Measuring the Likelihood of Food Insecurity in Ohio's "Food Deserts"

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By all accounts, the U.S. is a rich and powerful nation, with which come attributes that often blind us to some of the more intractable problems of our society, such as hunger and inadequate access to healthful and nutritious food (food insecurity). As a nation we spend less than 10 percent of our disposable income on food (USDA 2009), yet statistics for 2007 show that 37.3 million Americans lived in poverty and 36.2 million lived in food insecure households (USDA 2009). Within, and perhaps beyond, these dreadful statistics are communities that have come to be known as "food deserts," which are, by definition, lacking in the supply of retail food stores except for perhaps convenience stores and small mom-and-pop stores. Food prices are often higher at these outlets and these higher prices serve to further aggravate conditions of poverty and food insecurity.

Food insecurity implies that a household suffers from a continuous lack of access to enough food for an active, healthy life for all household members. While food deserts may not be the primary source of food insecurity, they frame the conditions under which disadvantaged households must expend greater resources to obtain food through normal sources. Research has shown that across all regions of the U.S., rural areas are more likely to be food deserts (Blanchard and Lyson 2003; Morton et al. 2005). While rural America generally is where food is produced, the rural poor often have no farmland or assets with which to grow their own food. Thus the vulnerability to food insecurity that they already face is exacerbated in a food desert.

As an effort to understand the problems that households in food deserts face in purchasing adequate and nutritious food, this study focuses on studying random samples of households in two Ohio counties: Vinton and Seneca. Both counties are rural and have been classified as food desert counties us-

ing spatial analysis. Using primary data collected from household surveys, an empirical analysis using an ordered logit regression model is conducted using food insecurity as a categorical dependent variable. Independent variables include geographic, socioeconomic, and demographic predictors. This research seeks to answer the following key question: How is household food security impacted by the lack of access to food stores? Answers to this question could suggest needed changes in public policies.

The paper is organized as follows: first, I briefly assess the current state of research on food deserts and food insecurity. Next, I present evidence from survey data collected from households in Vinton and Seneca counties. I then describe the empirical methodology and present results. Finally, I discuss the implications of my findings and offer policy recommendations.

Literature on Food Deserts and Food Insecurity

Studies have shown that the development of food deserts in the U.S. has occurred gradually, with population migration and globalization of food production and distribution being two of the major factors (Blanchard and Lyson 2003; Heffernan 1999). With many small towns having a declining share of the nation's population, there is a shift from a large number of widely dispersed small-scale local grocers to a concentration of supermarkets in more densely populated geographic areas. A study of Iowa's rural communities found that Iowa lost 52.6 percent of its grocery stores between 1976 and 2000 (Morton et al. 2005).

In a study of 36 counties in the Lower Mississippi Delta, Kaufman (1998) found an average of one supermarket per 190.5 square miles. This region of the country is also plagued by poverty, which puts residents at an even greater risk of food insecurity. Further research conducted by Blanchard and Lyson (2003) found that over 70 percent of poor Missis-

sippi residents living in the Delta region traveled 30 or more miles to purchase groceries. According to Godwin and Tegegne (2006), a key factor affecting consumption of fruits and vegetables is accessibility and proximity of consumers to supermarkets. They found that only 62 percent of stores in food-retail-deprived neighborhoods had a least one canned fruit or vegetable and only 74 percent had at least one fresh fruit or vegetable.

Morland et al. (2001) conducted a study of the effect of the local food environment on residents' diets and found that the presence of at least one additional supermarket increased adult fruit and vegetable intake. Further academic research has been conducted to analyze food insecurity as it relates to dietary health. McLeod and Veall (2006) found a link between changes in health status and changes in food security such that for females, food insecurity in 1996 contributed to poorer health in 1998. Results from the USDA's 2007 annual food security survey showed a national average of 11 percent for food insecurity in U.S. households. The prevalence rate of food insecurity for households located in rural areas was 11.7 percent. Results of food insecurity by state showed that in 2007, Ohio was above the national average, at 12.2 percent (Nord, Andrews, and Carlson 2008).

Sampling Process and Survey Results

Description of Sample Areas

This research started by first identifying food deserts within the state of Ohio. Previous research by Blanchard and Lyson (2003) defined non-metropolitan (rural) food deserts nationwide. They identified four Ohio counties as food desert counties that could be used for this research: Seneca, Harrison, Athens, and Vinton. Three of these counties are located in the Appalachian region of Ohio. Seneca County is located in the northern central section of Ohio and it is a larger, slightly more diverse county than those in Appalachia. For this study to be more representative of various types of households, Seneca and Vinton counties were selected. Vinton County was selected from the Appalachian region because it has the lowest total county population and the highest household poverty rate of all food desert counties, 15.1 percent (United States Census Bureau 2007).

Sampling Frame and Mode

A randomly generated mailing list of 500 households each in Vinton and Seneca counties was compiled. Each survey included questions regarding the ability of the household to meet its food needs during the last 30 days, the household's proximity to the nearest supercenters and supermarkets/grocery chain stores, transportation access, shopping behavior, and additional socioeconomic and demographic questions. The head of household or primary food shopper was requested to complete the survey. A net response rate of 41 percent was achieved.

Demographic Data

The respondents were overwhelmingly female (62 percent), which is consistent with observed behavior that shows women composing a higher percentage of primary shoppers for groceries. The median age for Vinton and Seneca counties was 53 and 54 years, respectively, which may be attributed to the fact that roughly 30 percent of adults are older than 55 in both counties. Categories for race, educational level, income, household size, and household composition were comparable to census data. Both counties were roughly 95 percent Caucasian, had greater than 80 percent of their population with at least a high school diploma, reported average household incomes of roughly $38,000, had average household sizes of 2.9 people, and reported 64 percent married households.

Socioeconomic Data

Combined survey results show that 56.6 percent of the households travel ten miles or more to the nearest supercenter or supermarket/grocery store, with 37.7 percent having to travel 20 minutes or more. Seventeen percent of the households do their primary food shopping at stores other than a supercenter or supermarket/grocery chain store, although 94.5 percent of the households report having their own transportation. Overall, eight percent of the households reported receiving public assistance in the form of food stamps or WIC benefits and 7.6 percent of the households reported receiving some form of community food assistance. Thirty-three percent of the households reported owning a garden. Table 1 shows the socioeconomic survey results for each county.

Table 1. Socioeconomic Characteristics of Vinton and Seneca Households.

Survey questions/statements	Vinton County (n = 197) % yes responses	Seneca County (n = 220) % yes responses
Majority of groceries purchased at stores other than supercenters or supermarkets/grocery chain stores	19.8	13.6
Home is located 10 miles or more from the nearest supercenter or supermarket/grocery store	80.7	35.0
Household has a vehicle (car, truck, van, etc.)	92.9	95.9
Travel time to nearest supercenter or supermarket/grocery store:		
Less than 5 minutes	3.6	14.6
5–9 minutes	7.1	35.0
10–14 minutes	8.6	17.8
15–19 minutes	16.8	18.6
More than 20 minutes	64.0	14.1
Household has a garden and grows own vegetables and/or fruit for family's consumption	36.9	30.3
Family receives monthly public assistance (Food stamps or WIC)	9.6	6.3
Family receives community food assistance (Food Pantry, Meals on Wheels, etc.)	13.1	2.7
Family receives both public assistance and community assistance	3.0	1.4

Food Insecurity Data

Combined county results show a 35 percent overall rate of food insecurity. Forty percent of respondents reported that the food they purchased didn't last long enough and they didn't have money to buy more; 38.7 percent reported that they couldn't afford to eat balanced meals; and 18.4 percent skipped meals due to lack of money, on average skipping meals on 8.3 days. Nineteen percent of the respondents ate less food than they thought they should due to lack of money and 13 percent went hungry due to lack of money for food. The rates of food insecurity for households in both counties are well above the state average of 12.2 percent and are consistent with theory regarding higher levels of food insecurity in rural households. Table 2 shows the food insecurity survey results by County.

Methodology

Probability models are often used to determine the likelihood of an event or phenomenon. Models focus on conditions that may occur between two or more discrete or categorical categories. The ordered logit model allows for a sequence of odds or likelihoods to be specified for the ordered outcome. In the equation for food insecurity, there is an ordered ranking among the categories of food insecurity and each rank is treated differently. Householder responses from the survey instrument were used to determine the difficulty in households meeting their food needs. Affirmative answers to each question were summed for each household producing a ranking of food insecurity from 0 to 5, where 5 represents the highest level of food insecurity.

The ordered logit model is expressed as

Table 2. Responses to Food Insecurity Questions.

Food insecurity questions/statements	Vinton County (n = 198) affirming responses	Seneca County (n = 221) affirming responses
1. The food that I/we bought just didn't last, and I/we didn't have money to get more.	41.9%	38.0%
2. I/we couldn't afford to eat balanced meals.	45.5%	32.6%
3a. In the last 30 days did you and/or other adults in your household ever cut the size of your meals or skip meals because there wasn't enough money for food?	24.2%	13.1%
3b. If yes, above, how many days did this happen?	8.60 avg. days	7.73 avg. days
4. In the last 30 days did you ever eat less than you felt you should because there wasn't enough money to buy food?	23.2%	14.9%
5. In the last 30 days were you ever hungry but didn't eat because there wasn't enough money for food?	17.2%	9.5%
Food insecure ("Yes" to two or more items)	40.4 percent	29.9 percent

$$\text{(1)} \quad Log\left\{\frac{P(FI \le j \,|\, x)}{1 - P(FI \le j \,|\, x)}\right\} = \mu_j - \sum_{k=1}^{K} \beta_k X_k,$$

$$j = 0, 1, 2, 3, 4, 5,$$

where food insecurity (FI) is observed in j number of ordered categories and the μ's are unknown threshold parameters that separate the categories to be estimated. β_k represents the sum of regression coefficients (β_1, β_2, β_3, . . ., β_{11}), and X_k represents explanatory or (independent) variables. The model is written out as

$$\text{(2)} \quad \begin{aligned} Log\{P(FI \le j \mid x)/1 - P(FI \le j \mid x)\} &= \mu_j - \beta_0 \\ + \beta_1 TT_i + \beta_2 AGS_i + \beta_3 TRP_i + \beta_4 GRD_i \\ + \beta_5 PCA_i + \beta_6 INC_i + \beta_7 AGE_i + \beta_8 EDU_i \\ + \beta_9 GEN_i + \beta_{10} HHC_i + \beta_{11} HHS_i, \end{aligned}$$

where β_0 is the intercept and β_1 to β_{11} are regression coefficients. The explanatory variables are:

(1) Travel time to nearest supercenter or supermarket/grocery store (TT_i): This is a categorical variable with values ranging from 1 to 5. Time is coded as 1 = less than 5 minutes, 2 = 5–9 minutes, 3 = 10–14 minutes, 4 = 15–19 minutes, and 5 = 20 or more minutes.

(2) Alternative grocery shopping (AGS_i): This is a binary variable equal to 1 if the household's primary grocery shopping is at food sources other than a supercenter, supermarket, or grocery chain store, and 0 otherwise.

(3) Transportation owned by household (TRP_i): This is a binary variable equal to 1 if the household has 1 or more vehicles, 0 if no vehicle.

(4) Household owns a garden/grows own fruits and/or vegetables (GRD_i): This is a binary variable equal to 1 if yes, and 0 if no.

(5) Household receives public/community assistance (PCA_i): This variable captures monthly public assistance (food stamps, WIC, etc.) and monthly community food assistance (food pantry donations, meals-on-wheels, etc.) given to the household. This is a categorical variable coded as 0 = no assistance received, 1 = one form of assistance received, 2 = both forms of assistance received.

(6) Household income (INC_i): Income is a categorical variable and it is defined by three categories: low, medium, and high income for each household. Income groupings were determined from survey results. Low income = 1 and is defined by annual incomes less than $29,999; medium income = 2 and is defined by annual incomes between 30,000

and 59,999; and high income = 3 and is defined by annual incomes higher than 60,000.

(7) Age of householder (AGE_i): This is a continuous variable that measures age in years.

(8) Educational level of householder (EDU_i): This is a categorical variable and is measured in levels of degree attainment. 1 = No degree, 2 = High school diploma/GED equivalent, 3 = Associate degree, 4 = Bachelors degree, 5 = Masters degree, 6 = Professional degree, and 7 = Doctorate degree.

(9) Gender (GEN_i): This is a binary variable equal to 1 if female, and 0 if male.

(10) Household composition (HHC_i): This is a binary variable equal to 1 if the household is headed by a single parent, and 0 otherwise.

(11) Household size (HHS_i): This variable is continuous and measures the number of individuals living in the household.

Results

Table 3 shows the ordered logit estimates and marginal effects for the combined county sample. In terms of access to food retail stores, the variable alternative grocery shopping (AGS) shows statistical significance at the 0.10 level, which lends support to the hypothesis that householders that primarily shop for groceries at food stores other than supercenters or supermarket/grocery chains are more likely to be food insecure. Other access variables were travel time (TT) and transportation (TRP); however, the z-statistics do not indicate statistical significance for those variables. The statistically significant demographic and socioeconomic variables show that as income (INC), educational level (EDU), and AGE increase, households' likelihood of food insecurity decreases. For public and/or community food assistance (PCA) the positive coefficient indicates the link between food insecurity and the need for food assistance. Household composition (HHC) and household size (HHS) indicate that single-parent households and larger households have a greater likelihood of food insecurity.

The marginal effects in this model indicate that for the variable AGS, there is a 5.2 percent greater likelihood of initially becoming food insecure for householders that primarily shop at alternative food stores. For INC, EDU, and AGE the likelihood of food insecurity decreases as those variables increase from marginal food security to severe food insecu-

Table 3. Food Insecurity Ordered Logit Estimates and Marginal Effects.

Variable	β	Z-statistic	Stage 0	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
					Marginal effects			
TT	0.045	0.588	−0.011	0.002	0.005	0.001	0.002	0.002
AGS	0.507	*1.718	−0.126	0.015	0.052	0.013	0.021	0.025
TRP	0.509	1.116	−0.123	0.028	0.051	0.010	0.016	0.017
GRD	0.074	0.309	−0.018	0.003	0.007	0.002	0.003	0.003
PCA	0.597	**2.341	−0.149	0.026	0.062	0.014	0.022	0.025
INC	−1.937	***−9.388	0.482	−0.086	−0.202	−0.044	−0.072	−0.080
AGE	−0.042	***−4.900	0.010	−0.002	−0.004	−0.001	−0.002	−0.002
EDU	−0.225	*−1.658	0.056	−0.010	−0.024	−0.005	−0.008	−0.009
GEN	0.328	1.399	−0.081	0.015	0.034	0.007	0.012	0.013
HHC	0.484	*1.943	−0.120	0.018	0.050	0.011	0.019	0.021
HHS	0.256	***3.278	−0.064	0.011	0.023	0.006	0.010	0.011

***Significant at 1 percent, ** Significant at 5 percent, * Significant at 10 percent.
LR statistic = 209.15 (P < 0.01).

rity. Stage 1 is classified as a marginal level of food security and Stage 2 is the first level of a household initially being classified as food insecure. At Stage 2 there is a 20.2 percent decrease in food insecurity likelihood as income level increases, implying that households are 20.2 percent less likely to become food insecure as they move from one income level to the next. Once they have become food insecure, the marginal effects show that as income increases the likelihood of food insecurity decreases by 4.4 percent at Stage 3, by 7.2 percent at Stage 4, and by 8 percent at Stage 5. This suggests that the most significant level for determining the likelihood of food insecurity is the initial level of a household going from food secure to food insecure status. Because Stages 3 through 5 are severe levels of food insecurity, they are associated with more deprivation and hunger in the household. These results indicate that an increase from one income level to the next has a smaller effect on whether or not a family moves from severe food insecurity to food secure status. The variables AGE, EDU, HHS, and HHC show similar patterns and reflect that the most significant level in determining the likelihood of food insecurity is the initial level.

Conclusions and Recommendations

This study identifies and measures the likelihood of food insecurity for households in rural food deserts. The ordered logit results showed that for households in food desert counties, primarily shopping for groceries at stores that are not grocery stores has a significant impact on household food insecurity. Results showed a 5.2 percent greater likelihood of becoming food insecure. The type of store where consumers primarily purchase their food has an effect on food insecurity. Also, this study theorized that households receiving monthly public and/or community food assistance were less likely to be food insecure. Analysis of the data indicate that households receiving monthly public and/or community food assistance were more likely to be food insecure. However, the actual amount of public assistance received by the household was not captured by this variable, and the usage of these benefits is limited in a food desert community, explaining why this variable indicated that households were still more likely to be food insecure. These results show that an important aspect left out of current food in-

security research is the gap in the food distribution system across geographic areas and how that gap affects access to healthy food sources. Rural food deserts lead to inadequate supplies of food retail for rural households, which may lead to an increase in the risk of food insecurity. These findings provide relevance for further studies regarding food desert households.

Since lack of access to food retail is shown to increase the likelihood of food insecurity, it seems reasonable that the State of Ohio, in partnership with Vinton and Seneca Counties, should increase investments in local economies to promote food retail expansion in those areas. Strategies can include marketing initiatives and community grant programs to promote and provide financial support for local agricultural production, making locally produced foods affordable and available for retail purchase. This not only can result in more accessible food sources for rural households, but would also promotes community sustainability and community food security. These efforts have the potential to spur growth of new community food sources, which can spillover into increased service and employment opportunities for local residents.

Because income and education are also two of the most significant variables affecting food insecurity, policies should be implemented to improve rural business finance opportunities. In addition, public-private collaboratives through local governments and community-based organizations can steer employment and educational opportunities for rural residents. Strategies can include adult education programs focused on helping adults complete diplomas or degrees and gaining job training for better employment opportunities. These activities will help to bridge the gap and compensate for the disparities that consumers face in food deserts. Policy recommendations must be both people- and place-based and focus on the overall economic and social benefits to rural Ohio.

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