Dollar Store Expansion, Food Retail Competition, and Rural Employment

Keenan Marchesi, United States Department of Agriculture, keenan.marchesi@usda.gov

Rigoberto Lopez, University of Connecticut, rigoberto.lopez@uconn.edu

Sandro Steinbach, North Dakota State University, sandro.steinbach@ndsu.edu

Invited paper prepared for presentation at the ASSA

2023 Annual Meeting, January 6-8, 2023

Dollar Store Expansion, Food Retail Competition, and Rural Employment*

Rigoberto Lopez Keenan Marchesi Sandro Steinbach

Abstract

This paper studies the impact of dollar store entry on independent grocery retailers using establishment-level data for the United States from 2000 to 2019. We exploit the unique spatial and temporal features of our dataset to estimate the causal effects of dollar store exposure on the economic outcomes of independent grocery retailers. Our main results show that independent grocery retailers are 2.3 percent more likely to exit after dollar store entry, with affected grocery retailers experiencing an employment reduction of 3.7 percent and lower sales of 5.7 percent. In addition, we show that the exit probability of independent grocery retailers is almost three times larger in rural than urban communities. After dollar store entry, retail employment decreases by 7.1 percent, while sales fall by 9.2 percent for independent grocery retailers in rural census tracts. Finally, event studies show that the response of independent grocery retailers to dollar store entry is delayed, with the exit probability being indifferent from zero one year after dollar store entry. Those adverse entry effects are more pronounced and persistent in rural communities, reflecting increased exit rates, higher job losses, and consistently depressed sales among independent grocery retailers.

Keywords: Dollar store expansion, food retail competition, independent grocery retailers, incumbent exit, employment, sales, rural communities

JEL Codes: L66, Q19, R11

---

* Rigoberto Lopez, Department of Agricultural and Resource Economics, University of Connecticut, email: rigoberto.lopez@uconn.edu; Keenan Marchesi, Economic Research Service, United States Department of Agriculture, email: keenan.marchesi@usda.gov; and Sandro Steinbach, Corresponding Author, Department of Agribusiness and Applied Economics, North Dakota State University, email: sandro.steinbach@ndsu.edu. This work is supported by the USDA National Institute of Food and Agriculture through AFRI Grant 2022-67023-36405 and the USDA Economic Research Service through the Cooperative Agreement Award 58-4000-0-0018. Any opinions, findings, conclusions, or recommendations expressed in this paper are those of the authors and do not necessarily reflect the views of the United States Department of Agriculture. We acknowledge excellent research assistance from Hyun Suh and Enrique Figueroa. We thank participants at the 2022 FADS workshop, the 2022 AAEA annual meeting, and the 2023 ASSA Annual Meeting for their comments on an earlier version of this paper.

1. Introduction

Dollar stores have proliferated throughout the United States since 2000. As of 2019, there were almost 35,000 dollar store format retailers in the United States, with their numbers more than doubling over the last two decades (NETS 2022). Dollar stores continued to thrive and were among the few food retailers that experienced revenue growth following the Great Recession from 2008 to 2010, outperforming 'big-box' discounters and membership-only retail warehouses, such as Walmart, Target, and Costco (Caoui et al. 2022). Dollar General, Dollar Tree, and Family Dollar are the prominent players among dollar stores. They are predominantly located in rural and low-income communities with limited new retail investment and lower lease rates for retail space, allowing them to compete with larger retail stores (Chenarides et al. 2021; Shannon 2021). According to the USDA Food Access Research Atlas (United States Department of Agriculture 2022a), 11 to 27 percent of U.S. households reside in those low-income and low-access census tracts, where their dwellings are, on average, more than one mile away from the nearest supermarket in an urban census tract or 10 miles in a rural census tract. Supermarket access is critical for those households, and dollar stores target these locations with lower costs and offer higher accessibility to rural households (Richards et al. 2022).

Dollar stores sell a variety of processed and nonperishable foods at much lower prices than chain and independent grocery retailers, acting as horizontal competitors to incumbent food retail formats (Richards et al. 2022). Much of the ongoing dollar store research focuses on the healthfulness of the assortment and how dollar store entry might limit access to healthy food (Volpe et al. 2018; Chenarides and Jaenicke 2019). Racine et al. (2016) find that few dollar stores in North Carolina sell fresh fruits or vegetables, although they also offer healthier food staples, such as frozen meats, brown rice, and whole wheat bread. Handbury (2019) showed that high-income households experience a higher consumer utility in wealthy cities than in poor towns, primarily due to the broader product assortment available in those high-income areas. Cai et al. (2017) show that average produce purchases decrease with the count of 'big-box' discounters and dollar stores. Such a lack of access to healthy food in areas predominantly served by dollar stores can be characterized as a problem on the supply side. However, Bustillos et al. (2009) found that dollar stores offer the best variety of food staples and canned products among convenience or nontraditional food stores in rural Texas

counties. The supply of food assortment does not seem to be the leading cause of food access disparities. Allcott et al. (2019) find that 90 percent of nutritional inequality of the rural poor is driven by differences in demand, even if full-service grocery retailers are located in ex-food deserts. In this regard, it is unsurprising that Drichoutis et al. (2015) did not find a statistically significant impact of dollar store entry on childhood obesity in Arkansas.

Although the health effects of dollar stores are widely studied, there is far less research on the impact of dollar store entry on retail competition. Çakir et al. (2020) focus on the effects of Walmart entry on independent grocery retailers, pointing to a positive association between Walmart entry and the exit of independent grocery retailers after 2009, but only briefly mentioning the role of dollar stores. Grigsby-Calage et al. (2021) study the spatial dimension of dollar store expansion and suggest that given their small market areas, low costs, and low prices, dollar stores can operate in competitive environments that conventional grocers or larger 'big-box' discounters cannot survive in. Richards et al. (2022) speak specifically to the entry effects of dollar stores, finding that their entry is likely to benefit large-format grocery retail stores and 'big-box' discounters. Using a dynamic discrete choice model, Arcidiacono et al. (2016) find that Walmart entry negatively impacts supermarkets, but smaller stores, such as independent grocery retailers, thrive. In a follow-up study, Arcidiacono et al. (2020) provide evidence for adverse revenue effects due to competitive market entry from Walmart. In addition, Hicks and Wilburn (2001) find that Walmart entry increases retail employment but has no impact on wages and other labor market outcomes. Basker (2005) provides additional evidence for increased retail employment after Walmart entry. In stark contrast, Neumark et al. (2008) show that Walmart entry into a local retail market reduces retail employment. Although considerable research has looked at the impact of Walmart entry on competition and labor market outcomes, the effects of dollar stores on incumbent exit, employment, and sales remain an area of open inquiry.

Dollar stores present a competitive threat to independent grocery retailers because of their low costs, lower prices, and large corporate structure (Caoui et al. 2022). Dollar stores lease their retail space and operate smaller locations, about 7,500 square feet on average. According to McGreal (2018), they often find retail space in communities that provide utility or tax incentives, which may not be available to independent grocery retailers. Inventories are also smaller, less varied, and usually purchased at a discount, providing additional cost savings. In addition, the small store

format requires fewer employees per store. These features mean that dollar stores can take advantage of economies of scale in distribution and more favorable financing of investments. Such cost advantages, combined with the low prices and the convenience that dollar stores offer, make them strong competitors for independent grocery retailers. Consequently, independent grocery retailers struggle to survive, particularly in rural areas. According to Bailey (2010), rural independent grocery retailers face numerous challenges, including capital needs, an unreliable customer base, and fewer retail opportunities stemming from rural demographics. Cho and Volpe (2017) find that the share of independent grocery retailers had fallen to 43 percent in 2015 from its peak of 46 percent around 2007. Despite some recent empirical work, the effects of dollar store entry on incumbent retailers are still poorly understood. Grigsby-Calage et al. (2021) found that the density of superettes and supermarkets correlates with dollar store entry, suggesting that dollar stores may be competing directly with these retailers. Richards et al. (2022) provide evidence for competition between superettes and dollar stores but suggest the opposite effect for large grocery stores and 'big-box' discounters. By simulating the impact of dollar store entry, they find that supermarket chains and 'big-box' discounters are likely to increase their profits and density following entry by a dollar store in a competitive grocery retail market. This effect would suggest that dollar store entry could support additional large-format market entry and could negatively impact the economic outcomes of independent grocery retailers.

This paper assesses the impact of dollar store entry on independent grocery retailers using establishment-level data for the entire United States from 2000 to 2019. We construct a unique panel of business activities at the census tract level and exploit the spatial and temporal features of our dataset to estimate the causal effects of dollar store exposure on the economic outcomes of incumbent independent grocery retailers. Our main results indicate that independent grocery retailers are 2.3 percent more likely to exit the market after dollar store entry, experiencing an employment reduction of 3.7 percent and lower sales of 5.7 percent. The treatment effects of dollar store entry are more pronounced in rural census tracts, where the exit probability is almost three times larger than that of independent grocery retailers operating in urban census tracts. After dollar store exposure, retail employment and sales of independent grocery retailers in rural census tracts decrease by 7.1 percent and 9.2 percent, respectively. Event studies show that the response

of independent grocery retailers to dollar store entry is delayed, with the exit probability being indifferent from zero one year after a dollar store entry. Afterward, the exit probability increases in both urban and rural census tracts, reaching -1.8 percent and -5.0 percent, respectively, in the post-event period. These findings hold up to a battery of robustness checks, including spatial spillover effects, various concepts of rurality, treatment heterogeneity, the fixed effects choice, and different estimators.

Our paper provides three distinct contributions to the growing literature on dollar store expansion, retail competition, and rural employment. First, the research speaks to the empirical literature on the impact of market entry in the food retail industry. Previous research focused on the implication of Walmart entry on local market structure, retail employment, and revenues (Basker 2005; Neumark et al. 2008; Arcidiacono et al. 2016, 2020). We extend this literature by showing that not only does the entry of 'big-box' discounters has adverse implications for grocery retailers but also that the expansion of the dollar store format has considerable implications for retail competition. We expand on Çakir et al. (2020), who analyzed the impact of Walmart and dollar store entry on grocery retailers, by offering distinct insights into how the dollar store entry effect operates across the extensive and intensive margins. Second, our work contributes to the growing literature on the relationship between dollar stores and independent grocery retailers (Çakir et al. 2020; Chenarides et al. 2021; Caoui et al. 2022; Richards et al. 2022). We show that dollar store entry harms independent grocery retailers, leading to a higher exit probability and reducing employment and sales. These findings are critical in light of the vital contribution that independent grocery retailers provide to rural communities in terms of access to healthy food and community services (Racine et al. 2016; Shannon 2021). Third, we add to the literature concerned with the heterogeneous effects of dollar store entry on local food markets (Çakir et al. 2020; Chenarides et al. 2021; Grigsby-Calage et al. 2021; Shannon 2021). We provide evidence for considerable treatment heterogeneity. The dollar store entry effect operates mainly in rural communities, which experience a substantial reduction in the number of grocery retail stores. Notably, these adverse entry effects are more prominent and persistent in rural communities, reflected in increased exit rates, higher job losses, and consistently depressed sales among independent grocery retailers.

2. Background and Data

U.S. food retail businesses sold $710 billion worth of retail food and non-food products in 2019 (United States Department of Agriculture 2022b). More than 92.1 percent of those sales were realized by grocery retailers, which include supermarkets and smaller grocery stores. The food retailing industry consists of regional and national chains and sole proprietorships, which vary in size from a single store to several thousand outlets (Arcidiacono et al. 2020). The grocery retail sector is predominately brick and mortar, although the COVID-19 pandemic has given rise to new formats of food procurement (Hobbs 2021; Meemken et al. 2022). The food retailing industry is dominated by horizontally integrated grocery retail chains, which procure a mix of branded and store-brand products (Geyskens et al. 2010). In addition to the larger retail chains, there are numerous mom-and-pop and small-chain stores that either have a single location or operate a few stores in a confined area. These stores are called independent grocery retailers as they do not belong to a regional or national grocery retail chain (Çakir et al. 2020).

Independent grocery retailers offer products and services that are horizontally and vertically differentiated. Many small food retailers specialize their product assortment to a particular demographic group, which implies that they horizontally differentiate their services. Such targeting indicates that those grocery retailers are more insulated from direct price competition with rival firms, as they have obtained a degree of local market power that allows them to tolerate higher operational costs (Arcidiacono et al. 2020). In addition, independent grocery retailers offer vertically differentiated services, as they operate businesses of various sizes that offer consumers a selection of products that are differentiated in terms of quality (Rojas et al. 2012). Therefore, it is unsurprising that they employ more personnel per square foot than the average regional or national chain grocery retailers. While they account for only 38 percent of total food sales, they employ more than 43 percent of the retail grocery workforce in rural America (Çakir et al. 2020). Because of price insulation from offering product assortments and service levels that attract different consumer types, independent grocery retailers could remain competitive in rural markets, where retail margins are lower, deferring entry from national grocery retail chains. However, recent research by Çakir et al. (2020) and Chenarides et al. (2021) has shown that the appearance of new food retail formats, such as Aldi, Walmart, and dollar stores, resulted in increased competition for rural consumers.

The rapid growth of the dollar store retail format over the past decades has had broad implications for the retail landscape in the United States (Caoui et al. 2022). The dollar store concept originates from Dollar General, which opened its first store in 1955. Dollar stores sell a wide range of low-cost basis products, often at a single price point. They offer a moderately sized assortment of brand and private label products, selling essential consumables and highly processed food. In 2021, several dollar store formats started to add fresh food to their assortment. A remarkable feature of the dollar store expansion strategy is that they focus on low-income and underserved food markets traditionally served by independent grocery retailers in rural America (Chenarides et al. 2021). Figure 1 shows that dollar stores have been expanding rapidly, adding more than 20,000 locations between 1999 and 2019. The nearly 35,000 dollar stores are concentrated in the South, with strong annualized growth in the Midwest and Northeast since 2010. This significant growth has raised concerns about the implications of dollar store entry on independent grocery retailers.

Our analysis uses data from the National Establishment Time Series (NETS 2022). NETS is a micro-level dataset that used Dun & Bradstreet archival establishment data to construct a historical account of business activities for the United States. The dataset has been widely used to answer empirical research questions. Related studies have looked at business survival (Choi et al. 2017), entrepreneurship (e.g., Echeverri-Carroll and Feldman 2019; Low et al. 2021), job creation (e.g., Neumark et al. 2006, 2011), healthcare access (Tsui et al. 2020), and the local food environment (Schuetz et al. 2012; Berger et al. 2019). Although concerns had been raised by Crane and Decker (2019) about the ability of NETS to detect business trends for some industries, Zeballos and Marchesi (2022) showed that NETS is well suited to capture employment patterns similar to the County Business Patterns (CBP) for the grocery retail industry (Eckert et al. 2020). We use the 2019 NETS dataset, which covers about 71 million establishments between 2000 and 2019.[1]

We identify independent grocery retailers based on the 2019 North American Industry Classification System (NAICS) code 445110 following Çakir et al. (2020). We filter establishments classified as

[1] Although we have access to data before 2000, we discard this period from the analysis because of data reporting issues (Cho et al. 2019). Note that when we construct the dollar store exposure measures, we account for market entry before 2000. We also exclude years after 2019 due to concerns over the rise in online food retailing during the COVID-19 pandemic and its potential implications for business activities (Meemken et al. 2022).

standalone with zero related firms and a headquarters DUNS that is the same as the establishment DUNS. In addition, we define local chain grocery retailers with fewer than three locations within the same state as independent grocery retailers. To identify dollar stores, we use regular expression matching on the NETS variables *company* and *tradename* with the following keywords: Dollar, 99, Dime, Value, Cent, Five, Under, Below, Discount, or Bargain; or one of the following know dollar store names: Dollar General, Family Dollar, Dollar Tree, All Ways 99, Five Below, Fred's Stores, Big Lots, and Ollie's Bargain Outlet.[2] Although NETS provides the county name, no further spatial classification at the census tract level is available.[3] To obtain the census tract, we use the establishment address and match that to the census tract using a spatial matching algorithm based on the longitude and latitude information associated with the establishment address. We use the census tract as the spatial unit of interest because it allows us to model the exit probability of independent grocery retailers. Lastly, we use the 2010 Rural-Urban Commuting Area (RUCA) codes to identify rural census tracts (Economic Research Service 2022).[4] We provide the descriptive statistics for urban and rural census tracts in Appendix Table A.2.

3. Empirical Model

We exploit the unique spatial and temporal features of our dataset to estimate the causal effects of dollar store exposure on the economic outcomes of incumbent independent grocery retailers (Arcidiacono et al. 2020; Çakir et al. 2020; Richards et al. 2022). The empirical model is applied to the count, employment, and sales of independent grocery retailers at the census-tract-year level. For brevity, we represent the three outcomes with y_{it} in the following generalized regression specification:

$$y_{it} = \exp\left(\alpha_i + \alpha_t + \alpha_m t + \delta \mathrm{DS}_{jt}\right) \eta_{it}\,, \tag{1}$$

[2] This regular expression match is sensitive to the exact specification of the strings used for matching. Therefore, we add a space after each key term to avoid false matches where the phrase is part of another word construct. In addition, we use the headquarter DUNS as an additional condition to identify dollar stores.

[3] Census tracts are small, relatively permanent statistical subdivisions of a county or an equivalent entity. The primary purpose of census tracts is to provide a stable set of geographic units to present census data. They have a population size between 1,200 and 8,000 people. They are a reasonable measure of a local grocery retail market.

[4] Appendix Table A.1 provides the list of RUCA codes. We use RUCA codes 4 to 10 to identify rural census tracts and map them in Appendix Figure A.1.

where we denote the census tract with i, the year with t, and the retail market with m. DS_{jt} is an indicator variable for the presence of the j-th dollar store in census tract i at time t.[5] The identification of δ could be confounded by a correlation between the error term and the treatment measure. Because dollar stores could deliberately choose to locate in a census tract, this correlation is likely non-trivial and different from zero (see, e.g., Chenarides et al. 2021; Richards et al. 2022). To account for this potential source of estimation bias, we take advantage of the timing of dollar store entry across census tracts and include fixed effects at the census tract and year levels, denoted by α_i and α_t, respectively. Following Arcidiacono et al. (2020), we also include market-specific time trends to account for changes in the market attractiveness over time.[6] Lastly, we denote the multiplicative error term with η_{it}.

The main identifying assumption is that the timing and location of dollar store entry are uncorrelated with the error term η_{it}, conditional on census tract fixed effects, time dummies, and linear market trends. The empirical model is implemented with an indicator variable that takes the value one when census tract i is exposed to dollar store j at time t. This empirical model can be understood as a generalization of the difference-in-differences (DiD) model, where contemporaneous changes in outcomes are compared between census tracts treated by a dollar store entry and those that did not experience an entry (Roth et al. 2022). For a given census tract, the control group includes census tracts never exposed and those exposed earlier or later throughout the observation period following the identification strategy of Arcidiacono et al. (2020) and Çakir et al. (2020).[7]

The primary outcome of interest is denoted by y_{it}. It represents the non-negative integer count of independent grocery retailers, employment, and sales in a given census tract i in year t. One approach to identifying the relationship of interest would be to transform the outcome using a log-linear regression model. However, this approach could induce estimation bias because a linear regression

[5] Note that Equation 1 implies that the treatment effect of a particular dollar store entry on the economic outcomes of independent grocery retailers is independent of the previous exposure.

[6] The retail markets are based on Census Bureau's metropolitan statistical areas (MSA) (U.S. Census Bureau 2022). For those independent grocery retailers in census tracts not belonging to an MSA, we use state-specific time trends.

[7] We investigate the robustness of the main results to this assumption in Subsection 4.3, where we exclude always-treated units from the control group (Callaway and Sant'Anna 2021; Baker et al. 2022; de Chaisemartin and D'Haultfoeuille 2022).

model cannot ensure the positivity of the predicted values of the count outcome (Wooldridge 1999; Cameron and Trivedi 2013). The discrete nature of the outcome makes it difficult to find a conditional mean transformation that is linear in parameters. In addition, heteroskedasticity could further exacerbate this issue as the transformed errors could be correlated with the covariates. Such correlation could result in an inconsistent identification of the treatment effects. To account for this issue, we directly model the relationship of interest between the outcomes and the treatment variable. We ensure the positivity of the covariates by deploying a non-linear regression model that uses an exponential form equation.

We follow common practice in the empirical literature and rely on the Poisson pseudo-maximum likelihood (PML) estimator to identify the relationship of interest (Gong and Samaniego 1981; Gourieroux et al. 1984). Even if the conditional variance is not proportional to the conditional mean, the estimator is unbiased and robust to heteroskedasticity (Wooldridge 1999). A further advantage of the Poisson PML estimator is that the scale of the dependent variable does not affect the parameter estimates and that the estimator allows us to deal with zero outcomes consistently (Cameron and Trivedi 2013). As shown in Appendix Table A.1, the share of zero observations is considerable at the census tract level. We account for the high-dimensional fixed effects using a modified version of the iteratively re-weighted least-squares algorithm that is robust to statistical separation and convergence issues (Correia et al. 2019, 2020). Because the standard errors could be correlated at the census tract level, we follow standard practice in the industrial organization literature and cluster them at this level (Cameron and Miller 2015).

4. Main Results

Table 1 presents estimates of the dollar store exposure effect on the independent grocery retailer count, employment, and sales. Panel A shows that independent grocery retailers are 2.3 percent more likely to exit the market after dollar store entry.[8] These estimates are in line with earlier work by Caoui et al. (2022), who found an average treatment effect of 3.1 percent. The dollar store entry effects are smaller than those for Walmart entry, which causes 40 to 50 percent of small discount

[8] We transformed the parameter estimates to percentage effects using the formula $(\exp(\beta) - 1) * 100$.

stores to exit the market (Jia 2008). Interestingly, the dollar store treatment effect is larger for the employment (-3.7 percent) and sales (-5.7 percent) of independent grocery retailers. These findings add to earlier work concerned about the entry effects in grocery retail markets. Ellickson and Grieco (2013) find that the impact of Walmart entry on independent grocery retailers operates more through the intensive than the extensive margin. Our estimates are smaller in magnitude than those for Walmart entry, which causes a drop in supermarket revenue of over 16 percent when Walmart locates within one mile (Arcidiacono et al. 2020). More intensive price competition can explain the stronger employment effects, implying that the marginal surviving firm has to be more efficient in smaller markets (Asplund and Nocke 2006). In contrast to chain stores, independent grocery retailers are more likely to adjust prices as they are not limited by uniform pricing across markets (DellaVigna and Gentzkow 2019). This pricing pattern could be one explanation for the larger sales effects observed for independent grocery retailers.

Panel B of Table 1 compares the estimated treatment effects for independent grocery retailers in urban and rural census tracts. We find that the treatment effects for urban and rural census tracts are statistically different from one another at conventional levels of statistical significance. The exit probability is almost three times larger in rural census tracts than that of independent grocery retailers operating in urban census tracts. These findings align with earlier work by Çakir et al. (2020), who find an annual exit rate of 6.6 percent for independent grocery retailers in rural counties from 1990 to 2015. Similar patterns are observable for employment and sales. After dollar store exposure, retail employment and sales of independent grocery retailers in rural census tracts decrease by 7.1 percent and 9.2 percent, respectively. An explanation for the larger treatment effects in rural markets is the lower profit margins of independent grocery retailers in those markets. Ellickson and Grieco (2013) document that the grocery retailer exit probability is higher in rural than in urban markets after a Walmart entry.[9] In addition, the potential dollar store entry effects are also larger as the probability of new entry of independent grocery retailers is lower because

[9] Interestingly, the competition effect between a grocery store and a distant supercenter outside its zip code but within 25 miles is much smaller than the competition effect between two small grocery stores in the same zip code, pointing toward complicated spatial competition effects (Grieco 2014). We explore this pattern for dollar stores in Subsection 4.3.

retailer entry thresholds are higher in rural markets (Cleary and Chenarides 2022). This pattern also reflects in the differential productivity effects between urban and rural regions caused by competitive market entry (Håkansson et al. 2019).

4.1 Treatment Dynamics

A causal interpretation of the estimated treatment effects is justified under the assumption that the dollar store entry timing and location are conditionally exogenous (Roth et al. 2022). Although we cannot directly test the validity of this assumption, the outcome trends in the pre-treatment period can be informative in this regard (Arcidiacono et al. 2020; Caoui et al. 2022). Suppose the observed outcomes in treated census tracts have similar trends in the pre-treatment period to those in untreated census tracts. In that case, we can accept that the "parallel trends" assumption holds and that dollar store entry is exogenous to the independent grocery retailer outcomes (Freyaldenhoven et al. 2019; Sun and Abraham 2021; Roth 2022). To implement this pre-event test and explore treatment dynamics in the post-treatment period, we rely on an "event study" design that interacts the treatment measure with a time dummy defined relative to the year of dollar store entry:

$$y_{it} = \exp\left(\alpha_i + \alpha_t + \delta_m t + \sum_{m=-7}^{7} \delta_m \mathrm{DS}_{jt,t-m}\right)\eta_{it}\,, \tag{2}$$

where the general notation is the same as in Equation 1. The dynamic treatment model includes seven leads and lags relative to the event of interest, which enables us to capture pre-trends and assess post-event treatment dynamics (Freyaldenhoven et al. 2021).[10] We assume that all latent confounders are captured by the census tract fixed effects, time dummies, and market trends. The term $\sum_{m=-7}^{7} \delta_m \mathrm{DS}_{jt,t-m}$ measures the treatment dynamics of dollar store entry for the corresponding outcome. The specification allows the magnitude of the dollar store exposure effect to vary before dollar store exposure and uncovers how the treatment effect evolves in the post-treatment period.

We present the event study estimates for dollar store exposure and the independent grocery retailer outcomes for urban and rural census tracts in Figure 2. Each subfigure plots the dynamic

[10] We follow common practice in the event study literature and bin the endpoints of the event study window. The binned endpoints allow us to check for long-term pre-trends and leveling-off treatment effects.

treatment parameters, 95 percent confidence intervals, and uniform sup-t bands for the event-time of the outcome (Montiel Olea and Plagborg-Møller 2019; Freyaldenhoven et al. 2021).[11] We also overlay estimates from the static model represented by the dashed red line. The figure notes in Figure 2 report the corresponding p-value for Wald tests for pre-event trends and anticipatory behavior. We find no evidence of significant pre-trends for the retailer count, employment, and sales specifications.[12] We also conduct a Wald test for the null hypothesis that the treatment dynamics level off because the treatment effect could be dynamic at the endpoints of the event window. The Wald tests provide some statistical support for leveling off treatment effects for urban census tracts but not for rural census tracts at conventional levels of statistical significance for all outcomes.

The event study estimates reveal some intriguing patterns regarding the dollar store exposure effect on the count, sales, and employment of independent grocery retailers. First, we find evidence that the response to entry is delayed, with the exit probability being indifferent from zero one year after dollar store entry. Afterward, the exit probability increases in both urban and rural census tracts, reaching -1.8 percent and -5.0 percent, respectively, on average in the post-event period.[13] A similar pattern is observable for employment, while the adverse sales effects are more immediate. Confirmatory bias and motivated reasoning, which causes managers to discount negative performance information, retain overly optimistic beliefs, and delay exit, can explain this delayed exit pattern (Elfenbein et al. 2017). Second, while the treatment effects remain negative and statistically significant for rural census tracts, they become indifferent from zero for urban census tracts after five years, pointing toward new entry of independent grocery retailers after dollar store exposure in those markets. Lesser entry costs and technology scaling in urban census tracts can explain this recovery pattern (Balland et al. 2020; Cleary and Chenarides 2022). Third, the average post-event treatment effects are statistically indifferent from the static estimates, implying that the dollar

[11] Although various simultaneous confidence bands are available, there exists little theory to select among them. To address this issue, we follow Montiel Olea and Plagborg-Møller (2019) and use a Bayesian sup-t band with exact finite-sample simultaneous credibility.

[12] Since the pre-trend tests are statistically insignificant and the treatment pathways in the pre-treatment period are flat, the research design is validated. The fixed effects can accurately account for unobservables unrelated to the treatment but predictive of the outcome, such as the 2008 recession and Walmart expansion (see, e.g., Basker 2007; Ellickson and Grieco 2013; Cleary and Chenarides 2022).

[13] We transformed the parameter estimates to percentage effects using the formula $\big(\exp(\bar{\beta}_k) - 1\big) * 100$.

store entry timing and location are conditionally exogenous, which validates the research design.

4.2 Spatial Spillover Effects

So far, we have assumed that dollar store entry only affects independent grocery retailers only in the census tract where the entry occurred. A causal interpretation of the main results is justified if dollar store entry in neighboring census tracts has no effect on the estimated dollar store treatment effects for treated urban and rural census tracts. This assumption could be invalidated if the dollar store entry effect spills over to neighboring census tracts. The identification concern relates to earlier work on Walmart entry. For instance, Arcidiacono et al. (2020) showed that the Walmart entry effect levels off at about seven miles from the entry location. Such spatial spillover effects could challenge the causal interpretation of our estimated treatment effects.[14] To test for the presence of such spillover effects, we introduce a spatial lag term as specified below:

$$y_{it} = \exp\left(\alpha_i + \alpha_t + \alpha_m t + \delta_1 \mathrm{DS}_{jt} + \delta_2 W\mathrm{DS}_{jt}\right)\eta_{it}\,, \tag{3}$$

where the notations are the same as in Equation 1, except that we added a spatial lag term for dollar store exposure in first-degree neighboring census tracts, which we denote with $W\mathrm{DS}_{jt}$. We test three competing spatial lag models, comparing treatment effects for the margins of dollar store entry with the density of dollar store entry (LeSage and Pace 2009). Because earlier work by Arcidiacono et al. (2020) and Caoui et al. (2022) showed that the Walmart and dollar store entry effects are localized, we limit the spatial spillover effects to first-degree neighboring census tracts.

Table 2 presents estimates for the dollar store exposure effect conditional on the presence of spatial spillover effects. The spatial lag coefficient is statistically significant at conventional levels for the number of entries in adjacent census tracts and the share of adjacent census tracts with a dollar store entry. The parameter estimates point toward a positive spatial spillover effect, where dollar store entry in neighboring census tracts benefits independent grocery retailers in treated census

[14] Note that dollar store entry could also occur in proximity to the border between two census tracts, implying potential estimation bias due to dollar store entry spillover effects to neighboring census tracts.

tracts.[15] There are a variety of factors that could explain such spillover effects. Among them, a substitution of consumers in urban census tracts that lost access to their neighborhood grocery store is a possible explanation. Meltzer (2016) find that small businesses relocate in response to economic and social change in their neighborhood. In addition, the changing urban retail landscape due to gentrification could result in consumers frequenting neighborhood stores on their way to work more often after a grocery retailer exits in their neighborhood (Russell and Heidkamp 2011). Although those drivers can explain the positive spatial spillover effects observed for dollar store entry, the estimates should be taken with caution as a causal interpretation of the covariates is not justified (Wooldridge 1999; Cameron and Trivedi 2013). Since the estimated treatment effects of dollar store entry are statistically indifferent from those presented in Table 1, we can conclude that the treatment is indeed "random" and the treatment effect estimates are likely causal (Callaway and Sant'Anna 2021).

4.3 Robustness Checks

Concepts of Rurality — The applied research and public policy community uses various concepts and definitions of rurality. Nelson et al. (2021) conducted a systematic review of rurality measures and how researchers operationalize them in empirical and quantitative studies. We present estimates for two alternative rurality measures in Appendix Table A.3 to see how robust our main results are to those alternative rurality concepts. Panel A identifies rural census tracts based on the Census Bureau's definition of metropolitan statistical areas (U.S. Census Bureau 2022). This rurality definition is less granular than the RUCA classification developed by the Economic Research Service (2022). We find no evidence for dollar store treatment effects that differ from the main results at conventional levels of statistical significance. In addition, we assess treatment heterogeneity based on the RUCA classification for metropolitan (codes 1 to 3), micropolitan (codes 4 to 7), and small towns and rural census tracts (codes 8 to 10) in Panel B. Although the estimated treatment effects are statistically indifferent from the main results, we find a larger magnitude of the exit probability effect for census tracts classified under RUCA codes 8 to 10. In contrast, the employment and sales

[15] Note that this spillover effect disappears when we estimate the sample separately for rural census tracts. These estimates are available upon request from the authors.

effects are more considerable for independent grocery retailers in micropolitan census tracts.

Treatment Heterogeneity — A potential concern regarding our identification strategy relates to unobserved treatment heterogeneity. Dollar store exposure could cause distinct treatment effects for the economic outcomes of independent grocery retailers that vary across time, regions, and grocery retail formats (see, e.g., Çakir et al. 2020; Chenarides et al. 2021; Richards et al. 2022). Reduced entry barriers and market power in a spatially differentiated grocery retail market could result in heterogenous treatment effects over time (Neumark et al. 2008; Schivardi and Viviano 2010). We test for such treatment heterogeneity in Panel A of Appendix Table A.4. The results show that the dollar store exposure effect in rural census tracts increased over time. The estimates for 2000 to 2004 are statistically different from those after 2010. However, the estimated treatment effects for periods after 2010 are statistically indifferent from the main results at conventional levels of statistical differences. Although grocery retail markets were already highly concentrated before the considerable expansion of dollar stores after 2000 (McCorriston 2002; Çakir et al. 2020), it seems likely that dollar stores have developed substantial market power in relevant rural markets, exerting increasing competitive pressure in those horizontally differentiated markets (Sexton 2013).

Next, we study treatment heterogeneity across census regions. Grigsby-Calage et al. (2021) document considerable geographic differences in the entry patterns of dollar stores across the United States. Up to 2000, dollar stores were mainly entering markets in the South, Midwest, and Northeast regions. Since then, they have aggressively expanded in non-metro areas in the Northeast and Midwest (Chenarides et al. 2021). Panel B of Appendix Table A.4 shows that the heterogeneous treatment effect estimates of dollar store exposure in rural census tracts reflect this expansion pattern. For instance, we find more considerably adverse treatment effects for the Midwest region, where dollar store exposure leads to a 7.0 percent increased exit probability, an employment reduction of 8.2 percent, and reduced sales of 11.6 percent. However, we cannot conclude that those treatment effects are different from each other at conventional levels of statistical significance. These findings highlight that the underlying mechanisms of entry, exit, and investment cause similar economic outcomes for independent grocery retailers across census regions (Caoui et al. 2022).

Lastly, we explore whether the treatment response varies by retailer scale. Chain grocery retailers could be incentivized to extenuate their response to dollar store entry by adjusting food prices and changing the product range (Uusitalo 2004). Therefore, supermarkets and other large-format grocery retailers are unlikely to exit shared retail markets but could face adverse sales effects in such competitive markets (Richards et al. 2022). The estimates of the dollar store exposure effects for chain grocery retailers in rural census tracts, as presented in Panel C of Appendix Table A.4, provide no statistical evidence for adverse treatment effects for retailer count and employment. At the same, we find some statistical support for adverse sales effects that are smaller than those observed for independent grocery retailers. This finding indicates that dollar stores compete directly with independent and chain grocery retailers for the local retail market despite the horizontal differentiation of the product characterizing independent grocery retailers (Çakir et al. 2020).

Fixed Effects Choice — The baseline specification includes census tract fixed effects, time dummies, and linear market trends following Arcidiacono et al. (2020). This choice implies that our main results are conditional on those fixed effects absorbing the unobserved correlation at those levels that could potentially bias our estimates. Related empirical studies rely on various fixed effects structures when estimating the entry effects in grocery retail markets (see, e.g., Arcidiacono et al. 2020; Çakir et al. 2020; Caoui et al. 2022; Richards et al. 2022). To test the robustness of our main results to the choice of the fixed effects, we estimate Equation 1 excluding the linear market trends in Model (1) and adding state-year fixed effects in Model (2) and county-year fixed effects in Model (3), as presented in Appendix Table A.5. We find limited evidence for treatment heterogeneity conditional on the fixed effects choice. While the treatment estimates are (sometimes) smaller when accounting for a larger share of variation through the interacted year fixed effects, all estimates are statistically indifferent from the main results at conventional levels of statistical significance. Therefore, the estimated treatment effects of dollar store exposure on the economic outcomes of independent grocery retailers are likely causal and not caused by unobserved correlation due to excluding more stringent fixed effects (Lu and White 2014).

Never-Treated and Not-Yet-Treated Census Tracts — The causal inference of the dollar store treatment effects depends not only on the parallel trends assumption to hold but also on the use of a credible and transparent comparison group (see for a review, Roth et al. 2022). Although we

observe the dollar store entry history at the census tract level for up to ten years before the panel start year, a potential concern is the use of always-treated units as control groups (Callaway and Sant'Anna 2021; Baker et al. 2022; de Chaisemartin and D'Haultfoeuille 2022). To account for this identification concern, we disregard always-treated census tracts and use never-treated and not-yet-treated census tracts for the regressions presented in Appendix Table A.6. Although the estimated treatment effects are of a larger magnitude for most economic outcomes, they are indifferent to the main results at conventional levels of statistical significance. Therefore, the "true" causal treatment effects likely lie between our main results and the estimates that exclude always-treated census tracts.

Log-Linear Regression — Related studies rely on a log-linear model specification to estimate the treatment effects of competitor entry in grocery retail markets (see, e.g., Arcidiacono et al. 2020; Çakir et al. 2020; Caoui et al. 2022; Richards et al. 2022). Although we believe that there are drawbacks to this approach because of its inability to consistently deal with the abundance of zeros (that have an important economic meaning), we test for the robustness of our main results using the transformed outcome and a log-linear regression model in Appendix Table A.7. The treatment effects of dollar store exposure are similar for the outcome of independent grocery retailer count but differ in magnitude for employment and sales. However, this difference is statistically insignificant at conventional levels, implying that our main results are robust to the distribution choice. Furthermore, because the Poisson PML estimator is unbiased and robust to heteroskedasticity, the main results represent the "true" treatment effect of dollar store exposure on the economic outcomes of independent grocery retailers (Wooldridge 1999; Cameron and Trivedi 2013).

5. Conclusion

The grocery retail industry is a vital source of income and employment in rural America (Çakir et al. 2020). Independent grocery retailers provide essential services to largely remote communities and offer access to healthy food and other community services (Racine et al. 2016; Shannon 2021). The considerable expansion of dollar stores in rural communities has raised concerns about the implications of dollar store entry for independent grocery retailers and food access (Chenarides et al. 2021). So far, there is no systematic understanding of how dollar store entry affects the

rural retail landscape. We fill this research gap using establishment-level business data for all U.S. grocery retailers from 2000 to 2019. Exploiting our dataset's spatial and temporal features, we estimate the causal effects of dollar store exposure on the economic outcomes of incumbent independent grocery retailers. Our main results show that independent grocery retailers are 2.3 percent more likely to exit after dollar store entry, experiencing an employment reduction of 3.7 percent and lower sales of 5.7 percent. Zooming in on rural communities, we show that the exit probability of independent grocery retailers is almost three times larger than that of independent grocery retailers operating in urban communities. After dollar store exposure, retail employment decreases by 7.1 percent, while sales fall by 9.2 percent for independent grocery retailers in rural census tracts. Event studies show that the response of independent grocery retailers to dollar store entry is delayed, with the exit probability being indifferent from zero one year after a dollar store entry. Notably, the adverse dollar store entry effects are more pronounced and persistent in rural communities, reflected by increased exit rates, higher job losses, and systematically depressed sales among independent grocery retailers.

Our research nuances previous work on dollar store entry, retail competition, and rural employment (Çakir et al. 2020; Chenarides et al. 2021; Richards et al. 2022). Different from Walmart entry, which has been shown to have limited implications for mom-and-pop and small chain stores due to horizontal differentiation (Basker 2005; Neumark et al. 2008; Arcidiacono et al. 2016, 2020), we provide evidence that dollar store entry has considerable and persistent implications for independent grocery retailers in rural communities. Matsa (2011) showed that competition from Walmart incentivizes grocery retailers to invest in product quality because of the risk that customers will switch stores. Similar incentives may play out in urban census tracts, where the dollar store entry effect disappears after five years. In addition, lower entry costs and technology scaling in urban census tracts can explain this recovery pattern (Balland et al. 2020). The adverse dollar store entry effects in rural census tracts are more persistent and larger in magnitude because entry thresholds are higher in those retail markets (Cleary and Chenarides 2022). This pattern also reflects in the differential productivity effects between urban and rural regions caused by competitive market entry (Håkansson et al. 2019). Particularly after 2019, the emergence of online e-commerce in grocery retail has presented itself as a new opportunity and threat to rural grocery retailers, which could

have considerable implications for how food retailing operates in rural communities (Hortaçsu and Syverson 2015; Meemken et al. 2022). A particularly exciting venue for future research relates to the competitive effects of market entry for the retail market structure accounting for different retail formats, competition bands, and treatment dynamics (Arcidiacono et al. 2020).

References

Allcott, H., R. Diamond, J.-P. Dubé, J. Handbury, I. Rahkovsky, and M. Schnell 2019. Food deserts and the causes of nutritional inequality. *The Quarterly Journal of Economics 134*(4), 1793–1844.

Arcidiacono, P., P. Bayer, J. R. Blevins, and P. B. Ellickson 2016, 03. Estimation of Dynamic Discrete Choice Models in Continuous Time with an Application to Retail Competition. *The Review of Economic Studies 83*(3), 889–931.

Arcidiacono, P., P. B. Ellickson, C. F. Mela, and J. D. Singleton 2020, July. The competitive effects of entry: Evidence from supercenter expansion. *American Economic Journal: Applied Economics 12*(3), 175–206.

Asplund, M. and V. Nocke 2006, 04. Firm Turnover in Imperfectly Competitive Markets. *The Review of Economic Studies 73*(2), 295–327.

Bailey, J. M. 2010. Rural grocery stores: Ownership models that work for rural communities. *Center for Rural Affairs*.

Baker, A. C., D. F. Larcker, and C. C. Wang 2022. How much should we trust staggered difference-in-differences estimates? *Journal of Financial Economics 144*(2), 370–395.

Balland, P.-A., C. Jara-Figueroa, S. G. Petralia, M. Steijn, D. L. Rigby, and C. A. Hidalgo 2020. Complex economic activities concentrate in large cities. *Nature Human Behaviour 4*(3), 248–254.

Basker, E. 2005. Job creation or destruction? Labor market effects of Wal-Mart expansion. *Review of Economics and Statistics 87*(1), 174–183.

Basker, E. 2007, September. The Causes and Consequences of Wal-Mart's Growth. *Journal of Economic Perspectives 21*(3), 177–198.

Berger, N., T. K. Kaufman, M. D. Bader, A. G. Rundle, S. J. Mooney, K. M. Neckerman, and G. S. Lovasi 2019. Disparities in trajectories of changes in the unhealthy food environment in new york city: A latent class growth analysis, 1990–2010. *Social Science & Medicine 234*, 112362.

Bustillos, B., J. R. Sharkey, J. Anding, and A. McIntosh 2009. Availability of more healthful food alternatives in traditional, convenience, and nontraditional types of food stores in two rural texas counties. *Journal of the American Dietetic Association 109*(5), 883–889.

Cai, X., R. J. Volpe, C. Schroeter, and L. Mancino 2017, July. Food Retail Market Structure and Produce Purchases in the U.S. 2017 Annual Meeting Proceedings 258471, Agricultural and Applied Economics Association.

Çakir, M., X. Kong, C. Cho, and A. Stevens 2020. Rural food retailing and independent grocery retailer exits. *American Journal of Agricultural Economics 102*(5), 1352–1367.

Callaway, B. and P. H. Sant'Anna 2021. Difference-in-differences with multiple time periods. *Journal of Econometrics 225*(2), 200–230.

Cameron, A. C. and D. L. Miller 2015. A practitioner's guide to cluster-robust inference. *Journal of Human Resources 50*(2), 317–372.

Cameron, C. and P. Trivedi 2013. *Regression Analysis of Count Data*. Cambridge: Cambridge University Press.

Caoui, E. H., B. Hollenbeck, and M. Osborne 2022. The impact of dollar store expansion on local market structure and food access. *Working Paper*, https://elhadicaoui.github.io/files/dollarstores.pdf.

Chenarides, L., C. Cho, R. M. Nayga, and M. R. Thomsen 2021. Dollar stores and food deserts. *Applied Geography 134*, 102497.

Chenarides, L. and E. C. Jaenicke 2019. Documenting the Link Between Poor Food Access and Less Healthy Product Assortment Across the U.S. *Applied Economic Perspectives and Policy 41*(3), 434–474.

Cho, C., P. McLaughlin, E. Zeballos, J. Kent, and C. Dicken 2019. Capturing the Complete Food Environment with Commercial Data: A Comparison of TDLinx, ReCount, and NETS Databases. Technical Bulletins 288291, United States Department of Agriculture, Economic Research Service.

Cho, C. and R. Volpe 2017. Independent grocery stores in the changing landscape of the US food retail industry. *United States Department of Agriculture*.

Choi, T., A. Rupasingha, J. C. Robertson, and N. G. Leigh 2017. The effects of high growth on new business survival. *Review of Regional Studies 47*(1), 1–23.

Cleary, R. and L. Chenarides 2022. Food retail profits, competition, and the great recession. *Agribusiness 38*(3), 557–578.

Correia, S., P. Guimarães, and T. Zylkin 2019. Verifying the existence of maximum likelihood estimates for generalized linear models. *arXiv preprint arXiv:1903.01633*.

Correia, S., P. Guimarães, and T. Zylkin 2020. Fast Poisson estimation with high-dimensional fixed effects. *The Stata Journal: Promoting Communications on Statistics and Stata 20*(1), 95–115.

Crane, L. D. and R. Decker 2019. Business dynamics in the national establishment time series (nets). *FEDS Working Paper, 2019-34*.

de Chaisemartin, C. and X. D'Haultfoeuille 2022, January. Two-way fixed effects and differences-in-differences with heterogeneous treatment effects: A survey. Working Paper 29691, National Bureau of Economic Research.

DellaVigna, S. and M. Gentzkow 2019. Uniform Pricing in U.S. Retail Chains. *The Quarterly Journal of Economics 134*(4), 2011–2084.

Drichoutis, A. C., R. M. Nayga, H. L. Rouse, and M. R. Thomsen 2015. Food environment and childhood obesity: The effect of dollar stores. *Health Economics Review 5*(1), 1–13.

Echeverri-Carroll, E. L. and M. P. Feldman 2019. Chasing entrepreneurial firms. *Industry and Innovation 26*(5), 479–507.

Eckert, F., T. C. Fort, P. K. Schott, and N. J. Yang 2020. Imputing missing values in the us census bureau's county business patterns. Technical report, National Bureau of Economic Research, w26632.

Economic Research Service 2022. 2010 Rural-Urban Commuting Area (RUCA) Codes. *United States Department of Agriculture*, https://www.ers.usda.gov/data–products/rural–urban–commuting–area–codes/documentation/.

Elfenbein, D. W., A. M. Knott, and R. Croson 2017. Equity stakes and exit: An experimental approach to decomposing exit delay. *Strategic Management Journal 38*(2), 278–299.

Ellickson, P. B. and P. L. Grieco 2013. Wal-Mart and the geography of grocery retailing. *Journal of Urban Economics 75*, 1–14.

Freyaldenhoven, S., C. Hansen, J. P. Pérez, and J. M. Shapiro 2021. Visualization, identification, and estimation in the linear panel event-study design. Working paper 29170, National Bureau of Economic Research.

Freyaldenhoven, S., C. Hansen, and J. M. Shapiro 2019. Pre-event trends in the panel event-study design. *American Economic Review 109*(9), 3307–38.

Geyskens, I., K. Gielens, and E. Gijsbrechts 2010. Proliferating private-label portfolios: How introducing economy and premium private labels influences brand choice. *Journal of Marketing Research 47*(5), 791–807.

Gong, G. and F. J. Samaniego 1981. Pseudo maximum likelihood estimation: Theory and applications. *The Annals of Statistics*, 861–869.

Gourieroux, C., A. Monfort, and A. Trognon 1984. Pseudo maximum likelihood methods: Applications to poisson models. *Econometrica 52*(3), 701–720.

Grieco, P. L. E. 2014. Discrete games with flexible information structures: an application to local grocery markets. *The RAND Journal of Economics 45*(2), 303–340.

Grigsby-Calage, C., C. C. Mullally, and R. J. Volpe 2021. The geography of dollar stores. *Working Paper*.

Handbury, J. 2019. Are poor cities cheap for everyone? Non-homotheticity and the cost of living across US cities. Technical report, National Bureau of Economic Research, w26574.

Hicks, M. J. and K. L. Wilburn 2001. The regional impact of Wal-Mart entrance: A panel study of the retail trade sector in West Virginia. *Review of Regional Studies 31*(3), 305–313.

Hobbs, J. E. 2021. Food supply chain resilience and the covid-19 pandemic: What have we learned? *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie 69*(2), 189–196.

Hortaçsu, A. and C. Syverson 2015, November. The Ongoing Evolution of US Retail: A Format Tug-of-War. *Journal of Economic Perspectives 29*(4), 89–112.

Håkansson, J., Y. Li, O. Mihaescu, and N. Rudholm 2019. Big-box retail entry in urban and rural areas: Are there productivity spillovers to incumbent retailers? *The International Review of Retail, Distribution and Consumer Research 29*(1), 23–45.

Jia, P. 2008. What Happens When Wal-Mart Comes to Town: An Empirical Analysis of the Discount Retailing Industry. *Econometrica 76*(6), 1263–1316.

LeSage, J. and R. K. Pace 2009. *Introduction to Spatial Econometrics*. Chapman and Hall/CRC.

Low, S. A., M. Bass, D. Thilmany, and M. Castillo 2021. Local Foods Go Downstream: Exploring the Spatial Factors Driving U.S. Food Manufacturing. *Applied Economic Perspectives and Policy 43*(3), 896–915.

Lu, X. and H. White 2014. Robustness checks and robustness tests in applied economics. *Journal of Econometrics 178*, 194–206.

Matsa, D. A. 2011, 08. Competition and Product Quality in the Supermarket Industry. *The Quarterly Journal of Economics 126*(3), 1539–1591.

McCorriston, S. 2002. Why should imperfect competition matter to agricultural economists? *European Review of Agricultural Economics 29*(3), 349–371.

McGreal, C. 2018. Where even walmart won't go: how dollar general took over rural america. *The Guardian*, https://www.theguardian.com/business/2018/aug/13/dollar–general–walmart–buhler–haven–kansas.

Meemken, E.-M., M. F. Bellemare, T. Reardon, and C. M. Vargas 2022. Research and policy for the food-delivery revolution. *Science 377*(6608), 810–813.

Meltzer, R. 2016. Gentrification and small business: Threat or opportunity? *Cityscape 18*(3), 57–86.

Montiel Olea, J. L. and M. Plagborg-Møller 2019. Simultaneous confidence bands: Theory, implementation, and an application to SVARs. *Journal of Applied Econometrics 34*(1), 1–17.

Nelson, K. S., T. D. Nguyen, N. A. Brownstein, D. Garcia, H. C. Walker, J. T. Watson, and A. Xin 2021. Definitions, measures, and uses of rurality: A systematic review of the empirical and quantitative literature. *Journal of Rural Studies 82*, 351–365.

NETS 2022. National Establishment TimeSeries. *Walls & Associates*.

Neumark, D., B. Wall, and J. Zhang 2011. Do Small Businesses Create More Jobs? New Evidence for the United States from the National Establishment Time Series. *The Review of Economics and Statistics 93*(1), 16–29.

Neumark, D., J. Zhang, and S. Ciccarella 2008. The effects of Wal-Mart on local labor markets. *Journal of Urban Economics 63*(2), 405–430.

Neumark, D., J. Zhang, and B. Wall 2006. Where the jobs are: Business dynamics and employment growth. *Academy of Management Perspectives 20*(4), 79–94.

Racine, E. F., A. Batada, C. A. Solomon, and M. Story 2016. Availability of foods and beverages in supplemental nutrition assistance program- authorized dollar stores in a region of north carolina. *Journal of the Academy of Nutrition and Dietetics 116*(10), 1613–1620.

Richards, T. J., L. Chenarides, and M. Çakir 2022. Dollar store entry. *Working Paper*, https://ageconsearch.umn.edu/record/322100/files/22564.pdf.

Rojas, C., N. Lavoie, and S.-S. Wang 2012. Buyer power and vertically differentiated retailers. *Journal of Agricultural & Food Industrial Organization 10*(1).

Roth, J. 2022, September. Pretest with caution: Event-study estimates after testing for parallel trends. *American Economic Review: Insights 4*(3), 305–22.

Roth, J., P. H. Sant'Anna, A. Bilinski, and J. Poe 2022. What's trending in difference-in-differences? a synthesis of the recent econometrics literature. *arXiv preprint arXiv:2201.01194*.

Russell, S. E. and C. P. Heidkamp 2011. 'food desertification': The loss of a major supermarket in new haven, connecticut. *Applied Geography 31*(4), 1197–1209.

Schivardi, F. and E. Viviano 2010, 03. Entry Barriers in Retail Trade. *The Economic Journal 121*(551), 145–170.

Schuetz, J., J. Kolko, and R. Meltzer 2012. Are poor neighborhoods "retail deserts"? *Regional Science and Urban Economics 42*(1-2), 269–285.

Sexton, R. J. 2013. Market power, misconceptions, and modern agricultural markets. *American Journal of Agricultural Economics 95*(2), 209–219.

Shannon, J. 2021. Dollar stores, retailer redlining, and the metropolitan geographies of precarious consumption. *Annals of the American Association of Geographers 111*(4), 1200–1218.

Sun, L. and S. Abraham 2021. Estimating dynamic treatment effects in event studies with heterogeneous treatment effects. *Journal of Econometrics 225*(2), 175–199.

Tsui, J., J. A. Hirsch, F. J. Bayer, J. W. Quinn, J. Cahill, D. Siscovick, and G. S. Lovasi 2020, 05. Patterns in Geographic Access to Health Care Facilities Across Neighborhoods in the United States Based on Data From the National Establishment Time-Series Between 2000 and 2014. *JAMA Network Open 3*(5), e205105–e205105.

United States Department of Agriculture 2022a. Low-Income and Low-Foodstore-Access Census Tracts, 2015–19. *United States Department of Agriculture, Economic Research Service*, Economic Information Bulletin No. 236.

United States Department of Agriculture 2022b. Retail Food Sales and Sales Growth. *United States Department of Agriculture, Economic Research Service*, https://www.ers.usda.gov/topics/food–markets–prices/retailing–wholesaling/retail–trends/.

U.S. Census Bureau 2022. Metropolitan and Micropolitan. *United States Department of Agriculture*, https://www.census.gov/programs–surveys/metro–micro.html.

Uusitalo, O. 2004. Competitive reactions to market entry: The case of the Finnish grocery retailing industry. *British Food Journal 106*(9), 663–672.

Volpe, R., E. C. Jaenicke, and L. Chenarides 2018. Store formats, market structure, and consumers' food shopping decisions. *Applied Economic Perspectives and Policy 40*(4), 672–694.

Wooldridge, J. 1999. *Handbook of Applied Econometrics Volume II: Quasi-likelihood Methods for Count Data*. Oxford: Blackwell Publishing Inc.

Zeballos, E. and K. Marchesi 2022. Comparing food sector employment headcount and sales data in the national establishment time series database to federal data. *USDA Technical Bulletin, 1958*.

Tables and Figures

Table 1: Main Results.

	Count	Employment	Sales
Panel A: Average treatment effects			
All census tracts	-0.023***	-0.038***	-0.059***
	(0.004)	(0.007)	(0.017)
Pseudo R-squared	0.305	0.693	0.827
Observations	1,069,824	1,069,824	1,069,824
Panel B: Conditional average treatment effects			
Urban census tracts	-0.017***	-0.028***	-0.048**
	(0.004)	(0.008)	(0.020)
Rural census tracts	-0.051***	-0.074***	-0.096***
	(0.009)	(0.016)	(0.022)
Pseudo R-squared	0.305	0.693	0.827
Observations	1,069,824	1,069,824	1,069,824

Note. The table shows estimates of the dollar store exposure effect on independent grocery retailer count, employment, and sales. All regressions include census tract fixed effects, time dummies, and linear market trends. Standard errors are adjusted for within-cluster correlation at the census tract level. ***, **, and * indicate statistical significance at the 1 percent, 5 percent, and 10 percent confidence levels, respectively.

Table 2: Spatial Spillover Effects.

	Count	Employment	Sales
Panel A: Number of entries in adjacent census tracts			
Urban treatment effect	-0.018***	-0.030***	-0.050**
	(0.004)	(0.008)	(0.020)
Rural treatment effect	-0.051***	-0.073***	-0.095***
	(0.009)	(0.016)	(0.022)
Spatial lag	0.009***	0.011***	0.014***
	(0.001)	(0.002)	(0.004)
Pseudo R-squared	0.305	0.693	0.827
Observations	1,069,824	1,069,824	1,069,824
Panel B: Any entry in adjacent census tracts			
Urban treatment effect	-0.017***	-0.028***	-0.048**
	(0.004)	(0.008)	(0.020)
Rural treatment effect	-0.051***	-0.074***	-0.096***
	(0.009)	(0.016)	(0.022)
Spatial lag	0.006*	-0.004	-0.001
	(0.004)	(0.008)	(0.009)
Pseudo R-squared	0.305	0.693	0.827
Observations	1,069,824	1,069,824	1,069,824
Panel C: Share of adjacent census tracts with entry			
Urban treatment effect	-0.018***	-0.029***	-0.049**
	(0.004)	(0.008)	(0.020)
Rural treatment effect	-0.051***	-0.074***	-0.095***
	(0.009)	(0.016)	(0.022)
Spatial lag	0.059***	0.050***	0.047
	(0.010)	(0.019)	(0.031)
Pseudo R-squared	0.305	0.693	0.827
Observations	1,069,824	1,069,824	1,069,824

Note. The table shows estimates of the dollar store exposure and spatial spillover effects on independent grocery retailer count, employment, and sales. We test three competing spatial lag models. We look at the margins of dollar store exposure in Panels A and B and the density of dollar store exposure in neighboring census tracts in Panel C. All regressions include census tract fixed effects, time dummies, and linear market trends. Standard errors are adjusted for within-cluster correlation at the census tract level. ***, **, and * indicate statistical significance at the 1 percent, 5 percent, and 10 percent confidence levels, respectively.

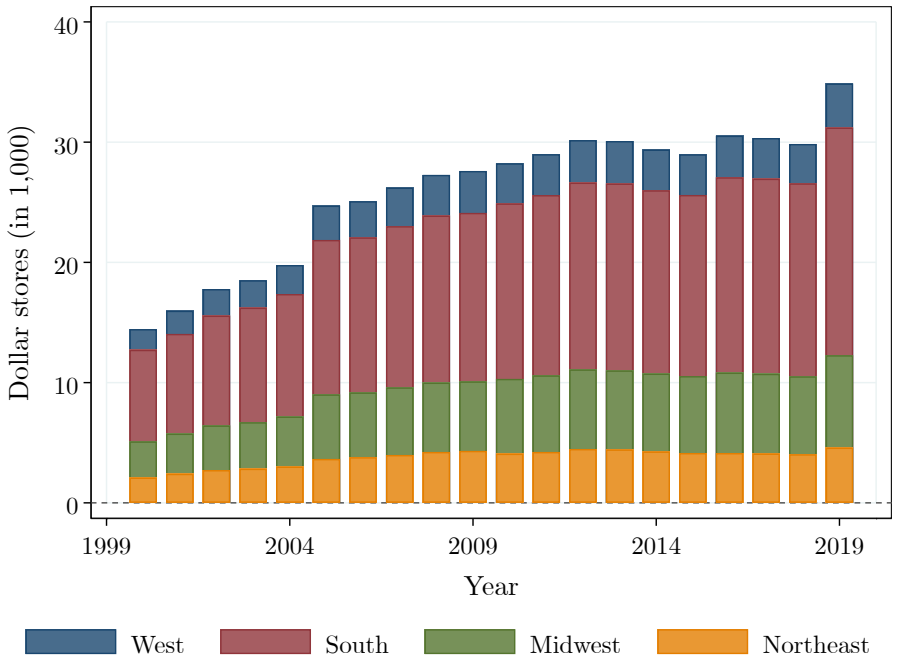

Figure 1: Dollar Store Expansion.

Note. The figure shows the number of dollar stores by census region between 2000 and 2019.

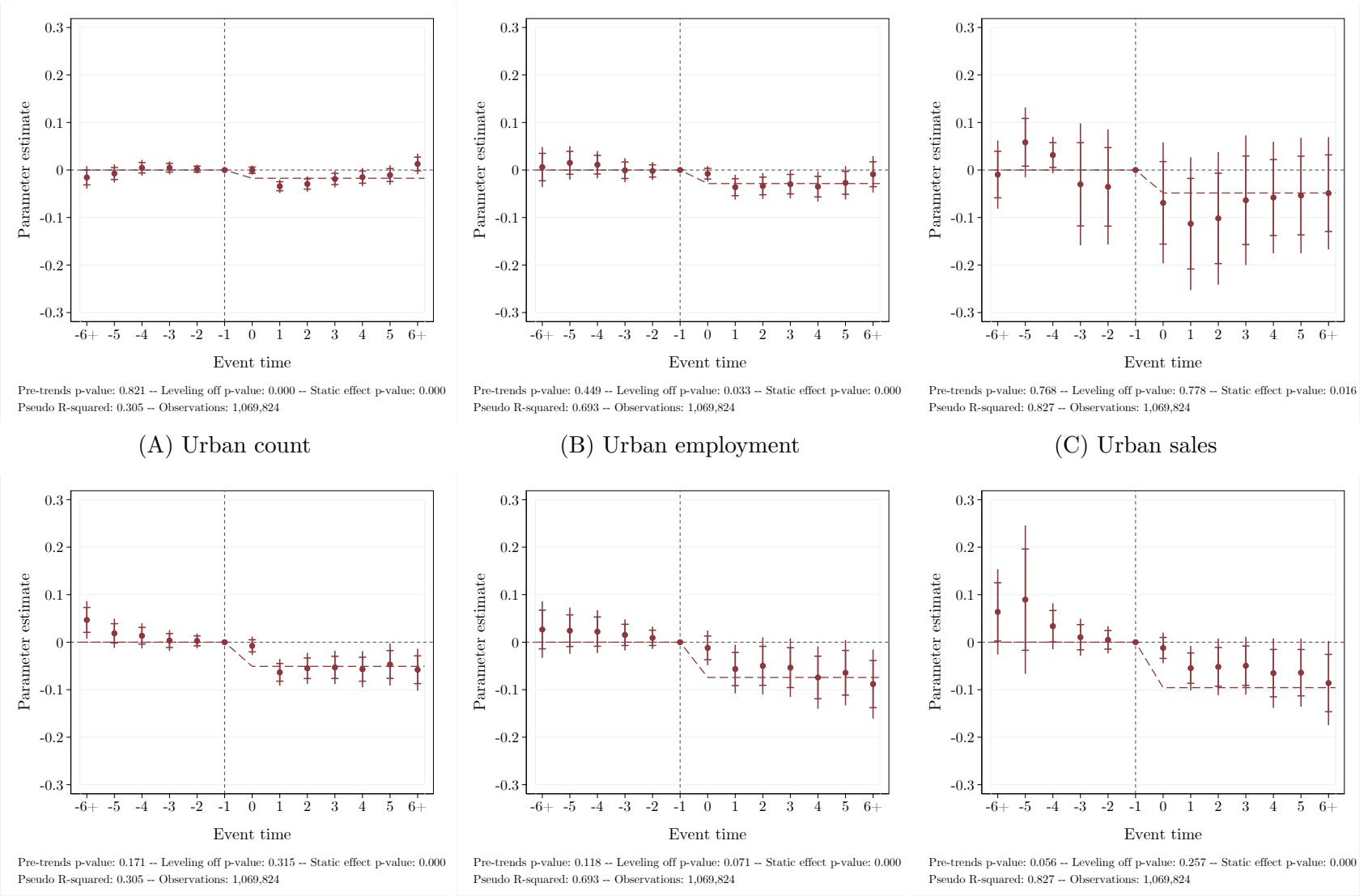

Figure 2: Event Studies.

Note. The figure shows event study estimates for dollar store exposure and independent grocery retailer count, employment, and sales for urban and rural census tracts. All regressions include census tract fixed effects, time dummies, and linear market trends. Standard errors are adjusted for within-cluster correlation at the census tract level. We plot the dynamic treatment parameters, 95 percent confidence intervals, and uniform sup-t bands for the event-time coefficients. Results from a static model are overlaid as a dashed line. We report Wald tests for pre-trends, leveling off dynamic treatment effects, the pseudo R-squared, and the observation number in the figure note.

Appendix Tables and Figures

Table A.1: 2010 RUCA Codes.

Code	Classification Description
1	Metropolitan area core: primary flow within an urbanized area (UA)
2	Metropolitan area high commuting: primary flow 30 percent or more to a UA
3	Metropolitan area low commuting: primary flow 10 percent to 30 percent to a UA
4	Micropolitan area core: primary flow within an urban cluster of 10,000 to 49,999 (large UC)
5	Micropolitan high commuting: primary flow 30 percent or more to a large UC
6	Micropolitan low commuting: primary flow 10 percent to 30 percent to a large UC
7	Small town core: primary flow within an urban cluster of 2,500 to 9,999 (small UC)
8	Small town high commuting: primary flow 30 percent or more to a small UC
9	Small town low commuting: primary flow 10 percent to 30 percent to a small UC
10	Rural areas: primary flow to a tract outside a UA or UC
99	Not coded: Census tract has zero population and no rural-urban identifier information

Note. The table describes the 2010 RUCA codes. The data come from the Economic Research Service (2022).

Table A.2: Descriptive Statistics.

	Sum	Mean	SD	Min.	Max.	Obs.
Panel A: All census tracts						
Count	2,358,259	2.08	2.08	0	57	1,131,414
Employment	14,306,497	12.64	23.96	0	4,048	1,131,414
Sales	1,477,074,563	1,305.51	4,440.36	0	769,117	1,131,414
Dollar stores	519,126	0.46	0.80	0	45	1,131,414
Panel B: Urban census tracts						
Count	1,944,530	2.13	2.19	0	57	913,242
Employment	11,005,974	12.05	24.04	0	4,048	913,242
Sales	1,138,802,583	1,246.99	4,735.36	0	769,117	913,242
Dollar stores	377,205	0.41	0.74	0	15	913,242
Panel C: Rural census tracts						
Count	413,729	1.90	1.57	0	56	218,172
Employment	3,300,523	15.13	23.48	0	700	218,172
Sales	338,271,980	1,550.48	2,883.08	0	235,914	218,172
Dollar stores	141,921	0.65	0.99	0	45	218,172

Note. The table shows the descriptive statistics for all census tracts and separates the outcome and treatment variables by urban and rural census tracts. We calculated the sum, mean, standard deviation (SD), minimum (min.), maximum (max.), and observation numbers (obs.) for the three outcome variables (independent grocery retailer count, employment, and sales) and the treatment variable (dollar store count).

Table A.3: Concepts of Rurality.

	Count	Employment	Sales
Panel A: Census definition of rurality			
Urban census tracts	-0.017***	-0.032***	-0.042***
	(0.004)	(0.008)	(0.016)
Rural census tracts	-0.047***	-0.059***	-0.112**
	(0.009)	(0.016)	(0.044)
Pseudo R-squared	0.305	0.693	0.827
Observations	1,069,824	1,069,824	1,069,824
Panel B: RUCA codes 4 to 7 and 8 to 10			
Metropolitan census tracts	-0.017***	-0.028***	-0.048**
	(0.004)	(0.008)	(0.020)
Micropolitan census tracts	-0.038***	-0.082***	-0.110***
	(0.012)	(0.021)	(0.029)
Small town and rural census tracts	-0.081***	-0.056***	-0.062**
	(0.016)	(0.021)	(0.026)
Pseudo R-squared	0.305	0.693	0.827
Observations	1,069,824	1,069,824	1,069,824

Note. The table shows estimates of the dollar store entry exposure on independent grocery retailer count, employment, and sales for different concepts of rurality. Panel A uses the Census Bureau's definition of metropolitan and micropolitan statistical areas (U.S. Census Bureau 2022). We follow their procedure and define all census tracts in non-metropolitan as rural. Panel B uses the RUCA codes to distinguish metropolitan from micropolitan and other census tracts (Economic Research Service 2022). All regressions include census tract fixed effects, time dummies, and linear market trends. Standard errors are adjusted for within-cluster correlation at the census tract level. ***, **, and * indicate statistical significance at the 1 percent, 5 percent, and 10 percent confidence levels, respectively.

Table A.4: Treatment Heterogeneity.

	Count	Employment	Sales
Panel A: Over time			
2000 to 2004	-0.014	0.013	-0.011
	(0.013)	(0.020)	(0.028)
2005 to 2009	-0.037***	-0.040**	-0.056**
	(0.010)	(0.016)	(0.025)
2010 to 2014	-0.070***	-0.119***	-0.158***
	(0.010)	(0.017)	(0.022)
2015 to 2019	-0.063***	-0.136***	-0.158***
	(0.012)	(0.020)	(0.027)
Pseudo R-squared	0.305	0.694	0.827
Observations	1,069,824	1,069,824	1,069,824
Panel B: Between census regions			
Northeast	-0.057**	-0.091**	-0.101**
	(0.026)	(0.036)	(0.039)
Midwest	-0.073***	-0.086***	-0.123***
	(0.017)	(0.026)	(0.038)
South	-0.042***	-0.048*	-0.088**
	(0.014)	(0.027)	(0.043)
West	-0.041*	-0.091**	-0.056
	(0.025)	(0.042)	(0.039)
Pseudo R-squared	0.306	0.692	0.827
Observations	1,064,782	1,064,782	1,064,782
Panel C: Across store formats			
Dollar store exposure	-0.020	-0.036	-0.086*
	(0.013)	(0.031)	(0.051)
Pseudo R-squared	0.207	0.748	0.782
Observations	582,064	582,064	582,064

Note. The table shows treatment heterogeneity estimates of the dollar store exposure effect on independent grocery retailer count, employment, and sales. We present interaction effects by the panel period in Panel A and by the census region in Panel B. Panel C shows estimates for chain grocery retailers. We only report estimates for the rural census tracts. Estimates for the urban census tracts are available upon request from the authors. All regressions include census tract fixed effects, time dummies, and linear market trends. Standard errors are adjusted for within-cluster correlation at the census tract level. ***, **, and * indicate statistical significance at the 1 percent, 5 percent, and 10 percent confidence levels, respectively.

Table A.5: Robustness to Fixed Effects Structure.

	Count			Employment			Sales		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Panel A: Average treatment effects									
All census tracts	-0.026***	-0.025***	-0.029***	-0.052***	-0.040***	-0.042***	-0.070***	-0.056***	-0.045***
	(0.004)	(0.004)	(0.004)	(0.007)	(0.007)	(0.007)	(0.019)	(0.013)	(0.009)
Pseudo R-squared	0.303	0.307	0.313	0.689	0.695	0.708	0.822	0.829	0.851
Observations	1,069,915	1,069,824	1,062,855	1,069,915	1,069,824	1,062,855	1,069,915	1,069,824	1,062,855
Panel B: Conditional average treatment effects									
Urban census tracts	-0.006	-0.021***	-0.028***	-0.025***	-0.033***	-0.039***	-0.046*	-0.048***	-0.037***
	(0.004)	(0.004)	(0.004)	(0.008)	(0.008)	(0.008)	(0.023)	(0.015)	(0.010)
Rural census tracts	-0.132***	-0.047***	-0.038***	-0.151***	-0.067***	-0.060***	-0.156***	-0.089***	-0.083***
	(0.010)	(0.009)	(0.010)	(0.017)	(0.015)	(0.015)	(0.023)	(0.022)	(0.018)
Pseudo R-squared	0.303	0.307	0.313	0.689	0.695	0.708	0.822	0.829	0.851
Observations	1,069,915	1,069,824	1,062,855	1,069,915	1,069,824	1,062,855	1,069,915	1,069,824	1,062,855

Note. The table shows robustness estimates of the dollar store exposure on independent grocery retailer count, employment, and sales. Model (1) excludes the linear market trends, while we add state-year fixed effects in model (2) and county-year fixed effects in model (3). All regressions include census tract fixed effects, time dummies, and linear market trends. Standard errors are adjusted for within-cluster correlation at the census tract level. ***, **, and * indicate statistical significance at the 1 percent, 5 percent, and 10 percent confidence levels, respectively.

Table A.6: Exclude Always-Treated Census Tracts.

	Count	Employment	Sales
Panel A: Average treatment effects			
All census tracts	-0.025***	-0.056***	-0.088***
	(0.005)	(0.008)	(0.022)
Pseudo R-squared	0.270	0.674	0.823
Observations	834,480	834,480	834,480
Panel B: Conditional average treatment effects			
Urban census tracts	-0.017***	-0.039***	-0.076***
	(0.005)	(0.009)	(0.026)
Rural census tracts	-0.070***	-0.115***	-0.133***
	(0.011)	(0.017)	(0.022)
Pseudo R-squared	0.270	0.674	0.823
Observations	834,480	834,480	834,480

Note. The table shows estimates of the dollar store exposure effect on independent grocery retailer count, employment, and sales when excluding always-treated census tracts. The control group includes not-yet-treated and never-treated units. All regressions include census tract fixed effects, time dummies, and linear market trends. Standard errors are adjusted for within-cluster correlation at the census tract level. ***, **, and * indicate statistical significance at the 1 percent, 5 percent, and 10 percent confidence levels, respectively.

Table A.7: Log-linear Regression.

	Count	Employment	Sales
Panel A: Average treatment effects			
All census tracts	-0.035***	-0.119***	-0.111***
	(0.009)	(0.006)	(0.006)
Adjusted R-squared	0.773	0.728	0.738
Observations	1,100,680	1,100,680	1,100,680
Panel B: Conditional average treatment effects			
Urban census tracts	-0.019*	-0.110***	-0.101***
	(0.011)	(0.006)	(0.006)
Rural census tracts	-0.105***	-0.158***	-0.154***
	(0.018)	(0.014)	(0.014)
Adjusted R-squared	0.773	0.728	0.738
Observations	1,100,680	1,100,680	1,100,680

Note. The table shows estimates of the dollar store exposure effect on independent grocery retailer count, employment, and sales using a log-linear regression model. We kept the count outcome in levels and log-transformed employment and sales. All regressions include census tract fixed effects, time dummies, and linear market trends. Standard errors are adjusted for within-cluster correlation at the census tract level. ***, **, and * indicate statistical significance at the 1 percent, 5 percent, and 10 percent confidence levels, respectively.

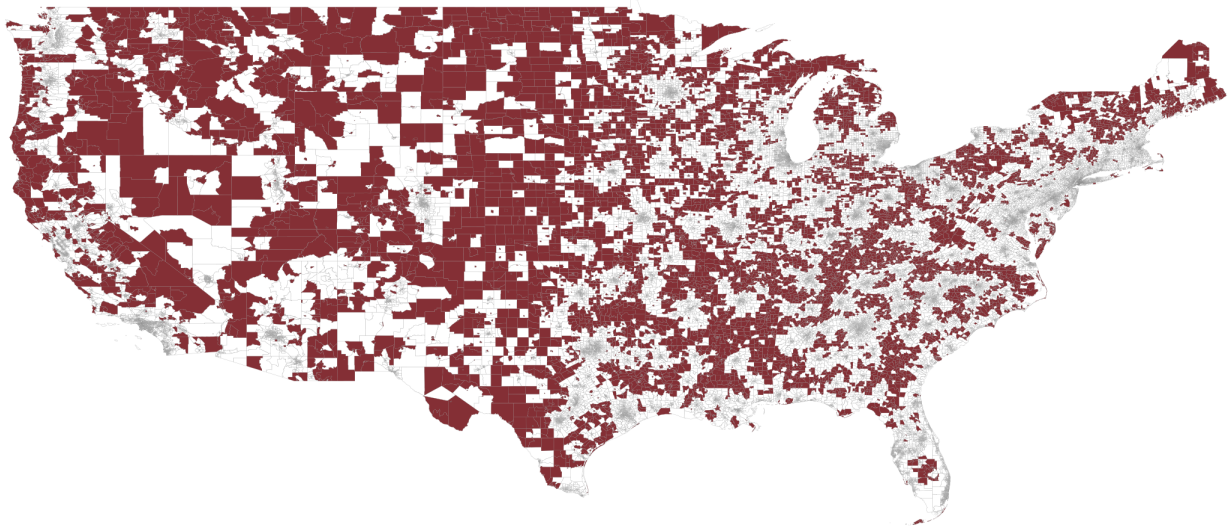

Figure A.1: Rural Census Tracts.

Note. The figure shows rural census tracts in the continental United States. We define rural census tracts based on RUCA codes 4 to 10. Appendix Table A.1 provides the description of these codes. provides The census tract shapes are simplified.