Retail Wastelands:

Characteristics and Influential Factors of Food Deserts

Paula Dutko

Shelly Ver Ploeg

Tracey Farrigan

Abstract

Applying a census tract-level definition of food deserts, areas with limited access to affordable and healthy food, ERS has identified over 6,500 food desert tracts in the U.S. based on data from the 2000 Census of the Population. In this report, we examine the socioeconomic and demographic characteristics of these tracts to see how they differ from other tracts. We describe the demographic and socioeconomic characteristics of food desert census tracts compared with all other census tracts and how these tract characteristics have changed over time. Then, using multivariate logit analysis and data from the 1990 Census and 2000 Census, we attempt to isolate which characteristics separate food desert tracts from other low-income census tracts, to help distinguish areas that are vulnerable to low access problems in the future. Descriptive results indicate that relative to all other census tracts, food desert tracts tend to have smaller populations, higher rates of abandoned or vacant homes and residents with lower levels of education, lower incomes, and lower labor force participation. Multivariate analysis indicates that census tracts with higher poverty rates are more likely to be food deserts than otherwise similar low-income census tracts in rural and in very dense urban areas. For less dense urban areas, census tracts with higher concentrations of minority populations are more likely to be food deserts, while tracts with substantial decreases in minority populations between 1990 and 2000 were less likely to be food deserts in 2000.

Summary

What is the Issue?

In support of the proposed Healthy Food Financing Initiative, U.S. Department of Agriculture's Economic Research Service applied a census tract-level definition of food deserts—areas with limited access to affordable and healthy food—to the contiguous United States using 2000 Census data. As policymakers consider interventions to reduce limited food access, it is important to understand the level of hardship and other barriers that may be present in these food desert tracts—particularly those barriers which may be amenable to policy intervention. In this report, we therefore examine the socioeconomic and demographic characteristics of the over 6,500 census tracts identified as food deserts, as well as how these tract-level characteristics changed in the decades before and after 2000. We also examine which of these characteristics distinguish food desert tracts from other low-income census tracts.

What Were the Major Findings?

The effects of poverty on areas of low food access tend to be persistent, but other factors in food access differ between very dense urban areas, less dense urban areas and rural areas.

- Poverty is a statistically significant predictor of food desert status regardless of rural or urban designation; this result is especially true in very dense urban areas where other population characteristics tend to be homogeneous across tracts.
- In all but these very dense urban areas, the percent of tract population that is minority is positively and significantly related to food desert status.
- Low-income tracts in the Northeast are less vulnerable to access problems than low-income tracts in other regions of the country
- Rural areas experiencing population growth were less likely to be food deserts.

How Was the Study Conducted?

This study uses data from the 1990 and 2000 Census, as well as 5-year average data from the 2005-2009 American Community Survey to describe changing characteristics of the 6,529 food desert census tracts over time, relative to all other tracts. We focus particularly on population and population density, poverty, labor force participation and unemployment, education, race/ethnicity, income, and vehicle ownership status.

In addition to providing statistical descriptions of tracts classified as food deserts , we conduct an analysis of the factors associated with food desert tracts to determine which characteristics are most strongly associated with whether a low-income census tract is a food desert.   We model the probability a census tract is a food desert using a multivariate logit model to assess the impact of factors such as population and housing characteristics; racial and ethnic composition; unemployment; poverty; and changes in these characteristics from 1990 to 2000. Separate analyses are performed for urban areas and rural areas in order to accommodate different definitions of food deserts and systematic differences

in tract characteristics between rural and urban areas. We also further distinguish very dense urban areas from less dense urban areas for the multivariate analysis.

I.   Introduction

In the 2008 Food, Conservation and Energy Act, Congress directed the U.S. Department of Agriculture (USDA) to assess the extent of areas in the United States where populations have limited access to a variety of healthy and affordable food. Commonly referred to as "food deserts," these regions of the country often feature large proportions of households with low income, inadequate access to transportation, and a limited number of food retailers providing fresh produce and healthy groceries for affordable prices. In response to this directive, the USDA published a report in 2009 entitled "Access to Affordable and Nutritious Food: Measuring and Understanding Food Deserts and Their Consequences." The report measured the extent of limited food access in the United States, highlighted potential sources and consequences of the problem, and suggested general policy solutions. The report found, among other conclusions, that 23.5 million people live in low-income areas that are further than 1 mile from a large grocery store or supermarket, and that 11.5 million of these people have low income themselves. Building on these findings, we examine what systematic socioeconomic and demographic differences exist between food deserts and other low-income tracts, as well as attempt to isolate the primary factors that influence the evolution of food deserts.

Increased attention to national health issues, such as the rising incidence of obesity and overweight and the growing prevalence of diabetes, have made the concept of food deserts increasingly important in the realm of public policy. Several cities and states have implemented or are developing programs to improve access in underserved areas, including the state of Pennsylvania and the cities of New Orleans and New York. Perhaps the most high-profile effort is the Healthy Communities component of First Lady Michelle Obama's *Let's Move!* Campaign, which considers access to healthy food one of four pillars in the effort to address childhood obesity. To improve access to healthy food, the Obama administration has proposed the Healthy Food Financing Initiative (HFFI) to formulate ways to bring affordable, nutritious food to areas of low access and low income.

As part of this initiative, a working group comprised of members from the departments of Treasury, Health and Human Services, and USDA, is collaborating to expand the availability of nutritious food in underserved areas. That working group, along with researchers from the Economic Research Service (ERS) of USDA, has developed a census tract-level definition of food deserts, in order to help identify areas of the nation that may be in need of improved food access. Census tracts are defined as food deserts if they meet both low-income and low food access criteria. Using the specific definitions of both low income and low access (as detailed in the subsequent discussion), 6,500 census tracts have been identified as food deserts across the continental U.S. and mapped through an on-line mapping tool.[1]

The relevance of food deserts to discussions of public health and food access policy nationwide makes critical the task of isolating potential causes of low-access areas. As a first step toward this identification, we explore over time the demographic characteristics of the 6,500 tracts identified as food deserts by the HFFI working group. Using data from the 1990 and 2000 Decennial Censuses, as well as from the 2005-2009 American Community Survey (ACS), we compare the economic and

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[1] See the Food Desert Locator: http://www.ers.usda.gov/data/fooddesert/.

demographic traits of census tracts identified as food deserts with all other tracts, as well as the changes in these statistics between survey years. We first use descriptive statistics to compare food desert tracts to all other census tracts, examining demographic, economic and employment, population density, and commuting patterns of census tracts. Next, we use multiple regression analysis to examine which of these characteristics are important in explaining whether a low-income tract is a food desert.

Our analysis has several practical motivations. First, we want to better understand the new HFFI national measure of food deserts and how the designation of some low-income tracts as food deserts breaks down along important population and economic characteristics. Second, by contrasting the population characteristics in areas of low access with those of other low-income areas, we can detect any systematic differences in the composition of food deserts. Identifying economic and demographic characteristics that are highly associated with low access to supermarkets and grocery stores will help policymakers better understand those neighborhoods with food access limitations, how they have changed over time, and other potential barriers faced by residents of these areas. This is important for providing surveillance for areas that may be at-risk of becoming food deserts and can aid policymakers in formulating policies better-adapted to the specific needs of these communities. Finally, results from this analysis can help develop hypotheses to study further the mechanisms by which food deserts arise, thus allowing policymaking to address root problems rather than mere symptoms.

We next review the literature on both how community food access has been measured and the characteristics of areas with limited access. Then we describe how the measures of food deserts used by the HFFI were derived and implemented. This is followed by a presentation of the methods used in the analysis, and finally by the results and conclusions.

II.   Literature

Areas with limited access to healthy, affordable food often lack access to many other services, as well, such as banks, health care, transportation infrastructure, and parks or recreational areas. In addition to poor access, residents of impoverished or deprived areas frequently face higher prices for food and other necessities. Poor education and limited healthcare services in conjunction with high prices for fresh produce and other healthy food may result in poor diet and adverse health outcomes for residents of these areas. These issues have motivated researchers to attempt to characterize low-access areas and to determine what demographic and economic factors influence low access.

 Past studies have typically considered the correlation between demographic and socioeconomic characteristics such as race, ethnicity, income, education, deprivation and other features of an area such as roadway connectivity, with the level of food store access.   Most of these studies have been conducted in localized areas such as neighborhoods or cities, but recently two noteworthy studies have been conducted at a national level (Powell et al., 2006; USDA, 2009). The measures of food store access used vary, as well, including measures such as the distance to a supermarket, number of grocery stores or fast food restaurants per capita in a geographical area, vehicle ownership, or the ratio of stores that carry healthy food options to stores that only carry less-healthy food options.

Perhaps because of the wide variety of measures used and the wide variety of places examined, results of the studies have not reached a consensus on the characteristics of areas that lack access to healthy food. Studies have produced conflicting results as to the correlation among race, income and access to healthy and affordable food. Many researchers have concluded that neighborhoods consisting primarily of minorities – in particular, predominantly African American neighborhoods – and low-income neighborhoods have fewer supermarkets than wealthier, Whiter neighborhoods (Berg & Murdoch 2008; Powell et al 2006; Block, Chavez & Birgin 2008). Others, however, have found either no correlation, or that minority and low-income neighborhoods have a greater number of grocery stores and are closer to these stores than wealthier areas (Alwitt and Donley, 1997; Moore & Diez Roux 2006; Opfer 2010; and Sharkey and Horel, 2008). Results from the two national-level studies are also inconclusive. Powell et al. (2006) found that zip codes with more minorities and lower-income populations had fewer chain supermarkets, but more non-chain supermarkets. USDA (2009) found that, on average, low-income and minority populations were closer to supermarkets than higher income and non-Hispanic whites. Multivariate analysis techniques, however, showed that measures of income inequality and racial segregation were important predictors of low access in urban core areas; the most important factor in rural areas was lack of transportation infrastructure (USDA, 2009).

The lack of consistent findings in this literature leads us to examine further the relationship between neighborhood characteristics and food access. Our analysis builds upon previous studies and, in particular, components of USDA (2009) but is unique, however, in other ways. First, the specific definition of a food desert developed for the HFFI working group is based on the methods and data used in the 2009 USDA report but has been adapted to fit policy needs and to be consistent with multiple Federal agencies' programs. Our analysis will serve as a way to understand better and to validate a newly-developed national-level measure of food deserts. Second, unlike previous studies, our analysis uses multiple years of census data to understand how changes in the population are correlated with food deserts. For example, by using data from the 1990 and 2000 census and from the 2005-2009 American Community Survey, we will be able to assess how factors such as changes in an area's overall population or changes in the ethnic and racial composition of an area are correlated with food access. Eventually, this information could help predict which areas may be at risk of becoming food deserts and which areas may see improvements in food access.

III.   Method for Defining and Measuring Food Deserts

The 2009 ERS report measures the distance to the nearest healthy-food retailer, using the locations of supermarkets and large grocery stores as a proxy, by referencing 1-kilometer square grids for geographical analysis. These grids come from the Socioeconomic Data and Applications Center (SEDAC) and are based on information from the 2000 Census of Population (SEDAC, 2006). These population data (including socioeconomic and demographic data), which are released at the block group level, are first allocated to blocks and then allocated aerially down to roughly 1-square-kilometer grids across the continental United States. For each grid cell, the distance from its geographic center to the nearest supermarket or large grocery store is used to measure access for people who live in that grid. Grids that are farther than a specified distance from the nearest supermarket or large grocery store are considered areas of low access; and low access areas with a large percentage of low-income population are noted in

particular. Use of the grid-level data provides two important benefits for the analysis: first, they provide greater accuracy in estimating where people and households are located than data on larger geographic areas, such as census tracts; and thus, they provide better precision in measuring distance to stores. Second, the process of allocating census data to 1-square-kilometer grid cells transforms the irregular shapes and sizes of census geographies or other geographies such as zip codes, into regular grid cells.

While the 1-km square grid-based measures increase the precision in measuring where people are and how far they are from sources of healthy food and provide consistency in defining geographic areas across the country, the SEDAC grids are not widely-used geographic units. Currently, no standardized nomenclature exists to identify a specific grid (as counties, zip codes, or census tracts can be identified), and they cannot easily be linked to other geocoded data. For this reason, the HFFI working group definition of a food desert uses the census tract as the geographic unit of analysis, because it is more commonly used and has a standardized numbering system.

Census tracts are relatively static subdivisions of a county, containing between 1,000 and 8,000 people and ideally encompassing a population of about 4,000. Food deserts are defined as low-income tracts in which a substantial number or proportion of the population has low access to supermarkets or large grocery stores. Low-income tracts are characterized by either a poverty rate equal to or greater than 20 percent, or a median family income that is 80 percent or less of the metropolitan area's median family income (for tracts in metropolitan areas) or the statewide median family income (for tracts in nonmetropolitan areas). This definition of low-income tracts is used to designate tracts that are eligible for the Department of the Treasury's New Markets Tax Credit (NMTC) program. [2] Low access is characterized by at least 500 people and/or 33 percent of the tract population residing more than 1 mile from a supermarket or large grocery in urban areas, and more than 10 miles in rural areas. [3]

Information on supermarket and large grocery store locations comes from a directory of supermarkets and large grocery stores, defined as food stores with at least $2 million in sales that contain all the major food departments found in a traditional supermarket. The directory was developed from a list of stores authorized to receive Supplemental Nutrition Assistance Program (SNAP) benefits and was augmented by data from Trade Dimensions' TDLinx (a Nielsen company), a proprietary source of individual supermarket store listings. Both sets of data were provided for the year 2006.

Using this definition, the HFFI working group identified 6,500 census tracts that met the definition of "food desert" based on data from the 2000 Census of the Population. [**Text box 1 here**] Table 1 provides a breakdown of the number and percentage of all tracts that are food deserts over all census tracts, for tracts that are designated as NMTC low-income tracts, and separately for rural and urban areas. Our descriptive analysis compares the demographic characteristics of those 6,500 tracts relative to the

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[2] For additional information on the NMTC, visit
http://www.cdfifund.gov/what_we_do/programs_id.asp?programID=5

[3] The 1-kilometer square grids are still used to calculate the number of people who are more than 1 or 10 miles from a supermarket, which are then aggregated to the census tract level.

characteristics of all census tracts that are not considered food deserts by rural and urban status. We also compare changes in these characteristics over time to explore how demographic shifts might be associated with food desert areas.   Our multivariate analysis only considers census tracts that are designated as NMTC low-income tracts.

Descriptive Analyses

Tract level data from the 1990 and 2000 Census of the Population, as well as from the 2005-2009 American Community Survey are used for population characteristics. Food desert status is determined based on year 2000 data and is constant from one survey year to the next; so the group of food desert tracts and the group of non food desert tracts consist of the same tracts in each survey year. Our analysis compares statistics for the tracts defined as food deserts based on the 2000 data with statistics for other tracts. We also calculate differences in characteristics of food deserts from 1990 to 2000, 2000 to 2005/2009, and over the entire period and compare these to changes in the same statistics for all other tracts. We use 5-year average data from the 2005-2009 ACS to provide a recent picture of the demographics of food desert tracts.[4] We conduct and present these analyses separately for rural and urban tracts, as demographics tend to differ significantly between rural and urban areas. Rural Urban Commuting Area (RUCA) codes designate each tract as urban or rural.[5] RUCA codes use census tracts to identify urban cores and adjacent areas that are integrated with these urban cores. Ten primary codes and 33 secondary codes are assigned based on the designation of areas as metropolitan or micropolitan, and high-commuting or low-commuting. We use a four-category classification that allocates the 33 RUCA secondary codes into urban, large rural, small rural, or isolated areas.[6] We then combine large rural, small rural and isolated areas to create a single, broad rural category.

Group quarters typically have institutional cafeterias and retail food facilities that are not counted in our list of supermarkets and large grocery stores. Some tracts that are dominated by university, prison, or military populations may appear to be food deserts, but because their populations are likely to be unique, we eliminate all tracts in which more than 50 percent of the total population resides in group quarters. This results in the exclusion of 105 rural and 557 urban tracts in 1990, 116 rural and 594 urban tracts in 2000, and 139 rural and 600 urban tracts in 2005/09.

For the purpose of comparing the same tracts over time, we convert data for 1990 census tracts to their corresponding Census 2000 tracts.[7] We accomplish this task using a set of correspondence codes provided by Census.[8] Tracts used in the 2005-2009 ACS are generally the same tracts as identified in the

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[4] The ACS replaces the long form Census after the year 2000 and provides much of the same data as the Decennial Census long form. We use the 5-year data as it is the only increment for which tract-level data is available for most variables.

[5] http://www.ers.usda.gov/Data/RuralUrbanCommutingAreaCodes/

[6] http://depts.washington.edu/uwruca/ruca-maps.php

[7] Census tracts are delineated by local census statistical areas committees and maybe be revised or redefined due to physical changes to the area, such as major roadways dividing a tract, or population growth or decline.

[8] A detailed description of the methods used to convert tracts across years is available upon request.

2000 Census and require little altering. A small number of tracts listed in the 2005-2009 ACS data using their 2010 tract identification required reconciliation with their 2000 definitions.[9] We also convert all variables expressed in dollars to year 2000 dollar-equivalents using the Consumer Price Index for All Urban Consumers (CPI-U) provided by the Bureau of Labor Statistics.[10]

To compare food desert tracts with non food desert tracts in each individual year, we conduct t-tests grouping variables by food desert status. For inter-year comparison, we aggregate each variable to its average value by food desert status and by survey year and perform t-tests comparing average values for food desert tracts with average values for other tracts for each survey. Differences in values between 1990 and 2000, between 2000 and 2005/2009, and over the entire 1990-2005/2009 period are obtained as the difference calculated by each t-test. Changes reported are thus slightly different than those calculated by directly comparing variable means computed individually by year, as the STATA t-test command we used drops un-matched observations for each variable.

Results: Comparing Food Desert Tracts to All Other Tracts

Our analysis compares economic and demographic characteristics of food desert tracts and non food desert tracts separately for rural and urban areas to control for the differences between these two populations. For the most part, our results suggest that differences between food desert tracts and other tracts are consistent regardless of rural or urban designation. In general, food desert tracts tend to have smaller populations, and abandoned or vacant homes are more prevalent in these tracts than in their counterparts. Residents of food desert tracts also tend to have lower levels of education, to earn lower incomes, and to participate in the labor force in lower numbers. Those that do participate in the labor force are more likely to be unemployed in food desert areas than in non food desert areas. Such socioeconomic differences between food deserts and other areas suggest that demographics may play a role in determining food access.

In all three survey years of our analysis, rural Census tracts categorized as food deserts have slightly smaller total populations: from 9 to 14 percent fewer people than all other rural tracts (Table 2). Also, the proportion of housing units that are vacant is higher in rural food desert tracts than in other rural areas. In conjunction with lower population numbers, this may suggest population loss and desolation in food deserts.

Financial disparities between food desert tracts and other rural areas are also prevalent. Median family income is around 18 percent lower in rural food deserts than in non food desert rural tracts.[11] Data from

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[9] Tracts included in the ACS data using their 2010 tract numbers are listed with their corresponding 2000 tract number on the Census website:
http://www.census.gov/acs/www/Downloads/geography/areas_published/BlockGroupsTable.pdf
[10] ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt
[11] This difference appears smaller, at 15.7% in the ACS data. ACS income and poverty data is not directly comparable to income and poverty data provided by the Census, however. While the CPS measures income-related variables using the calendar year, ACS data is calculated based on the last 12 months. ACS data is adjusted for the month for which the data is provided. A study conducted by the Census Bureau found only few statistically significant differences between state-by-state poverty rates from the ACS compared with poverty rates from the

the 2000 Census shows a difference of less than 50 percent in the share of the population with income below the federal poverty line from rural food deserts to all other rural tracts. Differences of similar size exist for the specific populations of children age 17 and under, and the elderly age 65 and older. The depth of economic disparity is further reflected in a higher percentage of individuals with an income below 200 percent of the federal poverty level in food desert tracts. Accordingly, a higher percent of households receives some form of public assistance in rural tracts identified as food deserts than in other rural tracts. These trends persist throughout the three surveys.

Ownership of or access to a private vehicle plays a large role in determining the ease of obtaining sufficient, healthy, and affordable food. Vehicle ownership rates are typically higher in rural areas than in urban areas as a result of the greater dispersion of residences, retailers, schools, and places of work in rural areas. Data from the two Decennial Censuses suggest that 25 percent more of all occupied housing units report having no access to a vehicle in rural food deserts than in most rural tracts. The difference in vehicle access between food deserts and other rural tracts is smaller in the ACS data, at about 15 percent.

Time spent commuting between home and work, as well as the mode of transportation used for this commute may also reveal the distance residents must travel from home to supermarket. A higher percent of the working population in rural food deserts has longer commutes (spend 45 minutes or more traveling to work) than in other rural tracts – around 10 percent greater in the most recent two surveys Differences in work commute times between residents of rural food deserts and other rural areas could also reflect differences in modes of transportation used by workers. Private vehicles are used by a greater proportion of the working population in non food desert rural tracts, while public transportation use is slightly higher in rural food desert tracts.   Alternative methods of commuting (by foot, bicycle, or other) are substantially higher for residents of rural food desert tracts.

In rural areas, Census tracts for which food access is limited also have different ethnic and racial composition than all other rural tracts. Non-Hispanic whites comprise about 12 percentage points more of the population in non food desert rural tracts relative to those that are food deserts. Food desert tracts have a greater concentration of all minorities, including Hispanics. The proportion of minorities in the total population is around 65 percent greater in food deserts than non food deserts in the most recent two surveys, down from an 80 percent difference in 1990. The gap between rural food deserts and non food deserts is of similar size for African Americans and Hispanics; the gap in the proportion of the population that is of Hispanic ethnicity appears to be diminishing more noticeably over the period. A dissimilarity index measures a tract as highly dissimilar (the indicator variable equals unity) if the percent of the population comprised of non-White minorities is greater than 75 percent. Applying this dissimilarity index shows that food desert tracts are 2 to 4 times more likely to be racially dissimilar tracts than non food desert tracts in rural areas.

Census data; and the statistically significant differences were not necessarily economically significant. As our discussion highlights differences between geographic areas, we discuss ACS income-related data along with Census data.

Average education of the population, as well as labor force participation and unemployment rates differ markedly between food desert tracts and other rural tracts. Labor force participation provides a more accurate picture of economic well-being of a region, as unemployment rates may deceptively drop when discouraged workers exit the labor market. We therefore analyze both labor force participation and unemployment rates for the population age 16 and older to provide a fuller picture, but emphasis should be on the former statistic. Residents of rural food desert tracts tend to have lower levels of educational attainment, lower levels of labor force participation, and higher incidence of unemployment. Labor force participation is approximately 6 percent lower in rural food deserts than in other rural tracts, while unemployment is anywhere from 13 to 37 percent higher; and the proportion of the population age 25 and older with at least a bachelor's degree is nearly 20 percent lower in food deserts.

As with rural areas, urban tracts that have been identified as food deserts typically have a smaller population than other urban tracts. In 1990 and 2000 the difference was between 7 and 8 percent of other tract populations; in the ACS data, the population of food desert tracts was almost 13 percent less than that of other tracts, indicating that year-2000 food desert tracts are growing at a slower pace than non-food desert tracts (Table 3). In a related metric, the proportion of housing units that are occupied is persistently lower in urban food desert tracts than other urban areas. This may reflect a general movement of population out of these tracts, leaving behind smaller populations and abandoned neighborhoods as appears to be true for rural food desert tracts.

Median family income is similarly lower in urban food desert tracts than other urban tracts and the gap is even larger in urban tracts than in rural areas. Likewise, poverty is more prevalent in tracts designated as food deserts and a larger proportion of households receiving public assistance income. This gap between urban food deserts and other urban tracts appears to narrow slightly over the time period and is larger for children age 17 and under living below poverty than for seniors living below poverty. All three survey years show persistently higher incidences of poverty in the population of food deserts, ranging from 94 percent higher in 1990 to 89 percent in the most recent survey.

The percentage of households reporting no access to a private vehicle is greater in urban food deserts as compared to non food deserts. However, a higher proportion of workers in urban food deserts has a short commute to work (less than 25 minutes) compared with workers in other urban tracts. The proportion of urban food desert residents with a commute to work shorter than 25 minutes is approximately 12 percent higher than in non food desert urban tracts. Those workers living in food deserts, despite lower access to private vehicles, report commuting to work by private vehicle in slightly greater proportion – a difference of 3 percent – than those in other urban areas. Residents of non food desert tracts use public transportation in greater proportions than their food desert counterparts. This could be explained by a greater number of workers in food desert tracts using alternative forms of transportation, such as walking or biking, instead of private vehicles or mass public transit. Further, it could partly be responsible for the difference in commute times to work between food desert residents and other urban populations.

Differences in ethnic and racial composition between food desert tracts and non food desert tracts are similar for urban areas and rural areas. In urban food deserts, a much higher proportion of the population is composed of minorities than in non food deserts. This difference is nearly 70 percent in 1990 data, approximately 60 percent in the 2000 Census, and 53 percent in the 2005-2009 data. The percent of the population who are non-Hispanic Blacks is over twice as large in urban food deserts than in other urban areas. Disparities in the dissimilarity index between urban food deserts and other urban tracts are of nearly the same magnitude, around 100 percent higher in food deserts.

In urban areas, education, labor force participation and employment levels are much lower in food deserts. The gap between unemployment rates in food deserts and in other tracts is much larger for urban areas than for rural: unemployment is about 60 percent higher in food deserts than other urban tracts in 2000. Labor force participation is around 9 percent lower in food desert tracts in 2000 and 6.4 percent lower in the most recent survey year used.

Changes in Food Desert Tract Characteristics Over Time

Food desert tracts and other tracts appear to change in many of the same ways throughout the period of study (Table 4 for rural and Table 5 for urban). Many of these changes reflect general trends in national socioeconomic composition, such as rising unemployment and diminishing labor force participation as a result of multiple recessions since the year 2000. Interestingly, food desert tracts in both rural and urban areas show far fewer statistically significant changes over the 30-year period than other tracts; and rural food desert tracts show fewer statistically significant changes than urban food desert tracts. This may reflect a relative stagnation in the characteristics of food desert tracts despite substantial changes in the economic climate; or it may simply be a manifestation of the smaller sample size of food desert tracts. Characteristics that did not change significantly across survey periods may be important in determining why certain tracts become food deserts and indicate tracts experiencing persistent deprivation.

Over the period surveyed, urban food desert areas experienced population loss of 10 percent, while other urban areas experienced a loss of 4.8. Rural areas, however, experienced small growth in population overall – less than one percent in food deserts and 6.8 percent in non food deserts – suggesting a movement from cities to more suburban or rural areas. Population growth is smaller in rural tracts classified as food deserts than in other rural areas; so some residents of urban food deserts may be moving into rural areas with improved food access. While the percent of the population in group quarters in any given tract is small, this population experienced a sizable relative increase of around 24 percent in all rural areas from 1990 to 2009. A similar, but smaller increase in the population in group quarters of 3 percent is observed in urban food desert tracts. This difference is not statistically significant. The share of population in group quarters decreased, however, by 3.8 percent in other urban areas.

In all tracts except rural food deserts, the proportion of the population age 17 and under living below poverty increased significantly over the period from 1990 to 2009.[12] In rural food deserts, the proportion actually fell by about 8 percent, from 29.8 percent to 27.4 percent. The proportion of the population age 65 and older living below the federal poverty level, however, decreased over this period in all tracts. In rural areas, this drop in elderly poverty rates was larger than in urban tracts, representing about a 35 percent decrease – from 23.1 percent of the 65-and-older population to 15.3 percent – as opposed to a decrease of around 12 percent in urban areas – from 18 percent of the elderly population to 15.4 percent in 2009.

On average, both food desert and non food desert tracts in rural areas saw a decrease in the percent of individuals with income-to-poverty ratios of less than 200%: in rural food desert areas, this percent dropped from 51.4 percent of the population in 1990 to 46.8 percent in 2009; and for other rural tracts, the proportion fell from 40.2 percent in 1990 to 37.8 percent in 2009. Meanwhile, urban tracts experienced an increase in low income households in both food desert and non food desert tracts. In urban food deserts, the percent of the population with income less than 200 percent of the federal poverty line rose from 46.6 to 47.6 between 1990 and 2000, and from 27.6 percent to 27.8 percent in the same period in non food desert urban areas. At the same time, the percent of households receiving public assistance also decreased over the period for all tracts, rural and urban. The universality of the latter trend may reflect lower public assistance caseloads and stricter standards for these programs due to welfare reform in the 1990s. Combined with rising urban poverty rates, lower public assistance may compound food access issues in cities and other urban areas during this period.

Observing changes in racial and ethnic composition may help explain how the populations of each area have shifted. The percent of the population reporting their race as non-Hispanic White decreased in all urban tracts over the period and by a small amount in rural, non food desert areas; the non-Hispanic White population increased very slightly in rural food deserts. Minorities gained in number relative to the total population on a national level. Interestingly, the relative increase in minority population was larger in both rural and urban non food desert tracts than in food desert tracts. The increase in the percent of the population of a minority race or ethnicity is reflected in a higher dissimilarity index rating for all urban areas from the 1990 Census through the most recent ACS.

A declining portion of all housing units that are occupied is common to urban and rural areas, as well as across tracts identified as food deserts and all other tracts. An increasing number of vacant housing units seems at odds with a growing population in rural tracts but may imply families moving in with one another to ease financial stress. Growth in vacant housing units may also reflect market conditions: overproduction during the housing boom in the late 1990s and early 2000s left many units vacant in high-growth areas after the real estate bubble popped. These additional unoccupied housing units would be reflected in the later data years. Despite these indications of declining economic conditions,

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[12] Income and poverty estimates are calculated differently by the ACS than by the CPS: CPS uses a calendar year reference period, while ACS uses a rolling 12-month reference period. Because of this difference, direct comparison of poverty and income estimates between the Census and the ACS are inaccurate. We present changes over the entire period, as opposed to only those between the two Census years in order to capture the dramatic changes in national economic welfare that occurred between 2000 and 2009.

the percent of occupied housing units without access to a vehicle has fallen. The proportion of households with no access to a vehicle decreased from 10.8 percent to 6.2 percent for rural food deserts and from 16.6 percent to 11.5 percent in urban food deserts over the period. These statistics reflect documented increases in vehicle ownership by low-income and single female-headed families over the past decade as public assistance programs have relaxed vehicle ownership rules (Baum and Owens, 2010; Hurst and Ziliak, 2004; and Sullivan, 2004) and the Earned Income Tax Credit has expanded (Goodman-Bacon and McGranahan, 2008; Romich and Weisner, 2000; and Smeeding et al., 2000).

Data from the two Censuses and the ACS show a growing number of workers with longer commute times (45 minutes or more). In 1990, 9.7 percent of workers in urban food deserts spent at least 45 minutes commuting to work, compared to 12.4 percent in 2005/2009; in other urban tracts, this proportion grew from 13.3 percent to 16 percent. In rural food desert tracts, the average proportion of workers commuting longer than 45 minutes expanded from 10.3 percent to 14.6 percent; in other rural areas, from 9.7 percent to 13.2 percent. The increase is larger for rural workers than for urban workers, but these shifts in commuting patterns are consistent over all tracts, regardless of food desert status. Working residents of both urban and rural food deserts increasingly rely on active or alternative commutes, as opposed to public transit or private vehicles. Changes in the proportion of workers using public transportation to commute to work are generally small and not statistically significant, while fewer urban non food desert residents are using private vehicles and all workers in rural areas are barely increasing their use of privately-owned cars, trucks and vans.

Patterns in labor force participation and employment rates between 1990 and 2009 tend to reflect the general economic downturn: while civilian unemployment appears to have fallen over the period, the percent of the population age 16 and older who are actively in the labor force has also fallen in all but urban food deserts. In rural food deserts, labor force participation in 1990 was 56 percent, compared to 54.1 percent in 2005/2009; participation in these years for other rural tracts was 60.1 percent and 57.6 percent, respectively. In non food desert urban tracts, the labor force participation dropped from 66.2 percent to 63.3 percent. The change in labor force participation is a much more accurate indicator of economic well-being, as unemployment numbers will drop when discouraged workers cease searching for jobs and thus are no longer counted in the civilian labor force.

Over the course of the 20-year period studied, educational attainment appears to have increased, with a growing percentage of the population age 25 and older having obtained at least a bachelor's degree. This proportion increased from 11.8 percent to 15 percent of the urban food desert population over the period, and from 22.4 percent to 29.6 percent of the non food desert urban population. In rural food desert tracts and non food desert tracts, the proportion of the population with at least a college degree grew from 10.2 to 14 percent and from 12.7 to 17.4 percent, respectively between 1990 and 2005/2009. Concomitantly, the proportion of the same population having completed less than a full high school education has dropped.

Regression Analysis: Methodology

The descriptive statistics in Tables 1-5 show differences in characteristics of food desert tracts compared with all other census tracts but do not show which variables are the most strongly associated with whether an area is a food desert. Further, the HFFI definition of a food desert only considers census tracts that meet low income criteria as possible food deserts. To further understand what distinguishes food desert tracts from other low income tracts, we estimate logistic regressions of the probability that a low-income census tract is a food desert. Our analysis focuses on characteristics as of the year 2000, as well as changes from the 1990 Census to the 2000 Census. The regression analysis includes these years because we are interested in determining what characteristics and changes in tracts may have influenced conditions prior to the designation of food desert status based on 2000 Census data. The outcome of interest is binomial with a value of 1 if the area is a food desert and 0 if otherwise. The regression analysis only examines the food desert status of census tracts that are classified as low-income by the U.S. Treasury's New Market Tax Credit (NMTC) program, because low income is a criterion for defining a food desert. Examining only low-income (NMTC) tracts allows us to isolate the characteristics that distinguish low-access tracts from other low-income tracts.

We expect food desert status to be influenced by population characteristics, economic and employment characteristics, population density, commuter and travel patterns and by trends in these characteristics over time. All of the tract-level characteristics included in the descriptive analysis above were considered for inclusion in the logistic regressions. However, because many of these characteristics are highly correlated with each other, we do not include them all. Given the definition of food deserts as low income areas, we know that poverty plays a role in food desert status. We selected variables to include in the regression with the aim of determining what factors are most significant in influencing poverty levels. Some of these factors may be affected by policy, such as unemployment or education, while others such as race cannot. Focusing our regression on the determinants of poverty can reveal whether the most significant factors can be addressed by policy. We use food desert status as the regressand in three different specifications. The first regression, which is our basic model, includes static measures of census tract demographic and economic characteristics, along with regional indicator variables:

- median family income in thousands of dollars;
- percent of housing units vacant;
- percent population of minority race/ethnicity;
- percent of population age 16 or older who is unemployed;
- percent of the population with income below the federal poverty line;
- indicator variables for each of the four Census regions of the United States; and
- population density, measured as thousands per square mile.

We next test the effect of adding variables to reflect changes in demographics. The second model includes the above regressors, as well as indicator variables for an increase in population greater than 10 percent; a decrease in population greater than 10 percent; and increase in the minority percent of the population greater than one standard deviation of the change in percent minority; and a

corresponding variable for decrease in percent minority population. For very dense urban areas, we replace the variables for significant increase and significant decrease in the percent of the population that is of minority race/ethnicity with an indicator for any significant change, regardless of direction, in percent minority. A change in percent minority with an absolute value of at least 10 percent is considered significant in defining this variable.

The third specification tests the effects of variables indicating tract-level economic changes between 1990 and 2000 in the regression. Variables for an increase in the poverty rate greater than one standard deviation of the average change in poverty rate across all tracts, and a corresponding variable for a decrease in the poverty rate of the same scale are added.

We run an initial regression on the set of all tracts, both rural and urban, that qualify for the New Market Tax Credit using the following dependant variables:

- median family income in thousands of dollars;
- percent of vacant housing units;
- percent population of minority race/ethnicity (percent non-Hispanic White);
- percent of population age 16 or older who is unemployed;
- percent of population with income below the federal poverty line;
- indicator variables for each of the four Census regions of the United States (Northeast is omitted); and
- a variable to indicate whether each tract is rural or urban.

To determine whether separate regressions should be run for urban and rural tracts, we fully interact the model using the binary urban indicator and perform a Chow test to determine whether these interaction terms are jointly significantly different from zero. The Chow test results in a chi-squared value of 540.01 and a p-value of 0.000, confirming that the socioeconomic factors above interact differently with food desert status depending on whether a tract is rural or urban. As a result, we run separate models for rural tracts and for urban tracts.

The variety of tracts that fall into the urban category varies widely—from very dense central city tracts, to suburban tracts, to small city and large town tracts. Retail development, population density, and other area characteristics could be very different in densely populated tracts than in the less dense urban areas. We also consider the possibility that the factors that affect food desert status in very dense urban areas differ from those in less-dense urban areas. We define very dense urban areas as those in which the population per square mile (in 1000s) is at or above the 90th percentile of population density for all urban tracts. We perform a similar Chow test to determine whether all urban areas should be grouped together for purposes of the regression or if very dense areas should be estimated separately from less dense urban areas. This test produces a chi-squared of 370.50 and a p-value of 0.000. Therefore, we create separate data sets for urban areas with high population density ("very dense") and all other ("less-dense") urban tracts. There are 6,519 rural NMTC tracts in our sample. The total sample of urban tracts is 17,940, of which 14,385 tracts are considered "less dense" and 3,555 tracts fall into our "dense" category, with population density in the 90th percentile or higher.

For each set of rural tracts, very dense urban tracts, and less-dense urban tracts, we perform three logistic regressions based on the models outlined above. To further control for differences among less dense urban tracts, we add a variable for population density – thousands of people per square mile.

In rural areas, many of the variables have the expected relationship with food desert status (table 6). The percent of housing units within a tract that are vacant is a significant predictor of food desert status with a consistently large odds ratio. The percent of the tract population that is poor is also a consistently strong predictor of food desert status; tracts with higher poverty rates are more likely to be food deserts than otherwise similar NMTC tracts. As some of the previous studies have found, we also find that the racial/ethnic composition of a tract are correlated with food desert status. The percent of the tract population that is minority is a consistently positive predictor of food desert status. Unexpectedly, higher rates of unemployment decrease the odds of a tract's fitting the definition of a food desert. This result, while counterintuitive, is robust across specifications. Rural tracts located in the West, Midwest, and South are also much more likely to be food deserts than rural tracts located in the Northeast. This might reflect the relative proximity of rural tracts in the Northeast to urban tracts (that contain grocery stores) compared with the more sparsely populated rural areas in the South, Midwest, and West.

Variables that indicate the degree of tract-level change in demographics and economic conditions generally do not have a significant effect on the probability of an area as a food desert. There are some exceptions. First, a large decrease in percent minority population within a tract increases the probability of a food desert. Second, a 10 percent or greater increase in the tract population between 1990 and 2000 reduces the odds that a tract is a food desert, at least in the model that includes changes in both demographics and economic conditions. This may be because rural tracts with relatively large population growth are near growing urban tracts that have more food retailers. A similarly large decrease in tract population was not associated with food desert status. Substantial changes in the poverty rate have no significant effect on the probability of low access.

Many of the same demographic factors are important predictors of food deserts in less-dense urban areas as in rural areas, although some differences exist. Notable differences also exist between very dense and less dense urban tracts (table 7).

As is the case with rural tracts, the percent of the tract that is minority is a strong predictor of food desert status in the less dense urban tracts. In these tracts, a 1 percentage point increase in the percent minority is associated with about a 50 percent increase in the odds of being a food desert. In less dense urban areas, the models that includes changes in demographic characteristics over time indicates that a large decrease in minority status also lowers the odds that a tract is a food desert in less-dense urban areas. Interestingly, the percent of the population of minority race or ethnicity in a tract is not a significant predictor of food desert status in very dense urban tracts, nor are the variables for changes in the percentage minority between 1990 and 2000.

18

The extent of poverty in very dense urban tracts is an important predictor of food deserts, but it is not a predictor of food desert status in less dense urban areas. Median family income is not associated with food desert status in either type of urban tract. Other indicators of economic conditions have surprising signs. The percent of vacant housing units and the unemployment rate both appear to reduce the probability of food deserts in less-dense urban tracts, but not in very dense urban tracts. The model that includes a measure of the change in poverty rates between census years shows that poverty changes in less-dense urban areas are not related to the odds a tract is a food desert. However, in very dense urban areas, a substantial decrease in a tract's poverty rate increases the odds a tract is a food desert. This result is counterintuitive. It is possible that the few very dense tracts with large swings in poverty rates may be in a state of flux with respect to residential and retail development.

Among less-dense urban tracts, those in the West are less likely to be food deserts than their counterparts in the Northeast. And as expected, higher population density within the less-dense areas reduces the odds of a food desert slightly. In dense urban areas located in the West, Midwest and South are also all more likely to be food deserts than dense areas in the Northeast. This may reflect the difference between very dense cities in the Northeast (New York, Philadelphia) where few neighborhoods are more than 1 mile from a supermarket compared with very dense urban tracts in other cities that may be surrounded by slightly less densely populated tracts and thus, people and stores are more spread out. The characteristics that predict food desert status in less-dense urban tracts are notably different than those that predict food desert status in dense urban areas. This may be partly due to the fact that less-dense urban areas include a wide range of tracts, from suburbs to small cities to small towns, all of which may have very different characteristics. This variation in the socioeconomics of the tracts in the set of less-dense urban areas may make difficult the detection of any real meaningful links between economic and demographic characteristics and the existence of food deserts. Very dense urban tracts, however, are much more likely to resemble one another in terms of composition. Our regressions on these areas are much more revealing of the strong link between poverty and the presence of food deserts in crowded urban areas.

Some common factors can be traced between the presence of rural food deserts and urban food deserts. Tracts that have larger representations from minority groups are more likely to be food deserts in rural, urban, and dense urban food deserts. This is true even after controlling for income and other tract-level characteristics. High poverty rates are usually positive predictors of a food desert tract, and regions in the South, Midwest and West tend to be more likely to be food deserts than tracts in the Northeast. Vacant housing is also often important in increasing the probability of the existence of a food desert, although the predicted odds ratios for dense urban tracts are not statistically significant.

Conclusion

Our study confirms poverty's primary role in the evolution of food deserts. Our statistical analyses build on previous research by examining the characteristics of food deserts defined for the first time on a national level. The analyses also provide additional insight by investigating changes in these

19

characteristics over time. Results from our descriptive analysis contrasting food desert tracts and other tracts support much of the previous research, concluding that minority status and poverty are more prevalent in areas with limited access to healthy and affordable food. Observation of three survey periods also illuminates stagnation of deprived conditions in food desert tracts. The persistence of low access and low income conditions in food deserts suggests that as community development and infrastructure investment are neglected, residents remain in impoverished states.

While our research finds a number of characteristics that are associated with low access and low income, econometric analysis isolates only a few of these as strong, consistent predictors of food deserts. Different factors are important in rural areas than in urban areas, and in very dense versus less dense urban areas. Overall, the most significant predictor of low access is concentrated poverty in a tract. This is true even as our set of tracts is limited to those already designated as low-income, implying that even among poor tracts, those with greater levels of poverty are more likely to be food deserts. The predictive strength of poverty rate is most easily observed among the set of densely-populated urban tracts, where other demographic factors are likely to be more uniform across tracts. As opposed to the poverty rate itself, changes in tract poverty rate are not statistically significant in most cases (although a decrease in the poverty rate greater than one standard deviation is associated with a higher probability of a food desert in less-dense urban areas). When viewed in conjunction with the importance of the poverty rate at a single point in time, this insignificance provides further argument for the persistent effects of poverty: a tract with high poverty rates at a given point is much more likely to be a food desert despite any changes in the poverty rate over time.

A slightly less important factor affecting food desert status is percent of minority population in a tract. Minority population is significant in rural and less dense urban areas, although not among very dense urban areas. These findings partially corroborate the conclusions from the econometric analysis in USDA 2009 and indicate that racial/ethnic aspects influence retail development across a wide range of neighborhoods.

Our findings also imply that low-income tracts in the Northeast are less vulnerable to problems of access than low-income tracts in any other region of the country. As described earlier, the HFFI food desert definition is based upon distance from the nearest grocery store. This may translate into relatively fewer food deserts in the Northeast where development is more densely distributed.

Identifying further characteristics that influence the development and persistence of food deserts across rural, urban, and very dense urban areas is difficult. In less-densely populated urban areas and in rural areas, economic and demographic heterogeneity from tract to tract obfuscates the most important causal factors of low access. For example, high vacant housing rates affect the probability of a food desert differently in rural areas than in less-dense urban areas, and they have a statistically insignificant effect in very dense urban areas. This suggests that abandoned property and movement of population is more detrimental to already dispersed rural populations. The insignificant impact of vacant housing rates in very dense urban areas is likely a result of a still highly-concentrated population.

Concentrated poverty and minority population emerge from our study as the critical factors in determining low access. As impoverished and minority populations are already more likely to have poor access to healthcare and proper recreation or fitness, limited access to healthy food may compound the effects of this deprivation. These environments, plagued with low income, low education levels, and low labor force participation may well be unattractive markets for supermarkets and grocery stores. Difficulty in training and retaining staff from such a population, as well as low demand resulting from poverty pose significant disincentives for retailers to operate in these areas. If profit potential to attract these retailers does not exist, effective policy may focus on lowering other barriers to access, such as providing better public transportation to enable access to retailers in surrounding areas or addressing education and employment shortcomings directly. Policies that emphasize community development and infrastructure investment in areas of concentrated poverty may also be effective options to remove barriers to food retail development and to create healthier living environments in these areas. Tailoring solutions to specific communities may be more efficient than a one-size-fits-all approach, as different infrastructure failures are at fault in urban areas than rural areas, and even in very densely-populated areas than in other areas. Recognizing these differences will be crucial to the success of any policy option.

Potential for future research exists in identifying connections between low access and poor health outcomes. Such a relationship is difficult to identify in a national-level study, as very little in the way of specific health data exists at such a level. Disentangling consumer's preferences regarding location and diet from market forces can also help further shape effective policy in addressing access problems.

ERS will soon be updating food access measures including the census tract measure of food deserts. Updated data will provide food desert measures at two points in time in addition to multiple years of population data. We can use these data to see how tracts that changed food desert status between years compare with those that did not experience a change in their status. This may help us understand better the determinants of food deserts. Multiple years of food access data will also provide useful longitudinal data to match with other longitudinal survey data on individuals and families to understand how food access affects well-being over time.

Table 1: Number and percentage of food desert status by rural and urban status and by NMTC status.

	Overall	Rural	Urban
Number of Food Desert Tracts	6,529	2,204	4,175
Number of NMTC Tracts	24,927	6,519	17,940
Total # of Tracts	64,999	13,827	50,784
Food Desert Tracts as % of NMTC Tracts	26.2%	33.8%	23.3%
Food Desert Tracts as % of Total Tracts	10.0%	15.9%	8.2%

*Totals for rural and urban sets exclude tracts with greater than 50% of the population living in group quarters, which eliminates 710 tracts – 116 rural and 594 urban.

Source: Authors' calculations using data from Census 1990 and Census 2000 data from National Change Database, and American Community Survey 2005-2009 data from US Census Bureau

Table 2: Mean Variables by Food Desert Status for Rural Tracts: 1990 Census, 2000 Census, and 2005-2009 ACS

Variable	1990			2000			2005-2009		
	FD=1	FD=0	% Difference	FD=1	FD=0	% Difference	FD=1	FD=0	% Difference
Total population	3,538.66	3,890.52	(0.09)	3,608.12	4,020.54	(0.10)	3,556.99	4,143.12	(0.14)
	(1878.267)	(1828.165)	0.03	(1858.598)	(1810.424)	0.03	(1984.479)	(2102.12)	(0.06)
Population density	0.59	0.59	(0.00)	0.56	0.48	0.15	N/A	N/A	N/A
	(1.229)	(3.211)	(0.62)	(1.091)	(1.078)	0.01	N/A	N/A	N/A
% Population in group quarters/institutions	0.03	0.02	0.06	0.03	0.03	0.14	0.03	0.03	0.08
	(0.0564)	(0.0509)	0.11	(0.0697)	(0.0575)	0.21	(0.073)	(0.066)	0.11
% Vacant housing units	0.19	0.14	0.28	0.18	0.14	0.30	0.22	0.17	0.31
	(0.139)	(0.132)	0.05	(0.128)	(0.12)	0.07	(0.137)	(0.125)	0.10
% Population non-Hispanic White	0.77	0.87	(0.12)	0.74	0.84	(0.13)	0.77	0.87	(0.11)
	(0.278)	(0.19)	0.46	(0.29)	(0.213)	0.36	(0.264)	(0.167)	0.58
% Population non-Hispanic Black/Afr American	0.11	0.07	0.54	0.11	0.07	0.55	0.11	0.07	0.53
	(0.206)	(0.147)	0.40	(0.211)	(0.15)	0.41	(0.211)	(0.15)	0.41
% Population Hispanic	0.06	0.04	0.70	0.08	0.05	0.53	0.09	0.07	0.38
	(0.16)	(0.107)	0.50	(0.173)	(0.122)	0.42	(0.18)	(0.134)	0.34
% Population minority	0.23	0.13	0.81	0.26	0.16	0.66	0.29	0.17	0.64
	(0.278)	(0.19)	0.46	(0.29)	(0.213)	0.36	(0.291)	(0.202)	0.44
% Population age 25+ w/educ less than HS diploma	0.36	0.31	0.16	0.28	0.23	0.20	0.21	0.18	0.19
	(0.122)	(0.12)	0.02	(0.112)	(0.104)	0.08	(0.107)	(0.095)	0.13
% Population age 25+ w/bachelor's degree or higher	0.10	0.13	(0.20)	0.12	0.15	(0.22)	0.14	0.17	(0.20)
	(0.0619)	(0.0778)	(0.20)	(0.0683)	(0.0886)	(0.23)	(0.081)	(0.098)	(0.17)
Median family income	$ 30,085.83	$ 36,688.39	(0.18)	$ 33,281.30	$ 40,698.43	(0.18)	$ 35,860.64	$ 42,550.44	(0.16)
	(6971.205)	(9265.964)	(0.25)	(6688.86)	(10407.65)	(0.36)	(8931.062)	(11301.7)	(0.21)
% Population w/income < poverty	0.24	0.16	0.46	0.21	0.14	0.50	0.20	0.15	0.34
	(0.118)	(0.093)	0.27	(0.108)	(0.08)	0.35	(0.108)	(0.083)	0.30
% Population age <18 below poverty	0.30	0.21	0.44	0.26	0.18	0.48	0.27	0.21	0.31
	(0.147)	(0.124)	0.19	(0.134)	(0.112)	0.20	(0.161)	(0.139)	0.16
% Population age 65+ below poverty	0.23	0.17	0.32	0.17	0.12	0.39	0.15	0.11	0.37
	(0.132)	(0.106)	0.25	(0.112)	(0.077)	0.45	(0.114)	(0.082)	0.39
% Individuals w/income<= 200% federal poverty line	0.51	0.40	0.28	0.47	0.36	0.31	0.47	0.38	0.24
	(0.126)	(0.13)	(0.03)	(0.123)	(0.122)	0.01	(0.138)	(0.132)	0.05
% Households receiving public assistance	0.12	0.08	0.42	0.12	0.09	0.39	0.03	0.02	0.38
	(0.078)	(0.0533)	0.46	(0.074)	(0.054)	0.37	(0.0436)	(0.024)	0.82
% Population age 16+ in civilian labor force and unemployed	0.09	0.07	0.32	0.08	0.06	0.37	0.05	0.04	0.13
	(0.0579)	(0.0401)	0.44	(0.0571)	(0.0383)	0.49	(0.037)	(0.025)	0.48
% Occupied housing units W/O vehicle access	0.11	0.09	0.24	0.09	0.08	0.25	0.06	0.05	0.15
	(0.075)	(0.063)	0.19	(0.0642)	(0.0538)	0.19	(0.0514)	(0.0479)	0.07
% Population age 16+ commuting <25mins to work	0.74	0.74	(0.01)	0.67	0.70	(0.03)	0.65	0.68	(0.03)
	(0.134)	(0.124)	0.08	(0.147)	(0.132)	0.11	(0.163)	(0.143)	0.14
% Population age 16+ commuting >=45 mins to work	0.10	0.10	0.06	0.14	0.13	0.11	0.15	0.13	0.10
	(0.0691)	(0.0629)	0.10	(0.085)	(0.072)	0.18	(0.096)	(0.081)	0.19
% Population commuting to work by private vehicle	0.85	0.89	(0.04)	0.88	0.91	(0.03)	0.88	0.90	(0.03)
	(0.098)	(0.073)	0.34	(0.084)	(0.059)	0.42	(0.088)	(0.069)	0.28
% Population commuting to work by public transport	0.01	0.01	0.22	0.01	0.01	0.19	0.01	0.01	0.05
	(0.0122)	(0.0174)	(0.30)	(0.0115)	(0.0103)	0.12	(0.0199)	(0.0161)	0.24
% Population commuting to work by foot/bike/other	0.08	0.06	0.31	0.06	0.04	0.35	0.11	0.09	0.29
	(0.0575)	(0.0504)	0.14	(0.0502)	(0.0431)	0.16	(0.086)	(0.066)	0.30
# Tracts	**2,211**	**11,476**		**2,204**	**11,472**		**2,202**	**11,451**	

*N/A indicates that a variable was not available for that data year. Standard errors are in parentheses.

Source: STATA t-test command output and authors' calculations of percentage differences

Table 3: Mean Variables by Food Desert Status for Urban Tracts: 1990 Census, 2000 Census, and 2005-2009 ACS

Variable	1990			2000			2005-2009		
	FD=1	FD=0	% Difference	FD=1	FD=0	% Difference	FD=1	FD=0	% Difference
Total population	4,679.15	5,082.05	(0.08)	4,111.47	4,447.19	(0.08)	4,204.80	4,834.18	(0.13)
	(3154.111)	(3459.29)	(0.09)	(2161.978)	(2186.521)	(0.01)	(2605.649)	(2986.424)	(0.13)
Population density	4.193	7.727	(0.46)	3.507	6.866	(0.49)	N/A	N/A	N/A
	(6)	(15.163)	(0.60)	(3.261)	(13.786)	(0.76)	N/A	N/A	N/A
% Population in group quarters/institutions	0.03	0.02	0.68	0.03	0.02	0.63	0.03	0.02	0.67
	(0.072)	(0.0475)	0.52	(0.072)	(0.0482)	0.49	(0.075)	(0.0517)	0.45
% Vacant housing units	0.11	0.08	0.42	0.10	0.07	0.52	0.15	0.10	0.53
	(0.079)	(0.0726)	0.09	(0.077)	(0.0673)	0.14	(0.095)	(0.0842)	0.13
% Population non-Hispanic White	0.57	0.75	(0.23)	0.48	0.68	(0.29)	0.56	0.72	(0.22)
	(0.329)	(0.293)	0.12	(0.322)	(0.309)	0.04	(0.299)	(0.265)	0.13
% Population non-Hispanic Black/Afr American	0.29	0.12	1.37	0.32	0.14	1.19	0.31	0.14	1.19
	(0.326)	(0.233)	0.40	(0.111)	(0.164)	(0.32)	(0.323)	(0.236)	0.37
% Population Hispanic	0.11	0.09	0.21	0.16	0.13	0.28	0.20	0.15	0.28
	(0.201)	(0.17)	0.18	(0.232)	(0.198)	0.17	(0.249)	(0.212)	0.17
% Population minority	0.43	0.25	0.69	0.52	0.32	0.60	0.56	0.36	0.53
	(0.329)	(0.293)	0.12	(0.322)	(0.309)	0.04	(0.313)	(0.308)	0.02
% Population age 25+ w/educ less than HS diploma	0.35	0.23	0.49	0.30	0.19	0.57	0.24	0.15	0.60
	(0.146)	(0.151)	(0.03)	(0.133)	(0.143)	(0.07)	(0.124)	(0.125)	(0.01)
% Population age 25+ w/bachelor's degree or higher	0.12	0.22	(0.47)	0.13	0.26	(0.51)	0.15	0.30	(0.49)
	(0.102)	(0.156)	(0.35)	(0.106)	(0.179)	(0.41)	(0.116)	(0.189)	(0.39)
Median family income	$ 33,770.05	$ 52,655.01	(0.36)	$ 33,709.76	$ 56,105.42	(0.40)	$ 34,250.95	$ 58,328.22	(0.41)
	(11418.21)	(22236.19)	(0.49)	(9849.384)	(25167.3)	(0.61)	(12809.35)	(27833.14)	(0.54)
% Population w/income < poverty	0.23	0.12	0.94	0.23	0.12	0.91	0.25	0.13	0.89
	(0.147)	(0.121)	0.21	(0.124)	(0.114)	0.09	(0.136)	(0.114)	0.19
% Population age <18 below poverty	0.31	0.15	1.01	0.30	0.15	1.01	0.34	0.17	1.00
	(0.191)	(0.165)	0.16	(0.164)	(0.151)	0.09	(0.196)	(0.175)	0.12
% Population age 65+ below poverty	0.18	0.11	0.61	0.15	0.10	0.59	0.15	0.10	0.57
	(0.134)	(0.1066)	0.26	(0.116)	(0.0983)	0.18	(0.132)	(0.113)	0.17
% Individuals w/income<= 200% federal poverty line	0.47	0.28	0.69	0.48	0.28	0.71	0.51	0.30	0.68
	(0.179)	(0.187)	(0.04)	(0.152)	(0.185)	(0.18)	(0.163)	(0.191)	(0.15)
% Households receiving public assistance	0.13	0.07	0.72	0.13	0.08	0.67	0.04	0.03	0.66
	(0.096)	(0.0855)	0.12	(0.085)	(0.083)	0.02	(0.043)	(0.0365)	0.18
% Population age 16+ in civilian labor force and unemployed	0.10	0.06	0.58	0.09	0.06	0.57	0.07	0.05	0.45
	(0.064)	(0.0531)	0.21	(0.06)	(0.0539)	0.11	(0.043)	(0.0323)	0.33
% Occupied housing units W/O vehicle access	0.17	0.12	0.38	0.16	0.12	0.33	0.11	0.09	0.24
	(0.137)	(0.161)	(0.15)	(0.118)	(0.151)	(0.22)	(0.0879)	(0.1257)	(0.30)
% Population age 16+ commuting <25mins to work	0.69	0.62	0.12	0.65	0.59	0.11	0.65	0.57	0.13
	(0.138)	(0.16)	(0.14)	(0.145)	(0.162)	(0.10)	(0.157)	(0.171)	(0.08)
% Population age 16+ commuting >=45 mins to work	0.10	0.13	(0.27)	0.13	0.16	(0.21)	0.12	0.16	(0.23)
	(0.074)	(0.1056)	(0.30)	(0.0855)	(0.1118)	(0.24)	(0.0941)	(0.118)	(0.20)
% Population commuting to work by private vehicle	0.87	0.85	0.02	0.88	0.85	0.03	0.87	0.84	0.03
	(0.111)	(0.164)	(0.32)	(0.099)	(0.162)	(0.39)	(0.111)	(0.171)	(0.35)
% Population commuting to work by public transport	0.05	0.07	(0.27)	0.05	0.07	(0.30)	0.05	0.07	(0.33)
	(0.0779)	(0.1354)	(0.42)	(0.0709)	(0.1323)	(0.46)	(0.0747)	(0.138)	(0.46)
% Population commuting to work by foot/bike/other	0.06	0.05	0.25	0.05	0.04	0.22	0.08	0.08	(0.05)
	(0.067)	(0.0607)	0.10	(0.058)	(0.0578)	0.00	(0.077)	(0.0715)	0.08
# Tracts	4,197	46,331		4,175	46,316		4,166	46,320	

*N/A indicates variable was not available for that data year. Standard errors are in parentheses.

Source: STATA t-test command output and authors' calculations of percentage differences

Table 4: Changes in Mean Statistics by Food Desert Status for Rural Tracts, 1990-2005/09

	FD=1						FD=0					
	1990-2000		2000-2009		1990-2009		1990-2000		2000-2009		1990-2009	
Variable	Level Change	% Change	Level Change	% Change	Level Change	% Change	Level Change	% Change	Level Change	% Change	Level Change	% Change
Total population	64.12	1.8%	(44.76)	-1.2%	20.64	0.6%	143.01	3.7%	118.49	2.9%	262.86	6.8%
Population density	(0.04)	-6.4%	N/A	N/A	N/A	N/A	(0.10)	-17.2%	N/A	N/A	N/A	N/A
% Population in group quarters/institutions	0.01	27.0%	(0.00)	-0.2%	0.01	24.7%	0.00	18.4%	0.00	3.7%	0.01	23.4%
% Vacant housing units	(0.00)	-1.4%	0.03	18.6%	0.03	16.7%	(0.00)	-2.7%	0.02	17.6%	0.02	14.6%
% Population non-Hispanic White	(0.03)	-4.2%	0.04	4.8%	0.00	0.4%	(0.03)	-3.4%	0.02	2.1%	(0.01)	-0.9%
% Population non-Hispanic Black/Afr American	0.01	6.3%	(0.00)	-1.5%	0.00	4.3%	0.00	5.9%	(0.00)	-1.1%	0.00	5.5%
% Population Hispanic	0.02	28.5%	0.01	14.1%	0.03	47.1%	0.02	43.9%	0.01	24.6%	0.03	82.0%
% Population minority	0.03	14.0%	0.02	8.4%	0.05	23.4%	0.03	22.8%	0.02	16.2%	0.05	39.9%
% Population age 25+ w/educ less than HS diploma	(0.08)	-23.2%	(0.06)	-22.1%	(0.14)	-40.2%	(0.08)	-25.4%	(0.05)	-22.0%	(0.13)	-41.8%
% Population age 25+ w/bachelor's degree or higher	0.02	18.2%	0.02	15.7%	0.04	36.9%	0.03	21.4%	0.02	13.1%	0.05	37.4%
Median family income	$ 3,209.36	10.7%	$ 2,540.86	7.6%	$ 5,739.83	19.1%	$ 4,074.95	11.1%	$ 1,417.03	3.4%	$ 5,742.10	15.6%
% Individuals w/income<poverty	(0.03)	-12.6%	(0.00)	-1.9%	(0.03)	-14.3%	(0.02)	-14.7%	0.01	9.4%	(0.01)	-6.6%
% Population age <18 below poverty	(0.03)	-11.2%	0.01	3.5%	(0.02)	-8.1%	(0.03)	-13.3%	0.03	15.4%	0.00	0.8%
% Population age 65+ below poverty	(0.06)	-27.7%	(0.01)	-8.6%	(0.08)	-33.7%	(0.05)	-31.0%	(0.01)	-8.2%	(0.06)	-36.0%
% Individuals w/income<= 200% federal poverty line	(0.05)	-9.1%	0.00	0.1%	(0.05)	-9.0%	(0.05)	-11.4%	0.02	6.2%	(0.02)	-5.9%
% Households receiving public assistance	(0.00)	-0.9%	(0.09)	-71.7%	(0.09)	-72.0%	0.00	1.9%	(0.06)	-71.9%	(0.06)	-71.2%
% Population age 16+ in civilian labor force and unemployed	(0.01)	-11.7%	(0.03)	-40.5%	(0.04)	-47.4%	(0.01)	-15.0%	(0.02)	-28.5%	(0.03)	-38.8%
% Occupied housing units W/O vehicle access	(0.01)	-12.5%	(0.03)	-34.1%	(0.05)	-42.4%	(0.01)	-12.6%	(0.02)	-27.6%	(0.03)	-37.2%
% Population age 16+ commuting <25mins to work	(0.06)	-8.3%	(0.02)	-3.1%	(0.08)	-11.1%	(0.05)	-6.4%	(0.02)	-2.8%	(0.07)	-9.0%
% Population age 16+ commuting >=45 mins to work	0.04	36.9%	0.01	3.7%	0.04	41.6%	0.03	31.1%	0.00	3.6%	0.03	35.9%
% Population commuting to work by private vehicle	0.03	3.6%	(0.00)	-0.2%	0.03	3.3%	0.02	2.4%	(0.01)	-0.6%	0.02	1.8%
% Population commuting to work by public transport	(0.00)	-10.1%	(0.00)	-14.3%	(0.00)	-17.8%	(0.00)	-3.5%	0.00	3.0%	(0.00)	-1.4%
% Population commuting to work by foot/bike/other	(0.02)	-24.4%	0.06	95.8%	0.04	48.5%	(0.02)	-26.5%	0.05	103.7%	0.03	50.9%

*Gray shading indicates change is statistically insignificant. N/A indicates variable not available for that data year.

Source: STATA t-test command output and authors' calculations of percentage differences

Table 5: Changes in Mean Statistics by Food Desert Status for Urban Tracts, 1990-2005/09

Variable	FD=1						FD=0					
	1990-2000		2000-2005/09		1990-2005/09		1990-2000		2000-2005/09		1990-2005/09	
	Level Change	% Change	Level Change	% Change	Level Change	% Change	Level Change	% Change	Level Change	% Change	Level Change	% Change
Total population	(566.23)	-12.1%	92.91	2.3%	(479.93)	-10.2%	(632.02)	-12.4%	387.32	8.7%	(245.33)	-4.8%
Population density	(0.69)	-16.4%	N/A	N/A	N/A	N/A	(0.86)	-11.1%	N/A	N/A	N/A	N/A
% Population in group quarters/institutions	0.00	8.8%	(0.00)	-4.3%	0.00	2.9%	0.00	5.9%	(0.00)	-9.6%	(0.00)	-3.8%
% Vacant housing units	(0.01)	-8.0%	0.05	45.4%	0.04	33.2%	(0.01)	-13.9%	0.03	44.4%	0.02	24.2%
% Population non-Hispanic White	(0.09)	-15.8%	0.07	15.4%	(0.02)	-3.0%	(0.07)	-9.5%	0.04	6.0%	(0.03)	-4.0%
% Population non-Hispanic Black/Afr American	0.03	11.2%	(0.00)	-1.5%	0.03	9.6%	0.02	16.1%	0.00	2.4%	0.02	19.1%
% Population Hispanic	0.05	44.8%	0.03	20.1%	0.08	74.1%	0.03	37.3%	0.02	19.2%	0.06	63.9%
% Population minority	0.09	21.3%	0.04	7.9%	0.13	31.1%	0.07	28.3%	0.04	13.5%	0.11	45.8%
% Population age 25+ w/educ less than HS diploma	(0.05)	-13.2%	(0.06)	-19.1%	(0.10)	-29.7%	(0.04)	-20.5%	(0.04)	-20.5%	(0.08)	-34.5%
% Population age 25+ w/bachelor's degree or higher	0.01	9.8%	0.02	15.8%	0.03	27.2%	0.04	18.2%	0.03	12.0%	0.07	32.3%
Median Family Income	$ (45.99)	-0.1%	$ 321.94	1.0%	$ 352.46	1.0%	$ 3,436.46	6.5%	$ 2,015.88	3.6%	$ 5,466.73	10.3%
% Individuals w/income<poverty	(0.00)	-0.6%	0.02	8.8%	0.02	7.8%	0.00	0.8%	0.01	9.8%	0.01	10.7%
% Population age <18 below poverty	(0.01)	-2.8%	0.04	14.5%	0.03	11.1%	(0.00)	-2.7%	0.02	14.2%	0.02	11.4%
% Population age 65+ below poverty	(0.03)	-14.2%	0.00	0.4%	(0.03)	-14.0%	(0.01)	-13.2%	0.00	1.9%	(0.01)	-11.5%
% Individuals w/income<= 200% federal poverty line	0.01	2.1%	0.03	7.3%	0.04	9.4%	0.00	0.6%	0.03	9.2%	0.03	9.9%
% Households receiving public assistance	0.01	5.6%	(0.09)	-67.4%	(0.08)	-65.5%	0.01	8.7%	(0.05)	-67.2%	(0.05)	-64.3%
% Population age 16+ in civilian labor force and unemployed	(0.01)	-7.4%	(0.02)	-25.6%	(0.03)	-31.2%	(0.00)	-7.0%	(0.01)	-19.6%	(0.02)	-25.1%
% Occupied housing units W/O vehicle access	(0.01)	-6.3%	(0.04)	-26.1%	(0.05)	-31.0%	(0.00)	-3.0%	(0.03)	-21.5%	(0.03)	-24.0%
% Population age 16+ commuting <25mins to work	(0.04)	-5.7%	(0.01)	-0.9%	(0.04)	-6.5%	(0.03)	-5.3%	(0.01)	-2.3%	(0.05)	-7.5%
% Population age 16+ commuting >=45 mins to work	0.03	28.9%	(0.00)	-1.3%	0.03	26.8%	0.03	19.5%	0.00	1.0%	0.03	20.8%
% Population commuting to work by private vehicle	0.01	1.3%	(0.01)	-1.0%	0.00	0.2%	0.00	0.4%	(0.01)	-1.5%	(0.01)	-1.1%
% Population commuting to work by public transport	(0.00)	-5.0%	(0.00)	-1.7%	(0.00)	-7.1%	(0.00)	-1.9%	0.00	2.4%	0.00	0.4%
% Population commuting to work by foot/bike/other	(0.01)	-16.6%	0.03	55.5%	0.02	29.8%	(0.01)	-14.8%	0.04	96.9%	0.03	67.7%

*Gray shading indicates change is not statistically significant. N/A indicates variable was not available for that data year.

Source: STATA t-test command output and authors' calculations of percentage differences

Table 6: Logistic Regression Odds Ratios and 95% Confidence Intervals for Rural New Market Tax Credit Tracts

RURAL NMTC TRACTS	Basic Model: All Rural Tracts	Basic Model w/Demographic Change: All Rural Tracts	Basic Model w/Demographic & Economic Change: All Rural Tracts
Median family income	0.99	0.991	0.992
	(0.979 - 1.000)	(0.981 - 1.001)	(0.982 - 1.003)
% Vacant housing units	14.152**	14.844**	14.361**
	(8.532 - 19.773)	(8.756 - 20.933)	(8.454 - 20.269)
% Population minority	2.351**	2.442**	2.346**
	(1.816 - 2.886)	(1.858 - 3.025)	(1.776 - 2.916)
% Population age 16+ in civilian labor force and unemployed	0.027**	0.028**	0.027**
	(-0.006 - 0.060)	(-0.006 - 0.062)	(-0.006 - 0.059)
% Individuals w/income<poverty	3.312*	3.176*	3.434*
	(0.628 - 5.997)	(0.596 - 5.755)	(0.543 - 6.326)
West Census Region	2.574**	2.685**	2.658**
	(2.046 - 3.101)	(2.125 - 3.246)	(2.102 - 3.213)
Midwest Census Region	2.827**	2.864**	2.787**
	(2.308 - 3.347)	(2.337 - 3.392)	(2.268 - 3.306)
South Census Region	1.270*	1.305*	1.278*
	(1.023 - 1.517)	(1.049 - 1.561)	(1.025 - 1.530)
Population density	0.981	0.982	0.982
	(0.942 - 1.019)	(0.943 - 1.021)	(0.944 - 1.021)
Substantial increase in population		0.889	0.888
		(0.794 - 0.984)	(0.793 - 0.983)
Substantial decrease in population		1.012	1.012
		(0.877 - 1.147)	(0.877 - 1.148)
Substantial increase in % minority		0.906	0.921
		(0.785 - 1.027)	(0.795 - 1.048)
Substantial decrease in % minority		1.454	1.418
		(0.949 - 1.960)	(0.924 - 1.912)
Substantial increase in poverty rate			1.045
			(0.845 - 1.244)
Substantial decrease in poverty rate			1.125
			(1.006 - 1.244)
Observations	6519	6519	6519

95% confidence intervals in parentheses
* significant at 5%; ** significant at 1%

Source: STATA regression output using Census 2000 and Census 1990 data from National Change Database

Table 7: Logistic Regression Odds Ratios and 95% Confidence Intervals for Urban New Market Tax Credit Tracts

URBAN NMTC TRACTS	Basic Model: All Urban Tracts	Basic Model: Less-Dense Urban Tracts	Basic Model: Very Dense Urban Tracts	Basic Model w/Demographic Change: Less-Dense Urban Tracts	Basic Model w/Demographic Change: Very Dense Urban Tracts	Basic Model w/Demographic & Economic Change: Less Dense Urban Tracts	Basic Model w/Demographic & Economic Change: Very Dense Urban Tracts
Median family income	1.003 (0.998 - 1.007)	1.003 (0.998 - 1.007)	1.01 (0.985 - 1.036)	1.003 (0.999 - 1.008)	1.014 (0.988 - 1.041)	1.003 (0.998 - 1.007)	1.017 (0.990 - 1.044)
% Vacant housing units	0.532* (0.291 - 0.774)	0.504* (0.273 - 0.735)	47.657 (-107.830 - 203.144)	0.542* (0.289 - 0.795)	55.841 (-135.670 - 247.352)	0.568* (0.302 - 0.834)	15.333 (-37.553 - 68.219)
% Population minority	1.472** (1.287 - 1.656)	1.550** (1.353 - 1.747)	0.508 (-0.030 - 1.045)	1.526** (1.329 - 1.723)	0.637 (-0.064 - 1.338)	1.562** (1.357 - 1.767)	0.646 (-0.093 - 1.385)
% Population age 16+ in civilian labor force and unemployed	0.354** (0.130 - 0.578)	0.372* (0.134 - 0.609)	0.015 (-0.054 - 0.083)	0.374* (0.132 - 0.616)	0.021 (-0.079 - 0.121)	0.378* (0.134 - 0.622)	0.009 (-0.033 - 0.051)
% Individuals w/income<poverty	0.92 (0.555 - 1.284)	0.805 (0.481 - 1.128)	37.608** (-43.978 - 119.193)	0.858 (0.510 - 1.206)	44.670** (-52.237 - 141.576)	0.851 (0.496 - 1.205)	116.650** (-142.253 - 375.553)
West Census Region	0.754** (0.668 - 0.841)	0.735** (0.649 - 0.821)	3.137** (1.177 - 5.096)	0.742** (0.654 - 0.830)	3.446** (1.163 - 5.729)	0.743** (0.655 - 0.831)	3.550** (1.214 - 5.887)
Midwest Census Region	1.049 (0.937 - 1.161)	1.028 (0.916 - 1.140)	2.925** (0.936 - 4.914)	1.025 (0.913 - 1.137)	2.903** (0.928 - 4.879)	1.037 (0.923 - 1.151)	2.062 (0.618 - 3.506)
South Census Region	1.150* (1.030 - 1.269)	1.113 (0.996 - 1.231)	4.760** (1.412 - 8.108)	1.117 (0.999 - 1.235)	4.893** (1.434 - 8.351)	1.12 (1.001 - 1.238)	4.544** (1.311 - 7.777)
Population density	0.825** (0.817 - 0.833)	0.820** (0.810 - 0.829)		0.818** (0.808 - 0.827)	Omitted Omitted	0.817** (0.808 - 0.827)	Omitted Omitted
Substantial increase in population 1990-2000				0.924 (0.849 - 1.000)	0.425* (0.153 - 0.698)	0.927 (0.851 - 1.003)	0.418* (0.150 - 0.686)
Substantial decrease in population 1990-2000				0.995 (0.918 - 1.071)	0.591 (0.261 - 0.922)	0.997 (0.921 - 1.074)	0.58 (0.255 - 0.905)
ǂSubstantial increase in % minority 1990-2000				1.051 (0.980 - 1.123)	1.512 (0.735 - 2.289)	1.04 (0.967 - 1.114)	1.950* (0.903 - 2.996)
Substantial decrease in % minority 1990-2000				0.586** (0.416 - 0.756)		0.598** (0.424 - 0.772)	Omitted Omitted
Substantial increase in poverty rate 1990-2000						0.985 (0.900 - 1.071)	0.461 (0.127 - 0.796)
Substantial decrease in poverty rate 1990-2000						0.908 (0.828 - 0.989)	3.127** (1.396 - 4.858)
Observations	17940	14383	3557	14383	3557	14383	3557

95% confidence intervals in parentheses

* significant at 5%; ** significant at 1%

ǂ Substantial change in either direction for very dense urban tracts

Source: STATA regression output using Census 2000 and Census 1990 data from National Change Database

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Key Terms
Food desert A census tract which meets both low-income and low-access criteria including: 1)poverty rate>= 20% OR median family income <= 80% statewide (rural/urban) or metro-area (urban) median family income; and 2)at least 500 people or 33% of the population located more than 1 mile (urban) or 10 miles (rural) from the nearest supermarket or large grocery store. **Low-income area** A tract in which the poverty rate is greater than or equal to 20%; or in which median family income does not exceed 80% of the statewide or metro-area median family income **Low-income household** A household with income less than the federal poverty level **Rural area** Includes areas defined by Rural-Urban Commuting Area codes as large rural, small rural, and isolated rural areas