Supply-Side Subsidies to Improve Food Access and Dietary Outcomes: Evidence from the New Markets Tax Credit

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Abstract

In an effort to improve diet and health outcomes, policymakers have increasingly turned to supply-side subsidies aimed at encouraging investment by supermarkets and other food retailers in traditionally underserved areas. This paper examines whether the U.S. federal government's New Markets Tax Credit (NMTC) has affected the entry of retail food establishments, and in turn food shopping and purchasing patterns, in low-income communities. To identify the impacts of the program, we take advantage of a discontinuity in NMTC funding generated by the formula used to determine the eligibility of census tracts for investment under the program. We find that the NMTC Program has had modest, but positive impacts on supermarket entry in low-income communities. Based on household-level scanner data, there are no detectable effects on households' food purchasing patterns in affected neighborhoods, at least in the short run.

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1 Introduction

In many countries, there is growing concern about the availability of affordable and nutritious food in low-income communities. To mitigate the possible negative diet and health implications of so-called "low-income, low-access areas," policymakers have increasingly turned to supply-side subsidies aimed at encouraging investment by supermarkets and other food retailers in traditionally underserved communities. For example, several cities and states in the U.S. have attempted to address perceived food access problems by providing property tax abatements or other tax incentives to retail food establishments that locate in certain neighborhoods (Centers for Disease Control and Prevention 2011).

Evaluating the effects of these initiatives is difficult for several reasons. First, programs that aim to subsidize the entry of healthy food retailers tend to be fairly limited in scale. Second, finding suitable comparison groups is challenging given that communities eligible for subsidies are typically not randomly selected; as a result, it is often unclear if observed changes in areas that receive subsidized investment are attributable to the investment itself or to other, potentially unobserved neighborhood characteristics. Whether there is indeed a market failure that would justify government intervention is also not entirely clear; differences in consumer preferences over alternative food options could give rise to measured differences in access.

To the extent that place-based programs induce entry of supermarkets and other food retailers in low-income, low-access areas that would not have otherwise occurred, they can potentially break the endogeneity of firm entry with respect to consumer preferences and help to isolate the role of healthy food access in giving rise to observed differences in food purchasing patterns and health outcomes across communities. To explore the potential for supply-side subsidies to improve food access and in turn address nutritional disparities, this paper examines the effects of the U.S. federal government's New Markets Tax Credit (NMTC) Program, a large-scale, national program that provides tax incentives to encourage private investment in low-income neighborhoods. In order to credibly identify the effects of the program, we exploit a discontinuity in NMTC funding generated by the formula used to determine the eligibility of census tracts for investment under the program. The discontinuity creates quasi-experimental variation in subsidized investment around a certain income threshold; tracts with median incomes below the threshold are eligible to receive NMTC-

subsidized investment, while tracts with median incomes above generally are not eligible.

We first explore the NMTC Program's impacts on the entry of retail food establishments in low-income areas across the country. Combining data from the U.S. Treasury on tax credit allocation and tract-level demographic and housing information with rich, comprehensive data on retail food establishments between 2004 and 2009 from A.C. Nielsen's TDLinx database, we compare outcomes among tracts within a narrow window around the income threshold determining eligibility under the program. This approach allows for causal inferences regarding the impacts of the NMTC on investment in the retail food industry, overcoming endogeneity problems that have arisen in past research on government incentives designed to promote commercial investment in general, and investment in retail food outlets in particular. We find that the program induces modest, but positive growth in the local retail food industry, with the effects concentrated among supermarkets.

We then take advantage of household scanner data from Information Resources, Inc. (IRI) to explore whether NMTC-induced investment in low-income communities is associated with changes in food shopping and purchasing patterns among households. We find that, while the arrival of new supermarkets may have led some households to redirect purchases that might have otherwise happened at convenience stores, it had no discernable effects on the healthfulness of consumers' grocery purchases. While changes in purchasing habits might take longer to emerge than the short time horizon we consider, the lack of any substantive effect is consistent with recent case studies suggesting that the entry of new grocery outlets in areas previously lacking in stores with healthy food options seems to have little impact on attitudes toward diet or on food purchasing decisions.

Overall, our results suggest that improvements in access alone are unlikely to dramatically narrow nutritional or diet-related health disparities. Broader efforts aimed at reducing prices of nutritious food items or shifting preferences in favor of such items may also be necessary to generate significant and lasting effects on the diets and health of lower income households.

This paper is organized as follows. The next section provides a brief review of the literature on low-income, low-access areas and discusses how our work relates to and builds upon past research. After we describe the NMTC Program in Section 3, we outline our empirical strategy for estimating the effects of the program on food retailer entry as well as food purchasing patterns in affected communities in Section 4. We discuss the data we use in Section 5. Section 6 presents our main results as well as a number of robustness tests. Section 7 concludes.

2 Background

There exist large disparities in nutrition and diet-related health outcomes across different socioeconomic groups in the U.S. Preferences for less healthy foods, higher prices for healthy foods, and limited access to healthy foods could each contribute to these disparities. The latter has received particular attention among policymakers, who have emphasized the potential negative consequences of so-called low-income, low-access areas, also known as food deserts, in advancing legislation that seeks to increase access to healthier foods in communities that are currently underserved (Centers for Disease Control and Prevention 2011, Aussenberg 2014, Handbury et al. 2016).

Substantial debate exists on the importance of access relative to other factors in generating observed nutritional disparities between groups (Wrigley 2002, Bitler and Haider 2011). There is consistent evidence that access to healthy food is greater in wealthier and more educated neighborhoods (Powell et al. 2007, Larson et al. 2009, Bader et al. 2010, Beaulac et al. 2009, Ver Ploeg et al. 2009), and that poor households tend to eat a less healthy diet (Bhattacharya and Currie 2001, Cutler and Lleras-Muney 2010). Moreover, a number of largely cross-sectional studies have found a correlation between greater access to healthy foods and better dietary quality as well as a lower incidence of chronic health conditions (Li et al. 2009, Caspi et al. 2012, Dubowitz et al. 2012, Auchincloss et al. 2013).

However, it does not immediately follow that improving access to healthy food in lower income and less educated communities would reduce nutritional and health disparities, since differences in consumption patterns could be driven as much, if not more, by differences in preferences and/or price sensitivities. Indeed, using household data on food purchases, Kyureghian et al. (2013) find that densities of supermarkets and other retail outlets have little effect on fruit and vegetable purchases. In a comprehensive study of food purchases made between and within stores by higher and lower income households, Handbury et al. (2016) also find that differences in access play only a minor role in explaining observed differences in food expenditure patterns. They contend that differences in preferences or price sensitivities likely account for most of the disparities, which in turn suggests that improving access may be expected to have only small effects on actual food consumption habits and thus diet-related health outcomes.

Several recent case studies on the food consumption and health effects of single store openings

in perceived food deserts corroborate these findings. For example, Cummins et al. (2014) find that a new supermarket in an underserved community in Philadelphia improved residents' perceptions of food availability, but did not induce changes in reported healthy food consumption or body mass indices. Elbel et al. (2015) similarly find that a new supermarket in a previously underserved area in New York City had no discernable effects on the amounts of healthful or unhealthful foods kept at home or on children's diets in the affected neighborhood. However, in case studies on supermarket openings in other cities in the UK and U.S., Wrigley et al. (2002, 2003) and Weatherspoon et al. (2013, 2015) document positive, albeit modest effects of improved access on healthy food expenditures among households in distressed communities. In all of these case studies, however, one might be concerned about both the generalizability of the results as well as the non-random selection of neighborhoods by supermarkets.

Our study takes a different approach than past research not only by using data on a large number of retail food store openings nationwide, but also by taking advantage of quasi-experimental variation in the location of this investment generated by particular features of the NMTC Program. In previous work on food deserts that exploits variation over time or across geographies in nutritious food availability, the endogeneity of food retailer location decisions with respect to local food demand could bias estimates of greater food access on the consumption of nutritious food. Our empirical approach exploiting discontinuities in the formula used to determine neighborhood eligibility for NMTC subsidies is aimed at breaking this endogeneity, in turn allowing us to more credibly estimate the impacts of healthy food access on dietary outcomes. The results of this research are informative as to not only the efficacy of place-based policies in improving food access in areas with a perceived lack of availability of healthy and affordable food, but also the extent to which improving access alone might help to narrow nutritional and diet-related health disparities across different socioeconomic groups.[1]

[1]Our work also relates to a broader body of research on retail food industry dynamics, which has been recently studied by Davis et al. (2006, 2009), Basker and Noel (2009), Hanner et al. (2015), and Hosken et al. (2016).

3 The New Markets Tax Credit Program

The U.S. Congress established the NMTC Program in December 2000 as part of the Community Renewal Tax Relief Act of 2000.[2] The program, which is administered by the Community Development Financial Institutions (CDFI) Fund at the U.S. Treasury, is intended to promote greater investment into operating businesses and real estate projects located in low-income neighborhoods across the country. It does so by permitting individuals or corporate investors to receive a tax credit against their federal income tax in return for making equity investments in certain, Treasury-approved financial institutions known as Community Development Entities (CDEs).[3]

Tax credit allocations to CDEs, which have totaled over $43 billion since the program began, are awarded competitively.[4] After being awarded an allocation, which averaged close to $50 million during the 2000s, a CDE has five years to use the proceeds to make qualified low-income community investments (QLICIs) of equity or debt capital. Historically, the vast majority of QLICIs have taken the form of loans to developers and businesses, which can be offered at below-market interest rates and with other preferential terms because investors' returns are at least partly covered by the tax credit. While CDEs have significant latitude in determining what types of investments to make, about two-thirds of CDE investment has gone to commercial real estate development. Much of the remaining third are loans to businesses.[5] NMTC financing covers over one-third of project costs on average (U.S. GAO 2010).

CDEs must invest "substantially all" of the equity they receive in certain areas called "low-income communities" (LICs). During the 2000s, neighborhoods could qualify as LICs in several ways. First, census tracts with median family income (MFI) that does not exceed 80% of the greater of their metropolitan statistical area's (MSA's) MFI and their state's MFI qualify.[6] Any tract with a poverty rate of at least 20% also qualifies. A small number of "low-population" and

[2] More information on the NMTC Program can be found in Freedman (2012), Abravanel et al. (2013), and on the CDFI Fund's website at www.cdfifund.gov.

[3] The tax credit totals 39% of the original investment and is claimed over a period of seven years. CDEs are domestic corporations or partnerships that demonstrate a primary mission of serving or providing investment capital to low-income communities or persons, and that maintain accountability to residents of low-income communities through representation on a governing or advisory board to the entity.

[4] This includes $3 billion in Recovery Act Awards as well as $1 billion for Gulf Opportunity Zones after Hurricane Katrina. During the 2003-2009 period that is the basis for our main analysis, allocations totaled $26 billion.

[5] A very small fraction of NMTC funds help to finance residential real estate development, in part because the financing of rental property development is generally not allowed under the program.

[6] For tracts outside MSAs, only the statewide MFI is relevant in determining the income ratio.

"rural, high out-migration" tracts also qualify.[7]

During the 2000s, 39% of the 65,443 tracts in the U.S. qualified as LICs. Nearly all that qualified (98%) qualified either on the MFI ratio criterion or on the poverty rate criterion. Of those that qualified on one of these two criteria, the vast majority (95%) qualified on the MFI ratio criterion. The result is a discrete drop-off in tract eligibility at the 80% MFI ratio cutoff; the percentage of tracts designated as LICs falls from 100% among tracts below the cutoff to 11% among tracts with MFI ratios between 0.8 and 0.9. This nonlinearity in eligibility generates quasi-exogenous variation in the location of NMTC-subsidized investment, variation that we can use to identify the causal effects of that investment on local retail food markets.

Improving access to healthy foods in underserved communities was not initially a goal of the NMTC Program. However, investment in food production and distribution businesses are eligible uses of NMTC funds as long as the assets of the businesses are located in LICs. A sizable fraction of QLICIs during the 2000s were in retail food, which is attributable to several features of the industry.[8] First, grocers are unlikely to violate program rules on excessive working capital. Second, most of the business activities that are not eligible for NMTC financing (e.g., gambling, tanning salons, and liquor) are either seldom combined with food retailing or represent a sufficiently small share of revenues as to not disqualify them for financing. Third, supermarkets do not change ownership as frequently as many businesses, which means that the seven-year NMTC period is less problematic than for businesses in other sectors (Reinvestment Fund 2011). In response to the Obama administration's Healthy Food Financing Initiative (HFFI) and building on the perceived track record of the NMTC in improving food access in underserved communities, CDEs began to be asked in their applications for NMTC allocations to describe any projects that would increase access to fresh and healthy food for low-income populations beginning in 2011. Given that the HFFI has only existed several years, and the fact that it incorporated other strategies aimed at improving the supply of healthy food in low-income areas independent of the NMTC, we focus only

[7] "Low-population" tracts have populations less than 2,000, are located in federal Empowerment Zones, and are contiguous with another LIC. "Rural, high out-migration" tracts are located outside MSAs, have MFI not exceeding 85% of statewide MFI, and have net out-migration between 1980 and 2000 of at least 10%.

[8] Determining the exact fraction is difficult given that some CDEs provide no or only vague descriptions of their investments. Based on business descriptions provided, over 6% of QLICIs are explicitly in retail food. This is a lower bound, however, since some of those investments in commercial real estate development could include retail food. Of those projects reporting tenant businesses in telephone surveys, 14% reported grocery stores, making it the second most common type of tenant business (Abravanel et al. 2013).

on NMTC-subsidized investment through 2009 in this paper.

Despite a growing body of research on policies that provide tax or other incentives to encourage business investment in certain geographic areas, there is substantial debate on the effectiveness of these place-based programs in spurring commercial development (Neumark and Simpson 2015). Freedman (2012, 2015) examines the effects of investment subsidized under the NMTC Program on conditions within targeted neighborhoods and finds positive, albeit modest impacts. However, Freedman's focus is primarily on aggregate employment and housing conditions in affected communities. Harger and Ross (2016) study whether the NMTC had important effects of on the entry and expansion of establishments across different broad industries and find that it had a disproportionate effect on manufacturing and retail. However, they do not examine its impacts on retail food specifically, nor do they consider other community-level impacts of the subsidized investment beyond its effects on establishment entry and employment growth.[9]

Reasons frequently cited for the dearth of retail food investment in low-income neighborhoods include poor infrastructure, zoning issues, crime, traffic patterns, parking, and a lack of large parcels of land (Food Marketing Institute 1998, Short et al. 2007, Ver Ploeg et al. 2009). To the extent that the NMTC helped to overcome some of these barriers and encouraged expansion in the retail food industry either through new entry or growth among incumbents, associated improvements in access to high-quality and affordable food could have important health consequences for residents of these communities.

4 Empirical Strategy

In this section, we outline our strategy for identifying the causal effects of supply-side subsidies on food access, and in turn the effects of quasi-exogenous changes in food access on food shopping and purchasing patterns. In order to identify these effects, we take advantage of the formula structure of the NMTC, and specifically the cutoffs determining the eligibility of census tracts for NMTC-subsidized investment.

[9] Notably, Grossman (2015) considers the health and fertility impacts of the federal Empowerment Zone Program. He finds large positive effects on infant health, which he argues are the result of increased investment in children owing to higher parental wages in affected communities. However, Horn et al. (2016) find little evidence that higher local minimum wages lead to improvements in worker health.

The basic regression of interest is

$$y_i = \beta_0 + \beta_1 NMTC_i + \mathbf{X}_i\mathbf{\Omega} + \varepsilon_i \tag{1}$$

where y_i is the outcome y for tract i, $NMTC_i$ is the amount of NMTC-subsidized investment in tract i, and $\mathbf{X}_i$ is a vector of initial tract characteristics. The main parameter of interest is β_1, relating the amount of NMTC investment to outcomes of interest. However, using OLS to estimate this regression is likely to yield a biased estimate of β_1, as certain unobserved features of neighborhoods may influence the likelihood of receiving NMTC investment and independently affect outcomes.

To address this endogeneity issue, we follow Freedman (2012) and exploit a regression discontinuity (RD) design. Specifically, we focus on a select group of tracts close to the 80% MFI ratio cutoff that largely determines eligibility for subsidies under the NMTC Program. Tracts immediately on either side of the cutoff are likely to be similar on both observed and unobserved dimensions, except that those right below the threshold are eligible for NMTC-subsidized investment while those right above are generally not eligible. Given this, any discontinuity in outcomes for tracts near the cutoff can be attributed to a causal effect of NMTC-subsidized investment.[10]

The first-stage regression for the RD design can be written as

$$NMTC_i = \alpha_0 + \alpha_1 LIC_i + f(m_i) + \mathbf{X}_i\mathbf{\Pi} + u_i \tag{2}$$

and, substituting (2) into (1), the reduced-form regression is

$$y_i = \gamma_0 + \gamma_1 LIC_i + \beta_1 f(m_i) + \mathbf{X}_i\mathbf{\Phi} + v_i \tag{3}$$

where m_i is the fraction of households in tract i with incomes below 80% of area MFI (the running variable), LIC_i takes a value of 1 if tract i qualifies as an LIC based on the threshold and a value of 0 otherwise, and $f(m_i)$ is a cubic polynomial in the running variable relative to the 80% cutoff where the coefficients are permitted to vary above and below the cutoff. Because this model is

[10]Notably, the formula discontinuity approach we adopt is distinct from a spatial or border discontinuity approach that would involve using ineligible tracts that neighbor LICs as controls. Unlike the latter approach, our empirical strategy mitigates bias stemming from spatial spillovers, since control tracts (i.e., those that just barely failed to qualify as LICs) are not necessarily geographically close to treated tracts.

just-identified, the IV estimate of β_1 in (1) is $\hat{\gamma}_1/\hat{\alpha}_1$.[11]

For the RD design to be valid, any unmeasured determinants of outcomes must evolve smoothly through the MFI ratio cutoff that largely determines eligibility for NMTC-subsidized investment. One possible threat to this would be unobserved sorting of tracts around the cutoff. Such sorting of neighborhoods around the threshold is highly implausible in this context, as the data determining LIC status during the 2000s were collected before but released only after the NMTC Program was signed into law. Therefore, not knowing the relevant thresholds, local officials could not have manipulated census returns to ensure eligibility. Meanwhile, not having the census data available yet, federal legislators could not have chosen the cutoffs to specifically include some tracts and not others (Freedman 2012, Harger and Ross 2016). Density tests and checks for covariate balance (discussed in more detail in Section 5.2) further suggest that no sorting occurred around the threshold.

Importantly, the RD estimates are local average treatment effects and may not generalize to a broader sample of neighborhoods. Indeed, it is unlikely to be the case that the effects of subsidized investment of the type financed by the NMTC Program would be the same in very affluent or very poor tracts as it is in the moderately poor tracts we consider in our main analysis. However, these moderately poor tracts are arguably of particular interest from a policy perspective, as private businesses, and especially retail food firms whose customer bases and pools of potential employees tend to be highly localized, are more likely to be swayed by government subsidies to locate in moderately poor neighborhoods than in severely distressed communities (Pothukuchi 2005).

5 Data

5.1 Data Sources

The data used in this study are derived from several sources. First, baseline neighborhood characteristics come from the 2000 Decennial Census. These data include a host of census tract-level demographic variables (population, racial and ethnic composition, age distribution, educational attainment, and household size) as well as housing variables (number of units, share vacant, share occupied, share owner-occupied, share with a mortgage, median age of units, and median number of

[11] For a comprehensive treatment of RD designs, see Lee and Lemieux (2010).

rooms). Variables determining LIC status (mainly median family income and poverty rates) during the 2000s are also derived from the 2000 Decennial Census data.

Data on retail food establishments come from A.C. Nielsen's TDLinx database.[12] These annual data include all grocery stores, wholesale clubs, and convenience stores starting in 2004.[13] The data include the exact location of each store, which in turn can be mapped to census tracts. The data also report information on each store's estimated size, estimated sales, and estimated number of employees. For the purposes of this paper, we follow Hosken et al. (2016) and define "supermarkets" as grocery stores as well as wholesale club stores, although the results are very similar excluding wholesale club stores.

For information on food shopping and purchasing patterns, we take advantage of IRI's InfoScan Consumer Network Database. This database is derived from the National Consumer Panel, a joint venture between IRI and Nielsen. In addition to a number of household characteristics, the Consumer Network Database provides rich data on household food shopping trips and purchases.[14] Households in the survey report information about their shopping destinations and scan universal product codes (UPCs) on products purchased from all stores. We obtained geographic identifiers for households' residences that allowed us to assign them to census tracts.

5.2 Sample and Descriptive Statistics

For our main analysis, we focus on a narrow sliver of tracts around the 80% MFI ratio cutoff that largely determines eligibility for NMTC investment. Figure 1 shows the number of tracts in each percentage point bin of the MFI ratio between 0.6 and 1, which encompasses the main sample (0.7 to 0.9) as well as larger windows considered in robustness tests. The lines represent cubic fits through the points, separately estimated on either side of the 0.8 cutoff. As the figure makes clear, the density is smooth at the cutoff; that is, there is no evidence of any bunching of tracts on either side of the threshold that would suggest that sorting had occurred around the cutoff that might invalidate the RD design. McCrary (2008) density tests confirm that there is no statistically

[12] Hanner et al. (2015) and Hosken et al. (2016) describe these data in detail.

[13] As discussed in Freedman (2012), while CDEs started receiving NMTC allocations in 2003, Qualified Low-Income Community Investments only began in earnest after 2004. Hence, 2004 data are unlikely to capture any significant amount of NMTC-subsidized investment.

[14] Zhen et al. (2015) describe these data in detail.

significant discontinuity at the threshold.

In Table 1, we present descriptive statistics for tracts in the two ten percentage-point windows immediately on either side of the 80% MFI ratio cutoff. As Panel A of the table suggests, tracts right below are very similar to tracts right above the cutoff in terms of population, racial and ethnic composition, the age distribution, educational attainment levels, and housing characteristics. As Panel B of the table also suggests, the number of grocery stores and convenience stores in 2004 (the earliest year that TDLinx data are available) are also very similar in tracts immediately on either side of the cutoff. Further evidence of the balance in covariates on either side of the cutoff appears in Figure 2, which shows for several selected baseline (year 2000) census characteristics (log population, share black, poverty rate, and share with a bachelor's degree or more) as well as baseline (year 2004) food retailing characteristics (number of supermarkets and number of convenience stores) average values within each half percentage point bin of the running variable for the main sample of tracts with MFI ratios between 0.7 and 0.9. The lines in each figure again represent cubic fits through the points, separately estimated on either side of the 0.8 cutoff. All the baseline covariates evolve smoothly through the cutoff, suggesting again that there were no pre-treatment differences among tracts immediately on either side of the threshold that might threaten to invalidate the RD design.

6 Results

6.1 First-Stage Estimates

First, we establish that low-income community status affected the amount of NMTC-subsidized investment in those communities. Graphical evidence that the MFI ratio threshold for LIC qualification generates a discontinuity in NMTC activity appears in Figure 3, which shows average NMTC-subsidized investment (in millions of dollars) in half percentage point bins of the running variable in a 20 percentage point window around the cutoff. The lines represent cubic fits through the points, separately estimated on either side of the 0.8 MFI ratio threshold. In sharp contrast to the baseline characteristics, each of which evolved smoothly through the cutoff, there is a sharp drop off in NMTC investment at the 0.8 MFI ratio threshold.

The regression counterparts to Figure 3 (based on estimating equation (2)) appear in Table

2. In each of the regressions, we use a cubic control function and include county fixed effects. In the regression appearing in column (2), we also control for the baseline demographic and housing variables listed in Panel A of Table 1. The standard errors shown in the table are clustered at the county level, which allows for arbitrary correlation in errors within county but assumes that they are independent across counties.[15]

The first-stage results suggest that LICs receive on average about $900,000 more in NMTC investment compared to tracts just above the threshold. The highly statistically significant effect is similar with and without tract-level demographic and housing controls. The results are nearly identical excluding county fixed effects and with alternative control functions as well.[16] These first-stage results echo those of Freedman (2012, 2015), which focused on the impacts of NMTC investment on neighborhood composition and commuting patterns. To the extent that a portion of the investment was going to the retail food industry, the NMTC also generates quasi-experimental variation in food access in low-income communities. We turn to the specific effects of the NMTC on the entry of retail food establishments in the next section.

6.2 The Effects of the NMTC on Entry and Expansion in the Retail Food Industry

In Figure 4 and Table 3, we present results examining the effects of the NMTC on retail food establishment entry and expansion. Figure 4 shows the reduced-form estimates of the effects of LIC designation based on the MFI ratio on growth in the numbers of supermarkets and convenience stores measured between 2004 and 2009. The dots show average growth in tracts within half percentage point bins of the running variable on either side of the cutoff. The lines show cubic fits through the points, separately estimated on either side of the cutoff. The figure points to greater growth in the number of supermarkets among tracts just below the cutoff as compared to those just above the cutoff. Meanwhile, there is less of an apparent discontinuity in the change in the number of convenience stores at the MFI ratio cutoff.

[15] We use counties as opposed to MSAs because counties cover the entire U.S. However, clustering on MSA (treating the non-MSA parts of states as a separate MSA) yields similar standard error estimates.

[16] See Appendix Table A1. Freedman (2012) also presents a battery of additional tests. F-statistics for the excluded instrument range from 10.9 to 11.5, indicating that the instruments are reasonably strong.

In Table 3, we attach numbers (and standard errors) to the discontinuities (or lack thereof) depicted in Figure 4. The first column in Panel A presents reduced-form estimates of the relationship between LIC status and the change in the number of supermarkets between 2004 and 2009 (equation (3)). The first column in Panel B presents second-stage IV estimates of the effects of NMTC investment (in millions of dollars) on the same outcome, instrumenting NMTC investment with LIC status. The second column reports reduced-form and IV estimates for supermarket employment. The final column presents reduced-form and IV estimates for the number of convenience stores, which are less likely to have been subsidized directly by the NMTC and thus serve as something of a placebo.[17] All regressions include county fixed effects as well as tract-level demographic and housing controls.

The reduced-form and IV results point to a positive impact of the NMTC Program on growth in the grocery industry in affected communities. LIC status is associated with a statistically significant 0.06 additional grocery stores on average; dividing this by the first-stage estimate in the second column of Table 2, we arrive at the IV estimate of the effect of $1 million in NMTC investment on the number of grocery stores (0.07). Based on the amount of NMTC funding in the sample between 2003 and 2009, this would translate into approximately 25 grocery establishments, which is about 0.2% of the total stock of grocery stores in the sample. If we assume that 11% of CDEs' NMTC-subsidized projects include a supermarket (Abravanel et al. 2013), this would imply that about 65% of those supermarkets would have located in a low-income neighborhood even in the absence of any subsidies. The other roughly 35% of the grocery stores may represent new retail food industry activity generated by the NMTC Program, but could also have been merely redirected from higher-income communities into low-income communities.

In line with the results in column (1) of Table 3 suggesting that NMTC-subsidized investment is associated with growth in the number of supermarkets, the results in column (2) point to gains in supermarket employment in affected communities. The IV estimate implies that $1 million in NMTC investment increases employment at supermarkets by about 8 workers. Obviously, NMTC investment occurs through a variety of channels outside retail food, so interpreting the program's relatively small impacts on the number of supermarkets and employment at supermarkets as its sole effects is misguided. The results do, however, point to a meaningful, if modest, effect of the

[17] Employment at convenience stores is not available in the TDLinx data.

program on supermarket industry expansion.

Convenience stores are less likely to offer the affordable and nutritious food options that are perceived to be absent in low-income, low-access areas. They also lack most of the features of supermarkets that make the latter an attractive investment for CDEs that leverage NMTC funds. As the third column of Table 3 shows, NMTC investment has no statistically or economically meaningful effect on the number of convenience stores in low-income communities.

The estimated effects of the NMTC on the retail food industry are robust to alternative specifications and samples. For example, as shown in Table A2 in the Appendix, the estimates change very little with alternative control function specifications (e.g., quadratic or quartic) or when we condition on different sets of baseline neighborhood characteristics. As illustrated in Appendix Figure A1, we also find very similar effect sizes for windows around the threshold as small as ten and as large as 30 percentage points; in fact, the estimated reduced-form effect on supermarket growth is between 0.05 and 0.10 and consistently statistically significant at least at the 10% level for every sample of tracts within that range. In contrast, regardless of the window used, the estimated reduced-form effect on convenience store growth is always very close to zero and never statistically significant.

6.3 The Effects of the NMTC on Food Shopping and Purchasing Patterns

NMTC-subsidized investment could plausibly affect measured food shopping patterns in recipient communities in several ways. First, to the extent that subsidized investment improved the circumstances of existing residents (potentially by providing new job opportunities) or attracted new, relatively affluent residents to affected neighborhoods, it could result in changes in observed shopping frequency and food purchases. Freedman (2012) finds evidence that communities that received NMTC-subsidized investment during the 2000s experienced modest reductions in poverty rates and increases in household income levels, at least some of which he attributes to changes in resident composition in those neighborhoods. If existing households' incomes rose or relatively affluent residents moved into neighborhoods that received NMTC investment more so than into other, similar areas, this would likely have the effect of increasing the quantity of healthier food purchased (Bhattacharya and Currie 2001, Cutler and Lleras-Muney 2010).

Additionally, some NMTC funds were used to subsidize the establishment or expansion of health

care facilities in low-income communities (Abravanel et al. 2013). In a study on CDE investment activity, the NMTC Coalition (2014) reported that between 2003 and 2012, 9.6% of NMTC projects were in the health care industry. To the extent that new health care centers provided any outreach or counseling to residents about diet choices, they would also likely serve to increase the amount of healthy food purchased.

Given the previous results, a final plausible channel by which NMTC investment could affect food purchasing patterns would be through its effects on food access.[18] We test this first by examining whether there are changes in the frequency of shopping trips to or dollars spent at supermarkets and convenience stores among households in eligible communities. Next, we explore if and how NMTC investment affected the composition of food purchases, and specifically whether it shifted household expenditures toward healthier foods.

We use household-level survey and scanner data from IRI to carry out these tests. Unfortunately, sample sizes in the IRI are substantially smaller prior to 2008, so we cannot compare changes in outcomes within tracts or within households before and after NMTC-subsidized investment using these data. We instead focus on differences in levels in post-treatment outcomes between households located in tracts immediately on either side of the 80% MFI threshold (i.e., within the same 20 percentage point window used in the previous regressions). To the extent that households living in neighborhoods within a narrow window around the cutoff are not systematically different, using levels as opposed to changes should not introduce bias. However, the estimates will reflect variation in shopping and purchasing patterns driven by changes in the composition of residents in the wake of LIC designation as well as changes in the behavior of existing residents. To partially address the question of how compositional changes might be affecting the results, we present estimates based on outcomes measured at the household level, where we can additionally control for individual household characteristics.

In the results presented here, we use outcomes measured in 2012. This has the benefit of allowing for some lag (albeit a modest one) in the impact of NMTC-subsidized on food shopping and purchasing behavior. It also maximizes the number of survey respondents with usable data,

[18] Another possible channel by which the NMTC could affect food shopping and purchasing in affected communities is through its effects on restaurant entry. However, given their higher failure rate, restaurants represent less attractive investments for CDEs. Between 2003 and 2012, only 0.8% of all NMTC projects were restaurants (NMTC Coalition 2014).

although we still are obliged to limit the sample to 30,306 households who live in tracts with MFI ratios within 20 percentage points of the 80% cutoff and for whom we have sufficient information to measure food shopping behavior.[19] The household characteristics available in the IRI data are also only reliable beginning in 2012, as IRI overwrote values from previous years as more recent survey information became available. For the IRI outcomes, we show only reduced-form results of the effects of LIC designation on outcomes; scaling these results up by a factor of about 1.2 yields the IV estimates of the effect of $1 million in NMTC investment on each outcome.[20]

In Panel A of Table 4, we show reduced-form results for the number of supermarket trips per month (first two columns) and convenience store trips per month (last two columns) using our RD sample. The first and third columns show estimates controlling for the cubic control function, county fixed effects, and baseline (year 2000) tract demographic and housing characteristics; the second and fourth columns present estimates in which we additionally control for household-specific characteristics (specifically, household size, household income, race, ethnicity, number and ages of children in the household, educational attainment levels, employment and occupation dummies, marital status, and whether the household rents or owns their home). The controls for household characteristics help to address any differences in the composition of households across areas, including those driven by NMTC-induced changes in neighborhood amenities.

As is evident in Panel A of Table 4, there is little evidence that LIC status is associated with any change in the average frequency with which people living in the tract visit a supermarket. Conditioning on baseline tract-level characteristics, we find that LIC status is associated with 0.007 fewer monthly supermarket trips on average. Adding household-specific characteristics to the regression attenuates the effect to 0.002 fewer supermarket trips per month per household. Both point estimates are within one-twentieth of one percent of the typical 4.2 supermarket visits per month among households in our sample. In contrast, the results in columns (3) and (4) of Panel A in Table

[19] There are 12,443 tracts represented in this sample. In Appendix Table A3, we show the reduced-form estimates of the effect of LIC designation on supermarket and convenience store growth for this restricted sample. The results are very similar to the main results presented in the previous subsection; LIC status is associated with a statistically significant 0.085 additional grocery stores and 7.5 additional grocery store workers on average in the restricted sample (compared to 0.058 and 7.0 for the full sample). Using levels as opposed changes in supermarkets and convenience stores also yields qualitatively similar results.

[20] We do not weight the regressions using IRI's projection weights, which are not designed to ensure representativeness for the particular geography on which we focus. However, for most outcomes, the results are not qualitatively different when we weight the regressions. Additionally, following our practice in previous sections, we cluster standard errors at the county level in the regressions presented in this section; the standard errors are similar, but typically smaller when we cluster at different geographic levels (such as tract).

4 suggest that households in tracts eligible for NMTC-subsidized investment make about 0.18 fewer visits per month to convenience stores, a statistically significant change that corresponds to a 46% reduction in the frequency of convenience store visits. This change is similar regardless of whether we control for household characteristics.

The results in Panel A of Table 4 hint that households in areas that receive new supermarkets, while not increasing the frequency of supermarket shopping trips, may be shifting some of their purchases from convenience stores to supermarkets. The results in Panel B of Table 4 provide one indication that this could in fact be occurring. Relative to households in barely ineligible neighborhoods, households in NMTC-eligible neighborhoods spend on average $4 more at supermarkets per month on average. Meanwhile, households spend $3 less at convenience stores per month on average. While neither estimate is statistically significant at conventional levels, the observed pattern of spending is consistent with some shifting of purchases away from convenience stores and toward supermarkets.

To the extent that households in affected neighborhoods are reallocating purchases toward supermarkets, we might expect it to show up in food expenditure patterns, and specifically the relative amount of nutritious food purchased. In Panel C of Table 4, we show reduced-form results for the healthfulness of food expenditures by households. We follow Volpe et al. (2012) to construct scores that capture the extent to which a household's expenditures on food deviate from the recommendations of the USDA's Center for Nutrition Policy and Promotion (CNPP). The CNPP determines food plans for households that help to ensure they meet the USDA's Dietary Guidelines for Americans. These recommendations vary with household composition (specifically, the presence and age of adult males and females in the household, as well as the presence and age of children in the household), which we adjust for using information in the IRI data. Based on these household recommendations and the observed expenditures by households on 23 food categories, we assign each household in the data a score that reflects the degree to which that household adhered to the USDA recommendations. The score is calculated as

$$BasketScore_{jh} = (\sum_{c}(ExpShare_{jhc} - RecExpShare_{hc})^2)^{-1} \quad (4)$$

where the subscript j denotes the household, h the household type (the basis for the USDA's

recommended food expenditure shares), and c the food category, and where *ExpShare* is the observed expenditure share of the household and *RecExpShare* is the share recommended under the USDA guidelines for a household of that type. This measure penalizes households for expenditures above or below the recommended amount in any particular category. We also assume in calculating this measure that households report all purchases, and therefore assign an expenditure share of zero in cases where we do not observe any purchases of food in a particular category. However, we also show results using a measure in which we do not include categories for which no purchases were made in a given month.[21]

The mean Basket Score in 2012 among households in the 20 percentage point window around the 0.8 cutoff that largely determines eligibility for NMTC-subsidized investment was 5.9. As shown in the first two columns of Panel C of Table 4, there is no discernable difference in this score among households in neighborhoods just above the cutoff relative to those just below the cutoff; including both neighborhood and household controls, households in a NMTC-eligible neighborhood had scores 0.026 higher than those in ineligible neighborhoods, a difference that is both economically small and statistically insignificant. Even the upper bound of the 95% confidence interval around the point estimate (a 0.19 higher score in NMTC-eligible communities) would only represent a small (9% of a standard deviation) difference in the Basket Score. As shown in columns (3) and (4) of Panel C, the results are qualitatively similar when we drop categories with zero expenditures (in which case the mean basket score is 7.8).[22]

Overall, our findings suggest that, to the extent that the NMTC Program is inducing supermarket entry in low-income communities, the resulting increase in food access is not having large effects on healthy food purchasing patterns. This may in part be because the NMTC is only prompting minor locational shifts for many grocery stores that take up the subsidy, leading to large changes in the menu of food buying options for only a small segment of the population. However, the fact that place-based programs like the NMTC will generally be associated with some degree of crowd-out and potentially only small changes in business siting merely highlights another reason supply-side

[21] We find similar results to those shown using a measure that does not penalize households for too little of an unhealthy purchase and too much of a healthy purchase. We also explored simpler, but less concise and arguably more arbitrary measures such as the absolute amount and share of expenditures on fresh fruit and vegetables, or on salty snacks and desserts. The estimated impacts on these measures were similarly small and statistically insignificant.

[22] These results are consistent with other qualitative evidence indicating that residents of areas with limited access to healthy food purchase most of their unhealthy food not at convenience stores, but at supermarkets (Vaughn et al. 2016).

subsidies of this type are unlikely to be the most effective policy lever by which to address major nutritional disparities. Importantly, though, the results above only capture changes in food purchasing behavior within affected communities in the short-run, and the impacts of improved access to healthy food on buying patterns may take longer than a few years to materialize. However, to the extent that NMTC-subsidized investment in communities might be expected to improve observed healthy food purchasing patterns through a number of channels, the lack of any estimated reduced-form effect implies that such place-based interventions may not be sufficient to dramatically alter diet-related health behaviors.

7 Conclusions

In an effort to improve diet and health outcomes, policymakers have increasingly turned to supply-side subsidies aimed at encouraging investment by supermarkets and other food retailers in traditionally underserved areas. This paper examines whether the U.S. federal government's NMTC Program has affected the entry of retail food establishments in low-income communities and whether there have been subsequent changes in food shopping and purchasing patterns among households in those neighborhoods. In order to identify the impacts of the program, we take advantage of a discontinuity in NMTC funding generated by the formula used to determine the eligibility of census tracts for subsidized investment under the program.

Our results suggest that the NMTC Program has had modest, but positive impacts on supermarket entry in low-income communities. This is not to suggest that the NMTC necessarily increased the number of supermarkets on aggregate, as many of the supermarkets that located in traditionally underserved communities with the help of preferable financing terms made possible by the NMTC might have otherwise located elsewhere. Nonetheless, the results suggest that supply-side subsidies can be a useful tool to at least redirect investment into certain targeted communities.

Whether this is desirable from a policy perspective depends on the extent to which subsidized investments have greater social returns in low-income neighborhoods as compared to the other neighborhoods in which they might have otherwise located. The potential positive health consequences of new grocery stores in low-income, low-access areas are one channel by which such social returns could be realized. However, our results suggest that supermarkets, along with any other amenities

or changes in neighborhood composition that come with NMTC-subsidized investment, do not have measurable effects on households' food buying patterns, at least in the short run. While changes in purchasing habits in favor of healthier foods may take longer to materialize than our limited time horizon allows, the results imply that improving access alone is unlikely to be sufficient to bring about any significant narrowing of nutritional disparities across communities.

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Table 1. Descriptive Statistics for Tracts Near the 0.8 MFI Threshold

	MFI Ratio Bin	
	[0.7, 0.8]	(0.8, 0.9]
	A. Demographic & Housing Characteristics (2000)	
Ln Population	8.23	8.27
Share Black	0.13	0.09
Share Hispanic	0.13	0.09
Share Age 18 or Under	0.07	0.06
Share Over age 65	0.14	0.14
Share in School	0.27	0.26
Share with HS Degree	0.34	0.34
Share Some College	0.26	0.28
Share with College Degree	0.15	0.17
Average Household Size	2.58	2.55
Ln Housing Units	7.40	7.43
Share Vacant	0.11	0.10
Share Occupied	0.89	0.90
Share Owner Occupied	0.57	0.62
Share with a Mortgage	0.62	0.64
Median House Age	36.70	34.91
Median No. of Rooms	5.05	5.27
	B. Retail Food Establishments (2004)	
Supermarkets	0.80	0.75
Convenience Stores	2.60	2.51
Census Tracts	8095	9176

Notes: Data from Decennial Census (Panel A) and TDLinx (Panel B).

Table 2. First-Stage Estimates

	(1)	(2)
	NMTC Investment ($ Mil.)	
LIC Status	0.957***	0.859***
	(0.282)	(0.260)
Cubic Control Function	✓	✓
County Fixed Effects	✓	✓
Tract Demographic & Housing Controls		✓
Kleibergen-Paap rk Wald F Statistic	11.543	10.896
Observations	17,271	

Notes: Standard errors (in parentheses) are adjusted for heteroskedasticity and clusters at the county level. Significant at the *10% level, **5% level, and ***1% level.

Table 3. Reduced-Form and IV Estimates for Retail Food Establishments

	(1)	(2)	(3)
	Supermarkets		Convenience Stores
	Establishments	Employment	Establishments
	A. Reduced Form		
LIC Status	0.058**	6.953**	-0.023
	(0.026)	(2.853)	(0.047)
	B. Second Stage		
NMTC Investment ($ Mil.)	0.068*	8.090*	-0.027
	(0.035)	(4.176)	(0.055)
Cubic Control Function	✓	✓	✓
County Fixed Effects	✓	✓	✓
Tract Demographic & Housing Controls	✓	✓	✓
Observations	17,271		

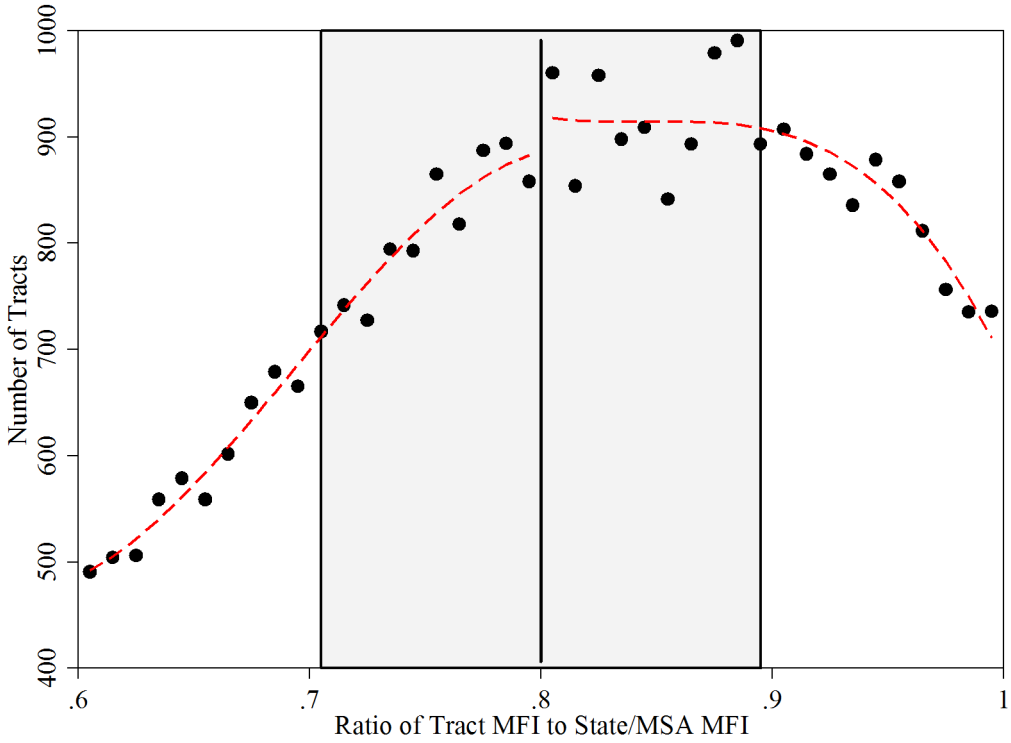
Notes: Standard errors (in parentheses) are adjusted for heteroskedasticity and clusters at the county level. Significant at the *10% level, **5% level, and ***1% level.

Table 4. Reduced-Form Estimates for Food Shopping and Purchasing Patterns

	(1)	(2)	(3)	(4)
	A. Trips per Month			
	Supermarkets		Convenience Stores	
LIC Status	-0.007	-0.002	-0.180*	-0.184*
	(0.172)	(0.170)	(0.105)	(0.105)
	B. Dollars Spent per Month			
	Supermarkets		Convenience Stores	
LIC Status	4.141	4.396	-2.623	-2.626
	(7.556)	(7.258)	(1.881)	(1.863)
	C. Food Purchases			
	Basket Score		Basket Score, Excl. Zero Purchase Categories	
LIC Status	0.018	0.026	0.081	0.075
	(0.088)	(0.084)	(0.125)	(0.121)
Cubic Control Function	✓	✓	✓	✓
County Fixed Effects	✓	✓	✓	✓
Tract Demographic & Housing Controls	✓	✓	✓	✓
Household Characteristics		✓		✓
Observations	30,306			

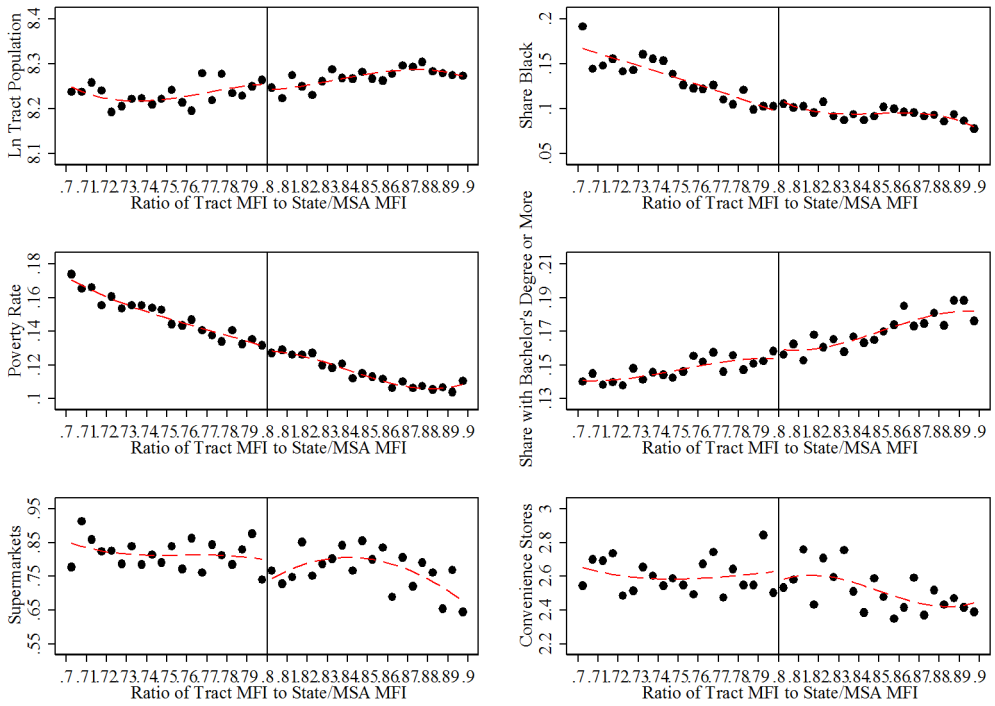
Notes: Standard errors (in parentheses) are adjusted for heteroskedasticity and clusters at the county level. Significant at the *10% level, **5% level, and ***1% level.

Figure 1. Density of Tracts around the 80% MFI Ratio Cutoff



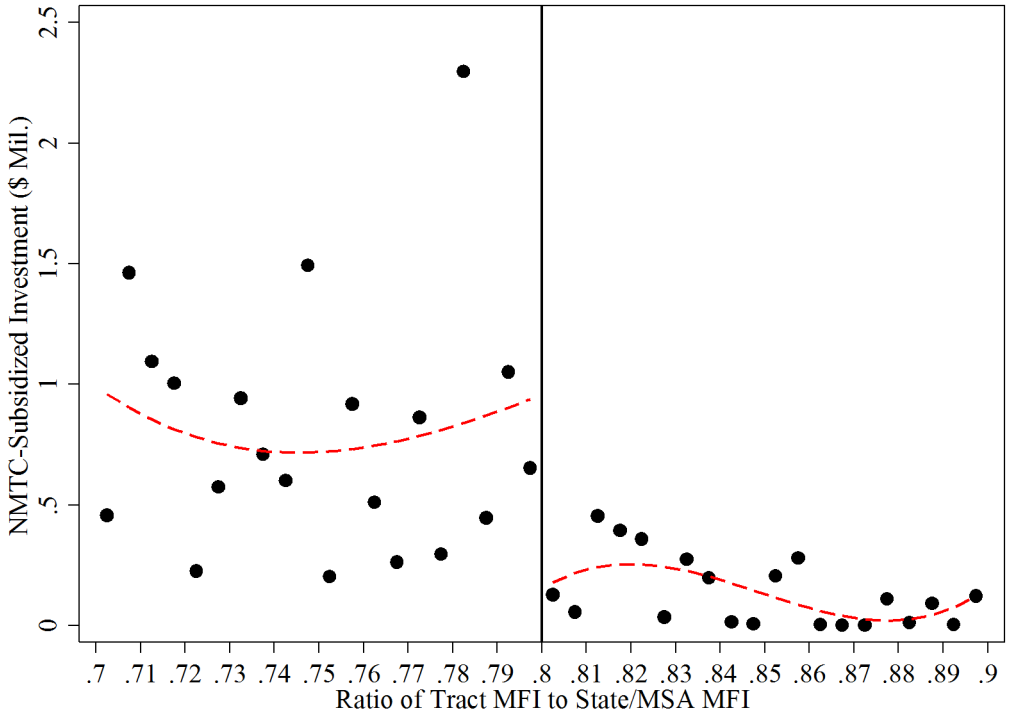
Notes: Dashed lines are cubic fits through the points, separately estimated on either side of the 0.8 MFI ratio cutoff.

Figure 2. Selected Baseline Tract Characteristics at the LIC MFI Ratio Eligibility Threshold, Decennial Census and TDLinx Data



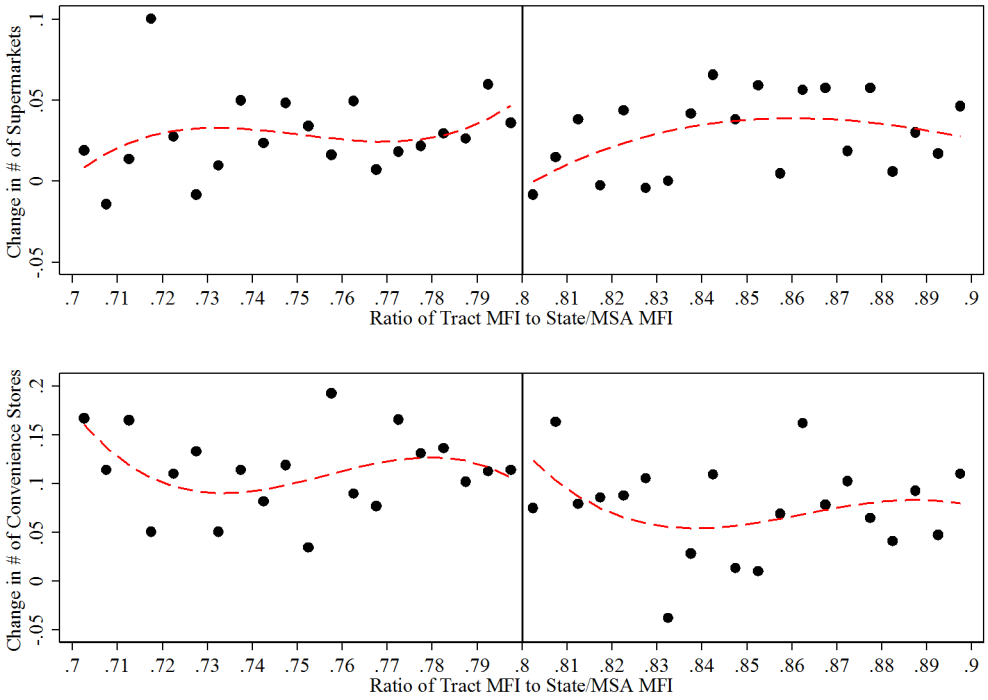
Notes: Dashed lines are cubic fits through the points, separately estimated on either side of the 0.8 MFI ratio cutoff.

Figure 3. NMTC Investment (Mil. $) at the LIC MFI Ratio Eligibility Threshold



Notes: Dashed lines are cubic fits through the points, separately estimated on either side of the 0.8 MFI ratio cutoff.

Figure 4. Supermarket and Convenience Store Growth at the LIC MFI Ratio Eligibility Threshold



Notes: Dashed lines are cubic fits through the points, separately estimated on either side of the 0.8 MFI ratio cutoff.

Appendix Tables and Figures

Table A1. First-Stage Estimates, Alternative Specifications

	(1)	(2)	(3)
	A. Quadratic Control Function		
LIC Status	0.793***	0.886***	0.797***
	(0.229)	(0.259)	(0.262)
	B. Cubic Control Function		
LIC Status	0.868***	0.957***	0.859***
	(0.282)	(0.282)	(0.260)
	C. Quartic Control Function		
LIC Status	0.888***	1.110***	0.979***
	(0.299)	(0.330)	(0.299)
Cubic Control Function	✓	✓	✓
County Fixed Effects		✓	✓
Tract Demographic & Housing Controls			✓
Observations		17,271	

Notes: Standard errors (in parentheses) are adjusted for heteroskedasticity and clusters at the county level. Significant at the *10% level, **5% level, and ***1% level.

Table A2. Reduced-Form and IV Estimates for Retail Food Industry Growth, Alternative Specifications

	(1)	(2)	(3)	(4)
	Supermarkets		Convenience Stores	
	A. Quadratic Control Function			
	A.1 Reduced-Form Estimates			
LIC Status	0.040*	0.041*	0.005	0.010
	(0.021)	(0.021)	(0.036)	(0.036)
	A.2 Second-Stage Estimates			
NMTC Investment ($ Mil.)	0.045*	0.051*	0.006	0.013
	(0.026)	(0.031)	(0.040)	(0.045)
	B. Cubic Control Function			
	B.1 Reduced-Form Estimates			
LIC Status	0.057**	0.058**	-0.028	-0.023
	(0.026)	(0.026)	(0.047)	(0.047)
	B.2 Second-Stage Estimates			
NMTC Investment ($ Mil.)	0.059*	0.068*	-0.029	-0.027
	(0.030)	(0.035)	(0.049)	(0.054)
	C. Quartic Control Function			
	C.1 Reduced-Form Estimates			
LIC Status	0.035	0.037	-0.029	-0.024
	(0.033)	(0.033)	(0.057)	(0.057)
	C.2 Second-Stage Estimates			
NMTC Investment ($ Mil.)	0.032	0.037	-0.026	-0.024
	(0.030)	(0.035)	(0.052)	(0.059)
Cubic Control Function	✓	✓	✓	✓
County Fixed Effects	✓	✓	✓	✓
Tract Demographic & Housing Controls		✓		✓
Observations	17,271			

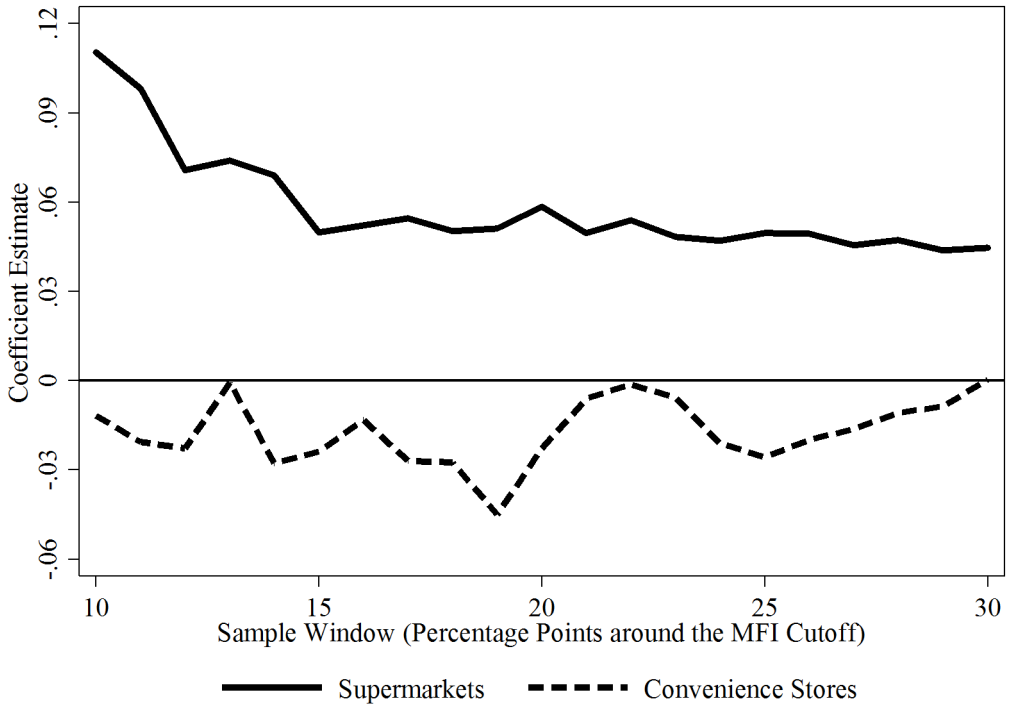
Notes: Standard errors (in parentheses) are adjusted for heteroskedasticity and clusters at the county level. Significant at the *10% level, **5% level, and ***1% level.

Table A3. Reduced-Form and IV Estimates for Retail Food Industry Growth, IRI Sample

	(1)	(2)	(3)
	Supermarkets		Convenience Stores
	Establishments	Employment	Establishments
	A. Reduced Form		
LIC Status	0.085***	7.521**	0.018
	(0.033)	(3.668)	(0.055)
	B. Second Stage		
NMTC Investment ($ Mil.)	0.150*	13.265	0.031
	(0.088)	(8.943)	(0.097)
Cubic Control Function	✓	✓	✓
County Fixed Effects	✓	✓	✓
Tract Demographic & Housing Controls	✓	✓	✓
Observations		12,443	

Notes: Standard errors (in parentheses) are adjusted for heteroskedasticity and clusters at the county level. Significant at the *10% level, **5% level, and ***1% level.

Figure A1. Reduced-Form Estimates for Retail Food Industry Growth, Alternative Windows



Notes: Reduced-form coefficient estimates on LIC status from regressions on samples based on varying windows around the cutoff in one percentage point increments from a ten percentage point window to a 30 percentage point window (i.e., samples of tracts in MFI ratio ranges of [0.75, 0.85], [0.745, 0.855], ..., [0.65, 0.95]). Each regression includes a cubic control function, county fixed effects, and the tract demographic and housing controls listed in Panel A of Table 1.