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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 low-income areas. This article examines whether the US 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 programme, 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 programme. 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 neighbourhoods, at least in the short run.

Keywords
consumption, economic development, health, place-based policies, retail food

摘要
为了改善饮食和健康结果，政策制定者越来越倾向于为供给侧提供补贴，以鼓励超市和其他食品零售商在低收入地区进行投资。本文考察了美国联邦政府的新市场税收抵免（NMTC）计划是否影响了零售食品企业的进入，以及低收入社区的食品购买和采购模式。为了确定该计划的影响，我们利用了 NMTC 补助资金因用于确定人口普查区投资资格的方案而产生的不连续性数据。我们发现 NMTC 计划对超市入驻低收入社区有一定程度的正面影响。根据家庭层面的调查数据，至少在短期内，NMTC 计划对所涉居民家庭的食品购买模式没有可察觉的影响。

关键词
消费、经济发展、卫生、地方政策、零售食品

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Introduction

In an effort to improve access to nutritious and affordable food, policymakers around the world have increasingly turned to supply-side subsidies aimed at encouraging investment by supermarkets and other food retailers in low-income areas. For example, several cities and states in the US 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 neighbourhoods.

Evaluating the effects of these initiatives is difficult for two reasons. First, programmes that aim to subsidise the entry of healthy food retailers tend to be 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 whether observed changes in areas that receive subsidised investment are attributable to the investment itself or to other, possibly unobserved neighbourhood characteristics.

Large-scale place-based policies that subsidise commercial investment provide an opportunity to study the impacts of potentially many shop openings over a broad geographic area. To the extent that they induce the entry of supermarkets and other food retailers in low-income neighbourhoods that would not have otherwise occurred, they can also make firm entry exogenous 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 across communities.

This article explores the potential for supply-side subsidies to improve food access and change food purchasing patterns by examining the effects of the US federal government's New Markets Tax Credit (NMTC) Program, which offers tax incentives to encourage private investment in low-income neighbourhoods across the country. To identify the effects of the programme, we exploit a discontinuity in NMTC funding generated by the formula used to determine the eligibility of census tracts for investment under the programme. The discontinuity creates quasi-experimental variation in subsidised investment around a certain income threshold; tracts with median incomes below the threshold are eligible to receive NMTC-subsidised investment, while tracts with median incomes above generally are not eligible.

We first examine the NMTC's impacts on the entry of retail food establishments in low-income areas during the 2000s. Combining information on NMTC-subsidised investments from the US Treasury with comprehensive data on retail food establishments from AC Nielsen's TDLinx, we compare outcomes among tracts within a narrow window around the income threshold determining eligibility under the programme. While it limits the generalisability of the results beyond the subset of tracts close to the threshold, this approach allows for causal inferences regarding the impacts of the NMTC on retail food investment. We find that the programme 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 the NMTC's impacts on food shopping and purchasing patterns among households in low-income neighbourhoods. We find that while the arrival of new supermarkets may have led some households to redirect purchases, it had no discernable effects on the healthfulness of consumers' food purchases, at least over the short time horizon that we consider.

Background

There exist large disparities in nutrition and diet-related health outcomes across

different socioeconomic groups in the US. To address these disparities, policymakers have advanced legislation that seeks to increase access to healthier foods in poor communities (CDC, 2011). It is not clear, however, that increasing access to healthy food in lower income areas will reduce nutritional and health disparities (Bitler and Haider, 2011). Differences in consumption patterns could be driven as much, if not more, by differences in preferences and/or price sensitivities. Indeed, in a comprehensive study of food purchases made between and within shops by higher and lower income households, Handbury et al. (2017) find that differences in access play only a minor role in explaining observed differences in food expenditure patterns.

While some recent case studies on the food consumption and health effects of single shop openings in low-income areas corroborate these findings (Cummins et al., 2014; Elbel et al., 2015), others document positive effects of improved access on healthy food expenditures among households in distressed communities (Weatherspoon et al., 2013; Wrigley et al., 2003). In such case studies, however, one might be concerned about both the generalisability of the results as well as the non-random selection of neighbourhoods by supermarkets. Our study takes a different approach from past research not only by using data on retail food shop openings across the US, but also by taking advantage of quasi-experimental variation in the location of this investment generated by particular features of the NMTC Program.

The New Markets Tax Credit Program

The NMTC Program was established under the Community Renewal Tax Relief Act of 2000 and is overseen by the US Department of Treasury. The programme is intended to promote greater investment in operating businesses and real estate projects located in low-income neighbourhoods. It does so by providing investors with 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).

Tax credit allocations to CDEs, which totalled US$26 billion between 2003 and 2009, are awarded competitively by the Treasury's Community Development Financial Instiutions (CDFI) Fund. After being awarded an allocation, a CDE has five years to use the proceeds to make qualified low-income community investments (QLICIs) of equity or debt capital. Historically, the 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 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. In the early years of the programme, the median size of NMTC projects was US$3.7 million, and programme funds covered over one-third of project costs on average (Abravanel et al., 2013; US GAO, 2010).

CDEs must invest 'substantially all' of the equity they receive in certain areas called 'low-income communities' (LICs). During the 2000s, neighbourhoods 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. Any tract with a poverty rate of at least 20% also qualifies. A small number of 'low-population' and 'rural, high out-migration' tracts also qualify.

During the 2000s, 39% of the 65,443 tracts in the US qualified as LICs. Nearly all LICs (98%) qualified either on the MFI

ratio criterion or on the poverty rate criterion. Of those that qualified on one of these two criteria, 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-subsidised investment, variation that we can use to identify the causal effects of that investment on local retail food markets.

Prior work on the NMTC has found mixed impacts on communities. Freedman (2012, 2015) examines the effects of NMTC investment on aggregate employment and housing conditions within targeted neighbourhoods and finds modest positive impacts. Harger and Ross (2016) study whether the NMTC affected the entry and expansion of establishments across different broad industries and find that it had a disproportionate effect on manufacturing and retail. However, Harger and Ross do not examine its impacts on retail food specifically, and nor do they consider other community-level impacts of the subsidised investment beyond its effects on establishment entry and employment growth.

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 is an eligible use 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.[1] First, grocers are unlikely to violate programme rules on excessive working capital. Second, most business activities that are not eligible for NMTC financing (e.g. gambling, tanning salons and alcohol) 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 frequently, which means that the seven-year NMTC period is less problematic than for businesses in other sectors (Reinvestment Fund, 2011).

Anecdotal evidence from CDEs suggests that the NMTC has helped to overcome certain barriers to retail food investment in low-income neighbourhoods, which include poor infrastructure, zoning issues, traffic patterns, parking and a lack of large parcels of land (Food Marketing Institute, 1998; Ver Ploeg et al., 2009). In 2010, the Obama administration's Healthy Food Financing Initiative lauded the NMTC's 'proven track record in expanding access to nutritious foods by catalyzing private sector investment' (US Department of Treasury, 2010).

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. The basic regression of interest is:

$$\Delta y_i = \beta_0 + \beta_1 NMTC_i + \mathbf{X}_i\mathbf{\Omega} + \varepsilon_i \qquad (1)$$

where Δy_i is the change in outcome y for tract i, $NMTC_i$ is the amount of NMTC-subsidised 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 changes in outcomes of interest. However, using OLS to estimate this regression is likely to yield a biased estimate of β_1, as unobserved features of neighbourhoods 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 NMTC Program eligibility. 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-subsidised 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-subsidised investment.

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

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

and the reduced-form regression is:

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

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 flexible polynomial in the running variable relative to the 80% cutoff.

Importantly, the RD estimates are local average treatment effects and may not generalise to neighbourhoods beyond the subset of moderately poor tracts we consider in our analysis. The average median household income in 2000 among tracts with MFI ratios between 0.7 and 0.9 (which represent our main sample) is just over US$36,000. While the impacts of subsidised investment, and in particular subsidised retail food investment, in poorer communities is also of policy interest, the structure of the NMTC Program does not allow for causal identification of such impacts. Notably, though, the initial retail food environment was not dissimilar in neighbourhoods more distressed than those we consider in our analysis. Based on data from the early to mid-2000s, 30% of tracts with MFI ratios between 0.7 and 0.8 were designated by the USDA as 'low-income, low-access areas'. This is in fact slightly greater than the fraction of tracts with MFI ratios below 0.7 that were classified as low-income, low-access areas (24%). Similarly, the TDLinx data indicate that in 2004, the average number of supermarkets in tracts with MFI ratios between 0.7 and 0.9 and in tracts with MFI ratios between 0 and 0.7 were very similar at 0.79 and 0.81, respectively. This is consistent with the findings of Taylor and Villas-Boas (2016), who detect little difference in the proximity of poor vs less poor households to supermarkets.

Data

Data sources

The data used in this study are derived from several sources. First, NMTC investment data come from the CDFI Fund at the US Treasury. These data include the amount of the investment and some general information about the nature of the investment. They also include the exact location of the investment, which allowed us to assign each to a census tract. Our measure of NMTC investment, $NMTC_i$, is total amount of NMTC-subsidised investment (in millions of dollars) in each tract between 2003 (the start of the programme) and 2009.[2]

Baseline neighbourhood characteristics, $\mathbf{X}_i$, come from the 2000 Decennial Census. We include a host of census tract-level demographic variables (population, racial and ethnic composition, age distribution, educational attainment, foreign born status, public assistance receipt, public transit use and household size) as well as housing variables (number of units, share occupied, share owner-occupied, share with a mortgage, median age of units and median number of rooms). Variables determining LIC status (including the MFI ratio m_i) during the 2000s are also derived from 2000 Decennial

Census data. LIC designations remained constant throughout our sample period.

Data on retail food establishments come from AC Nielsen's TDLinx. These annual data capture the universe of grocery shops, wholesale clubs and convenience shops starting in 2004.[3] The data include the exact location of each shop, which we map to census tracts. Using proprietary methods, Nielsen also estimates the number of employees at shops. We follow Hosken et al. (2016) and define 'supermarkets' as grocery shops as well as wholesale club shops. In our analysis of retail food entry and expansion, Δy_i is measured as the change in the number of retail food establishments or employment between 2004 and 2009.

For information on food shopping and purchasing patterns, we use IRI's Consumer Network Database, which is derived from the National Consumer Panel (NCP). Households are recruited into the NCP and offered incentives to record all shopping trips and purchases, which they do with a handheld scanning device. The data also contain household characteristics, including census tract of residence. Certain demographic groups, and in particular younger respondents, respondents with children and very low-income respondents, are less likely to report purchases consistently, but this is less of a problem when constructing our point-in-time measures (described in more detail below) than when trying to follow individual households over time (Muth et al., 2016). The IRI data's scope and detail allow us to richly characterise food shopping and purchasing behaviour across neighbourhoods.

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. In Table 1, we present descriptive statistics for tracts in the two 10 percentage point windows immediately on either side of the 80% MFI ratio cutoff. As Panel A suggests, tracts right below the cutoff are similar to tracts right above in terms of population, racial and ethnic composition, age distribution, foreign born status, educational attainment levels, welfare and transit use and housing characteristics. As Panel B shows, the numbers of grocery shops and convenience shops in 2004 are also similar in tracts immediately on either side of the cutoff, as are the numbers of shops in tracts that neighbour those in our main sample (which we consider in a supplemental analysis on possible spillovers).

Figure 1 shows for several selected baseline (year 2000) census characteristics as well as baseline (year 2004) food retailing characteristics average values within each half percentage point bin of the running variable for the main sample of tracts (note that employment at convenience shops is not available in TDLinx). The dashed lines in each panel 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 that there were no pre-treatment differences among tracts immediately on either side of the threshold that might invalidate the RD design.[4]

Results

First-stage estimates

First, we establish that LIC status affected the amount of NMTC-subsidised investment in those communities. Graphical evidence that the MFI ratio threshold for LIC qualification generates a discontinuity in NMTC activity appears in the first panel of Figure 2, which shows average cumulative NMTC-subsidised investment (in millions of dollars) between 2003 and 2009 in half percentage point bins of the running variable in a 20 percentage point window around the cutoff. In contrast to the

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 (0.48)	8.27 (0.48)
Share Black	0.13 (0.21)	0.09 (0.17)
Share Hispanic	0.13 (0.19)	0.09 (0.15)
Share Age 18 or Under	0.07 (0.02)	0.06 (0.02)
Share Over Age 65	0.14 (0.07)	0.14 (0.07)
Share Foreign Born	0.10 (0.14)	0.08 (0.12)
Share in School	0.27 (0.07)	0.26 (0.06)
Share with HS Degree	0.34 (0.09)	0.34 (0.08)
Share Some College	0.26 (0.07)	0.28 (0.07)
Share with College Degree	0.15 (0.09)	0.17 (0.09)
Share Public Assistance	0.10 (0.05)	0.08 (0.04)
Share Public Transit to Work	0.04 (0.10)	0.03 (0.09)
Average Household Size	2.58 (0.46)	2.55 (0.39)
Ln Housing Units	7.40 (0.48)	7.43 (0.47)
Share Occupied	0.89 (0.10)	0.90 (0.09)
Share Owner Occupied	0.57 (0.16)	0.62 (0.16)
Share with a Mortgage	0.62 (0.15)	0.64 (0.14)
Median House Age	36.70 (13.95)	34.91 (13.63)
Median No. of Rooms	5.05 (0.65)	5.27 (0.63)
	B. Retail Food Establishments (2004)	
Supermarkets	0.82 (0.97)	0.77 (0.94)
In Neighbouring Tracts†	4.36 (2.76)	4.36 (2.75)
Supermarket Employment	13.12 (50.65)	12.90 (50.56)
In Neighbouring Tracts†	70.48 (118.90)	76.88 (130.59)
Convenience Stores	2.60 (2.24)	2.51 (2.17)
In Neighbouring Tracts†	14.59 (9.46)	14.76 (9.75)
Census Tracts	8095	9176

Notes: Data from Decennial Census (Panel A) and TDLinx (Panel B). Standard deviations in parentheses. †Ten tracts have no neighbours.

baseline characteristics, there is a sharp drop in NMTC investment at the 0.8 MFI ratio threshold.

The regression counterparts to the figure (based on estimating equation (2)) appear in Panel A of Table 2. In each of the regressions, we use a cubic control function, which generally minimises the AIC and BIC in these and subsequent reduced-form regressions, and include county fixed effects. In the even-numbered columns, we also control for the baseline demographic and housing variables listed in Panel A of Table 1. The standard errors are clustered at the county level. F-statistics for the excluded instrument range from 10.3 to 11.5, indicating that the instrument is reasonably strong.

The first-stage results suggest that LICs received on average about US$900,000 more in NMTC investment between 2003 and 2009 compared to tracts just above the threshold. This highly statistically significant effect is

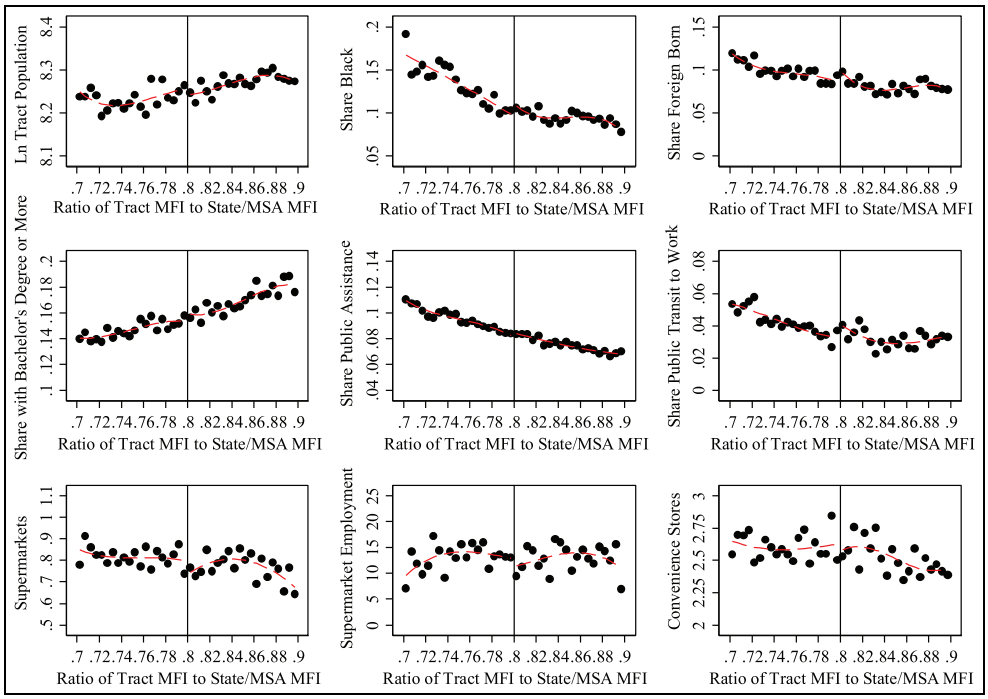

Figure 1. Selected baseline tract characteristics at the LIC MFI ratio eligibility threshold.
Source: Decennial Census and TDLinx.

similar with and without tract-level demographic and housing controls, as expected if the likelihood of falling on either side of the cutoff is almost as good as random. The results are similar excluding county fixed effects and with alternative control functions (e.g. quadratic or quartic).

The effects of the NMTC on entry and expansion in the retail food industry

To the extent that a portion of NMTC investment was going to the retail food industry, the programme also generates quasi-experimental variation in food access in low-income neighbourhoods. In the remaining panels of Figure 2 and Table 2, we present results examining the effects of the NMTC on retail food establishment entry and expansion. The final three panels of Figure 2 illustrate the effects of LIC designation based on the MFI ratio on changes in the number of supermarkets, supermarket employment and the number of convenience shops 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 figure points to greater growth in the number of supermarkets and supermarket employment 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 shops at the MFI ratio cutoff.

In Panels B and C of Table 2, we attach numbers (and standard errors) to these discontinuities (or lack thereof). We show results for each outcome without and with controls for baseline tract characteristics. All

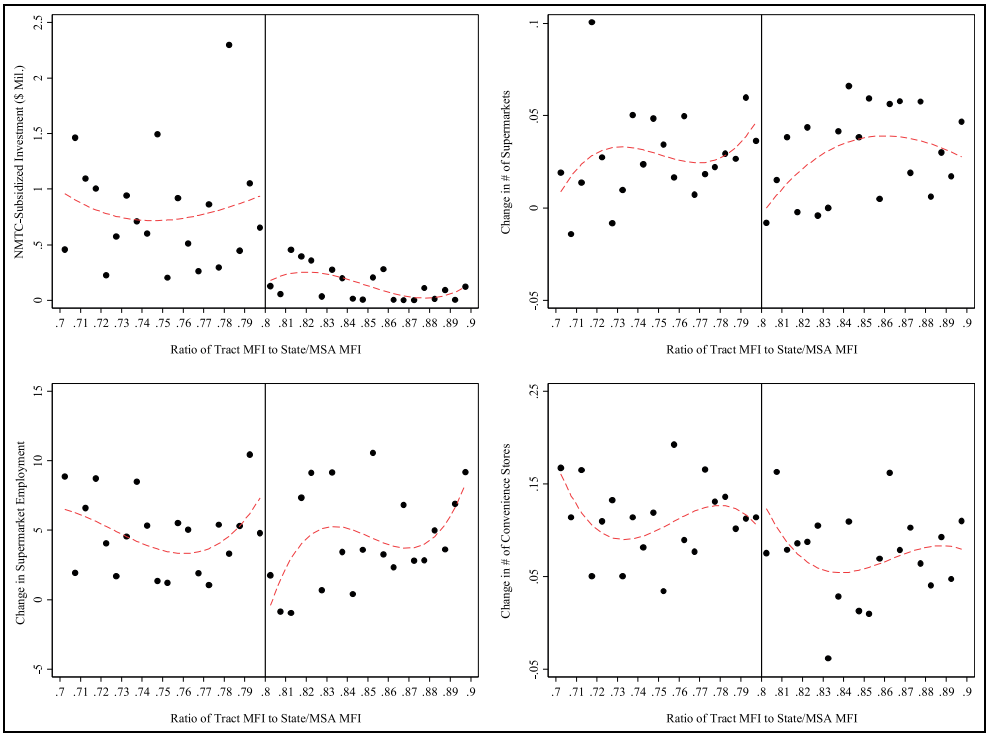

Figure 2. NMTC investment and retail food industry growth at the LIC MFI ratio eligibility threshold.
Source: Decennial Census, CDFI Fund and TDLinx.

regressions include county fixed effects. The first two columns in Panel B present reduced-form estimates of the relationship between LIC status and the change in the number of supermarkets between 2004 and 2009 (equation (3), where Δy_i is defined as the difference between 2009 and 2004 in the number of supermarkets in tract i). The first two columns in Panel C present IV estimates of the effects of NMTC investment (in millions of dollars) between 2003 and 2009 on the same outcome, instrumenting NMTC investment with LIC status. Columns (3) and (4) report reduced-form and IV estimates for supermarket employment. Columns (5) and (6) present reduced-form and IV estimates for the number of convenience shops, which are less likely to have been subsidised directly by the NMTC and thus serve as something of a placebo.

The results point to a positive impact of the NMTC Program on growth in the grocery industry in affected communities. Regardless of specification, we find that LIC status is associated with a statistically significant 0.06 additional grocery shops on average; dividing this by the first-stage estimate in Panel A, we arrive at the IV estimate of the effect of US$1 million in NMTC investment on the number of grocery shops (0.07 in the model controlling for baseline tract characteristics). Multiplying this by the total amount of NMTC funding in the sample between 2003 and 2009 implies that during this period, the NMTC causally induced the entry of 25 grocery establishments, which is about 0.2% of the total stock of grocery shops in the sample. Assuming the fraction of NMTC projects in our sample that are

Table 2. First-stage, reduced-form and IV estimates for retail food industry activity.

	(1)	(2)	(3)	(4)	(5)	(6)
	A. First-Stage Estimates NMTC Investment (US$ Mil.)					
LIC Status	0.957***	0.850***	0.957***	0.850***	0.957***	0.850***
	(0.282)	(0.265)	(0.282)	(0.265)	(0.282)	(0.265)
	B. Reduced-Form Estimates					
	Supermarket Establishments		Supermarket Employment		Conv. Shop Establishments	
LIC Status	0.057**	0.059**	7.192**	6.891**	–0.028	–0.024
	(0.026)	(0.026)	(2.819)	(2.855)	(0.047)	(0.047)
	C. IV Estimates					
	Supermarket Establishments		Supermarket Employment		Conv. Shop Establishments	
NMTC Investment (US$ Mil.)	0.059*	0.069*	7.512**	8.102*	–0.029	–0.028
	(0.030)	(0.035)	(3.739)	(4.238)	(0.049)	(0.055)
Cubic Control Function	✓	✓	✓	✓	✓	✓
County Fixed Effects	✓	✓	✓	✓	✓	✓
Tract Demographic & Housing Controls		✓		✓		✓
Kleibergen-Paap rk Wald F Statistic	11.543	10.333	11.543	10.333	11.543	10.333
Observations	17,271	17,271	17,271	17,271	17,271	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.

supermarkets is the same as the fraction nationwide that are supermarkets (6–14%), this would imply that 34–72% of those supermarkets would have located in a low-income neighbourhood even in the absence of NMTC subsidies. The other 28–66% of the supermarkets may represent new retail food industry activity generated by the NMTC Program, but could also have been merely redirected from higher-income to lower-income areas.

The results in columns (3) and (4) point to commensurate gains in supermarket employment in affected communities. The IV estimates imply that US$1 million in NMTC investment increases employment at supermarkets by eight workers. Obviously, NMTC investment occurs through a variety of channels outside retail food, so interpreting the programme's relatively small impacts on the number of supermarkets and employment at supermarkets as its sole effects is misguided. Indeed, our estimates imply that if all programme funds during the sample period had been dedicated to supermarkets, the NMTC would have led at least 179 supermarkets to enter low-income areas in our sample.

Convenience shops are less likely to offer the affordable and nutritious food options that are perceived to be absent in many low-income neighbourhoods. They also lack most of the features of supermarkets that make the latter an attractive investment for

CDEs that leverage NMTC funds. As the final two columns of Table 2 show, NMTC investment has no statistically or economically meaningful effect on the number of convenience shops in low-income areas.

These estimates are robust to alternative specifications and samples. For example, the estimates change very little with alternative control function specifications (e.g. quadratic or quartic), when we condition on different sets of baseline neighbourhood characteristics, or when we exclude county fixed effects. Linear probability models in which we evaluate whether the NMTC spurred supermarket entry in communities otherwise wholly lacking in supermarkets yield qualitatively similar, but less precisely estimated results. We also find very similar effect sizes for windows around the threshold as small as 10 and as large as 30 percentage points; 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 sample used, the estimated reduced-form effect on convenience shop growth is always very close to zero and never statistically significant.

We also explored possible heterogeneous impacts of the programme. In results not shown, we found larger impacts in tracts in MSAs relative to tracts outside of MSAs, but the differences in estimated effects were not statistically distinguishable. We also found that most of the effects are driven by relatively high-volume (more than US$2 million in annual sales) shops.

An important question is whether supermarket investment in LICs subsidised by the NMTC would have otherwise happened in other communities. To the extent displacement occurred in a localised fashion, the programme may have had little effect on the retail food environment facing low-income individuals even if it did prompt new investment in targeted areas. To test this, we identified every tract that neighbours a tract in the main sample. We then determined the aggregate change in the number of retail food establishments and employment in these adjoining tracts. Using the same identification strategy as for our main results, we examined how LIC status (in the reduced-form) and NMTC investment (in the IV) for each tract in our sample affected outcomes in its neighbours.[5]

As shown in Table 3, we find mixed results for growth in the supermarket industry in neighbouring tracts. The estimates point to a negative impact on the number of supermarkets, but a positive effect on supermarket employment. However, the estimates are not only imprecise, but are also very small in magnitude given that they are from a much larger base (see Table 1). For example, there were 4.36 supermarkets in neighbouring tracts in the sample on average in 2004, so the 0.05 supermarket decrease we find in response to US$1 million in NMTC investment is only about a 1% change. The effects for supermarket employment and the number of convenience shops are similarly small. Thus, we conclude that spillovers on the retail food environment in nearby neighbourhoods were minimal.

The effects of the NMTC on food shopping and purchasing patterns

NMTC-subsidised investment could plausibly affect measured food shopping patterns in recipient communities in several ways. First, to the extent that subsidised investment improved the circumstances of existing residents (potentially by providing new job opportunities) or attracted new, relatively affluent residents to affected neighbourhoods, it would likely have the effect of increasing the relative quantity of healthy food purchased (Cutler and Lleras-Muney, 2010).

Additionally, some NMTC funds were used to subsidise the establishment or

Table 3. First-stage, reduced-form and IV estimates for retail food industry activity in neighbouring tracts.

	(1)	(2)	(3)	(4)	(5)	(6)
	A. First-Stage Estimates NMTC Investment (US$ Mil.)					
LIC Status	0.957***	0.855***	0.957***	0.855***	0.957***	0.855***
	(0.282)	(0.267)	(0.282)	(0.267)	(0.282)	(0.267)
	B. Reduced-Form Estimates					
	Supermarket Establishments		Supermarket Employment		Conv. Shop Establishments	
LIC Status	–0.046	–0.041	5.575	6.255	0.031	0.027
	(0.069)	(0.068)	(8.316)	(8.315)	(0.118)	(0.118)
	C. IV Estimates					
	Supermarket Establishments		Supermarket Employment		Conv. Shop Establishments	
NMTC Investment (US$ Mil.)	–0.048	–0.048	5.824	7.319	0.032	0.031
	(0.073)	(0.081)	(8.934)	(10.142)	(0.123)	(0.138)
Cubic Control Function	✓	✓	✓	✓	✓	✓
County Fixed Effects	✓	✓	✓	✓	✓	✓
Tract Demographic & Housing Controls		✓		✓		✓
Kleibergen-Paap rk Wald F Statistic	11.538	10.275	11.538	10.275	11.538	10.275
Observations	17,261	17,261	17,261	17,261	17,261	17,261

Notes: Ten tracts have no neighbours. Standard errors (in parentheses) are adjusted for heteroskedasticity and clusters at the county level. Significant at the *10% level, **5% level and ***1% level.

expansion of health care facilities in low-income neighbourhoods. If new health care centres provided any outreach or counselling to residents about diet choices, they would also likely serve to increase the relative amount of healthy food purchased.

Given the previous results, a final channel by which NMTC investment could affect food purchasing patterns would be through its effects on food access. We test this first by examining the frequency of shopping trips to or dollars spent at supermarkets and convenience shops among households in eligible communities. Next, we examine the composition of food purchases among households in eligible communities. We use household-level survey and scanner data from IRI to conduct 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-subsidised 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 neighbourhoods 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 as well as changes in the behaviour of existing residents in the wake of LIC designation. 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.

We use outcomes measured in 2012, which has the benefit of allowing for some lag (albeit modest lag) in the impact of NMTC-subsidised investment on food shopping and purchasing behaviour. It also maximises the number of survey respondents with usable data, 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 behaviour. 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, and we again cluster standard errors at the county level.[6]

In Panel A of Table 4, we present results for the number of supermarket trips per month (first two columns) and convenience shop 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 additionally controlling for individual household 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 neighbourhood amenities.

As is clear in Panel A, there is little evidence that LIC status is associated with a difference 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 on average 0.006 fewer supermarket trips per month among households. Adding household-specific characteristics to the regression attenuates the effect to 0.002 fewer supermarket trips per month on average. 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 suggest that households in tracts eligible for NMTC investment make about 0.18 fewer visits per month to convenience shops on average, a statistically significant change that corresponds to a 46% reduction in the frequency of convenience shop visits. This change is similar regardless of whether we control for household characteristics.

These results hint that households in affected communities, while not increasing the frequency of supermarket shopping trips, may be shifting some of their purchases from convenience shops 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 neighbourhoods, households in NMTC-eligible neighbourhoods spend US$4 more at supermarkets per month on average. Meanwhile, households spend US$3 less at convenience shops per month on average. While neither estimate is

Table 4. Reduced-form estimates for food shopping and purchasing patterns.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Main Sample				*Including Neighbouring Tracts*			
	A. Trips per Month							
	Supermarkets		Conv. Shops		Supermarkets		Conv. Shops	
LIC Status	–0.006	–0.002	–0.180*	–0.184*	0.040	0.035	–0.055	–0.052
	(0.172)	(0.170)	(0.105)	(0.104)	(0.108)	(0.106)	(0.047)	(0.047)
	B. Dollars Spent per Month							
	Supermarkets		Conv. Shops		Supermarkets		Conv. Shops	
LIC Status	3.999	4.337	–2.616	–2.619	–4.413	–4.588	–0.203	–0.160
	(7.552)	(7.254)	(1.881)	(1.862)	(4.667)	(4.439)	(0.846)	(0.839)
	C. Food Purchases							
	BasketScore[A]		BasketScore[B]		BasketScore[A]		BasketScore[B]	
LIC Status	0.017	0.026	0.082	0.083	0.033	0.040	0.013	0.019
	(0.088)	(0.084)	(0.093)	(0.089)	(0.051)	(0.049)	(0.054)	0.053)
Cubic Control Function	✓	✓	✓	✓	✓	✓	✓	✓
County Fixed Effects	✓	✓	✓	✓	✓	✓	✓	✓
Tract Demographic & Housing Controls	✓	✓	✓	✓	✓	✓	✓	✓
Controls for Household Characteristics		✓		✓		✓		✓
Observations	30,306	30,306	30,306	30,306	82,366	82,366	82,366	82,366

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.

statistically significant, the observed pattern of spending is consistent with some shifting of purchases away from convenience shops and towards supermarkets.

If households in affected neighbourhoods are reallocating purchases towards 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 results for the healthfulness of food expenditures by households. We follow Volpe et al. (2013) 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 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:

$$BasketScore^{A}_{jh} = \left[\sum_{c}\left(exp_{jhc} - rec_{hc}\right)^{2}\right]^{-1}, \quad (4)$$

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 exp is the observed expenditure share of the household and rec is the share recommended under the USDA guidelines for a household of that type.

This measure penalises households for expenditures above or below the recommended amount in any particular category. We also show results using a measure calculated as:

$$BasketScore^{B}_{jh} = \left\{\left[\sum_{c\in healthful}\left(exp_{jhc} - rec_{hc}\right)^{2}\middle|exp_{jhc} < rec_{hc}\right] + \left[\sum_{c\notin healthful}\left(exp_{jhc} - rec_{hc}\right)^{2}\middle|exp_{jhc} \rangle rec_{hc}\right]\right\}^{-1}, \quad (5)$$

which does not penalise households for too much of a healthy purchase or too little of an unhealthy purchase.

The mean $BasketScore^{A}_{jh}$ ($BasketScore^{B}_{jh}$) in 2012 among households in the 10 percentage point window below the 0.8 cutoff was 5.8 (5.9), and that for households in the 10 percentage point window above the 0.8 cutoff was 5.9 (6.1). In regressions akin to (3) where the outcomes are the 2012 Basket Scores, we find no discernable difference in scores among households on either side of the threshold; as shown in Table 4, focusing on $BasketScore^{A}_{jh}$ and including both neighbourhood and household controls, households in a NMTC-eligible neighbourhood had scores 0.026 higher than those in ineligible neighbourhoods, 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 $BasketScore^{A}_{jh}$. As shown in columns (3) and (4) of Panel C, the results are qualitatively similar when we use $BasketScore^{B}_{jh}$, which does not penalise too little (much) of an unhealthy (healthy) purchase. We similarly find null results with alternative specifications, samples and measures of the healthfulness of food purchases.

Given we are isolating attention to households in directly affected tracts, we may be understating the impacts of the programme on food shopping and purchasing patterns. To examine this, we add to the sample all households in tracts adjacent to those in the main sample and test whether LIC status in a tract in the main sample affects outcomes among households over a broader geographic area. As the results in the final four columns of Table 4 show, we find no economically or statistically significant impacts on shopping habits or basket scores among households in this expanded sample.

Overall, our findings suggest that, to the extent that the NMTC is inducing supermarket entry in low-income neighbourhoods, the resulting increase in food access is not having large effects on food purchasing patterns. Notably, though, while we find little evidence of business displacement from neighbouring tracts, we cannot completely rule out that the NMTC is prompting only minor locational shifts for many grocery shops that take up the subsidy, leading to large changes in the menu of food buying options for only a small segment of the population. Additionally, our results only capture changes in food purchasing behaviour within 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 materialise.

Conclusion

This article examines the effects of the US federal government's NMTC Program on the retail food environment as well as food shopping and purchasing patterns in low-income neighbourhoods. Our results suggest that the NMTC has had modest positive impacts on supermarket entry in communities close to the income threshold that determines eligibility for the programme. This is not to suggest that the NMTC necessarily increased the number of supermarkets on aggregate, as many of the supermarkets that located in these 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, albeit potentially expensive, tool to at least redirect investment into certain targeted areas.

Whether this is desirable from a policy perspective depends on the extent to which subsidised investments have greater social returns in targeted neighbourhoods as compared to other neighbourhoods in which they might have otherwise located. The potential positive diet and health consequences of new grocery shops in low-income areas are one channel by which such social returns could be realised. However, at least in communities near the threshold that determines NMTC Program eligibility, our results suggest that supermarkets, along with any other amenities or changes in neighbourhood composition that come with NMTC investment, do not have measurable effects on households' food buying patterns, at least in the short run.

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Notes

1. 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 investments in commercial real estate could include retail food. Of those projects reporting tenant businesses in telephone surveys, 14% reported grocery shops, making this the second most common type of tenant business (Abravanel et al., 2013).
2. Our data report year of investment, rather than of project completion. To the extent that projects take more than a year to complete, our estimates will understate the impact of the programme.
3. While CDEs started receiving NMTC allocations in 2003, QLICIs only began in earnest after 2004. Hence, 2004 data are unlikely to capture any significant amount of NMTC investment.
4. Formal tests using the regression framework outlined in the Empirical Strategy section (using baseline characteristics as the

outcomes) reveal no statistically significant discontinuities. Density tests also confirm there is no bunching of tracts around the cut-off that might indicate sorting around the threshold.

5. For example, the reduced form is $\Delta y_i^N = \gamma_0 + \gamma_1 LIC_i + \beta_1 f(m_i) + \mathbf{X}_i\mathbf{\Phi} + v_i$, where Δy_i^N is the change in the number of retail food establishments or employment in all tracts neighbouring tract i, and all other variables are defined as before.
6. The reduced form is $y_{hi}^{2012} = \gamma_0 + \{\gamma_1 LIC_i + \beta_1 f(m_i) + \mathbf{X}_i\mathbf{\Phi} + \mathbf{Z}_h\mathbf{\Psi} + v_{hi}$, where y_{hi}^{2012} is the outcome for household h in tract i measured in 2012, $\mathbf{Z}_h$ is a vector of household h's characteristics and all other variables are defined as before. In the spillover analysis that follows, we include outcomes and characteristics for households in tract i and in all tracts neighboring tract i.

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