Food Purchasing & Nutrition: The Role of Dollar Stores

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Executive Summary

Dollar stores are a common source of food and in many rural areas are the only source. Compared to grocery stores, dollar stores offer a much smaller range of food items, especially with respect to fresh fruits and vegetables. Dollar stores, however, offer far better options than gas stations, which can be the only alternative in some rural areas. For individuals with limited resources, including poor access to transportation, dollar stores may improve food access in rural areas. This research seeks to assess how dollar stores affect the quality of food purchased in rural areas, especially for lower income households.

Data from National Neighborhood Data Archive (NANDA) on dollar stores and grocery stores were merged at the zip code level with monthly food purchase data from the NielsenIQ Consumer panel. Measures of dietary diversity and fruit-and-vegetable consumption were regressed on dollar store availability, controlling for grocery access. Differential effects on rural and low-income households were measured using interaction terms. Analyses were run for the United States overall and for the New Mexico subsample of households.

Results for the full U.S. sample show that households in rural zip codes with dollar stores buy smaller quantities of fruits and vegetables, especially fresh and canned fruits and vegetables, but spend less on groceries overall than households in rural zip codes without dollar stores. Low-income households in rural zip codes with dollar stores also buy fewer frozen fruits and vegetables. We find no effect on the diversity of foods purchased. Results for the overall United States should be interpreted as correlational and preliminary with additional analyses required to establish causality.

In NM, dollar stores have a bigger and slightly different impact overall – they are associated with an increase in the likelihood of any fruit-and-vegetable purchase (inclusive of fresh, canned and frozen fruits and vegetables), and in urban areas, reduced total food expenditures and reduced dietary diversity. In rural New Mexico, however, dollar stores are associated with increased dietary diversity, suggesting that dollar stores are more likely to substitute for the nearby gas station than for a nearby grocery store. The New Mexico analyses are more complete from a methodological perspective; however, the small sample size may limit generalizability, especially in rural areas.

The policy prescriptions for New Mexico suggested by these initial results include lowering barriers to entry for dollar stores in rural areas, where dollar stores likely are substituting for gas stations, and increasing awareness of the nutritional comparability of fresh, frozen, and canned fruits and vegetables, which might help offset some of the negative impact of dollar stores among urban households in New Mexico and increase the benefits from dollar stores experienced in rural New Mexico.

Data Disclaimer: The enclosed study represents the “researchers' own analyses calculated (or derived) based in part on data from Nielsen Consumer LLC and marketing databases provided through the NielsenIQ Datasets at the Kilts Center for Marketing Data Center at The University of Chicago Booth School of Business. The conclusions drawn from the NielsenIQ data are those of the researchers and do not reflect the views of NielsenIQ. NielsenIQ is not responsible for, had no role in, and was not involved in analyzing and preparing the results reported herein.”

1. Introduction

Households in rural areas face reduced dietary diversity and food-and-vegetable consumption (Dean and Sharkey, 2011). Feeding America (2025) reports that rural counties account for 9 out of 10 counties with the highest food insecurity rates. Dollar stores may play an important role in providing food access (Lo et al., 2019) but the effects vary by alternative, particularly in rural areas. In most urban areas, consumers have some access to a range of types of stores including grocery stores, dollar stores, gas stations, and even specialty food stores offering gourmet or international foods. In rural areas, the impact of a dollar store on shopping behaviors will vary, depending on the alternative. If the alternative to shopping at a dollar store is shopping at a more distant grocery store, then a dollar store is likely to worsen nutritional quality by decreasing dietary diversity and consumption of fresh foods like fruits, vegetables, and meat. Unfortunately, in many rural areas the only alternative to the local dollar store is a gas station, which typically offers an even smaller selection of foods than dollar stores, especially healthy foods. Lower income, rural households also face transportation restrictions (lack of public transit, unreliable vehicles), which may increase the impact of dollar store access on shopping behaviors.

Discount stores are a well-established part of any retail landscape with the subcategory of dollar stores in existence for decades. The first dollar store as founded in 1955 (Lopez, Marchesi, and Steinbach, 2024). The current dollar store market, worth $119.2B in revenue in 2025, is highly concentrated with two chains controlling almost two thirds of the U.S. market (Posada, 2025). Sales have been declining but store expansion continues (King, 2024). Meanwhile, grocery retailers, especially single location grocers, have been closing while dollar stores have been opening, especially in rural areas (Stevens, 2021). Dollar stores represent an increasing portion of grocery expenditures (Feng, Page, and Cash, 2023). People shop at dollar stores due to proximity and low prices (Caspi et al., 2016). Dollar stores identified in NielsenIQ retailer scanner data are most common in non-metro areas that are not food deserts, but food deserts with dollar stores are more likely to remain food deserts than areas without dollar stores (Chenarides, et al., 2021). Because of concerns about food quality, community safety, and local business sustainability, some localities have banned dollar stores (McCarthy et al., 2022).

An unpublished study by Caoui, Hollenbeck, and Osborne (2024) uses the NielsenIQ Consumer Panel and modern causal inference techniques, controlling for household demographics to

analyze the effect of dollar stores on grocery markets. The study finds that dollar stores are associated with a decline in the number of grocery stores, but the specification does not differentiate dollar stores entering declining grocery markets from dollar stores driving out grocery stores that otherwise would still be operating. The study results show that a single dollar store entry does not affect fresh produce spending, but that dollar stores entering within 0-2 miles gradually decrease fresh produce spending over time up to eight years post-entry. Dollar store entry has little effect on food categories other than fresh produce, and the reduction in fresh produce spending comes from low-income households.

Our study extends the literature by further exploring the net effect of dollar stores, particularly in rural areas, as measured by dietary diversity (the range of types of food consumed) and fruit-and-vegetable consumption, distinguishing between fresh, frozen, and canned fruits and vegetables. No other studies have directly studied the effect of dietary diversity or distinguished between fresh, frozen, and canned fruits and vegetables. The literature on the nutritional quality of fresh, frozen, and canned fruits and vegetables finds little consistent superiority of one over the other with canned sometimes even higher in certain nutrients, e.g., lycopene in canned tomatoes (Miller and Knudsen, 2014; Li et al., 2017). Fresh fruits and vegetables are still perceived by consumers as superior to frozen or canned (Dudley, 2025). A decline in fresh fruits and vegetables, not generally available at dollar stores, need not necessarily be negative for overall nutrition if the fresh fruits and vegetables are replaced with frozen or canned fruits and vegetables, which are typically available at dollar stores.

This research builds on our prior work exploring the relationship between food access and food purchase behaviors, using data from New Mexico (Li, Paudel, and Stith, 2025). We found little correlation between food desert measures based on geographic proximity to grocery stores, e.g., within 1 mile in urban areas and within 10 miles in rural areas, and purchase quality measures (nutritional diversity of foods purchased and fruit-and-vegetable purchase), even when controlling for income. Rural, however, was associated with a significant reduction in the diversity of foods purchased and whether any fruits and vegetables were purchased. This paper extends the analyses by investigating the role of dollar stores, which influence food access, particularly in rural areas, with the alternative (grocery or gas station) determining whether the impact is positive or negative. We also explore the role of living in a low-income household,

which exacerbates access issues, especially in rural areas where public transportation often is not available.

Using annual zip code-level data on dollar stores from the National Neighborhood Data Archive (NaNDA) combined with household-month-level data from the NielsenIQ Consumer Panel on purchases and a difference-in-differences estimation approach, our preliminary results show that dollar stores are associated with decreased fruit-and-vegetable purchasing and decreased overall expenditures. Dollar stores are not associated with reduced diversity of foods purchased as measured by a modified version of the Dietary Diversity Score (a USAID-endorsed measure of food diversity calculated by summing across fourteen food groups). In addition to the analysis of the overall United States, we conducted analyses focusing on specifically New Mexico. Results using comparable (two-way fixed effects) regression methods to those used in the overall sample suggest substantial heterogeneity in the effects of dollar stores across the United States. In addition to the correlational results, we conducted more modern causal analyses in line with Gardner (2022) for our New Mexico sample. (Due to computational capacity constraints, such analyses remain to be conducted for the full United States sample.)

In New Mexico, results using Gardner's (2022) approach show that dollar stores increase the likelihood of any produce purchase in a month but decrease the count of canned produce products purchased. Among urban households, dollar stores decrease dietary diversity and total food expenditures, while in rural areas dollar stores increase dietary diversity.

In addition to contributing to understanding patterns in the effects of dollar stores on rural diversity in food purchase and fruit-and-vegetable purchase, this study highlights the substantial heterogeneity in the effects of dollar store both geographically across states and between rural and urban areas within states, which suggest a one-size-fits-all policy would be misguided.

2. Data

This study uses 2018-2021 zip-code-level data on dollar stores and grocery stores and household-month-level data on household food purchases to conduct our analyses. The dollar store and grocery store data come from the National Neighborhood Data Archive (NaNDA), an open data repository containing measures of the physical, economic, demographic, and social environment data at various spatial levels (e.g., census tract, ZIP code tabulation area, county).

NaNDA is created and maintained by researchers in the Social Environment and Health program at the University of Michigan Institute for Social Research. Our data on dollar stores and grocery stores (grocery stores and departmental stores) come from two different NaNDA datasets: Dollar Stores by Census Tract and ZCTA (zip code tabulation area), United States, 1990-2021 (Melendez et al., 2024a), and Grocery and Food Stores by Census Tract and ZCTA, United States, 1990-2021 (Melendez et al., 2024b). Both datasets draw from the National Establishment Time Series (NETS) business microdata, which include address history and Standard Industrial Classification (SIC) code business classification. The census tract and ZCTA for each business in the NaNDA dataset are obtained by mapping each business's latitude and longitude - obtained from the NETS database - to the 2010 and 2020 TIGER/Line shapefiles from the US Census Bureau (United States Census Bureau, 2021a, 2021b).

The datasets include the annual count of businesses (dollar stores and other grocery stores) aggregated at zip code and census tract levels. NaNDA uses the SIC codes for business types to identify and group different businesses. For dollar stores, NaNDA included businesses from SIC codes 53310000 and 53119901 with "dollar" in their names. NaNDA defines both grocery and supermarkets as "*Establishments primarily engaged in the retail sale of food, including canned and dry goods, tea, coffee, spices, sugar, flour, fresh fruits and vegetables, fresh and prepared meats, fish, and poultry*." NaNDA classifies businesses with SIC 54119901 to 54119905 as "grocery stores" and businesses with SIC through 54110100 to 54110105 as "supermarkets."

For our study, we use the annual store count data at the zip code level for 2018 to 2021 to create two zip code-level treatment variables. First, we create a binary indicator for the presence of a dollar store, coded as 1 if there is at least one dollar store in the zip code in a given year and 0 if the zip code contains no dollar store. Second, we create a categorical treatment variable to measure the intensity of the presence of a dollar store. With zero as a reference group, we have four categories indicating the number of dollar stores in a zip code in a given year: one, two, three, and four or more. On average, a zip code in our sample has 2.35 dollar stores with similar counts for rural (2.38 dollar stores) and urban (2.34 dollar stores) zip codes. There are 6.60 grocery stores and 2.36 supermarkets in the average zip code with substantial differences in counts for rural (4.59 grocery stores) and urban (9.73 grocery stores) zip codes.

The household food purchase data used in this study come from NielsenIQ Consumer Panel (NCP) data, maintained by the University of Chicago Booth School of Business and the NielsenIQ Company (. The NCP contains information about the purchasing patterns of a geographically balanced sample of panelists. Each year, approximately 60,000 households are included in the sample. The panelists are asked to record all purchases intended for personal use using in-home scanners or mobile apps immediately after taking the purchased items home. Using detailed product-level information on product types, store types, and price information, we aggregate the household purchase data at the monthly level to capture general purchase behaviors. Hence, for each household-month, we have detailed information on purchased food types, expenditure, and the type of retail store at which the product was purchased. Our working dataset consists of 2,835,345 household-month observations from 2018-2021.

This study uses a variety of outcome variables to capture different aspects of shopping behaviors that may be affected by dollar stores, including a measure of the diversity of foods purchased, several measures of fruit-and-vegetable purchases (overall, fresh, canned, and frozen; binary and count measures), and variables capturing total expenditure, percent of expenditure at dollar stores and grocery stores, and total dollar store and grocery store visits in a month.

We use a modified version of the Dietary Diversity Score (DDS) as our key outcome variable for examining the variety of food items purchased by the households in a given month. The USAID Food and Nutrition Technical Assistance (FANTA) II Project introduced the DDS as an indicator of household's diverse and high-quality food access in 2006 (Swindale & Bilinsky, 2006). Since then, the DDS has been widely used in health and development literature as a proxy for nutrient adequacy, food sufficiency, and household well-being. A diversified diet, as measured by DDS, has been associated with a lower risk of obesity and improved heart health (Oldewage-Theron et al., 2013; Azadbakht et al., 2005), increases in the quantity and the quality of the household's food intake (Vandevijvere et al., 1965; Zhong et al.,2022; Azadbakht et al., 2005; Hoddinott & Yohannes, 2002; Wiesmann et al., 2009), and increased household expenditure in food items (Thorne-Lyman et al., 2010).

We constructed the DDS used in this study following the Food and Agriculture Organization (FAO) revised document "Guidelines for Measuring Household and Individual Dietary Diversity*"* prepared by Kennedy et al. (2011). The FAO guidelines include 12 food groups; we

add an additional two food groups (snacks and premade food), which are not traditionally included in the FAO's 12 food groups, do not fit cleanly into the existing 12 food groups, but which are common in the American diet and easy to identify in the NielsenIQ data. Having defined the 14 food groups, we grouped the purchased food types each group using product module codes from NielsenIQ Products data file. Table 1 shows the list of 14 food groups and the number of purchased items under those groups. If a household purchased a certain item in a food group in a given month, a score of 1 is assigned to that group, and a score of 0 is assigned otherwise. The DDS for the household in each month is then calculated by summing up the scores of all food groups for that month. The DDS for the household ranges from 0-14 as we have 14 different food groups.

For fruit-and-vegetable intake or purchase measures, studies have used different approaches. Pessoa et al. (2015) created a score (0-12) by asking individuals 12 sets of questions about their daily fruit-and-vegetable intake and weekly consumption of fruits and vegetables. Pastori et al. (2023) classified fruits and vegetables into six groups, assigning a binary score to each food group consumed daily and creating a total fruit and vegetable score by summing the fruit-and-vegetable groups consumed (0-6). Thompson et al. (1999) used a similar approach but asked about fruit-and-vegetable consumption in the past month. Seguin-Fowler et al. (2021) collected fruit-and-vegetable intake using 24-hour dietary recall and then converting into the equivalent number of cups.

Building on the approaches by existing studies, we constructed household-level fruit-and-vegetable purchase measures in two ways: a binary "any purchase" variable and a count variable for the total number of products purchased. To do so, we used NielsenIQ Products data file to identify fruits and vegetables based on their product module codes. We create our binary variable equal to one if any fresh, canned, or frozen fruits or vegetables are in a household's monthly purchase list and zero otherwise. While this binary variable provides information on whether a household purchases fruits and vegetables in a given month, it does not capture the extent or volume of purchases. To address this, we also created a continuous count variable of fruit-and-vegetable purchases that measures the total number of fresh, boxed, canned, or frozen fruit or vegetable products purchased by a household each month. In addition to binary and count variables for all fruits and vegetables, we also created three sub-categories based on the type of

fruits and vegetables purchased: fresh, canned, and frozen, using the product group codes from the NielsenIQ Products data file. For example, all product group codes with descriptions of "Fruits–Frozen" or "Vegetables–Frozen" are grouped under the frozen category. This categorization of fruits and vegetables into three different types enables analyses of not only the effect of the presence of dollar stores on the households' fruit-and-vegetable purchase behavior but also what type or form of fruits and vegetables they are likely to consume or purchase with fresh fruits and vegetables significantly more likely to be available through grocery stores than through dollar stores.

In addition to our food-related outcomes, we construct five household-month-level outcome variables to capture household expenditures in food items and household reliance on dollar stores. First, a total monthly food expenditure variable is calculated by summing up all the item-level prices and subtracting any coupons or promotional offers for those items at the time of purchase. To understand the household's reliance on dollar stores, we create two types of variables, the percent of expenditures that are at a dollar stores and grocery stores and the counts of dollar store and grocery store visits. The percent of expenditures at dollar stores and grocery stores was created by identifying all the purchases made in dollar stores and grocery stores using the NielsenIQ purchases, trips, and retailers data files based on the retail channel type classifications, and then by retail outlet type (dollar store or grocery store), summing all the item level prices and subtracting any coupons or promotional offers for those items at the time of purchase.

Our last outcome variables, monthly visits to dollar stores and grocery stores, captures a household's total visits to a dollar store (grocery store) in a month that resulted in purchased food items.

We include several demographic and geographic controls in our analyses. All our demographic and geographic information on the panelist households comes from the NielsenIQ Panelist data file. In the dataset, a household's income is reported in 20 different ranges. We use the provided categorical household income range and household sizes to create a binary variable, "low-income household". This variable equals to 1 if the income level is roughly at or below 150% of FPL based on household size. Further, we create variables based on the household head's education

level, race, Hispanic ethnicity, marital status, presence of children, and family structure: female-household-head-only, male-household-head-only, or both.

NeilsenIQ Panelist data file provides 5-digit zip codes as one of the geographical identifiers for households. Based on household zip code, we assigned rural-urban status to our panelist households using the Rural-Urban Commuting Area (RUCA) Codes developed by the U.S. Department of Agriculture's Economic Research Service (USDA ERS, 2022). We matched the zip codes from the RUCA data to our NielsenIQ dataset and created a binary indicator variable for households living in rural zip codes.

NielsenIQ also provides data on household shopping preferences through the annual Ailment, Health, and Wellness survey data set. We use these data to provide descriptive background information on trends in dollar store preferences. Future drafts will explore utilizing these data to better understand the social welfare implications of distributional shifts in shopping patterns driven by dollar store access.

Our analysis sample includes 61,371 unique households in 2018, 61,471 in 2019, 60,087 in 2020, and 58,206 in 2021, with approximately two percent of the households residing in rural zip codes each year. Table 2 presents the descriptive statistics of the variables used in our analysis from household-by-month sample data from 2018 to 2021. We use the projection factor from the NielsenIQ Consumer panel data as a sample weight for national representation. We have 2,835,345 household-by-week observations.

The average household level DDS is 9.18 (out of 14 max) across the full sample. The average DDS for rural households is slightly higher (9.23) than that of urban households (9.18). On average, 88.2% of the households purchased any fruits or vegetables in a month. The numbers were similar when comparing urban (88.4%) and rural (87.5%) households. Households purchased an average of 9.42 fruit or vegetable products each month, with a higher average among urban households (9.65) than among rural households (8.16). Urban households purchased more fresh and frozen fruits and vegetables, while rural households purchased more canned fruits and vegetables. Average monthly spending on food items was $223, with urban households spending $224.5 and rural households spending $214.3. While the total spending was not very different between rural and urban households, the share of spending at dollar stores is significantly higher in rural households (4.32%) as compared to the urban households (2.26%)

with the full sample average of 2.57%. We also find that, on average, rural households visited dollar stores more frequently (0.74) than urban households (0.42).

On average, panelist households live in a zip code with 2.35 dollar stores, 6.60 grocery stores, and 2.36 supermarkets. There is a significant difference in access to grocery stores and supermarkets for urban and rural households, with urban households having an average of 7.15 grocery stores and 2.58 supermarkets per zip code. In comparison, rural households have only 3.47 grocery stores and 1.11 supermarkets per zip code.

On average, 77% of the households have at least one dollar store in their zip codes, with similar averages across households living urban and rural zip codes.

We find some significant variation in our demographic variables when comparing households in rural and urban zip codes. On average, 8.7% of the total sample are low-income households. Households in rural areas are more likely to be low-income households (13.3%) than households in urban areas (7.9%). Overall, 9% of the households have household heads without a high school diploma, 16.3% have at least one household head who graduated high school but no household head completed college, 47.4% have at least one household head with some college education but no household head graduated college, and 35.3% have both household heads with college degrees. Households in rural zip codes were more likely to have no high school degrees, at least one high school graduate, and no college graduates than urban living households.

In contrast, urban living households had higher share of households with both heads college graduates. The disparity in education, particularly the lower education among rural households, may influence household food purchase decisions, especially shopping at dollar stores. In the full sample, 22.2% of households have children with similar rates in urban and rural areas. Overall, 79.4% of the sample households self-identified as White, with 90.4% of households in rural areas identifying as White. Hispanic households comprise 7.4% of the overall household sample, with 8.1% of households in urban zip codes reporting being Hispanic compared to 3.3% in rural areas. In the overall sample, 63.5% were households with married household heads. Regarding the household structure, female-only headed households comprised 28.1% of the total sample, while male-only headed households comprised 9.4% of the total sample. Both were more common in households living in urban zip codes than households living in rural zip codes.

Although analyses at the national level benefit from a much larger sample, and therefore, greater statistical precision, they represent an average national effect and may not be generalizable to specific areas. Given that the goal of the funded proposal underlying this project was to assess the effect of dollar stores on rural access to nutritional food in New Mexico, we conduct a case study, re-running our analyses for the state of New Mexico only.

3. Methods

Our initial estimation strategy analyzes the relationship between dollar store access on the household dietary diversity score, the purchase of fruits and vegetables, total monthly food expenditure and the prevalence of dollar stores in household shopping at a household-month level using a basic two-way fixed effects (TWFE) model. We use the following estimating equation:

$$y_{hzmy} = \beta_0 + \beta_1 DS_{zy} + \gamma X_{hy} + \tau_{zy} + \delta_z + \lambda_m + \theta_y + \varepsilon_{hzmy} \quad (1)$$

Where y_{hzmy} is the set of our outcome variables: dietary diversity score, binary and count measures of food-and-vegetable consumption (fresh, can and frozen), total food expenditure, total food expenditure at dollar stores and grocery stores and visits to the dollar stores and grocery stores for household *h* residing in the zip code *z* in month *m* in year *y*. The treatment variable DS_{zy} is the presence of dollar store (binary and categorical) at the zip code-year level. X_{hy} is a vector of annually collected household demographic characteristics, including education, presence of children in the household, race, ethnicity, marital status of household heads, female-only and male-only households, and whether the household is low income or living in a rural zip code. τ_{zy} captures the zip-code-level count of grocery stores and supermarkets. Given our treatment variable is defined at the zip code level, we include zip code level fixed effect δ_z to control for any time-invariant geographical characteristics effecting the relationship between dollar stores and the outcome variables, such as the geographical size of the zip code. We include month fixed effects λ_m to control for any seasonal patterns for our outcome variables, such as the availability of homegrown fruits and vegetables, and year fixed effects θ_y to control for any unobserved year-specific common factors effecting the relationship between the presence of dollar stores and outcome variables, e.g., COVID-19, changes in the nationwide marketing campaigns of major chains, and general changes in shopping preferences.

Standard errors are clustered at the zip code level to adjust for heteroskedasticity and arbitrary correlation within zip codes.

In order to explore the role of dollar stores in rural zip codes, specifically, and to capture possible differential effects experienced by low-income households, we modify our baseline model by including interaction terms for dollar stores, household low-income status and rural-living households.

$$y_{hzmy} = \beta_0 + \beta_1 DS_{zy} + \beta_2 LowInc_{hy} + \beta_3 Rural_{zy} + \beta_4\left(DS_{zy} \times LowInc_{hy}\right) + \beta_5\left(DS_{zy} \times Rural_{zy}\right) + \beta_6\left(LowInc_{hy} \times Rural_{zy}\right) + \beta_7\left(DS_{zy} \times LowInc_{hy} \times Rural_{zy}\right) + \gamma X_{hy} + +\tau_{zy} + \delta_z + \lambda_m + \theta_y + \varepsilon_{hzmy} \quad (2)$$

Here, the base reference group is the non-low-income urban living households living in zip codes without any dollar stores. β_1 captures the change in outcome for non-low-income households living in urban areas before and after the presence of dollar store. The coefficients β_4 and β_5 capture the differential effect of dollar stores on low-income households and rural households, respectively. The triple interaction coefficient β_7 captures any additional differential effect from being both a low-income household and living in a rural zip code.

We conduct two robustness checks on the main results. First, we combine the number of grocery stores and supermarkets to create a categorical variable that may better capture nonlinearities in the effect of other stores on the relationship between dollar stores and our outcome measures. For example, the effect of gaining one grocery store might be very different from gaining a seventh grocery store.

Our second robustness check uses relatively recent developments in causal inference to better account for the variation across zip codes in the timing of our treatment variable, dollar store entry. Standard TWFE models include the same units as both untreated and treated with whether a unit is included in the treated or untreated group depending on the time period, which means that the coefficients cannot be readily interpreted as the average effect of the treatment on the treated (Sun & Abraham, 2020; de Chaisemartin & d'Haultfoeuille, 2020; Goodman-Bacon, 2021). Due to staggered treatment timing, the average treatment effect, obtained by aggregating group-time average treatment effects, becomes a weighted average group-time treatment effect, with potentially even negative weights, which leads to biased estimates of the true average treatment effect (Butts &

Gardner, 2021). As a robustness check on our TWFE model, we employ Gardner's (2022) two-stage difference-in-differences estimator to address the issues with the TWFE method and identify the effect of dollar store entry. Unlike the TWFE approach, which estimates the average treatment effect on the treated with group and time fixed effects simultaneously, Gardner (2022) employs a two-stage approach. The first stage identifies group and period effects using only untreated observations (i.e., zip codes with no dollar stores), while the second stage compares the treated and untreated outcomes, removing the group and period fixed effects identified in the first stage.

Stage 1: Estimate the model using untreated subsample

$$y_{hzmy} = \delta_z + \lambda_m + \theta_y + \gamma X_{hy} + \tau_{zy} + \varepsilon_{hzmy}$$

Stage 2: Construct the adjusted outcome

$$\tilde{y}_{hzmy} = y_{hzmy} - (\hat{\delta}_z + \hat{\lambda}_m + \hat{\theta}_y + \hat{\gamma} X_{hy} + \hat{\tau}_{zy})$$

In the second stage, the outcome, net of the first stage, is regressed on the treatment status for the full sample, and the average treatment effect is estimated. By removing the variation from unit and time fixed effects along with the other covariates in the first stage, the second-stage regression estimates provide an unbiased estimate of dollar store entry.[1] In other words, the TWFE model provides correlational results, while the Gardner (2022) better approximates a causal relationship.

Future robustness checks include validating the parallel trends assumptions underlying our regressions, i.e., that but-for the entry of dollar stores, outcomes would have trended the same over time across zip codes, and running the Gardner (2022) analyses for the full sample. To date, computational capacity constraints have limited our ability to complete the analyses for the overall United States sample. We were able to complete the analyses for the smaller New Mexico sample, noting that the New Mexico sample is fairly small so that our analyses may suffer from a lack of statistical power, and lower income rural households likely are underrepresented by the app-based data collection method used by NielsenIQ.

4. Results

[1] We used did2s stata command developed by Kyle Butts https://github.com/kylebutts/did2s_stata.

Figure 1 shows trends in attitudes towards dollar stores from the NielsenIQ data. Overall levels of satisfaction with this type of store are increasing, while levels of dissatisfaction and never shopping at dollar stores has decreased over time. This pattern suggests an increasing importance for dollar stores as a source of food for consumers and underscores the importance of understanding their impact on the nutritional quality of foods purchased.

Tables 3 through 9 present our results for the association between dollar stores and our nutritional outcomes, including controlling for the counts of grocery stores and super markets, and differentiating the effect for those in rural versus urban zip codes and for those in low-income households, especially in rural areas. The columns in the tables vary in terms of the controls included with demographics and zip code, month, and year fixed effects included in Column 1; counts of grocery stores and supermarkets added in Column 2; subgroup analyses for urban and rural run in Columns 3 and 4, respectively; rural added as an interaction in Column 5; and rural and low-income added as a three-way interaction in Column 6.

Table 3 measures the association between dollar stores and diversity in food purchased. The results show no overall effect from dollar stores on the diversity of foods purchased across all specifications. Interactions between rural, low income, and rural x low income show no statistically significant associations with the diversity of foods purchased. The counts of grocery stores and supermarkets increase dietary diversity scores but only in urban areas.

Tables 4 and 5 show results for any fruit-and-vegetable purchase and for the count of fruit-and-vegetable products purchased. Table 4 shows no effect on the likelihood of purchase from any of the variables reported. Table 5 shows that dollar stores reduce the count of fruits and vegetables purchased in rural areas, and these effects are common across low-income and not-low-income households. Surprisingly, the count of grocery stores and supermarkets does not affect the likelihood of any purchase or the count of fruits and vegetables.

Table 6 splits out the results for fresh, frozen, and canned fruits and vegetables. The reduction in the count of fruits and vegetables purchased by rural households is driven by reductions in fresh and canned fruits and vegetables. For households in rural zip codes that are also low income, dollar store access is associated with a reduction in frozen fruit-and-vegetable purchases as well. Grocery stores and supermarkets serve primarily to increase the purchase of frozen and canned fruits and vegetables rather than fresh produce.

Table 7 shows results for total spending. Again, dollar stores effects are limited to rural areas – dollar stores are associated with a reduction in spending of $12.81 in the rural subgroup analysis in Model IV - Column 4.

To explore mechanisms behind our results we run additional regression using the count of dollar stores, explore associations between dollar store access and dollar store visits and percentage of expenditure at dollar stores. Dollar store access is expected to be positively correlated with the percentage of expenditure at dollar stores and the number of dollar store visits, but run these analyses to confirm that dollar store access does increase dollar store purchases for proximate households, i.e., that shopping patterns change in a measurable way.

Appendix Table 1 shows the results for Model VI using the number of dollar stores (1, 2, 3, 4+) rather than the existence of any dollar store as the treatment variable. As in the main regressions for the existence of any dollar store, the count of dollar stores has no statistically significant effect on DDS, the likelihood and count of fruits and vegetables purchased, or total spending. Only the entry of the first dollar store has any impact on dollar store spending or the number of visits to dollar stores. In rural areas, dollar stores have a greater effect, with more dollar stores leading to greater reductions in the likelihood of any fruit or vegetable purchase and total monthly spending. Low-income households are not differentially impacted by dollar stores with respect to DDS or fruit-and-vegetable purchase even though low-income households exhibit increased dollar store expenditures and visits in association with increased dollar store access. No large, statistically significant differences exist in particularly low-income households in rural zip codes.

Breaking out the categories of product in Appendix Table 2, again the count of dollar stores does not appear to impact fruit-and-vegetable purchasing, whether fresh, frozen or canned. The interaction effects are generally consistent with the main effects but most coefficients are insignificant. The general pattern suggests a decrease in the count of fresh and canned fruits and vegetables with access to dollar stores. The reduction in fresh fruit-and-vegetable counts appears to be increasing in the number of dollar stores. Low-income households show no consistent evidence of a differential effect with the number of dollar stores in their zip code. Low-income and rural households, as in the main tables, reduce their purchase of frozen fruits and vegetables

and this effect does appear to be statistically significantly increasing with the number of dollar stores at least through two dollar stores.

Results shown in Appendix Tables 4-6 demonstrate that using categories of combined grocery stores and supermarkets has little effect on the dollar-store-related coefficients and does not change the pattern of statistical significance in the TWFE model. The coefficients for the categorical store variables do vary from those using separate counts of grocery stores and supermarkets. For DDS, Appendix Table 4 suggests that more grocery stores decrease DDS while the continuous count variables in Table 3 show positive effects. More grocery stores have no effect on total spending in Appendix Table 4, although they have a positive effect in Table 7. In both Appendix Table 5 and Table 5, grocery stores and supermarkets do not impact the likelihood of any fruit or vegetable purchase or the count of fruits and vegetables purchased. Appendix Table 6 shows no effect from larger numbers of grocery stores and supermarkets, while Table 6 shows positive impacts on canned and frozen fruit-and-vegetable purchasing from more grocery stores and supermarkets. The role of grocery stores and supermarkets remains to be more fully explored through analyzing effects of dollar store entry on the distribution of spending and visits across store types.

4.1 New Mexico Sample

The New Mexico sample consists of 325 unique households in 2018, 320 in 2019, 305 in 2020 and 297 in 2021 totaling 14,703 observations, of which 3,216 are in rural zip codes. Descriptive statistics are available in Appendix Table 3. The main differences between New Mexico and the main sample are a significantly greater number of dollar stores and lower number of grocery stores. Ninety-percent of New Mexican households in the NCP live in a zip code with at least one dollar store, while only 77% of the overall sample of households in the NCP does. Zip-code-level counts of dollar stores and grocery stores average 3.4 and 3.9 in New Mexico and 2.3 and 6.6 in the overall sample. The other major difference between the overall sample and New Mexico is racial composition – the New Mexican NCP sample is 5 percent black, 1.5 percent Asian, 11.7 percent Other, and 23.3 percent Hispanic versus 11.3 percent black, 4.1 percent Asian, 5.2 percent Other, and 7.4 percent Hispanic in the overall NCP sample.

Table 8 shows results for New Mexico for the main outcome variables, using the full set of interaction variables, fixed effects and control variables. In the overall sample, dollar stores had

little overall impact outside of rural areas, but in New Mexico dollar store access is associated with a marginally statistically significant reduction in the diversity of foods purchased, and an 8-percentage point reduction in the likelihood of any fruit or vegetable purchase. In rural areas, as in the overall sample, reductions in the count of fruits and vegetables purchased are greater in rural areas. Low-income households in rural zip codes are particularly negatively affected, reducing their DDS and likelihood of purchasing any fruits or vegetables. Dollar store access in rural areas is associated with a large, marginally statistically significant increase of $122.61 per month in total shopping expenditures. Grocery store counts reduce total expenditure while supermarkets increase the count of fruits and vegetables purchased and increase total spending. Exploring mechanisms in the last two columns, dollar store access increases the percentage of total spending at dollar stores in low-income households in rural zip codes, decreases total dollar store visits in urban areas, and increases dollar store visits in rural areas.

Table 9 breaks out the results for fresh, frozen, and canned fruits and vegetables. Dollar stores decrease the likelihood of purchasing fresh and frozen fruits and vegetables but increase the likelihood of purchasing canned fruits and vegetables. Counts of frozen fruit-and-vegetable products decrease while counts of canned fruit-and-vegetable products increase almost exactly inline. In rural areas, dollar stores are associated with still further reductions in the likelihood of purchase and the count of fresh and frozen fruits and vegetables. Low-income households do not appear to be differentially affected. Grocery stores are associated with decreased purchase of any canned fruits and vegetables and supermarkets increase the count of fresh fruits and vegetables.

Appendix Tables 7 and 8 shows results for New Mexico using the count of dollar stores. Due to a lack of any zip codes changing between having three dollar stores to having four or more, we are unable to measure the effect of having four or more dollar stores overall and within rural zip codes. We are, however, able to capture the differential effect of having four or more dollar stores on low-income households, because the low income variable varies at the household rather than zip code level. Appendix Table 4 shows lower DDS and reduced likelihood of purchasing fruits or vegetables through two dollar stores, having three dollar stores is associated with an increase in the count and likelihood of purchasing fruits and vegetables. Rural areas face generally worse outcomes with more dollar stores, but low income households in urban areas may benefit from the entry of a single dollar store or moving to a zip code with a single dollar

store. Total spending increases with the first two dollar stores in rural areas, but this effect partially reverses with the entry of a third dollar store. In urban zip codes, dollar stores are associated with increased spending but it is only statistically significant for three dollar stores. Urban areas show a reduction in visits to dollar stores with more dollar stores, but a single dollar store increases dollar store visits in rural areas. The results for low-income rural households show generally negative effects for DDS and fruit-and-vegetable outcomes, and dollar store spending increases as a percent of total spending.

Splitting out the categories of fruit-and-vegetable purchases in Appendix Table 5 shows that most effects come from the first dollar store, but additional decreases in the likelihood of buying fresh or frozen fruits and vegetables exists with the second dollar store. The third dollar store reverses some of these effects. In rural areas, negative associations between the number of dollar stores and fresh and canned fruit-and-vegetable purchasing are worse the greater the number of dollar stores. Frozen fruit-and-vegetable purchases are less closely associated with dollar store access and counts than fresh and canned fruit-and-vegetable purchases. For low-income households, a single dollar store entering may have positive effects on fresh and canned fruit-and-vegetable purchase, but these associations reverse with the existence of two or more dollar stores. Fresh fruit-and-vegetable purchases appear particularly negatively affected by dollar stores in low-income households in rural zip codes.

The results following Gardner (2022) differ somewhat from the TWFE. Both models offer similar conclusions for DDS and total expenditure but results for fruit-and-vegetable purchase are different in sign for the likelihood of any fruit or vegetable purchase and are less statistically significant for the remainder of the fruit-and-vegetable-related outcomes using the Gardner (2022) model. In Table 10, dollar stores are associated with large reductions in DDS in the urban subsample and large increases in DDS in the rural subsample. Unlike in the TWFE model, the interactions are not statistically significant. For total expenditure, dollar stores are associated with decreased spending in the urban area but no statistically significant effect in the rural subsample or for any of the interaction terms. Again, this differs from the TWFE model in where the statistical significance appears, but the conclusion is the same, that dollar store access is not associated with a decrease in expenditures among rural households in New Mexico. For any fruit-and-vegetable purchase, Table 10 shows positive effects from dollar stores but this effect is

smaller among low-income households. The TWFE model shows positive effects only in the rural subsample and negative effects overall and especially among low-income households. No statistically significant associations exist between dollar stores and the count of fruits and vegetables purchased in Table 10. The TWFE model found a similar lack of an overall association but dollar stores reduced the count of fruits and vegetables in rural areas. Table 11 shows the results for fresh, frozen, and canned fruits and vegetables. Unlike in the TWFE model, no statistically significant associations are evident except for a reduction in the count of canned fruits and vegetables with dollar store access and a reduction in frozen fruits and vegetables associated with dollar store access among households in rural zip codes. The discrepancies between the results from the Gardner and the TWFE models merit further investigation. Subsequent version of this paper will redo the overall sample results using Gardner (2022) and explore alternative approaches to modeling staggered treatment effects. Some of the instability in the New Mexico results across models may arise from sample size issues given the small number of New Mexican households in the NielsenIQ sample, especially in rural areas, suggesting a regional model may be more appropriate as this research continues.

5. Discussion

Relying on a TWFE model, the overall sample results show no positive effects from dollar stores on the diversity of food purchased or on the likelihood or count of fruits and vegetables purchased. In rural areas, dollar stores are associated with reduced counts of fruits and vegetables purchased, driven by reduced counts of fresh and canned purchases. Total shopping expenditures also decrease. Low-income households are not differentially affected unless they are in rural zip codes, in which case they face reduced likelihood of purchasing any frozen fruit or vegetable and reductions in the count of frozen fruits and vegetables purchased. Counts of grocery stores and supermarkets have positive effects on DDS, the purchase of any canned or frozen fruits and vegetables, and the count of frozen and canned fruits and vegetables purchased, and grocery stores are also associated with increased total spending. Surprisingly, the counts of grocery stores and supermarkets did not increase the likelihood or count of fresh fruits or vegetables purchased in the overall sample.

In New Mexico, dollar stores have a greater impact on purchasing patterns than in the overall United States. Dollar stores are associated with decreased diversity in foods purchased and rural

households do not increase expenditures. Relying on the more reliable Gardner (2022) model, the results show that dollar stores increase the likelihood of any fruit-or-vegetable purchase and decrease in the count of canned fruits and vegetables. In urban areas, dollar stores appear to substitute for grocery stores, reducing dietary diversity and expenditures, while in rural areas, dollar stores appear to substitute for gas stations, increasing dietary diversity without any increase in expenditures.

Although the results suggest important impacts from dollar stores on food purchasing behaviors, the total impact of dollar stores on food access itself is likely fairly small. In 2022, only 2.7% of rural households and 1.05% of households spent more than 50% of their expenditures at dollar stores, meaning that opportunities to shop at grocery stores exist at least periodically for almost all households in our sample. Furthermore, these analyses were based on zip code of residence, and households with commuters may be proximate to grocery stores while at work even if they live in a rural zip code. This suggests that households are trading off travel costs with differences in prices and the range of products available for purchase between dollar stores and other retailers, not that households in zip codes with dollar stores are not able to access other stores. In other words, the changes in purchasing behavior documented in the results are not driven by a lack of an ability to access a specific type of store but rather changes in the relative costs of accessing different types of stores affecting the location of food purchases.

This study does have several methodological and data limitations. The NielsenIQ data capture only purchases of food for home consumption, not whether the food was actually consumed. The data also do not capture consumption of foods purchased outside the home, e.g., at restaurants, or not purchased, such as food received as a gift or home grown. In addition, total expenditures on food do not capture non-food expenses associated with food purchase like gas and vehicle costs or store memberships. Furthermore, the NielsenIQ sample includes only those households with the ability to consistently record their purchases, which likely omits many low-income households or households in rural areas without good internet access. Future drafts will extend the analyses to further explore changes in visits to grocery stores and supermarkets, as well as how results are changing over time. Dollar store inventory has not been stagnant over time and some dollar stores now sell fresh produce. The variation in the effects between the overall sample and the New Mexico case study and across the TWFE and Gardner (2022) models

suggest caution is warranted when applying the general results to any specific area and that the results for the overall sample must be interpreted as solely correlational. Meanwhile, the smaller sample New Mexico analyses may be too under-powered to pick up anything but the strongest relationships.

As this research continues, we intend to assess parallel trends, replace the TWFE results for the overall sample with more modern staggered difference-in-difference approaches such as Gardner (2022), explore the effect of dollar store entry on the distribution of stores where food is purchased, and further investigate heterogeneity in the effects across regions in order to better reconcile the national results with those for New Mexico and to explore factors likely influencing regional differences, e.g., distance between metropolitan areas, rural-to-urban area commuting patterns, and income and amenities in rural areas.

6. Conclusion

Generalizable policy prescriptions are difficult given the preliminary, correlational nature of the main results and the heterogeneity in the results between the U.S. and New Mexico samples. In the overall results, decreased produce purchases exist in rural areas but these are at least partially offset by decreased overall shopping expenditures. For New Mexico, dollar stores have mixed effects that vary by urban and rural status. Taking Gardner's (2022) approach to be less biased than the TWFE approach, dollar stores increase the likelihood of any produce purchase overall, decrease diversity in food purchasing and total expenditures in urban areas, and increase diversity in food purchasing in rural areas without any increase in expenditures.

Policymakers in New Mexico and beyond should be concerned that dollar stores are changing the retail landscape with mixed effects on their constituents' health and well-being. Reduced produce purchases in the overall sample and reduced DDS in urban areas in New Mexico may have negative health implications but are at least partially offset by reduced shopping expenditures. Reducing access to dollar stores would likely increase shopping at grocery stores in the overall sample and the urban New Mexico sample and reduce the temptation to take possible health shortcuts by shopping at the nearer-by dollar store rather than incurring the cost of traveling all the way to the grocery store. Based on the results of this study, a policy focused solely on increasing healthy food consumption might reasonably seek to reduce access to dollar stores in the overall sample and for urban areas in New Mexico. Indeed, some localities already

have adopted policies banning dollar stores (McCarthy, Minovi, and Singleton, 2022) with one of the stated goals being improvements in healthy food availability.

Dollar stores have distinct effects in rural New Mexico, however. The results of this study suggest that dollar stores increase DDS in rural areas without increased food expenditures and should be encouraged as a way to improve health outcomes among rural New Mexicans without added budgetary costs. In addition, dollar store access in rural areas likely offers significant savings from not having to travel as far for food, which include time, gas costs, vehicle depreciation, and the risk of death and injury from traveling, usually by car in rural areas. Proximity and prices are what drive dollar store purchasing (Caspi, et al., 2016). A recent paper studying retail environments more generally, i.e., beyond food, found that travel cost reductions from dollar store access offset most welfare losses associated with the closure of department stores and regional chains (Cao et al., 2024).

Households face obvious tradeoffs between buying healthy food and travel costs, suggesting that improving the quality of food at dollar stores (e.g., by encouraging dollar stores to carry more produce) or reducing the costs of accessing grocery stores, e.g., through ride-sharing programs or food delivery options, might be positive ways to offset negative effects of dollar store proximity on the motivation of households to seek out healthy food and improve the options available to rural households. Perhaps the easiest policy prescription for improving the nutritional quality of those shopping at dollar stores is to educate consumers on the similar nutritional content of fresh, frozen, and canned produce (Favell, 1998; Rickman, Bruhn, and Barrett, 2007; Li et al., 2017; Miller and Knudson, 2014), overcoming the perception that fresh produce is better than the canned or frozen options more commonly available at dollar stores (Dudley et al., 2025).

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FIGURES & TABLES

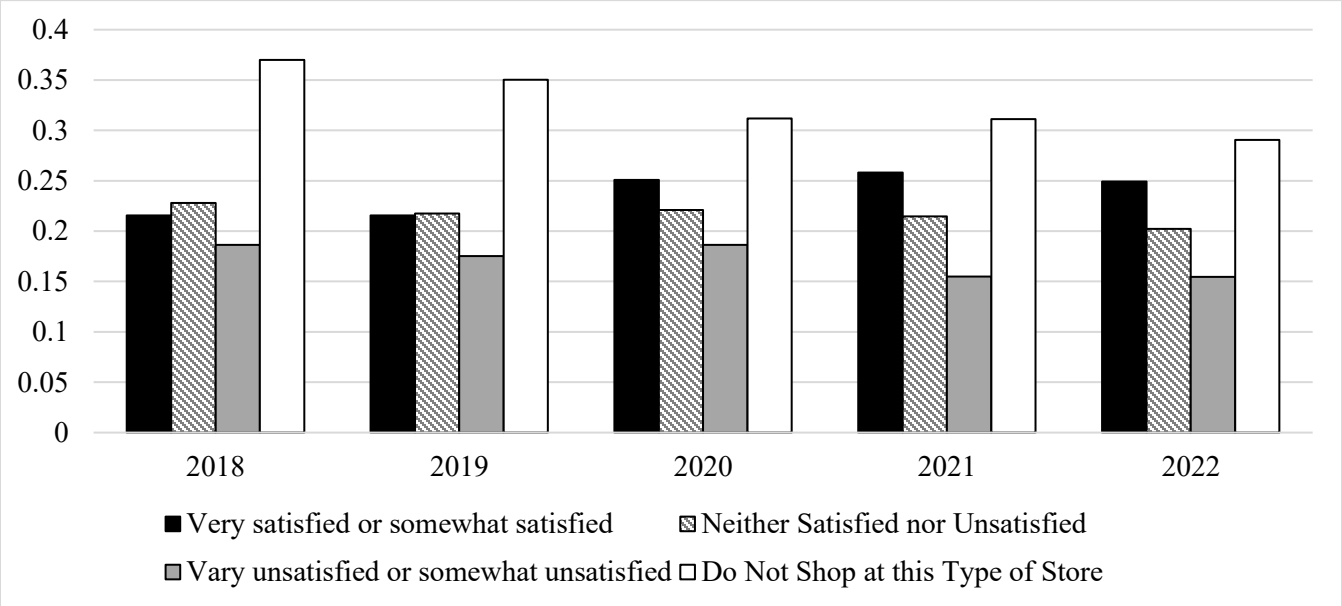

Figure 1: Attitude towards Dollar Stores

Notes: Data from the NielsenIQ Annual Ailments, Health, and Wellness Survey.

Table 1: DDS food groups and number of food items included in each food group

DDS Food Groups	**Number of Food Items**
12 Groups as per FAO guidelines	
Cereals	61
Roots and tubers	7
Vegetables	76
Fruits	48
Meat	57
Eggs	2
Fish and seafood	25
Legumes, Nuts and Seeds	30
Milk	64
Oil/Fat	10
Sugar/honey	161
Miscellaneous	173
Additional Groups	
Snacks	35
Premade food	61
Total	810

Notes: First 12 food groups are created following Food and Agriculture Organization (FAO) revised document "Guidelines for Measuring Household and Individual Dietary Diversity*"* prepared by Kennedy et al. (2011). This study uses two additional food groups, snacks and premade food, which are common in the NielsenIQ purchase data but do not fit cleanly into the 12 FAO food groups. The number of food items refers to the number of unique items classified in that category in the NielsenIQ, e.g., 61 different cereal products appear in the NielsenIQ data.

Table 2: Descriptive statistics

	Full Sample (N=2,835,345)				Urban (N=2,403,646)		Rural (N=420,638)	
	Mean	**SD**	**Min**	**Max**	**Mean**	**SD**	**Mean**	**SD**
Outcome Variables								
DDS value	9.184	2.779	1	14	9.178	2.795	9.228	2.678
Any FV	0.882	0.322	0	1	0.884	0.32	0.875	0.33
Any FV - Fresh	0.85	0.357	0	1	0.852	0.355	0.835	0.371
Any FV - Canned	0.345	0.475	0	1	0.341	0.474	0.366	0.482
Any FV - Frozen	0.231	0.422	0	1	0.233	0.423	0.221	0.415
All FV Count	9.426	9.897	0	193	9.652	10.1	8.167	8.553
Fresh FV Count	8.182	9.129	0	184	8.414	9.338	6.885	7.713
Canned FV Count	0.745	1.478	0	48	0.733	1.462	0.813	1.568
Frozen FV Count	0.499	1.287	0	43	0.505	1.296	0.468	1.237
Total Spending (2015 USD)	222.96	171.70	0.00	6791.60	224.55	173.19	214.36	160.40
DS Spending (% of Total Spending)	2.578	9.517	0	100	2.268	8.88	4.321	12.382
DS Visits	0.468	1.218	0	41	0.42	1.133	0.74	1.582
Count variables for stores (zip-code level)								
DS count	2.348	2.351	0	16	2.342	2.341	2.383	2.41
Grocery store count	6.606	8.008	0	141	7.154	8.44	3.477	3.475
Supermarket count	2.358	2.365	0	26	2.576	2.436	1.108	1.342
Grocery store and supermarkets combined - Categories								
Zip code with no stores	0.06	0.238	0	1	0.046	0.210	0.143	0.350
Zip code with 1-4	0.289	0.453	0	1	0.262	0.440	0.451	0.498
Zip code with 5-9	0.299	0.458	0	1	0.305	0.461	0.270	0.444
Zip code with 10+	0.352	0.478	0	1	0.387	0.487	0.136	0.343
DS - Categories								
Zip code without DS	0.23	0.421	0	1	0.231	0.422	0.222	0.416
Zip code with DS	0.77	0.421	0	1	0.769	0.422	0.778	0.416
Zip code with 1 DS	0.236	0.424	0	1	0.236	0.425	0.235	0.424
Zip code with 2 DS	0.166	0.372	0	1	0.163	0.369	0.186	0.389
Zip code with 3 DS	0.12	0.325	0	1	0.122	0.328	0.109	0.312
Zip code with 4+ DS	0.248	0.432	0	1	0.248	0.432	0.248	0.432
Demographic Variables								
No HS graduate	0.009	0.095	0	1	0.009	0.093	0.012	0.107
At least one HS graduate	0.163	0.369	0	1	0.15	0.357	0.239	0.426
At least one college graduate	0.474	0.499	0	1	0.467	0.499	0.519	0.500
Both college graduate	0.353	0.478	0	1	0.375	0.484	0.230	0.421
Low income	0.087	0.282	0	1	0.079	0.27	0.133	0.340

Child in household	0.222	0.416	0	1	0.225	0.417	0.209	0.407
White	0.794	0.404	0	1	0.776	0.417	0.904	0.295
Black	0.113	0.317	0	1	0.123	0.329	0.051	0.220
Asian	0.041	0.198	0	1	0.046	0.21	0.010	0.100
Other	0.052	0.221	0	1	0.054	0.227	0.035	0.185
Hispanic	0.074	0.261	0	1	0.081	0.272	0.033	0.179
Married	0.635	0.481	0	1	0.629	0.483	0.674	0.469
Female-only household head	0.281	0.45	0	1	0.286	0.452	0.251	0.434
Male-only household head	0.094	0.292	0	1	0.097	0.296	0.076	0.265

Notes: DDS = dietary diversity score, FV = fruits and vegetables, and DS = dollar store. Descriptive statistics for full, urban, and rural samples. Sample weights are used.

Table 3: Dollar stores and household Dietary Diversity Scores (DDS)

	Model I	Model II	Model III	Model IV	Model V	Model VI
			Urban	Rural		
Has DS (1=Yes)	-0.094	-0.098	-0.089	-0.145	-0.087	-0.103
	(0.084)	(0.085)	(0.098)	(0.108)	(0.098)	(0.099)
DS*Rural					-0.075	-0.040
					(0.144)	(0.146)
DS*Low-Income						0.141
						(0.101)
DS*Rural*Low-Income						-0.272
						(0.186)
Low-Income*Rural						0.093
						(0.173)
Grocery Stores Count		0.026***	0.026***	0.009	0.026***	0.026***
		(0.008)	(0.009)	(0.027)	(0.008)	(0.008)
Supermarkets Count		0.057***	0.062***	-0.084	0.057***	0.057***
		(0.017)	(0.017)	(0.060)	(0.017)	(0.017)
Observations	2,824,284	2,824,284	2,403,646	420,638	2,824,284	2,824,284
R-Squared	0.218	0.218	0.204	0.307	0.218	0.218

Notes: DS = dollar store. Model I includes treatment indicator: Has DS (1=Yes), household demographic controls: household head's education, low-income status, presence of children, race, Hispanic ethnicity, marital status, and household head gender composition (male-only or female-only household). Model II further controls for the number of grocery stores and supermarkets in the zip code. Model III & Model IV estimate the regressions separately for households in urban and rural zip codes, respectively. Model V includes an interaction term between dollar store presence and rural status. Model VI includes a triple interaction between dollar store presence, rural status, and low-income status All models include zip code, month, and year fixed effects. Standard errors are clustered at the zip code level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 4: Dollar stores and household fruit-and-vegetable purchase {0,1}

	Model I	Model II	Model III	Model IV	Model V	Model VI
			Urban	Rural		
Has DS (1=Yes)	-0.006	-0.006	-0.007	-0.005	-0.007	-0.008
	(0.009)	(0.009)	(0.010)	(0.016)	(0.010)	(0.010)
DS*Rural					0.003	0.005
					(0.019)	(0.019)
DS*Low-Income						0.013
						(0.012)
DS*Rural*Low-Income						-0.016
						(0.026)
Low-Income*Rural						0.003
						(0.024)
Grocery Stores Count		0.001	0.001	0.001	0.001	0.001
		(0.001)	(0.001)	(0.003)	(0.001)	(0.001)
Supermarkets Count		0.003	0.003	-0.002	0.003	0.003
		(0.002)	(0.002)	(0.008)	(0.002)	(0.002)
Observations	2,824,284	2,824,284	2,403,646	420,638	2,824,284	2,824,284
R-Squared	0.126	0.126	0.114	0.190	0.126	0.126

Notes: DS = dollar store. Model I includes treatment indicator: Has DS (1=Yes), household demographic controls: household head's education, low-income status, presence of children, race, Hispanic ethnicity, marital status, and household head gender composition (male-only or female-only household). Model II further controls for the number of grocery stores and supermarkets in the zip code. Model III & Model IV estimate the regressions separately for households in urban and rural zip codes, respectively. Model V includes an interaction term between dollar store presence and rural status. Model VI includes a triple interaction between dollar store presence, rural status, and low-income status All models include zip code, month, and year fixed effects. Standard errors are clustered at the zip code level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 5: Dollar stores and the count of fruit-and-vegetable products purchased

	Model I	Model II	Model III	Model IV	Model V	Model VI
			Urban	Rural		
Has DS (1=Yes)	0.196	0.190	0.313	-0.506*	0.324	0.287
	(0.240)	(0.242)	(0.279)	(0.266)	(0.279)	(0.281)
DS*Rural					-0.913**	-0.884**
					(0.380)	(0.393)
DS*Low-Income						0.348
						(0.342)
DS*Rural*Low-Income						-0.288
						(0.651)
Low-Income*Rural						-0.167
						(0.610)
Grocery Stores Count		0.034	0.035	0.038	0.034	0.034
		(0.029)	(0.030)	(0.104)	(0.029)	(0.029)
Supermarkets Count		0.076	0.088	-0.186	0.076	0.076
		(0.061)	(0.063)	(0.214)	(0.061)	(0.061)
Observations	2,824,284	2,824,284	2,403,646	420,638	2,824,284	2,824,284
R-Squared	0.222	0.222	0.204	0.352	0.222	0.222

Notes: DS = dollar store. Model I includes treatment indicator: Has DS (1=Yes), household demographic controls: household head's education, low-income status, presence of children, race, Hispanic ethnicity, marital status, and household head gender composition (male-only or female-only household). Model II further controls for the number of grocery stores and supermarkets in the zip code. Model III & Model IV estimate the regressions separately for households in urban and rural zip codes, respectively. Model V includes an interaction term between dollar store presence and rural status. Model VI includes a triple interaction between dollar store presence, rural status, and low-income status All models include zip code, month, and year fixed effects. Standard errors are clustered at the zip code level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 6: Dollar stores and any purchase and the count of fresh, canned, and frozen fruits and vegetables purchased

	(1)	(2)	(3)	(4)	(5)	(6)
	Fresh		Canned		Frozen	
	Any Purchase	Count	Any Purchase	Count	Any Purchase	Count
Has DS (1=Yes)	-0.006	0.268	0.008	0.035	-0.009	-0.016
	(0.011)	(0.262)	(0.009)	(0.027)	(0.009)	(0.025)
DS*Rural	0.001	-0.764**	-0.023	-0.100**	0.000	-0.020
	(0.021)	(0.365)	(0.015)	(0.046)	(0.016)	(0.045)
DS*Low-Income	0.016	0.376	0.011	-0.003	-0.005	-0.025
	(0.013)	(0.322)	(0.010)	(0.033)	(0.009)	(0.030)
DS*Rural*Low-Income	-0.032	-0.138	-0.009	-0.022	-0.033*	-0.129**
	(0.029)	(0.609)	(0.025)	(0.078)	(0.018)	(0.061)
Low-Income*Rural	0.013	-0.214	-0.009	-0.076	0.029*	0.123**
	(0.027)	(0.570)	(0.024)	(0.073)	(0.016)	(0.057)
Grocery Stores Count	0.001	0.011	0.004***	0.017***	0.002**	0.007***
	(0.001)	(0.027)	(0.001)	(0.002)	(0.001)	(0.002)
Supermarkets Count	0.002	0.047	0.006***	0.019***	0.003*	0.010*
	(0.002)	(0.058)	(0.002)	(0.006)	(0.002)	(0.006)
Observations	2,824,284	2,824,284	2,824,284	2,824,284	2,824,284	2,824,284
R-Squared	0.140	0.224	0.112	0.133	0.108	0.121

Notes: DS = dollar store. Each column represents a separate regression model with the outcome variable listed. The treatment variable “DS” is a binary variable where "Has DS (1=Yes)” represents zip codes with at least one dollar store. All models include household demographic controls: household head’s education, low-income status, presence of children, race, Hispanic ethnicity, marital status, and household head gender composition (male-only or female-only household). All models include zip code, month, and year fixed effects. Standard errors are clustered at the zip code level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 7: Dollar stores and total spending

	Model I	Model II	Model III	Model IV	Model V	Model VI
			Urban	Rural		
Has DS (1=Yes)	-1.218	-1.384	0.787	-12.813**	1.092	0.547
	(4.276)	(4.345)	(5.002)	(5.033)	(4.991)	(5.042)
DS*Rural					-16.860**	-17.854**
					(6.965)	(7.187)
DS*Low-Income						5.057
						(5.952)
DS*Rural*Low-Income						5.121
						(11.075)
Low-Income*Rural						-10.319
						(10.017)
Grocery Stores Count		0.991**	1.079**	-0.351	0.997**	0.999**
		(0.441)	(0.454)	(1.742)	(0.441)	(0.441)
Supermarkets Count		1.620	1.839*	-4.623	1.620	1.617
		(1.063)	(1.092)	(4.350)	(1.063)	(1.062)
Observations	2,824,284	2,824,284	2,403,646	420,638	2,824,284	2,824,284
R-Squared	0.262	0.262	0.246	0.371	0.262	0.262

Notes: DS = dollar store. Model I includes treatment indicator: Has DS (1=Yes), household demographic controls: household head's education, low-income status, presence of children, race, Hispanic ethnicity, marital status, and household head gender composition (male-only or female-only household). Model II further controls for the number of grocery stores and supermarkets in the zip code. Model III & Model IV estimate the regressions separately for households in urban and rural zip codes, respectively. Model V includes an interaction term between dollar store presence and rural status. Model VI includes a triple interaction between dollar store presence, rural status, and low-income status All models include zip code, month, and year fixed effects. Standard errors are clustered at the zip code level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 8: Dollar Stores and outcomes in New Mexico

	(1)	(3)	(2)	(4)	(5)	(6)
	DDS value	Any FV	FV Count	Total Spending	DS Spending (% of Total)	DS Visits
Has DS (1=Yes)	-0.978*	-0.080***	0.249	19.985	2.843	-0.333**
	(0.508)	(0.027)	(1.011)	(31.711)	(3.119)	(0.141)
DS*Rural	-0.011	0.021	-9.926**	122.614*	4.122	1.049***
	(1.053)	(0.120)	(3.887)	(62.990)	(6.131)	(0.360)
DS*Low-Income	1.119	0.040	-1.211	22.069	-0.549	0.130
	(1.506)	(0.071)	(1.509)	(67.998)	(4.291)	(0.276)
DS*Rural*Low-Income	-4.084**	-0.241**	-4.426	-105.268	27.237**	-0.035
	(1.773)	(0.103)	(3.053)	(74.433)	(12.099)	(0.441)
Low-Income*Rural	3.404**	0.327***	4.486***	80.747	-17.535***	0.196
	(1.497)	(0.069)	(1.651)	(64.175)	(3.340)	(0.190)
Grocery Stores Count	-0.107	0.013	-0.078	-14.292***	-0.072	0.009
	(0.108)	(0.017)	(0.368)	(5.291)	(0.432)	(0.034)
Supermarkets Count	0.271	0.026	1.838*	31.549***	-1.262	-0.112
	(0.227)	(0.053)	(1.040)	(10.532)	(1.485)	(0.189)
Observations	14,597	14,597	14,597	14,597	14,596	14,597
R-Squared	0.234	0.127	0.201	0.286	0.204	0.256

Notes: DDS = dietary diversity score, FV = fruits and vegetables, and DS = dollar stores. Each column represents a separate regression model with the outcome variable listed. The treatment variable “DS” is a binary variable where "Has DS (1=Yes)” represents zip codes with at least one dollar store. All models include household demographic controls: household head’s education, low-income status, presence of children, race, Hispanic ethnicity, marital status, and household head gender composition (male-only or female-only household). All models include zip code, month, and year fixed effects. Standard errors are clustered at the zip code level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 9: Dollar Stores and fresh, canned, and frozen fruit-and-vegetable purchase – New Mexico

	(1)	(2)	(3)	(4)	(5)	(6)
	Fresh		Canned		Frozen	
	Any Purchase	Count	Any Purchase	Count	Any Purchase	Count
Has DS (1=Yes)	-0.077**	0.169	0.331***	0.383***	-0.197***	-0.303***
	(0.031)	(0.934)	(0.049)	(0.113)	(0.033)	(0.080)
DS*Rural	-0.355**	-8.082**	-0.422***	-2.049***	-0.020	0.205
	(0.135)	(3.617)	(0.118)	(0.371)	(0.109)	(0.259)
DS*Low-Income	0.053	-1.033	-0.111	-0.035	-0.008	-0.143
	(0.070)	(1.346)	(0.067)	(0.186)	(0.149)	(0.400)
DS*Rural*Low-Income	-0.198*	-3.583	-0.028	-0.370	-0.201	-0.472
	(0.104)	(3.090)	(0.122)	(0.303)	(0.153)	(0.417)
Low-Income*Rural	0.309***	3.577**	0.066	0.347*	0.201	0.562
	(0.064)	(1.422)	(0.073)	(0.205)	(0.150)	(0.399)
Grocery Stores Count	0.014	0.003	-0.037**	-0.054	0.005	-0.026
	(0.016)	(0.309)	(0.014)	(0.043)	(0.020)	(0.065)
Supermarkets Count	0.053	1.812**	0.009	0.018	-0.049	0.007
	(0.048)	(0.874)	(0.036)	(0.046)	(0.077)	(0.157)
Observations	14,597	14,597	14,597	14,597	14,597	14,597
R-Squared	0.125	0.204	0.122	0.118	0.108	0.111

Notes: DS = dollar store. Each column represents a separate regression model with the outcome variable listed. The treatment variable “DS” is a binary variable where "Has DS (1=Yes)” represents zip codes with at least one dollar store. All models include household demographic controls: household head’s education, low-income status, presence of children, race, Hispanic ethnicity, marital status, and household head gender composition (male-only or female-only household). All models include zip code, month, and year fixed effects. Standard errors are clustered at the zip code level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 10: Dollar stores and outcomes in New Mexico – Gardner (2022)

	Urban	Rural	Interactions	Urban	Rural	Interactions
	DDS			Total Spending (2015 USD)		
Has DS (1=Yes)	-3.161***	1.379***	0.013	-192.165***	22.179	30.506
	(0.956)	(0.531)	(0.702)	(47.216)	(27.168)	(28.637)
DS*Low-Income			-1.062			-46.677
			(0.990)			(71.091)
DS*Rural			-0.547			-14.018
			(0.833)			(49.183)
DS*Rural*Low-Income			0.338			-4.195
			(1.716)			(81.956)
Low-Income*Rural			0.093			6.436
			(0.173)			(30.413)
	Any FV {0,1}			FV - Count		
Has DS (1=Yes)	-0.081	0.045	0.236**	-3.569	1.776	-0.357
	(0.109)	(0.059)	(0.117)	(3.892)	(2.025)	(2.148)
DS*Low-Income			-0.194*			-1.687
			(0.107)			(3.268)
DS*Rural			-0.030			-0.235
			(0.063)			(0.923)
DS*Rural*Low-Income			0.176			4.150
			(0.161)			(4.928)
Low-Income*Rural			-0.106			-3.879
			(0.109)			(3.183)
Observations	11,381	3,216	14,597	11,381	3,216	14,597

Notes: DDS = dietary diversity score, FV = fruits and vegetables, and DS = dollar stores. Each column represents a separate regression model with the outcome variable listed. Regressions were estimated in line with Gardner (2022). The treatment variable “DS” is a binary variable where "Has DS (1=Yes)” represents zip codes with at least one dollar store. All models include household demographic controls: household head’s education, low-income status, presence of children, race, Hispanic ethnicity, marital status, and household head gender composition (male-only or female-only household). All models include zip code, month, and year fixed effects. Standard errors are clustered at the zip code level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 11: Dollar stores and fresh, canned, and frozen fruit-and-vegetable purchase in New Mexico – Gardner (2022)

	Fresh		Canned		Frozen	
	Any	Count	Any	Count	Any	Count
Has DS (1=Yes)	0.203	0.482	-0.062	-0.795***	0.089	-0.044
	(0.149)	(2.024)	(0.068)	(0.235)	(0.106)	(0.323)
DS*Low-Income	-0.207	-2.244	-0.067	0.244	0.010	0.313
	(0.148)	(2.997)	(0.122)	(0.458)	(0.187)	(0.626)
DS*Rural	-0.127	-3.555	-0.042	-0.028	-0.118*	-0.297
	(0.108)	(2.862)	(0.082)	(0.344)	(0.069)	(0.210)
DS*Rural*Low-Income	0.249	3.454	0.297	0.527	0.019	0.169
	(0.180)	(4.126)	(0.226)	(0.657)	(0.170)	(0.554)
Low-Income*Rural	-0.069	-0.688	0.004	0.076	0.098	0.376
	(0.092)	(1.019)	(0.043)	(0.183)	(0.105)	(0.319)
Observations	14,597	14,597	14,597	14,597	14,597	14,597

Notes: DS = dollar store. Each column represents a separate regression model with the outcome variable listed. Regressions were estimated in line with Gardner (2022). The treatment variable "DS" is a binary variable where "Has DS (1=Yes)" represents zip codes with at least one dollar store. All models include household demographic controls: household head's education, low-income status, presence of children, race, Hispanic ethnicity, marital status, and household head gender composition (male-only or female-only household). All models include zip code, month, and year fixed effects. Standard errors are clustered at the zip code level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

APPENDIX FIGURES & TABLES

Appendix Table 1: Number of Dollar Stores and outcomes

	(1)	(2)	(3)	(4)	(5)	(6)
	DDS value	FV Count	Any FV Purchase	Total Spending	DS Spending (% of total spending)	DS Visits
DS (1)	-0.101	0.283	-0.008	0.492	0.442**	0.030
	(0.099)	(0.281)	(0.010)	(5.072)	(0.211)	(0.028)
DS (2)	-0.114	0.276	-0.014	1.602	0.299	-0.016
	(0.112)	(0.344)	(0.012)	(6.068)	(0.275)	(0.043)
DS (3)	-0.181	0.240	-0.016	-1.999	0.402	-0.044
	(0.122)	(0.398)	(0.013)	(6.895)	(0.355)	(0.064)
DS (4+)	-0.206	0.076	-0.021	-4.099	0.555	-0.076
	(0.131)	(0.448)	(0.014)	(7.783)	(0.426)	(0.088)
DS(1)*Rural	-0.057	-0.836**	0.004	-18.740***	-0.117	-0.046
	(0.146)	(0.396)	(0.019)	(7.230)	(0.855)	(0.074)
DS(2)*Rural	-0.021	-0.801	0.008	-22.410**	-0.270	-0.045
	(0.197)	(0.532)	(0.025)	(10.351)	(0.977)	(0.113)
DS(3)*Rural	0.077	-1.132*	-0.000	-19.949	0.064	0.019
	(0.236)	(0.682)	(0.029)	(13.107)	(1.173)	(0.143)
DS(4+)*Rural	0.175	-1.034	0.033	-19.002	-0.323	0.061
	(0.253)	(0.752)	(0.031)	(15.225)	(1.251)	(0.164)
DS(1)* LowIncome	0.132	0.371	0.015	4.758	0.518	0.125**
	(0.116)	(0.415)	(0.013)	(7.032)	(0.357)	(0.050)
DS(2)* LowIncome	0.163	0.319	0.020	6.957	0.976***	0.183***
	(0.122)	(0.459)	(0.014)	(7.407)	(0.366)	(0.049)
DS(3)* LowIncome	0.012	0.051	-0.011	-2.004	1.664***	0.180***
	(0.127)	(0.503)	(0.015)	(7.718)	(0.551)	(0.062)
DS(4+)* LowIncome	0.187*	0.465	0.017	7.080	1.611***	0.227***
	(0.112)	(0.361)	(0.013)	(6.577)	(0.401)	(0.054)
DS(1)*LowIncome*Rural	-0.162	-0.600	-0.013	12.382	-1.274	0.078
	(0.224)	(0.790)	(0.031)	(12.726)	(1.042)	(0.145)
DS(2)*LowIncome*Rural	-0.388*	-0.787	-0.024	-8.346	0.281	0.203
	(0.214)	(0.787)	(0.029)	(13.986)	(1.126)	(0.169)
DS(3)*LowIncome*Rural	-0.286	-0.115	-0.008	7.032	-2.222*	-0.144
	(0.236)	(0.863)	(0.035)	(13.858)	(1.147)	(0.137)

DS(4+)*LowIncome*Rural	-0.281	0.087	-0.019	6.694	-1.389	0.055
	(0.211)	(0.700)	(0.028)	(13.346)	(1.141)	(0.137)
Low Income*Rural	0.097	-0.182	0.003	-10.025	1.743**	0.022
	(0.173)	(0.610)	(0.024)	(10.033)	(0.773)	(0.087)
Observations	2,824,284	2,824,284	2,824,284	2,824,284	2,824,155	2,824,284
R-squared	0.218	0.222	0.126	0.262	0.231	0.296

Notes: DDS = dietary diversity score, FV = fruits and vegetables, and DS = dollar stores. Each column represents a separate regression model with the outcome variable listed. The treatment variable “DS” is the categorical variable where "DS (1)", "DS (2)", "DS (3)", and "DS (4+)" represent zip codes with 1, 2, 3, or 4 or more DSs, respectively. All models include household demographic controls: household head’s education, low-income status, presence of children, race, Hispanic ethnicity, marital status, and household head gender composition (male-only or female-only household) and controls for the number of grocery stores and supermarkets in the zip code. All models include zip code, month, and year fixed effects. Standard errors are clustered at the zip code level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Appendix Table 2: Number of Dollar Stores and fresh, frozen, and canned produce

	(1)	(2)	(3)	(4)	(5)	(6)
	Fresh		Canned		Frozen	
	Any Purchase	Count	Any Purchase	Count	Any Purchase	Count
DS(1)	-0.006	0.268	0.008	0.032	-0.009	-0.017
	(0.011)	(0.262)	(0.009)	(0.026)	(0.009)	(0.025)
DS(2)	-0.015	0.246	0.005	0.033	-0.005	-0.004
	(0.013)	(0.319)	(0.011)	(0.034)	(0.011)	(0.034)
DS(3)	-0.018	0.212	0.002	0.041	-0.008	-0.012
	(0.014)	(0.371)	(0.012)	(0.039)	(0.012)	(0.039)
DS(4+)	-0.023	0.043	0.007	0.035	-0.011	-0.003
	(0.016)	(0.422)	(0.014)	(0.044)	(0.013)	(0.043)
DS(1)*Rural	-0.000	-0.717*	-0.022	-0.101**	-0.001	-0.018
	(0.021)	(0.368)	(0.016)	(0.046)	(0.016)	(0.046)
DS(2)*Rural	0.009	-0.773	-0.006	-0.038	0.002	0.010
	(0.027)	(0.482)	(0.022)	(0.065)	(0.022)	(0.067)
DS(3)*Rural	0.008	-1.100*	-0.032	-0.092	0.013	0.060
	(0.032)	(0.613)	(0.027)	(0.080)	(0.027)	(0.096)
DS(4+)*Rural	0.048	-0.981	-0.053*	-0.132	0.035	0.079
	(0.035)	(0.682)	(0.030)	(0.091)	(0.029)	(0.100)
DS(1)*LowIncome	0.019	0.369	0.013	0.020	-0.004	-0.018
	(0.015)	(0.389)	(0.012)	(0.040)	(0.010)	(0.035)
DS(2)*LowIncome	0.027*	0.300	0.014	0.031	0.006	-0.012
	(0.015)	(0.436)	(0.013)	(0.042)	(0.011)	(0.039)
DS(3)*LowIncome	-0.012	0.113	0.007	-0.030	-0.011	-0.032
	(0.017)	(0.478)	(0.012)	(0.040)	(0.011)	(0.042)
DS(4+)*LowIncome	0.019	0.520	0.010	-0.023	-0.007	-0.033
	(0.014)	(0.339)	(0.011)	(0.038)	(0.010)	(0.032)
DS(1)*LowIncome*Rural	-0.029	-0.422	-0.011	-0.028	-0.024	-0.150**
	(0.034)	(0.731)	(0.028)	(0.089)	(0.023)	(0.075)
DS(2)*LowIncome*Rural	-0.039	-0.503	-0.018	-0.109	-0.054**	-0.176**
	(0.033)	(0.740)	(0.029)	(0.094)	(0.022)	(0.075)
DS(3)*LowIncome*Rural	-0.023	0.030	-0.021	-0.015	-0.027	-0.130
	(0.040)	(0.805)	(0.030)	(0.099)	(0.023)	(0.080)
DS(4+)*LowIncome*Rural	-0.035	0.158	0.001	0.023	-0.030	-0.094
	(0.032)	(0.653)	(0.028)	(0.089)	(0.020)	(0.068)
Low Income*Rural	0.013	-0.229	-0.010	-0.076	0.030*	0.123**
	(0.027)	(0.571)	(0.024)	(0.073)	(0.016)	(0.057)
Observations	2,824,284	2,824,284	2,824,284	2,824,284	2,824,284	2,824,284
R-squared	0.141	0.224	0.112	0.133	0.108	0.121

Notes: DS = dollar store. Each column represents a separate regression model with the outcome variable listed. The treatment variable “DS” is the categorical variable where "DS (1)", "DS (2)", "DS (3)", and

"DS (4+)" represent zip codes with 1, 2, 3, or 4 or more DSs, respectively. All models include household demographic controls: household head's education, low-income status, presence of children, race, Hispanic ethnicity, marital status, and household head gender composition (male-only or female-only household) and controls for the number of grocery stores and supermarkets in the zip code. All models include zip code, month, and year fixed effects. Standard errors are clustered at the zip code level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Appendix Table 3: Descriptive Statistics – New Mexico

	Full Sample (N=14,703)				Urban (N=11,381)		Rural (N=3,216)	
Variable	Mean	SD	Min	Max	Mean	SD	Mean	SD
Outcome Variables								
DDS value	9.067	2.765	1	14	9.005	2.790	9.288	2.677
All FV Count	9.527	9.799	0	109	9.841	9.934	8.525	9.329
Fresh FV Count	8.330	9.121	0	106	8.661	9.238	7.246	8.699
Canned FV Count	0.676	1.354	0	32	0.657	1.331	0.751	1.435
Frozen FV Count	0.521	1.205	0	19	0.523	1.225	0.528	1.149
Purchase Any FV	0.883	0.321	0	1	0.884	0.320	0.879	0.326
Purchase Any FV - Fresh	0.858	0.349	0	1	0.860	0.347	0.852	0.355
Purchase Any FV - Canned	0.329	0.470	0	1	0.324	0.468	0.350	0.477
Purchase Any FV - Frozen	0.262	0.440	0	1	0.263	0.440	0.265	0.441
Total Spending (2015 USD)	217.666	158.186	0	1534	214.600	153.640	225.784	164.398
DS Spending (% of Total Spending)	2.005	7.756	0	100	1.642	6.835	3.347	10.356
DS Visits	0.407	1.155	0	25	0.353	1.016	0.608	1.543
Count variables for stores								
DSs count	3.363	2.760	0	10	3.100	2.485	4.294	3.408
Grocery store count	3.945	3.301	0	13	3.981	3.313	3.820	3.253
Supermarket count	2.266	1.672	0	6	2.450	1.632	1.616	1.651
Zip code without DSs	0.097	0.296	0	1	0.069	0.253	0.195	0.396
Zip code with DSs	0.903	0.296	0	1	0.931	0.253	0.805	0.396
Zip code with 1 DS	0.171	0.377	0	1	0.202	0.401	0.063	0.243
Zip code with 2 DSs	0.283	0.450	0	1	0.325	0.469	0.132	0.338
Zip code with 3 DSs	0.080	0.272	0	1	0.085	0.279	0.062	0.241
Zip code with 4+ DSs	0.369	0.483	0	1	0.319	0.466	0.548	0.498
Demographic Variables								
No HS graduate	0.016	0.124	0	1	0.013	0.114	0.025	0.157
Atleast one HS graduate	0.082	0.274	0	1	0.068	0.253	0.132	0.339
Neither college graduate	0.517	0.500	0	1	0.507	0.500	0.558	0.497
Both college graduate	0.385	0.487	0	1	0.411	0.492	0.285	0.452
Low income	0.112	0.315	0	1	0.104	0.306	0.142	0.349
Child in household	0.248	0.432	0	1	0.261	0.439	0.209	0.406
White	0.818	0.386	0	1	0.813	0.390	0.831	0.375
Black	0.050	0.218	0	1	0.050	0.218	0.052	0.221
Asian	0.015	0.121	0	1	0.018	0.133	0.004	0.061
Other	0.117	0.321	0	1	0.119	0.324	0.114	0.318
Hispanic	0.233	0.422	0	1	0.250	0.433	0.180	0.384
Married	0.614	0.487	0	1	0.601	0.490	0.656	0.475

Female-only household head	0.299	0.458	0	1	0.314	0.464	0.245	0.430
Male-only household head	0.107	0.309	0	1	0.103	0.305	0.124	0.330

Notes: DDS = dietary diversity score, FV = fruits and vegetables, and DS = dollar stores. Descriptive statistics for full, urban, and rural samples. Sample weights are used.

Appendix Table 4: Dollar stores, DDS, and Total Spending – Categorical grocery store controls

	Urban	Rural	Interactions	Urban	Rural	Interactions
		DDS			Total Spending (2015 USD)	
Has DS (1=Yes)	-0.085	-0.135	-0.099	0.961	-12.581**	0.710
	(0.099)	(0.109)	(0.100)	(5.045)	(5.097)	(5.085)
DS*Low-Income			0.140			5.052
			(0.101)			(5.958)
DS*Rural			-0.032			-17.569**
			(0.147)			(7.231)
DS*Rural*Low-Income			-0.272			-10.285
			(0.186)			(10.024)
Low-Income*Rural			0.093			5.096
			(0.173)			(11.082)
Zip code with 1-4 grocery stores	-0.221**	0.235	-0.101	-9.368	6.353	-4.767
	(0.106)	(0.173)	(0.092)	(7.762)	(7.536)	(6.112)
Zip code with 5-9 grocery stores	-0.264**	-0.014	-0.172*	-8.784	-11.044	-6.572
	(0.115)	(0.195)	(0.101)	(8.283)	(10.081)	(6.663)
Zip code with 10+ grocery stores	-0.307**	-0.113	-0.218**	-13.638	-20.231	-11.761
	(0.124)	(0.256)	(0.111)	(8.752)	(14.002)	(7.187)
Observations	2,403,646	420,638	2,824,284	2,403,646	420,638	2,824,284
R-squared	0.204	0.307	0.218	0.246	0.371	0.262

Notes: DDS = dietary diversity score and DS = dollar stores. Each column represents a separate regression model with the outcome variable listed. The treatment variable "DS" is a binary variable where "Has DS (1=Yes)" represents zip codes with at least one dollar store. All models include household demographic controls: household head's education, low-income status, presence of children, race, Hispanic ethnicity, marital status, and household head gender composition (male-only or female-only household). The omitted category for the zip-code-level number of grocery stores variables is zip codes with no dollar stores. All models include zip code, month, and year fixed effects. Standard errors are clustered at the zip code level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Appendix Table 5: Dollar stores and fruit-and-vegetable purchase – Categorical grocery store controls

	Urban	Rural	Interactions	Urban	Rural	Interactions
	Any FV {0,1}			FV - Count		
Has DS (1=Yes)	-0.007	-0.004	-0.008	0.318	-0.487*	0.291
	(0.010)	(0.016)	(0.010)	(0.278)	(0.266)	(0.280)
DS*Low-Income			0.013			0.348
			(0.012)			(0.342)
DS*Rural			0.005			-0.878**
			(0.019)			(0.395)
DS*Rural*Low-Income			-0.016			-0.290
			(0.026)			(0.652)
Low-Income*Rural			0.003			-0.164
			(0.024)			(0.611)
Zip code with 1-4 grocery stores	-0.012	0.022	-0.003	-0.573	0.510	-0.265
	(0.011)	(0.016)	(0.010)	(0.500)	(0.397)	(0.387)
Zip code with 5-9 grocery stores	-0.009	-0.003	-0.004	-0.759	0.315	-0.447
	(0.012)	(0.020)	(0.011)	(0.529)	(0.469)	(0.416)
Zip code with 10+ grocery stores	-0.011	0.002	-0.005	-0.869	0.418	-0.543
	(0.013)	(0.027)	(0.012)	(0.555)	(0.600)	(0.445)
Observations	2,403,646	420,638	2,824,284	2,403,646	420,638	2,824,284
R-squared	0.204	0.307	0.218	0.246	0.371	0.262

Notes: DDS = dietary diversity score, FV = fruits and vegetables, and DS = dollar stores. Each column represents a separate regression model with the outcome variable listed. The treatment variable “DS” is a binary variable where "Has DS(1=Yes)” represents zip codes with at least one dollar store. All models include household demographic controls: household head’s education, low-income status, presence of children, race, Hispanic ethnicity, marital status, and household head gender composition (male-only or female-only household). The omitted category for the zip-code-level number of grocery stores variables is zip codes with no dollar stores. All models include zip code, month, and year fixed effects. Standard errors are clustered at the zip code level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Appendix Table 6: Dollar stores and fresh, canned, and frozen fruit-and-vegetable purchase – Categorical grocery store controls

	Fresh		Canned		Frozen	
	Any	Count	Any	Count	Any	Count
Has DS (1=Yes)	0.270	-0.006	0.037	0.008	-0.015	-0.009
	(0.262)	(0.011)	(0.027)	(0.009)	(0.025)	(0.009)
DS*Low-Income	0.376	0.016	-0.003	0.011	-0.025	-0.005
	(0.323)	(0.013)	(0.033)	(0.010)	(0.030)	(0.009)
DS*Rural	-0.767**	0.001	-0.093**	-0.021	-0.017	0.001
	(0.367)	(0.021)	(0.046)	(0.016)	(0.045)	(0.016)
DS*Rural*Low-Income	-0.141	-0.032	-0.021	-0.009	-0.129**	-0.033*
	(0.609)	(0.029)	(0.078)	(0.025)	(0.061)	(0.018)
Low-Income*Rural	-0.210	0.013	-0.077	-0.010	0.123**	0.029*
	(0.571)	(0.027)	(0.073)	(0.024)	(0.057)	(0.016)
Zip code with 1-4 grocery stores	-0.245	-0.008	-0.012	-0.001	-0.007	-0.009
	(0.343)	(0.010)	(0.042)	(0.012)	(0.047)	(0.012)
Zip code with 5-9 grocery stores	-0.383	-0.006	-0.043	-0.012	-0.020	-0.015
	(0.370)	(0.012)	(0.046)	(0.013)	(0.051)	(0.013)
Zip code with 10+ grocery stores	-0.450	-0.008	-0.070	-0.017	-0.023	-0.014
	(0.398)	(0.013)	(0.050)	(0.014)	(0.053)	(0.014)
Observations	2,824,284	2,824,284	2,824,284	2,824,284	2,824,284	2,824,284
R-squared	0.204	0.307	0.218	0.246	0.371	0.262

Notes: DS = dollar store. Each column represents a separate regression model with the outcome variable listed. The treatment variable “DS” is a binary variable where "Has DS (1=Yes)” represents zip codes with at least one dollar store. All models include household demographic controls: household head’s education, low-income status, presence of children, race, Hispanic ethnicity, marital status, and household head gender composition (male-only or female-only household). The omitted category for the zip-code-level number of grocery stores variables is zip codes with no dollar stores. All models include zip code, month, and year fixed effects. Standard errors are clustered at the zip code level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Appendix Table 7: Number of dollar stores and outcomes – New Mexico

	(1) DDS value	(2) FV Count	(3) Any FV Purchase	(4) Total Spending	(5) DS Spending (% of Total)	(6) DS Visits
DS(1)	-1.004*	0.001	-0.090***	19.021	2.517	-0.352**
	(0.509)	(1.024)	(0.027)	(31.044)	(2.941)	(0.143)
DS(2)	-1.392**	-1.867	-0.114**	3.056	3.699	-0.305**
	(0.588)	(2.014)	(0.052)	(32.670)	(3.631)	(0.152)
DS(3)	-0.212	5.615***	0.147***	2.117	2.775**	0.075
	(0.348)	(0.838)	(0.043)	(18.265)	(1.346)	(0.095)
DS(1)*Rural	-0.124	-10.756***	0.010	121.067*	3.752	1.027***
	(1.060)	(3.701)	(0.121)	(63.466)	(6.051)	(0.360)
DS(2)*Rural	-0.219	-3.416	-0.057	97.125	1.882	0.473
	(1.162)	(5.206)	(0.143)	(69.334)	(6.314)	(0.317)
DS(3)*Rural	-0.494	-6.851***	-0.176***	-80.472***	-0.828	0.047
	(0.413)	(0.907)	(0.055)	(21.265)	(1.173)	(0.086)
DS(1)* LowIncome	3.297**	3.532	0.197**	57.867	-2.109	0.400
	(1.533)	(4.327)	(0.091)	(77.072)	(3.091)	(0.351)
DS(2)* LowIncome	0.651	-4.071**	-0.034	8.479	-2.127	0.023
	(1.596)	(1.614)	(0.079)	(75.772)	(3.552)	(0.194)
DS(3)* LowIncome	0.198	-4.627**	-0.082	-29.385	-4.875	-0.681**
	(1.550)	(2.092)	(0.083)	(71.463)	(3.599)	(0.311)
DS(4+)* LowIncome	1.085	0.410	0.083	24.751	1.699	0.217
	(1.548)	(1.835)	(0.101)	(69.317)	(5.235)	(0.420)
DS(1)*LowIncome*Rural	-5.628***	-14.159***	-0.511***	-100.214	17.281***	-0.937**
	(1.636)	(4.512)	(0.104)	(80.582)	(3.613)	(0.411)
DS(2)*LowIncome*Rural	-3.719**	-13.459***	-0.287***	-74.719	23.119***	0.100
	(1.659)	(4.730)	(0.095)	(77.656)	(4.582)	(0.298)
DS(3)*LowIncome*Rural	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DS(4+)*LowIncome*Rural	-4.037**	-2.950	-0.233	-111.308	27.604*	-0.027
	(1.956)	(2.349)	(0.142)	(76.434)	(14.446)	(0.559)
Low Income*Rural	3.362**	4.386**	0.332***	77.667	-17.090***	0.223

	(1.514)	(1.703)	(0.074)	(64.809)	(3.126)	(0.188)
Observations	14,597	14,597	14,597	14,597	14,596	14,597
R-squared	0.240	0.216	0.132	0.287	0.210	0.259

Notes: DDS = dietary diversity score, FV = fruits and vegetables, and DS = dollar stores. Each column represents a separate regression model with the outcome variable listed. The treatment variable “DS” is the categorical variable where "DS (1)", "DS (2)", "DS (3)", and "DS (4+)" represent zip codes with 1, 2, 3, or 4 or more DSs, respectively. All models include household demographic controls: household head’s education, low-income status, presence of children, race, Hispanic ethnicity, marital status, and household head gender composition (male-only or female-only household) and controls for the number of grocery stores and supermarkets in the zip code. All models include zip code, month, and year fixed effects. Standard errors are clustered at the zip code level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Appendix Table 8: Number of dollar stores and produce purchase by fresh, frozen, or canned – New Mexico

	(1)	(2)	(3)	(4)	(5)	(6)
	Fresh		Canned		Frozen	
	Any Purchase	Count	Any Purchase	Count	Any Purchase	Count
DS(1)	-0.086***	-0.100	0.334***	0.421***	-0.202***	-0.320***
	(0.031)	(0.945)	(0.051)	(0.111)	(0.036)	(0.082)
DS(2)	-0.125*	-1.150	0.200*	-0.292	-0.255**	-0.426*
	(0.067)	(1.476)	(0.110)	(0.458)	(0.100)	(0.223)
DS(3)	0.147***	5.959***	-0.051*	-0.176	-0.060*	-0.169**
	(0.045)	(0.790)	(0.030)	(0.108)	(0.032)	(0.081)
DS(1)*Rural	-0.373***	-8.856**	-0.440***	-2.108***	-0.026	0.208
	(0.136)	(3.420)	(0.114)	(0.346)	(0.109)	(0.268)
DS(2)*Rural	-0.390**	-2.763	-0.356**	-1.474***	0.136	0.821**
	(0.162)	(4.765)	(0.138)	(0.467)	(0.174)	(0.388)
DS(3)*Rural	-0.279***	-6.050***	-0.135***	-0.529***	0.034	-0.272***
	(0.057)	(0.859)	(0.035)	(0.100)	(0.037)	(0.089)
DS(1)* LowIncome	0.231**	2.528	0.196**	0.763***	0.138	0.241
	(0.093)	(4.214)	(0.084)	(0.195)	(0.155)	(0.409)
DS(2)* LowIncome	-0.032	-3.576**	-0.191***	-0.201	-0.065	-0.294
	(0.088)	(1.379)	(0.058)	(0.161)	(0.149)	(0.402)
DS(3)* LowIncome	-0.091	-4.573**	-0.240***	-0.230	0.108	0.176
	(0.081)	(1.866)	(0.083)	(0.225)	(0.161)	(0.431)
DS(4+)* LowIncome	0.097	0.706	-0.124	-0.170	0.005	-0.126
	(0.100)	(1.731)	(0.082)	(0.183)	(0.155)	(0.409)
DS(1)* LowIncome*Rural	-0.491***	-14.472***	-0.047	-0.626**	-0.051	0.940**
	(0.112)	(4.389)	(0.127)	(0.267)	(0.158)	(0.428)
DS(2)* LowIncome*Rural	-0.268**	-13.102***	0.242***	0.358	-0.268	-0.715
	(0.113)	(4.394)	(0.087)	(0.254)	(0.186)	(0.464)
DS(3)* LowIncome*Rural	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DS(4+)* LowIncome*Rural	-0.185	-1.985	-0.074	-0.368	-0.216	-0.596
	(0.138)	(2.129)	(0.128)	(0.297)	(0.159)	(0.421)

Low Income*Rural	0.309***	3.633**	0.042	0.210	0.196	0.544
	(0.066)	(1.467)	(0.072)	(0.173)	(0.152)	(0.403)
Observations	14,597	14,597	14,597	14,597	14,597	14,597
R-squared	0.131	0.220	0.128	0.127	0.111	0.120

Notes: DS = dollar store. Each column represents a separate regression model with the outcome variable listed. The treatment variable “DS” is the categorical variable where "DS (1)", "DS (2)", "DS (3)", and "DS (4+)" represent zip codes with 1, 2, 3, or 4 or more DSs, respectively. All models include household demographic controls: household head’s education, low-income status, presence of children, race, Hispanic ethnicity, marital status, and household head gender composition (male-only or female-only household) and controls for the number of grocery stores and supermarkets in the zip code. All models include zip code, month, and year fixed effects. Standard errors are clustered at the zip code level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$