-0.194
	(0.067)	(0.261)	(0.229)	(0.111)	(0.166)
Dep. var. mean	2.16	61.51	23.7	5.02	7.61
Dep. var. std. dev.	5.53	30.47	28.73	12.39	13.27
R-Squared	0.691	0.796	0.821	0.749	0.676
Observations	461,903	461,903	461,903	461,903	461,903
Households	27161	27161	27161	27161	27161
Balanced Households	2983	2983	2983	2983	2983

Note: Food category expenditure share is calculated across all household food expenditure at all retail types.

Table 10: Changes in Expenditure Share at Other Retailers, Non-Metro Households (in percentage points)

	Dollar	Grocery	Mass Merch	Club	Other
	(1)	(2)	(3)	(4)	(5)
Post Entry	0.336***	-0.452	0.151	-0.161	0.125
	(0.099)	(0.307)	(0.297)	(0.132)	(0.155)
Dep. var. mean	2.24	52.23	34.81	4.95	5.77
Dep. var. std. dev.	6.02	31.9	32.18	11.56	10.98
R-Squared	0.686	0.82	0.832	0.725	0.679
Observations	276,237	276,237	276,237	276,237	276,237
Households	15644	15644	15644	15644	15644
Balanced Households	2091	2091	2091	2091	2091

Note: Food category expenditure share is calculated across all household food expenditure at all retail types.

Table 11: Changes in Expenditure Share at Other Retailers, First Entry Households (in percentage points)

	Dollar	Grocery	Mass Merch	Club	Other
	(1)	(2)	(3)	(4)	(5)
Post Entry	0.368***	-0.273	-0.082	0.035	-0.048
	(0.042)	(0.196)	(0.159)	(0.116)	(0.109)
Dependent variable mean	.97	62.75	17.7	11.84	6.74
Dependent variable standard deviation	3.6	28.87	24.41	19.07	11.84
R-Squared	0.657	0.779	0.803	0.769	0.675
Observations	1,977,839	1,977,839	1,977,839	1,977,839	1,977,839
Households	118923	118923	118923	118923	118923
Balanced Households	3904	3904	3904	3904	3904

Note: Food category expenditure share is calculated across all household food expenditure at all retail types.

Table 12: Changes in Trip Share at Other Retailers, All Households (in percentage points)

	Dollar	Grocery	Mass Merch	Club	Other
	(1)	(2)	(3)	(4)	(5)
Post Entry	0.417***	-0.160*	-0.135*	-0.027	-0.096
	(0.036)	(0.091)	(0.076)	(0.037)	(0.066)
Dependent variable mean	3.73	53.71	21.24	6.27	15.04
Dependent variable standard deviation	7.81	25	22.42	11.11	16.26
R-Squared	0.688	0.762	0.796	0.768	0.686
Observations	2,339,419	2,339,419	2,339,419	2,339,419	2,339,419
Households	128386	128386	128386	128386	128386
Balanced Households	14007	14007	14007	14007	14007

Note: Food category expenditure share is calculated across all household food expenditure at all retail types.

Table 13: Changes in Trip Share at Other Retailers, Low-Income Households (in percentage points)

	Dollar	Grocery	Mass Merch	Club	Other
	(1)	(2)	(3)	(4)	(5)
Post Entry	0.658***	0.145	-0.395**	0.046	-0.453**
	(0.102)	(0.224)	(0.186)	(0.072)	(0.180)
Dependent variable mean	6	52.48	22.1	3.23	16.19
Dependent variable standard deviation	10.09	25.62	23.68	7.94	17.5
R-Squared	0.733	0.785	0.82	0.755	0.721
Observations	461,903	461,903	461,903	461,903	461,903
Households	27161	27161	27161	27161	27161
Balanced Households	2983	2983	2983	2983	2983

Note: Food category expenditure share is calculated across all household food expenditure at all retail types.

Table 14: Changes in Trip Share at Other Retailers, Low-Access Households (in percentage points)

	Dollar	Grocery	Mass Merch	Club	Other
	(1)	(2)	(3)	(4)	(5)
Post Entry	1.414***	-0.034	-0.467	-0.146	-0.767***
	(0.223)	(0.432)	(0.400)	(0.154)	(0.298)
Dependent variable mean	6.32	48.87	25.89	5.37	13.56
Dependent variable standard deviation	11.17	25.85	23.79	9.96	15.7
R-Squared	0.761	0.807	0.831	0.792	0.729
Observations	261,318	261,318	261,318	261,318	261,318
Households	15622	15622	15622	15622	15622
Balanced Households	966	966	966	966	966

Note: Food category expenditure share is calculated across all household food expenditure at all retail types.

Table 15: Changes in Trip Share at Other Retailers, First Entry Households (in percentage points)

	Dollar	Grocery	Mass Merch	Club	Other
	(1)	(2)	(3)	(4)	(5)
Post Entry	0.927***	-0.421**	-0.272**	-0.035	-0.199
	(0.071)	(0.175)	(0.134)	(0.078)	(0.130)
Dependent variable mean	2.86	55.6	18.38	7.76	15.4
Dependent variable standard deviation	6.97	24.25	20.61	12.62	16.4
R-Squared	0.697	0.764	0.799	0.77	0.691
Observations	1,977,839	1,977,839	1,977,839	1,977,839	1,977,839
Households	118923	118923	118923	118923	118923
Balanced Households	3904	3904	3904	3904	3904

Note: Food category expenditure share is calculated across all household food expenditure at all retail types.

Table 16: Changes in Trip Share at Other Retailers, Non-Metro Households (in percentage points)

	Dollar	Grocery	Mass Merch	Club	Other
	(1)	(2)	(3)	(4)	(5)
Post Entry	0.884***	-0.292	-0.446*	-0.139*	-0.007
	(0.151)	(0.281)	(0.251)	(0.080)	(0.196)
Dependent variable mean	6.07	46.25	31.76	2.87	13.06
Dependent variable standard deviation	10.33	25.82	26.29	6.59	15.05
R-Squared	0.728	0.802	0.826	0.743	0.701
Observations	276,237	276,237	276,237	276,237	276,237
Households	15644	15644	15644	15644	15644
Balanced Households	2091	2091	2091	2091	2091

Note: Food category expenditure share is calculated across all household food expenditure at all retail types.

D.2.3 Marginal Purchases at Dollar Store

Table 17: Increase in Dollar Store Expenditure by Product Group, All Households

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Produce	Juice	Dairy	Snack / Dessert	Sugary Bev.	Meat	Meals	Other
Post Entry	0.041***	0.021**	0.068***	0.426***	0.086***	0.016	0.156***	0.155***
	(0.013)	(0.009)	(0.012)	(0.058)	(0.028)	(0.016)	(0.048)	(0.032)
Dep. var. mean	.27	.18	.24	3.12	.70	.13	.74	1.21
Dep. var. std. dev.	2.12	1.7	2.01	11.72	5.5	1.84	8.47	6.09
R-Squared	0.362	0.357	0.519	0.58	0.539	0.398	0.505	0.542
Observations	2,339,419	2,339,419	2,339,419	2,339,419	2,339,419	2,339,419	2,339,419	2,339,419
Households	128386	128386	128386	128386	128386	128386	128386	128386
Balanced Households	14007	14007	14007	14007	14007	14007	14007	14007

Table 18: Increase in Dollar Store Expenditure by Product Group, Low-Income Households

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Produce	Juice	Dairy	Snack / Dessert	Sugary Bev.	Meat	Meals	Other
Post Entry	0.027	0.046*	0.084***	0.760***	0.184**	0.056***	0.185***	0.169**
	(0.025)	(0.025)	(0.028)	(0.139)	(0.074)	(0.022)	(0.061)	(0.078)
Dep. var. mean	.4	.26	.37	4.64	1.09	.19	1.11	1.9
Dep. var. std. dev.	2.15	1.78	2.67	12.55	6.51	1.73	4.61	7.14
R-Squared	0.455	0.44	0.593	0.636	0.616	0.451	0.547	0.619
Observations	461,903	461,903	461,903	461,903	461,903	461,903	461,903	461,903
Households	27161	27161	27161	27161	27161	27161	27161	27161
Balanced Households	2983	2983	2983	2983	2983	2983	2983	2983

Table 19: Increase in Dollar Store Expenditure by Product Group, First Entry Households

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Produce	Juice	Dairy	Snack / Dessert	Sugary Bev.	Meat	Meals	Other
Post Entry	0.073**	0.043***	0.207***	0.904***	0.247***	0.071***	0.224***	0.405***
	(0.033)	(0.014)	(0.028)	(0.109)	(0.051)	(0.022)	(0.050)	(0.061)
Dep. var. mean	.22	.13	.24	2.5	.52	.12	.6	.98
Dep. var. std. dev.	2.26	1.2	2.14	9.39	5.26	1.7	3.6	5.29
R-Squared	0.384	0.365	0.543	0.597	0.562	0.427	0.58	0.567
Observations	1,977,839	1,977,839	1,977,839	1,977,839	1,977,839	1,977,839	1,977,839	1,977,839
Households	118923	118923	118923	118923	118923	118923	118923	118923
Balanced Households	3904	3904	3904	3904	3904	3904	3904	3904

Table 20: Increase in Dollar Store Expenditure by Product Group, Non-Metro Households

	(1) Produce	(2) Juice	(3) Dairy	(4) Snack / Dessert	(5) Sugary Bev.	(6) Meat	(7) Meals	(8) Other
Post Entry	0.130***	0.062	0.241***	1.026***	0.279**	0.083**	0.158**	0.488***
	(0.040)	(0.039)	(0.064)	(0.226)	(0.138)	(0.040)	(0.080)	(0.132)
Dep. var. mean	.42	.32	.57	5.25	1.47	.21	1.12	2.25
Dep. var. std. dev.	2.13	2.62	3.39	13.82	8.80	2.12	4.61	8.20
R-Squared	0.44	0.462	0.576	0.646	0.621	0.496	0.552	0.631
Observations	276,237	276,237	276,237	276,237	276,237	276,237	276,237	276,237
Households	15644	15644	15644	15644	15644	15644	15644	15644
Balanced Households	2091	2091	2091	2091	2091	2091	2091	2091

D.2.4 Overall Product Composition Effects

Table 21: Impact of Dollar Store Entry on Product Expenditure Shares, All Households (percentage points)

	(1) Produce	(2) Juice	(3) Dairy	(4) Snack / Dessert	(5) Sugary Bev.	(6) Meat	(7) Meals	(8) Other
Post Entry	-0.017	0.003	-0.087***	0.055	0.022	-0.064**	0.110***	-0.021
	(0.027)	(0.017)	(0.028)	(0.040)	(0.023)	(0.027)	(0.035)	(0.038)
Dependent variable mean	9.79	3.28	14.18	24.33	5.42	8.81	13.09	21.11
Dependent variable standard deviation	6.08	3.7	6.58	9.44	6	6	7.85	8.06
R-Squared	0.6	0.57	0.615	0.593	0.671	0.527	0.577	0.506
Observations	2,339,419	2,339,419	2,339,419	2,339,419	2,339,419	2,339,419	2,339,419	2,339,419
Households	128386	128386	128386	128386	128386	128386	128386	128386
Balanced Households	14007	14007	14007	14007	14007	14007	14007	14007

Table 22: Impact of Dollar Store Entry on Product Expenditure Shares, Low-Income Households (percentage points)

	(1) Produce	(2) Juice	(3) Dairy	(4) Snack / Dessert	(5) Sugary Bev.	(6) Meat	(7) Meals	(8) Other
Post Entry	0.005	0.010	-0.127*	-0.078	-0.066	-0.137**	0.238***	0.154
	(0.060)	(0.041)	(0.070)	(0.102)	(0.057)	(0.067)	(0.090)	(0.095)
Dependent variable mean	9	3.2	14.08	24.56	5.66	8.68	13.77	21.06
Dependent variable standard deviation	5.94	3.87	6.89	9.94	6.53	6.21	8.51	8.51
R-Squared	0.633	0.608	0.662	0.644	0.722	0.59	0.628	0.583
Observations	461,903	461,903	461,903	461,903	461,903	461,903	461,903	461,903
Households	27161	27161	27161	27161	27161	27161	27161	27161
Balanced Households	2983	2983	2983	2983	2983	2983	2983	2983

Table 23: Impact of Dollar Store Entry on Product Expenditure Shares, First Entry Households (percentage points)

	(1) Produce	(2) Juice	(3) Dairy	(4) Snack / Dessert	(5) Sugary Bev.	(6) Meat	(7) Meals	(8) Other
Post Entry	-0.040	0.024	0.010	0.062	0.028	-0.044	0.056	-0.095
	(0.053)	(0.032)	(0.057)	(0.076)	(0.042)	(0.049)	(0.065)	(0.073)
Dep. var. mean	9.98	3.31	14.66	24.23	4.91	8.54	13.04	21.32
Dep. var. std. dev.	6.35	3.76	6.69	9.60	5.74	5.89	7.87	8.21
R-Squared	0.605	0.572	0.617	0.596	0.674	0.53	0.579	0.509
Observations	1,977,839	1,977,839	1,977,839	1,977,839	1,977,839	1,977,839	1,977,839	1,977,839
Households	118923	118923	118923	118923	118923	118923	118923	118923
Balanced Households	3904	3904	3904	3904	3904	3904	3904	3904

Table 24: Impact of Dollar Store Entry on Product Expenditure Shares, Non-Metro Households (percentage points)

	(1) Produce	(2) Juice	(3) Dairy	(4) Snack / Dessert	(5) Sugary Bev.	(6) Meat	(7) Meals	(8) Other
Post Entry	-0.064	-0.039	-0.028	0.262**	0.040	0.029	-0.061	-0.139
	(0.074)	(0.045)	(0.083)	(0.114)	(0.072)	(0.085)	(0.098)	(0.114)
Dependent variable mean	9.35	2.91	14.4	24.39	5.95	9.01	12.35	21.65
Dependent variable standard deviation	5.7	3.38	6.75	9.08	6.36	6.10	7.35	8.1
R-Squared	0.625	0.601	0.663	0.636	0.721	0.579	0.608	0.564
Observations	276,237	276,237	276,237	276,237	276,237	276,237	276,237	276,237
Households	15644	15644	15644	15644	15644	15644	15644	15644
Balanced Households	2091	2091	2091	2091	2091	2091	2091	2091

D.2.5 Nutrition

Table 25: Impact of Dollar Store Entry on Nutrition Data Match Robustness Measures, All Households

	(1) Log Kilocalories	(2) Percent Matched	(3) Cost per Kilocalorie
Post Entry	0.002	0.001	-0.002
	(0.003)	(0.000)	(0.005)
Dependent variable mean	12.38	.82	2.61
Dependent variable standard deviation	.65	.11	1.13
R-Squared	0.678	0.744	0.649
Observations	2,337,676	2,337,676	2,337,676
Households	128374	128374	128374
Balanced Households	14007	14007	14007

Note: Log kilocalories in Column (1) are the number of kilocalories consumed for IRI food purchases matched to the nutrition data successfully. A decline in kilocalories suggests issues with the match rate. Percent matched is the share of household expenditure in IRI for a household-quarter that is matched to the nutrition data successfully. Cost per kilocalorie in Column (3) looks at other unusual patterns in calories in the nutrition data relative to expenditure.

Table 26: Impact of Dollar Store Entry on Nutrition Data Match Robustness Measures, Low-Access Households

	(1) Log Kilocalories	(2) Percent Matched	(3) Cost per Kilocalorie
Post Entry	-0.005	-0.001	0.016
	(0.012)	(0.002)	(0.021)
Dependent variable mean	12.48	.85	2.4
Dependent variable standard deviation	.63	.1	.98
R-Squared	0.716	0.79	0.696
Observations	261,117	261,117	261,117
Households	15621	15621	15621
Balanced Households	966	966	966

Note: Log kilocalories in Column (1) are the number of kilocalories consumed for IRI food purchases matched to the nutrition data successfully. A decline in kilocalories suggests issues with the match rate. Percent matched is the share of household expenditure in IRI for a household-quarter that is matched to the nutrition data successfully. Cost per kilocalorie in Column (3) looks at other unusual patterns in calories in the nutrition data relative to expenditure.

Table 27: Impact of Dollar Store Entry on Healthy Eating Index (HEI) Components (normalized), All Households

	(1) Vegetable	(2) Green/Bean	(3) Fruit	(4) Whole Fruit	(5) Whole Grain	(6) Dairy	(7) Protein	(8) Sea/Plant	(9) Fat Ratio
Post Entry	0.007*	-0.005	-0.001	0.001	-0.003	-0.004	-0.005	-0.004	0.002
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Dep. var. mean	-.01	-.02	-.02	-.01	0	-.04	0	.01	.04
Dep. var. std. dev.	.87	.83	.86	.87	.92	.91	.92	.92	.9
R-Squared	0.519	0.464	0.566	0.536	0.528	0.578	0.485	0.482	0.459
Observations	2,337,676	2,337,676	2,337,676	2,337,676	2,337,676	2,337,676	2,337,676	2,337,676	2,337,676
Households	128374	128374	128374	128374	128374	128374	128374	128374	128374
Balanced Households	14007	14007	14007	14007	14007	14007	14007	14007	14007

Note: Each column is a nutrition density measure (servings per calorie) that positive contributes to better nutrition (higher is good). Each variable is normalized to be interpreted in standard deviation changes. Vegetable refers to total servuings of vegetable while Green/Bean refers to dark greens and legumes specifically. Fruit in Column (3) refers to total servings of fruit. The fat ratio is the ratio between good fats (monounsaturated fatty acids and polyunsaturated fatty acids) and bad fats (saturated fat).

Table 28: Impact of Dollar Store Entry on Healthy Eating Index (HEI) Components (normalized), All Households

	(1) Sodium	(2) Refined Grain	(3) Added Sugar	(4) Saturated Fat
Post Entry	0.009**	0.005	-0.007	-0.001
	(0.004)	(0.004)	(0.004)	(0.004)
Dependent variable mean	-.04	-.07	.01	-.05
Dependent variable standard deviation	.79	.91	.97	.94
R-Squared	0.239	0.452	0.494	0.539
Observations	2,337,676	2,337,676	2,337,676	2,337,676
Households	128374	128374	128374	128374
Balanced Households	14007	14007	14007	14007

Note: Each column is a nutrition density measure (servings per calorie or percent of energy) that negatively contributes to better nutrition (higher is worse). Each variable is normalized to be interpreted in standard deviation changes.

Table 29: Impact of Dollar Store Entry on Healthy Eating Index (HEI) Components (normalized), Low-Income Households

	(1) Vegetable	(2) Green/Bean	(3) Fruit	(4) Whole Fruit	(5) Whole Grain	(6) Dairy	(7) Protein	(8) Sea/Plant	(9) Fat Ratio
Post Entry	0.016*	0.006	0.011	0.014	0.010	-0.005	0.010	0.005	0.009
	(0.009)	(0.009)	(0.010)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Dep. var. mean	-.05	-.11	-.07	-.07	-.04	-.06	-.04	-.08	.05
Dep. var. std. dev.	.87	.78	.88	.87	.97	.94	.93	.88	.92
R-Squared	0.572	0.498	0.622	0.586	0.589	0.621	0.541	0.536	0.526
Observations	461,558	461,558	461,558	461,558	461,558	461,558	461,558	461,558	461,558
Households	27159	27159	27159	27159	27159	27159	27159	27159	27159
Balanced Households	2983	2983	2983	2983	2983	2983	2983	2983	2983

Note: Each column is a nutrition density measure (servings per calorie) that positive contributes to better nutrition (higher is good). Each variable is normalized to be interpreted in standard deviation changes. Vegetable refers to total servuings of vegetable while Green/Bean refers to dark greens and legumes specifically. Fruit in Column (3) refers to total servings of fruit. The fat ratio is the ratio between good fats (monounsaturated fatty acids and polyunsaturated fatty acids) and bad fats (saturated fat).

Table 30: Impact of Dollar Store Entry on Healthy Eating Index (HEI) Components (normalized), Low-Income Households

	(1) Sodium	(2) Refined Grain	(3) Added Sugar	(4) Saturated Fat
Post Entry	0.012	0.020**	-0.023**	0.005
	(0.009)	(0.010)	(0.011)	(0.010)
Dependent variable mean	-.02	-.08	.13	-.04
Dependent variable standard deviation	.79	.94	1.04	.95
R-Squared	0.315	0.518	0.569	0.599
Observations	461,558	461,558	461,558	461,558
Households	27159	27159	27159	27159
Balanced Households	2983	2983	2983	2983

Note: Each column is a nutrition density measure (servings per calorie or percent of energy) that negatively contributes to better nutrition (higher is worse). Each variable is normalized to be interpreted in standard deviation changes.

Table 31: Impact of Dollar Store Entry on Healthy Eating Index (HEI) Components (normalized), First Entry Households

	(1) Vegetable	(2) Green/Bean	(3) Fruit	(4) Whole Fruit	(5) Whole Grain	(6) Dairy	(7) Protein	(8) Sea/Plant	(9) Fat Ratio
Post Entry	-0.004	-0.009	-0.011	-0.002	0.003	-0.001	-0.010	-0.006	-0.005
	(0.008)	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Dep. var. mean	0	.01	.01	.02	.04	-.02	.04	.06	.01
Dep. var. std. dev.	.89	.87	.88	.89	.93	.91	.96	.97	.93
R-Squared	0.522	0.467	0.569	0.539	0.53	0.579	0.49	0.487	0.463
Observations	1,976,327	1,976,327	1,976,327	1,976,327	1,976,327	1,976,327	1,976,327	1,976,327	1,976,327
Households	118911	118911	118911	118911	118911	118911	118911	118911	118911
Balanced Households	3904	3904	3904	3904	3904	3904	3904	3904	3904

Note: Each column is a nutrition density measure (servings per calorie) that positive contributes to better nutrition (higher is good). Each variable is normalized to be interpreted in standard deviation changes. Vegetable refers to total servuings of vegetable while Green/Bean refers to dark greens and legumes specifically. Fruit in Column (3) refers to total servings of fruit. The fat ratio is the ratio between good fats (monounsaturated fatty acids and polyunsaturated fatty acids) and bad fats (saturated fat).

Table 32: Impact of Dollar Store Entry on Healthy Eating Index (HEI) Components (normalized), First Entry Households

	(1) Sodium	(2) Refined Grain	(3) Added Sugar	(4) Saturated Fat
Post Entry	0.006	-0.003	0.003	-0.005
	(0.007)	(0.008)	(0.008)	(0.008)
Dependent variable mean	-.05	-.05	-.05	.01
Dependent variable standard deviation	.78	.94	.95	.98
R-Squared	0.248	0.456	0.499	0.541
Observations	1,976,327	1,976,327	1,976,327	1,976,327
Households	118911	118911	118911	118911
Balanced Households	3904	3904	3904	3904

Note: Each column is a nutrition density measure (servings per calorie or percent of energy) that negatively contributes to better nutrition (higher is worse). Each variable is normalized to be interpreted in standard deviation changes.

Table 33: Impact of Dollar Store Entry on Healthy Eating Index (HEI) Components (normalized), Non-Metro Households

	(1) Vegetable	(2) Green/Bean	(3) Fruit	(4) Whole Fruit	(5) Whole Grain	(6) Dairy	(7) Protein	(8) Sea/Plant	(9) Fat Ratio
Post Entry	-0.010	-0.012	0.001	0.003	0.004	-0.006	-0.019	-0.007	-0.005
	(0.012)	(0.011)	(0.011)	(0.011)	(0.012)	(0.011)	(0.012)	(0.012)	(0.012)
Dep. var. mean	-.04	-.12	-.1	-.1	-.08	-.06	-.03	-.04	.04
Dep. var. std. dev.	.83	.72	.82	.76	.85	.88	.86	.83	.87
R-Squared	0.563	0.501	0.624	0.573	0.589	0.616	0.534	0.52	0.515
Observations	276,085	276,085	276,085	276,085	276,085	276,085	276,085	276,085	276,085
Households	15643	15643	15643	15643	15643	15643	15643	15643	15643
Balanced Households	2091	2091	2091	2091	2091	2091	2091	2091	2091

Note: Each column is a nutrition density measure (servings per calorie) that positive contributes to better nutrition (higher is good). Each variable is normalized to be interpreted in standard deviation changes. Vegetable refers to total servuings of vegetable while Green/Bean refers to dark greens and legumes specifically. Fruit in Column (3) refers to total servings of fruit. The fat ratio is the ratio between good fats (monounsaturated fatty acids and polyunsaturated fatty acids) and bad fats (saturated fat).

Table 34: Impact of Dollar Store Entry on Healthy Eating Index (HEI) Components (normalized), Non-Metro Households

	(1) Sodium	(2) Refined Grain	(3) Added Sugar	(4) Saturated Fat
Post Entry	0.011	0.008	-0.026*	0.013
	(0.012)	(0.013)	(0.014)	(0.012)
Dependent variable mean	-.01	-.05	.09	-.03
Dependent variable standard deviation	.78	.86	.97	.91
R-Squared	0.307	0.491	0.542	0.594
Observations	276,085	276,085	276,085	276,085
Households	15643	15643	15643	15643
Balanced Households	2091	2091	2091	2091

Note: Each column is a nutrition density measure (servings per calorie or percent of energy) that negatively contributes to better nutrition (higher is worse). Each variable is normalized to be interpreted in standard deviation changes.