Food Deserts and Obesity in the American South: Retail Service Trends in Rural and Metropolitan Areas

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Abstract

Obesity rates in the United States have been climbing. One potential cause of this epidemic is food desertification: the process of grocery store consolidation in the rural United States and flight from urban areas. We look at the number of grocery stores, obesity rates, and income levels by county in the American South. Food desertification is related to obesity levels, but further research must be done to fully understand the connection.

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I. Introduction

Obesity, which was classified as an epidemic by the US surgeon general over ten years ago[1], is still one of the most pressing public health issues that the United States faces. There isn't a state in the American South that has obesity rates of less than 20%, with most over 30%. Obesity affects some populations disproportionately; for example, obesity rates are higher among nonwhite women, African Americans and Hispanic individuals[2]. Additionally, obesity has consequences that extend beyond health issues. Economically speaking, obesity has cost the United States over $110 billion in treatment costs and lost wages[3].Since obesity is not only a pressing health issue, but also an area of concern economically for the United States, policymakers should be looking at ways to prevent the constant increase in obesity rates.

One potential cause of obesity that has gained attention in the last ten years is an associated trend of food desertification. A food desert is an area in which there is limited access to affordable food[4]. The term was first used in reference to the United Kingdom, but has since been applied to many areas of the United States. Although the definition implies that barriers of any kind can create a food desert, they are generally caused by geographic barriers to access. The intuition is that as food deserts are created the cost of a food item is increased by the transportation costs spent attaining that food item. Another consequence of food desertification is that residents who cannot easily travel to a supermarket will substitute potentially healthier food items they would have purchased at that supermarket with items from convenience stores. While convenience stores may be geographically closer to residents of a food desert, the items available in those establishments tend to be less nutritionally balanced: high in calories and low in nutrition.

In order to combat food desertification, we must also look at why the phenomena is occurring. One trend that is contributing to food desertification in the United States is the influx of supercenters. As these large-scale establishments move in to an area, smaller scale establishments lose business and are forced out. After that happens, residents may find themselves in a food desert.

In this paper, we will focus on the connection between food deserts and obesity. We assume an economic model of budget constraint, varying between food deserts and non-food deserts. In order to test our hypothesis we look at county level obesity and income levels and business patterns. We assume that obesity levels depend on both the number of grocery stores in a county and the general income level of that county. We use income as an independent variable because it is so closely correlated with other variables that may be related to obesity. We find that the number of grocery stores may have a causal relationship with obesity, but that income levels have no clear relation to obesity, despite existing research that confirmed a relationship.

II. Literature Review

As the economic landscape of the United States changes, so too does the retail food landscape. One particularly common trend, especially in rural areas is for large "supercenter" establishments to move into an area and distance residents from food retail establishments. Blanchard (2002) looks at this trend. Many populations will be adversely affected by this process, in particular those without access to private transportation, low income individuals, disabled individuals, and the elderly. The effects of supercenters should be focused on in a rural context because nearly three fourths of supercenters are located in non-metropolitan areas. In terms of access to grocery stores in the South, nearly a quarter of residents of the South live more than ten miles from a grocery store. As supercenters continue to locate in new areas, further food desertification takes place. Now that food retail services have become a sort of economy of scale, not all consumers will benefit from the consolidation of those establishments. Blanchard also addresses the savings that supercenter establishments like Wal-Mart can offer. Although they do sometimes provide food at a lower cost, the travel cost may offset these savings.

Food accessibility (and similarly affordability and availability) are related to dietary intake[5]. Though this particular research focuses on the diets of pregnant women, the underlying intuition holds: when grocery stores are prohibitively far away from residents of an area, their diets degrade as they are forced to shop exclusively at convenience stores, where their only choices are low in nutritional content and high in calories. The intricacies of the relationship between retail food environments and diets in

an area are not entirely understood yet, just the dietary outcomes. Similar studies have been done that look at the effects of retail food service environments on the diets of schoolchildren in an area. Schafft (2009) looked at the effects on schoolchildren in Pennsylvania, and Lewis (2006) looked at the effects on schoolchildren in Georgia[6]. In the case of Georgia, residents of rural areas were at a higher risk of obesity than those in suburban and urban areas of the state. In Shafft's analysis of Pennsylvania (2009), food desertification contributed to incidences of overweight in schoolchildren, but other aspects of those food deserts also contributed: poverty rates, limited access to grocery stores, a lack of alternate transportation (preventing them from engaging in sports and other extracurriculars). Liese (2007) drew similar results to those of Lewis in the case of South Carolina: rural residents face more limited access to healthy foods than those of urban areas. However, Liese examined the kinds of foods offered at certain establishments in more detail. The availability of both fresh produce and of low fat versions of certain foods was considered[7].

Kimberly Morland has also done extensive research into this relationship between food retail environments, the neighborhoods in which they are located, and diet quality in those areas[8]. In her 2002 article, she looks at the departure of supermarkets from low-income areas. This effect is exacerbated by the fact that many residents of such areas don't have access to private transportation that would allow them to continue to purchase their groceries from supermarkets, supercenters, or the like. Morland (2002) concludes that low-income neighborhoods that are predominantly black have the lowest access to produce, and poorer diets than residents of higher socio-economic areas. The connection between low-income levels and increased rates of obesity has been independently established[9].

Unlike in some of her other works cited in this paper, in her 2006 work, Morland looks exclusively at the relationship between retail food environments and obesity rates[10]. She determines that there is both a causal relationship between food environments and obesity. She mentions specifically that an increased number of convenience stores in an area contributes to obesity levels in that area. In her 2009 article, she looks at suburban retail food service environments and concludes, once again, through a cross sectional study that a causal relationship between retail food service environments can be related to

the diets of residents. In fact, the presence of a supermarket in such a suburban environment lowers obesity by .7%[11].

In her 2007 work, Powell states that increased availability of chain supermarkets increases consumption of fruits and vegetables[12]. Generally speaking, for each additional supermarket, she finds that BMI in resident adolescents falls .11 on average, and the rates of overweight adolescents falls 0.6%. Interestingly enough, this only holds for chain supermarkets. Non-chain supermarkets were not statistically significantly correlated in any way with the weight of adolescents. On the other hand, for each additional convenience store, BMI increases 0.03 and the percent of overweight adolescents increases by 0.2%. These results were only for adolescents, however, and we would be interested to see if theyw ould hold for the poplation at large.

On the other hand, not all of the research suggests that food deserts are correlated to lower consumption of produce[13]. In this British study, results concluded that food deserts didn't change the diet of residents. In fact, lacking access to private transportation did not cause subjects to consume any less produce than their mobile counterparts. Pearson indicated that dietary choices depended on socio-cultural attitudes rather than food accessibility and that government policies should be aimed at changing those attitudes rather than retail food service environments. However, the results of this particular study rely on self-reports of produce intake, which may not be reliable. Additionally these effects may not hold true in the United States.

Ford and Dzewaltowski mentioned at the conclusion of their 2008 paper that they would like to see a hypothesis that looks at the relationship between income, retail food environments, and obesity rates. For this reason, I am studying the causes of obesity to find out if increasing the number of grocery stores in an area lowers the rates of obesity in that area because obesity is one of the largest public health crises in the United States and is growing at particularly alarming rates in the American South.

III. Economic Model

In order to analyze the relationship between obesity and food deserts, we must first model the relationship. First, we consider a budget constraint model of consumer theory in which there are two budget curves: one for residents of a food desert and one for residents of "normal areas" (areas in which food desertification has not occurred. We

assume that two individuals, with the same income, but with different access to grocery stores, will have different budget curves. We will consider that there are only two goods to choose from: packaged junk foods or a produce item. We assume that produce items in food deserts are more expensive, so individuals in food deserts will be able to purchase less of that good at any given mixture of the two (at any point along the budget curve. However, we assume that the prices of packaged junk foods will be the same in the two environments. We have provided a graphical representation of these assumptions in Figure 1. Based on this model, we hypothesize that as the number of grocery stores in a county falls (and the median income in that county falls) the rates of obesity will rise.

IV. Empirical Strategy

A. Econometric Model

We assume that the economics of food deserts can be modeled as a budget constraint (see Figure 1). Assuming two individuals with the same level of income, the resident of a food desert experiences higher prices on produce (due to transportation among other barriers), than the resident of a normal model. We will now find a way to test our hypothesis using an testable econometric model. In this model we will include obesity (as the dependent variable, number of grocery stores in an area, and median income levels of an area.

Assuming obesity is a function of food desertification, varying income levels, and other county specific effects, we estimate a linear model:

$$y_{it} = \alpha_i + \beta_1 x_{it} + \beta_2 x_{it} + u_{it}$$

Where *y* is the level of obesity in county i during year t, α accounts for county specific effects we will be unable to measure, β 1 and 1 are the parameters we area looking to measure: number of grocery stores in county i during year t and obesity levels in county i during year t, and *u* is the error term. We will use the following data to estimate our chosen parameters.

B. Description of Data

Before collecting data, we decided to analyze only states that are considered part of the American South. According to the US Census Bureau, the South includes: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina,

South Carolina, Tennessee, Texas, Virginia, West Virginia. The Census Bureau also includes the District of Columbia, but for the purposes of our research we are excluding that particular state. The findings for the District of Columbia would be incomplete without considering the outlying counties in Maryland and Virginia, which would already be considered independently within those respective states. We collected data on obesity rates, income levels, and the number of grocery stores in each county for all of the above states.

Obesity data was taken from the Center for Disease Control and Prevention (CDC)[14]. Data on obesity rates is collected as a part of the National Health and Nutrition Examination Survey (NHANES). This examination is overseen by the National Center for Health Statistics (NCHS), which is a division of the (CDC) and a part of the US Department of Health and Human Services (DHHS).

Income level and grocery store information were taken from projects of the US Census Bureau. The income level statistics were collected by the Small Area Income and Poverty Estimates program (SAIPE), within the Census Bureau[15]. The number of grocery stores per county in the United States can be found in the County Business Pattern data provided by the US Census[16]. All retail industries are classified according to the North American Industry Classification System (NAICS) codes. We chose median income as our second descriptive variable because it is highly correlated with other determinants of obesity. Median income level of a county should also reflect the percentage of minorities in the population of that county, the graduation rates of that county, and the number of mobile homes in that county—all of which could be related to obesity rates in an area.

These data area not perfect. Although it would be impossible to obtain, ideally we would determine whether or not food desertification was occurring by finding out where each resident shopped and how far from their home that establishment is located. Since this would be impossible, we have chosen to look at the number of grocery stores in a county and how that number either increases or decreases every two years. Some inconsistencies will result from the variable sizes of counties, the frequency with which grocery stores open and close, and the lack of information about what size each establishment is. Variable county size means that although the number of grocery stores

may be significantly smaller or larger than in a neighboring county, the number of grocery stores per square mile may be comparable. Ideally we would be able to take measurements more frequently than every two year, because such a length of time is long in a food retail establishment landscape, and many grocery stores or supermarkets could have opened and/or closed in that time. Without knowing what size each grocery store is, we are unable to categorize it is a grocery store, supermarket, or supercenter. We are mostly satisfied with our information about obesity rates and income. Although we are limited by the same two year gap as before with grocery stores, we believe that we have reliable estimates for the general adult population from the US Census Bureau. Obesity generally is not measured for those younger than adults: the correct term in that case is "overweight" according to the CDC (Powell 2007). Income levels for adolescents are also unimportant to us as they do not determine obesity levels. Obesity rates, income levels, and the number of grocery stores (not including convenience stores) collected at the county level for the aforementioned states for the years 2004, 2006, 2008, and aggregated into one data set.

C. Results

Since the trends for food desertification and retail food environments vary between rural and urban areas, we divided the data set into counties that contained metropolitan statistical areas (MSA) and those that did not. MSA, defined by the US Office of Management and Budget, are used by the US Census Bureau. They are areas with a densely populated core with economic connections in the area. Although they might not be considered rural tracts by the US Census Bureau, all counties that area not MSA are considered rural counties within this paper.

We elected to use panel regressions with obesity as our independent variable and the number of grocery stores per county and median income of a county as our dependent variables. We ran a fixed effects regression and a regression in which we included dummy variables for each state involved in the study. The following are our results.

Table 1 contains the information we discovered for metropolitan counties in the South. All of our results in that table are significant at the 99% level with the exception of the values for income in the regression using dummy variables for each state; those values are statistically insignificant. We find in metropolitan counties that obesity and the

number of grocery stores in a county are correlated in the direction we expected, however, income is correlated in a fixed effects regression, but in the opposite direction. The coefficient on the number of grocery stores per county in the fixed effects regression is -0.03, while that of income is 0.0002. Although the value of the coefficient is quite low, it doesn't have the anticipated sign. In the regression which included state level dummy variables, the information for income levels is insignificant, but we see that the coefficient for grocery stores has the sign we expected: -0.01.

Table 2 contains information for rural counties in the American South. All of the information in that table is significant at the 99% level. Regressions both with and without fixed effects yield somewhat robust results. The regression with fixed effects, but no state level dummy variables yielded a coefficient of -0.25 for the number of grocery stores in an area and a coefficient of 0.0005 for income levels in an area. Similar to our results with metropolitan counties, we see that although income is statistically significant, the relationship is the opposite of what we had anticipated, since the sign on the coefficient is positive. However, the results are unlike those for metropolitan counties because the coefficient on grocery stores is so much higher. Overall, we hypothesized correctly that the number of grocery stores in an area is negatively correlated with obesity rates in an area, and our results are significant, but we were incorrect in our assumption about the relationship between income levels and obesity rates.

D. Interpretation

Most of the results aligned with what we had expected: obesity levels are determined both by food desertification and income. The effects on obesity rates did differ between metropolitan and rural counties. In metropolitan areas, income didn't seem to be correlated with obesity rates, and in the case that it did seem to be related, the relationship was in the opposite direction than anticipated; when income rose, so did obesity rates (but to a limited degree). So, although income levels were correlated with obesity rates, we had assumed the wrong direction.

In rural counties, the relationship between grocery stores and obesity rates was much stronger. Additionally, there was a clear connection between income levels and obesity rates, however the relationship was opposed to what we had anticipated. Once again we saw that when income levels rose, so did obesity, however the relationship was nowhere

near as strong as that of obesity rates and the number of grocery stores in a county. Its also important to note that our results for rural counties, although not any more statistically significant than for metropolitan areas, were more robust.

Since none of our R squared values were above 0.5, there is obviously room for improvement in the quality of our results; they could be much more robust. Future studies could improve their results by including more independent variables that describe obesity trends.

V. Conclusion and Directions for Further Research

The number of grocery stores available to a population, and consequently the amount of healthy food (ie produce) available to that population does seem to affect the rates of obesity within that population. There are several possible policy implications associated with these findings. Strategies for the prevention of food desertification differ between rural and metropolitan areas. In rural areas, it would be more effective to ensure that grocery stores and supermarkets don't leave an area, even when a supercenter moves in. State and local governments could either block the entry of such supermarkets, or provide assistance in the form of tax breaks or other incentives to smaller businesses that may serve a population that wouldn't be sufficiently served by a larger but less accessible supercenter. In metropolitan areas, however, the strategy may be different. In recent history, local governments have successfully attracted supercenters to more densely populated but underserved urban areas in order to reverse food desertification in that area. In the case of metropolitan areas, the challenge lies not in preventing supermarkets and grocery stores from leaving, but in attracting those types of retail facilities to areas that they may consider dangerous or unprofitable.

One of the limitations of this research was our inability to measure each resident's distance from a grocery store. One way to conduct such research would be to use Geographic Information Systems (GIS) software, such as ARCVIEW to determine how far residents of a particular area are from the nearest grocery store, similar to the methodology used by Blanchard for his 2002 paper.

Further research could also consider the interactions of other independent variables that may affect obesity rates such as the racial makeup of a county, graduation rates of a county, general physical activity levels. Although the inclusion of some of the

above mentioned variables would improve the quality of the research, there are also some cultural effects that cannot be measured. Dietary habits vary across regions of the United States, some of which undoubtedly have effects on obesity rates. In the South, it is likely that those effects would be especially pronounced. Food traditions in the South tend to be especially high in calories: fried food, foods that are flavored with pork fats, foods that are high in sugar are all popular in the South. Despite the need for future research, this study does find that preventing food desertification in the American South may have positive outcomes with respect to obesity rates in that region.

VI. References

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VII. Tables

Table 1:

	Number of Grocery Stores	Median Income	
With Fixed Effects			R-sq = 0.27
Coefficient	-0.03***	0.0002***	
Standard Deviation	0..01***	0.00001***	
t-value	-2.89***	23.97***	
With State Dummy Vars			R-sq = 0.11
Coefficient	-0.01***	Statistically Insignificant	
Standard Deviation	0.002***	Statistically Insignificant	
z-value	-8.28***	Statistically Insignificant	

Table 2:

	Number of Grocery Stores	Median Income	
With Fixed Effects			R-sq = 0.49
Coefficient	-0.25***	0.0005***	
Standard Deviation	0.05***	0.00001***	
t-value	-5.48***	29.19***	
With State Dummy Variables			R-sq = 0.49
Coefficient	-0.15***	0.0001***	
Standard Deviation	0.03***	0.00001***	
z-value	-5.05***	11.89***	

VIII. Figures

Figure 1: