

HOW ACCESS TO FARMERS' MARKETS IMPACTS FOOD INSECURITY AMONG
SUPPLEMENTAL NUTRITION ASSISTANCE PROGRAM PARTICIPANTS

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By

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ABSTRACT

Farmers' markets have been viewed as an accessible and affordable option for expanding food access. However, it's unclear if farmers' markets have an impact on some of the most vulnerable in society, including supplemental nutrition assistance program (SNAP) recipients. SNAP is a federally funded entitlements program that provides monthly benefits to low-income households. SNAP Participants can redeem benefits at a variety of different stores, including some farmers' markets. Past literature has shown that having access to SNAP benefits has been associated with lower levels of food insecurity. Yet many SNAP participants still experience food insecurity. One explanation for this is a lack of access to affordable, healthy foods due to a shortage of food stores in communities. This thesis contributes to the existing literature by using administrative data from the state of Michigan to identify the relationship between farmers' market access and food insecurity among SNAP participants. My results suggest that there is no statistically significant relationship between farmers' market access and the rate of food insecurity among SNAP participants at the county level.

The research and writing of this thesis
is dedicated to everyone who helped me along the way.

Many thanks,
Chrissy Steigelman

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Introduction

The Supplemental Nutrition Assistance Program (SNAP) provides monthly benefits to low-income households to purchase food for their families. Having access to SNAP benefits reduces the likelihood of being food insecure by about 30 percent and reduces the likelihood of being very food insecure by 20 percent. However, over one-third of SNAP participants remain food insecure (Ratcliffe, 2010). Food insecurity is defined as having a lack of consistent access to enough food to support an active, healthy life. One reason a person or family may become food insecure is due to a lack of fresh food retailers that are accessible to them.

In order to address issues of food accessibility and insecurity, community-driven food security strategies have been implemented in some areas. These strategies can include small local grocers, community and school gardens, and farmers' markets. These types of strategies have intended to help increase access to healthy foods while also contributing to the local economy.

The U.S. Department of Agriculture (USDA) has committed itself to supporting these local initiatives by providing grants and other sources of funding to various initiatives. One example of this is the development of the Farmers Market Promotion Program (FMPP), which was established by Congress in the Farm Security and Rural Investment Act of 2002 and began receiving funding in 2006. The purpose of the program is to competitively award grants that help increase access to locally produced agriculture. In the 2014 Farm Bill, the program received a significant increase in funding, from \$10 million to \$30 million per fiscal year.

In addition, USDA has worked to ensure farmers' markets are accessible to SNAP participants. In order for SNAP participants to use benefits at a store, they must use their electronic benefit transfer (EBT) card that is processed using electronic fund transfer technology. Farmers' markets can apply to operate an EBT system if they choose. USDA partnered with the

Farmers Market Coalition from FY2014 to FY 2017 to provide eligible farmers' markets with free EBT equipment. Between FY2012 and FY2017, there was an increase of 129.5 percent in SNAP authorized farmers' markets. SNAP redemption rates also saw an increase of 35.2 percent during that time (Farmers Market Coalition, n.d.). Some states have even implemented programs that incentivize SNAP participants to shop at farmers' markets by increasing their purchasing power. However, not all farmers' markets have the resources to invest in an EBT system, limiting the number of farmers' market who accept SNAP benefits.

Farmers' markets are intended to increase access to healthy, affordable foods, which could potentially lead to a decrease in food insecurity. However, it is still unclear if they are successful at doing so, particularly for SNAP participants in areas that may have limited access to other types of food stores. Understanding the association between farmers markets and food insecurity among SNAP participants could help policymakers better target funding (e.g., expanding EBT systems to farmers' markets that don't currently accept SNAP benefits, expanding incentive programs).

Literature Review

This section will provide an overview of the literature that's relevant to my research question. The literature review has been broken down into three sections. The first will review the literature related to SNAP and food insecurity, the second will provide an overview of the literature related to the food environment, and the third will discuss literature related to farmers' markets. Finally, I will discuss how my research question is a unique contribution to the existing literature.

SNAP and Food Insecurity

USDA defines food insecurity as a lack of consistent access to enough food for an active, healthy life. In 2020, 13.8 million households in the U.S. were food insecure at some time during that year. Food insecurity was even higher for households with children, households headed by a single parent, households with Black, non-Hispanic, and Hispanic reference persons, and households with income below 185 percent of the poverty threshold (USDA, n.d.). Food insecurity has been associated with an array of negative health outcomes, including increased risk of asthma, birth defects, and anemia (Gundersen and Ziliak, 2015).

SNAP aims to increase food participants food security and their access to a healthy diet. Having access to SNAP benefits has been found to reduce food insecurity among participants. Ratcliffe and McKernan (2010) used nationally representative data from the late 1990s and early to mid-2000s and found that receiving SNAP benefits reduced the likelihood of being food insecure by 31.2 percent. It also reduced the likelihood of being very food insecure by 20 percent.

Similarly, some research has suggested that an increase in SNAP benefits results in an increase in food security among participants. The 2009 American Recovery and Reinvestment Act (ARRA) temporarily increased SNAP benefits by an average of 16 percent. Nord and Prell (2011) compared food security before and after the ARRA SNAP enhancement was implemented and found that food insecurity declined by 2.2 percent after the implementation. Once the SNAP enhancement expired in November 2013, food insecurity was found to increase. In addition, when looking at food insecurity rates for December 2012 and December 2014, Katare and Kim found that food insecurity increased by 7.6 percent after the expiration of the SNAP enhancement.

While SNAP benefits have been associated with a reduction in food insecurity in some studies, there are still many SNAP participants who are food insecure. Coleman-Jensen (2016) found that in 2015, SNAP participants had a food insecurity rate of above 50 percent, while eligible nonrecipients had a food insecurity rate of 25.3 percent. However, this is not necessarily a sign that SNAP has failed to decrease food insecurity. It must be noted that “the decision to participate in SNAP presumably is based in part on whether a household expects to be food insecure, and SNAP is designed to reach those who are most at risk of food insecurity” (Gundersen 2018). Therefore, those who choose to participate in SNAP are likely the most at risk for food insecurity.

The Food Environment

A lack of geographic access to food has been one explanation for food insecurity among low-income families. This is also sometimes known as a “food desert”. The USDA considers an area to be a food desert if it is low income and low access. A non-rural area is low access if enough people (500 people or 33 percent of the population) live more than a mile away from a grocery store, and in rural areas the minimum distance to a supermarket is 10 miles. Living in these areas can make it difficult to buy affordable or good quality fresh fruits and vegetables. These food deserts tend to be concentrated among low-income communities. Nationally, the number of supermarkets in low-income areas was nearly 30 percent less than the number in the highest income areas (Weinberg, 2000). In Philadelphia, one study found that the highest-income areas had 156 percent more supermarkets than the lowest-income areas, which had few to no supermarkets (Giang, 2008). Neighborhoods that are predominately home to people of color tend to be impacted the most. Morland (2002) found that supermarkets were four times more likely to

be found in predominately white neighborhoods than predominately black neighborhoods. Similarly, Block (2006) found that predominately black neighborhoods had fewer supermarkets and more small food stores with lower quality food items than white neighborhoods.

Large food stores, like supermarkets, tend to have larger variety of food options and higher quality food than smaller food stores. In one study of 24 larger grocery stores and 64 smaller convenience stores across a diverse set of neighborhoods, it was found that neighborhoods that were classified as high income had significantly more healthier options for almost all food, with the exception of diet soda, 100 percent fruit juice, and low-fat hot dogs (Glanz, 2007). Hendrickson (2006) found that urban residents in Minnesota's low-income food deserts faced poor quality food options among the 14 stores in the area. These stores were typically smaller corner stores that lacked access to refrigeration systems. The rural communities that were examined typically shopped at larger grocery stores that had higher quality food options. However, these larger stores tended to serve a large area, meaning people may have to travel far in order to access groceries.

Having access to higher quality food options may impact the types of healthy food individuals eat. A study by USDA (2009) found that SNAP households that didn't shop at large food stores tended to purchase smaller amounts of noncanned vegetables, noncanned fruits, and milk than households that frequently shopped at large food stores.

However, other literature has suggested that living in close proximity to a large food store does not significantly impact individual's ability to access healthy food. Allcott (2017) found that the difference in supermarket density explained no more than 1.5 percent of the difference in healthy eating between high- and low-income households. This is because most people will do their grocery shopping at a larger food store regardless of where they live; some may just be

required to travel farther distances to do so. Another study found that a small percentage of consumers were constrained in their ability to access healthy foods. When examining the data from the National Food Stamp Program Survey, researchers found that more than 90 percent of participating households redeemed their benefits in a larger food store compared to a smaller convenience store (Rose and Richards, 2004). In addition, the average distance to the nearest large food store was roughly 1.8 miles, while the average distance to the store used most often was 4.9 miles (USDA, 2009).

Small stores in areas without large food stores have also been shown to increase food security. Bonanno and Li (2013) found that the addition of one large food store per 90,000 people has the same ability to reduce food insecurity as one additional small food store for every 22,000 people. Therefore, smaller food stores may be a better option in more densely populated neighborhoods. More of them could also be located in rural areas which would reduce the need for some to travel long distances to a large food store.

Farmers' Markets

Some communities have looked to alternatives to large food stores to expand access to healthy food, such as farmers' markets. Over the years, the demand for farmers' markets has increased among consumers from all socioeconomic backgrounds throughout the United States. In 2016, there were 8,669 farmers' markets, nearly double the number from ten years earlier (Schupp, 2016). Farmers' markets can be a tool to expand food accessibility in areas that lack access to healthy, affordable food options. Starting and operating one tends to be less expensive and require less space than a new store development (Brace, 2020). Additional benefits include

an increased consumption of fruits and vegetables among consumers who frequently shop there (Pitts, 2014).

Farmers' markets can accept financial incentives, such as SNAP benefits. Some States have even expanded the access for SNAP participants by offering nutrition incentive programs. These programs, such as Double Up Food Bucks, double the value of SNAP benefits spent on fruits and vegetables at participating farmers' markets. These programs have been found to increase the amount of fruits and vegetables purchased. One self-reported survey found that 55.8 percent of respondents purchased fruits and vegetables once they began participating in the nutrition incentive program compared to 33.8 percent before participating (Parks, 2021). However, some farmers' markets do not accept social benefits programs. In 2018, of the 641 new or updated farmers' markets offering fresh fruits and vegetables that were added to the USDA Farmers Market Directory, a self-reported database, 62.4 percent accepted SNAP benefits. (Johnson, 2020).

An additional barrier to farmers' market use is their location. Research has found that farmers' markets tend to be located in areas with above average socioeconomic status. Schupp (2016) found that average household income, median house values, and average education rates of areas with farmers' markets were higher than areas without farmers' markets and higher than the U.S. median.

Farmers' markets also do not tend to be in areas with low food access. An examination of farmers' markets in Georgia found that only 7.2 percent of census tracts classified as food deserts had a farmers' market within their boundary. Acceptance of food assistance programs was also not common in farmers' markets throughout the State (Brace, 2016). A similar study was

conducted in Hawaii, where fewer than 20 percent of farmers' markets were located in areas that were classified as food deserts (Brace, 2020).

Original Contributions to Existing Literature

Existing literature primarily focuses on the link between large food stores and individual's ability to access healthy, affordable foods. Studies that exam the impact of farmers' markets on individuals eating habits and access to food tend to only look at a single neighborhood and gather data using a convenience sample. My thesis adds to this work by using administrative data, rather than a convenience sample or a self-reported survey, to analyze the impact of having access to a farmers' market on SNAP participants food security.

Data and Methods

I propose to create a linear regression model that will assess if access to farmers' markets is associated with a change in food insecurity among SNAP participants. Previous literature has found that access to farmers' markets has resulted in increased purchases of fruit and vegetables, however, this study was conducted using a convenience sample (Pitts, 2014). Other literature has used administrative data to determine that farmers' markets do not tend to be in areas with low food access. I will use county level administrative data for the years 2009 and 2016 for this research. Specifically, I will be looking at the state of Michigan, which has 83 counties.

Data

The USDA Food Environment Atlas has over 200 variables that aim to measure a community's food choice landscape. The three categories include food choices (e.g., proximity to a grocery store, availability of local food), health and well-being (e.g., diabetes and obesity

rates), and community characteristics (e.g., income and poverty, demographic composition). The extensive set of variables provides researchers and policymakers with the opportunity to examine the factors that impact family's food choices and health outcomes. Data on farmers' markets was compiled by the USDA's Agricultural Market Service, Marketing Service Division. Data on store availability are from the U.S. Department of Commerce, Bureau of the Census, County Business Patterns. The data is published by USDA and is publicly available for download. The variables in the dataset cover a variety of years. For this purpose, I will use the Food Environment Atlas from 2020 and 2017 so that I have access to 2016 data for all variables of interest. For the 2009 data, I will use the 2015, 2012, and 2011 Food Environment Atlas so that I have access to all the relevant variables of interest. All data is provided at the county level.

Feeding America's Map the Meal Gap Dataset aims to improve the understanding of food insecurity and cost at the local level. Data has been released annually since 2009 and is provided at the state, congressional, and county level. For the purpose of this analysis, I will be looking at the 2009 and 2016 county level data. Food insecurity estimates are estimated at the state and level by looking at data from the Bureau of Labor Statistics (BLS) Current Population Survey (CPS). Variables that are used including unemployment, poverty, homeownership, and other demographic variables. The county-level estimates are derived from the state-level relationships that exist between these variables and food insecurity. This is done by using the annual USDA Food Security Survey. Data must be requested from Feeding America.

Data on poverty rates will be collected from the Small Area Income and Poverty Estimates (SAIPE) State and County Estimates. The data are published by USDA and is publicly available for download. Data on the percentage of the population that is white comes from the

2010 and 2017 American Community Survey (ACS) five-year estimates. I used five-year estimates because one year data was not available.

Because data from both datasets are collected at the county level, there are some limitations in terms of how granular the analysis can be. For example, the largest county in Michigan has a population of over 1.7 million individuals with drastically different demographics and socioeconomic backgrounds. This lack of homogeneity in some counties may make it challenging to identify meaningful impacts of farmers' markets at the county level. Despite this drawback, these data sources provide the most detailed description of the food environment.

Variables

The key dependent variable will be food insecurity among SNAP participants. This comes from the Map the Meal Gaps Data. The dataset identifies the lowest and highest gross income limit as a percent of federal poverty guidelines for any federal nutrition program. These thresholds vary by state. The lowest eligibility threshold a State has is 130 percent of the federal poverty line, meaning that an individual who makes less than 130 percent of the federal poverty line would be eligible for SNAP. States also have the option to increase the gross income limit up to 200 percent of the federal poverty line. Michigan, the state that will be used for this analysis, has a gross income limit of 200 percent. A variable estimates the percentage of food insecure individuals who would be eligible for SNAP. This variable may overstate or understate the food insecurity among SNAP participants, since it is estimating the percent of individuals who would be eligible, not those who are enrolled.

My key independent variable is farmers' markets in a county that accept SNAP benefits. According to the USDA, a farmer's market is a retail outlet where two or more vendors sell agricultural products directly to the customers through a common marketing channel. Information on the hours and availability of the farmers' market are limited. For example, some farmers' markets may be open once a week while others are open 7 days a week. I will look at the density of farmers' markets in each county by creating a variable of farmers' markets per 1,000 people.

Table 1 lists the other independent variables that will be used for this analysis and provides a definition and proposed relation to the dependent variable. All data in the analysis will be from 2009 and 2016.

Table 1. Regression variables

Variable Definition	Variable Type	Variable Description	Proposed Relation
Food Insecurity	Dependent	% of food insecurity among SNAP participants	N/A
Farmers Markets	Independent	Number of farmers' market that accept SNAP/1000	-
Year_2016	Independent	A dummy variable that will equal 1 if the data is from 2016	TBD
Grocery Stores	Independent	Number of grocery stores/1000	-
Supercenters	Independent	Number of supercenters/1000	-
Convenience	Independent	Number of convenience stores/1000	TBD
Specialized	Independent	Number of specialized food stores/1000	TBD
SNAP-authorized stores	Independent	Number of SNAP-authorized stores/1000	+
Poverty	Independent	Poverty Rate	+
Percent White	Independent	Percentage of county population that is white	-
Average Cost per Meal	Independent	Average dollar amount spent on food per meal by food-secure individuals	+

Empirical Model

For this analysis, I am planning to run an ordinary least square (OLS) regression to analyze the impacts of farmers' markets on food insecurity among SNAP participants. Below is a representation of the full model.

$$\text{SNAP_FIPERCENT} = \beta_0 + \beta_1 * \text{FMRK_DENSITY} + \beta_2 * \text{YEAR_2016} + \beta_3 * \text{GROCPH} + \beta_4 * \text{SUPERCPTH} + \beta_5 * \text{CONVSPTH} + \beta_6 * \text{SPECSPH} + \beta_7 * \text{SNAPSPH} + \beta_8 * \text{POVERTY_RATE} + \beta_9 * \text{PERCENT_WHITE} + \beta_{10} * \text{MEAL_COST} + \beta_{11} * \text{FMRK_DENSITY} * \text{YEAR_2016} + \epsilon$$

Additionally, I will include the results from an alternative model with less variables present. I will also develop a model that only include the dependent and key independent variable, an interaction term between the key independent variable and the year variable, and all statistically significant variables that from the full model.

The regression will include numerous control variables, however unobserved variables may still bias the estimate.

Empirical Section

My research question is focused on the relationship between farmers' markets that accept SNAP benefits and food insecurity among SNAP recipients, specifically in Michigan. I anticipated that there might be slight negative relationship between the two. To explore this topic, I primarily rely on the USDA Food Environment Atlas and the Feeding America Map the Meal Gap Data, as well data from the Small Area Income and Poverty Estimates (SAIPE) State and County Estimates. I collect race demographic data from the American Community Survey (ACS) 5-year estimates for the years 2006-2010 for 2009 data and 2013-2017 for 2016 data.

I investigate my research question by using an ordinary least squares (OLS) linear regression models that includes data from the years 2009 and 2016. The dependent variable is the percent of SNAP participants, by county, experiencing food insecurity during that year. The key independent variable is the number of farmers' markets that accept SNAP per 1,000 people. I control for the following variables related to the food environment available in the USDA food environment atlas: density of grocery stores, convenience stores, supermarkets, supercenters, specialized food stores, and SNAP authorized stores. I also control for the average cost of meals for SNAP participants, poverty rate, percent of the county's population that is white, and a dummy variable for year.

Descriptive Statistics

As seen in Table 2, the key dependent variables, the percent of SNAP participants experiencing food insecurity, varies significantly with the lowest value being 39 percent and the highest being 96.3 percent. The median value for this variable is relatively high (73.0 percent), indicating that SNAP participants frequently experienced food insecurity. When comparing the food insecurity among SNAP participants during 2009 and 2016, we see that the average level of food insecurity was roughly 10 percentage points higher in 2016 than it was in 2009 (77.2 percent vs 67.2 percent).

The key independent variable, farmers' markets accepting SNAP per 1,000 people, has a relatively low median value (.0082). Nearly half of the 166 observations did not have any farmers' markets that accepted SNAP in the county in 2009 and/or 2016.

Table 2. Descriptive statistics for the dependent and all independent variable

Variable name	Variable Description	Min	Median	Mean	Max	SD
SNAP_FIPERCENT	Percent of SNAP participants experiencing food insecurity	39.0	73.0	72.2	96.3	9.805
FMRK_DENSITY	Farmers markets accepting SNAP per 1000 people	0	.0082	.0192	.276	.034
GROCPH	Grocery stores per 1000 people	.044	.2163	.2586	.935	.146
SUPERCPTH	Supercenters per 1000 people	0	.0218	.0216	.0854	.0202
CONVSPH	Convenience stores per 1000 people	.2401	.5481	.5897	1.322	.2215
SPECSPH	Specialized food stores per 1000 people	0	.0706	.0882	.4676	.0766
SNAPSPH	SNAP authorized stores per 1000 people	.3291	.9329	.9537	1.835	.2978
MEAL_COST	Average meal cost for SNAP participants	1.99	2.57	2.64	5.38	.3877
POVERTY_RATE	Poverty rate	5.8	15.5	15.56	26.7	3.891
PERCENT_WHITE	Percent of population that's white	52.0	95.0	92.0	99.0	7.934
YEAR	Equals 1 if the year is 2016					

The number of farmers' markets has increased in recent years, with an average increase of .0136 farmers' markets per 1,000 people. Of the 83 counties, only 2 had a decline in farmers markets while 38 had an increase and 43 had no change. As seen in Figure 1, some of the largest changes in the density of farmers' markets occurred in counties in northern Michigan, including

the Upper Peninsula. This highlights the increase in popularity and support for farmers markets in recent years. However, as noted before, the prominence of farmers' markets is still relatively low.

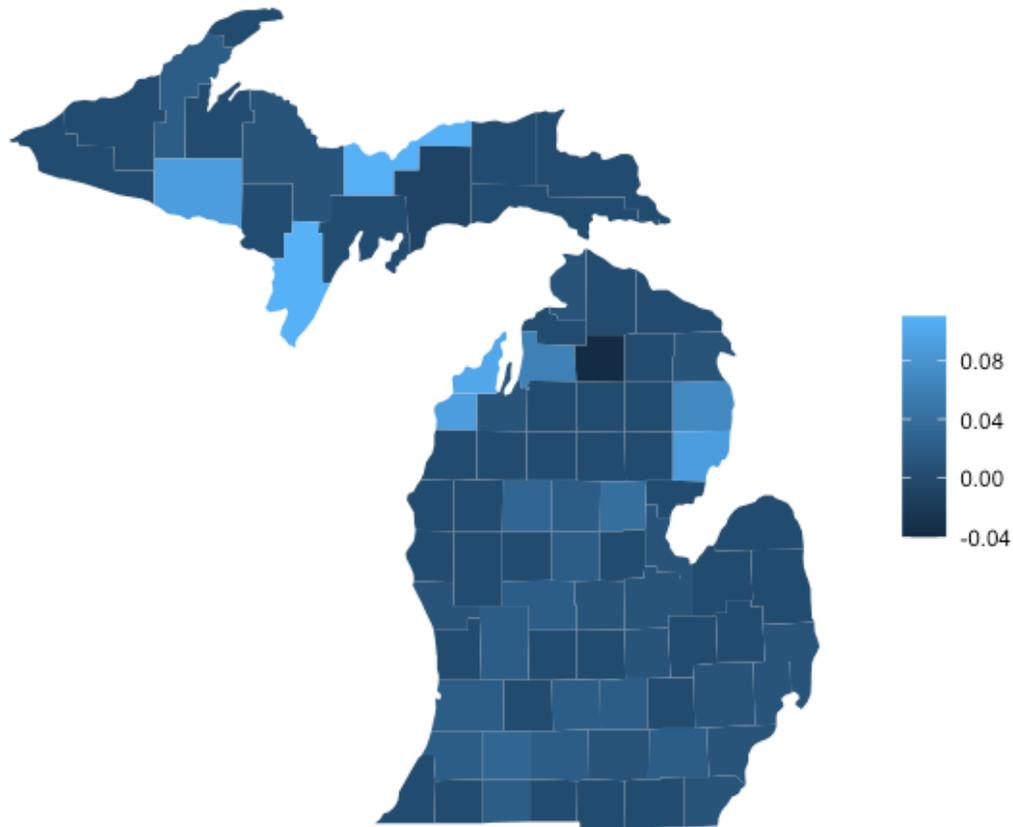


Figure 1. Map of change in farmers' market density between 2009 and 2016

In Table 3, we see that the correlation between farmers' markets accepting SNAP and food insecurity among SNAP participants as being close to zero, indicating that there is little linear correlation between the two variables. No variables in the model are highly correlated, indicating that multicollinearity should not be a significant issue in this model.

Table 3. Correlation matrix for the dependent and all independent variables

Variable	Farmers markets	Grocery stores	Supercenters	Convenience stores	Specialized stores	SNAP stores	Meal Cost	Poverty Rate	Percent White
SNAP food insecurity	.02	.12	-.04	.33	-.05	.55	.30	.43	.29
Farmers markets		.14	-.08	-.04	.34	-.06	.51	-.22	.11
Grocery stores			-.39	.5	.23	.24	.16	.04	-.05
Supercenters				-.18	-.05	-.09	-.12	.01	.06
Convenience stores					.24	.57	-.01	.33	.17
Specialized stores						-.02	.21	-.2	-.1
SNAP stores							.07	.52	.05
Meal cost								-.22	.08
Poverty Rate									-.24

Results

The estimated coefficients for the OLS regression model for the dependent variable, food insecurity among SNAP participants, are presented in Table 3. The first model produces an R^2 value of .204, indicating that the model explains 20.4 percent of variation in the percent of food insecurity among SNAP participants. The other two models, produce a relatively high R^2 value of .6890 and .6878. All models also produce relatively high F-statistics, meaning that predictor variables are jointly significant.

As seen in Table 3, the density of farmers' markets in a county does not have a statistically significant impact on the percent of food insecurity among SNAP participants at the county level in any of the models. In the reduced model (model 3), which only includes the farmers' market variable and all other statistically significant variables from model 2, I included an interaction term between the 2016-year dummy variable and the farmers' market density variable. This aims to assess if there is a variation in the effect of farmers' markets across the year 2009 and 2016. However, this variable was not statistically significant.

In the full model (model 2) and the reduced model (model 3), other types of food stores were found to have an impact on county SNAP food insecurity. The most notable impact was supercenters, which indicated that on average, an increase of one supercenter per 1,000 people in a county is associated with a decrease in food insecurity among SNAP participants of 43 percent; this is statistically significant at a .1 significance level for both models. The density of grocery stores, specialized food stores, and SNAP authorized stores also produced statistically significant results. On average, an increase of one grocery store and specialized food store per 1,000 people resulted in a 8.8 percent and 14.8 percent increase in food insecurity among SNAP participants in the full model. These types of food stores also presented similar statistically significant results

in model 3. An increase in SNAP authorized food stores was associated with an average increase of 5.9 percent food insecurity among SNAP participants in the full model and 6.2 percent in the restricted model. However, this may be explained by the fact that more SNAP authorized stores are in areas where SNAP participants reside.

Several other independent variables are statistically significant in both models, including the percent of the population that's white and poverty rate. As expected, a higher poverty rate is associated with higher rates of food insecurity among SNAP participants. On average, a 1 percent increase in poverty rates results in a 1.3 percent increase in food insecurity among SNAP participants; this is consistent for both model 2 and 3. A one percent increase in the population being white is associated with an average increase of food insecurity of .5 percent in both models. Both are significant at a .01 significance level.

Table 4. Regression results

Variable	Model 1	Model 2	Model 3
(Intercept)	67.5173 (.000)	5.6725 (.516)	10.4 (.241)
FMRK_DENSITY	-24.9671 (.204)	-5.89979 (.724)	-20.4564 (.467)
YEAR_DUMMY_2016	10.3001*** (.000)	12.051*** (.000)	12.1832*** (.000)
YEAR2016_FMRK			29.2765 (.387)
GROCPH		8.7707** (.027)	7.1165** (.050)
SUPERCPTH		-42.64* (.082)	-42.539* (.079)
SPECSPTH		14.828** (.034)	13.0886* (.051)
SNAPSPH		5.88*** (.006)	4.6552** (.020)
POVERTY_RATE		1.287*** (.000)	1.2464*** (.000)
PERCENT_WHITE		.4744*** (.000)	.4503*** (.000)

CONVSPTH		-3.7258 (.225)	
MEAL_COST		-3.504 (.128)	
N	166	166	166
R ²	.2672	.6890	.6878
F-Stat	29.72	34.33	34.15

Where *** 1% level of significance; ** 5% level of significance; * 10% level of significance.

Discussion and Conclusion

Discussion

The aim of this research was to examine the relationship between farmers' market access and food insecurity among SNAP participants, specifically in Michigan. I hypothesized that an increase in farmers' market access would be associated with a slight decrease in food insecurity among SNAP participants. In estimating the linear regression models, I found that there was no statistically significant relationship between the number of farmers' markets in a county and the percentage of SNAP participants in that county who were experiencing food insecurity. This may indicate that farmers' markets may not have an impact on food insecurity among SNAP participants and investing in expanding access may not be beneficial for some of the most vulnerable in our population.

While the results from my linear regression models were not statistically significant, it should be noted that there were some significant data limitations. The sample of data I was using was relatively small, with only 166 observations. This was because I was only able to access data for the State of Michigan, which has 83 counties, for the years 2009 and 2016. As noted in my empirical section, nearly half of my 166 observations did not have any farmers' markets that accepted SNAP in 2009 and/or 2016. While this does reveal that farmers' markets were not popular in many areas, it also may have skewed the results of our linear regression models. In

addition, all data I was looking at was at the county level. This did not allow me to look at the data on a more granular level.

Policy Implications

Increasing access to farmers' markets, particularly for SNAP participants, has become a priority for USDA in recent years. However, based on the results of this research and previous research, it's unclear if programs like the FMPP or expanded access to EBT equipment for farmers' markets are having the intended impact of expanding access to farmers' market to SNAP recipients.

Based on previous research, it's likely that many farmers' markets are in areas with above average socioeconomic status and areas that are not classified as food deserts (Schupp, 2016; Brace, 2016; Brace 2010). This may indicate that previous funding from USDA has primarily gone to supporting farmers' markets in areas where food insecurity is less prevalent. Specifically targeting Federal and state funding to farmers' markets in areas with higher rates of food insecurity could help to alleviate this problem. In addition, it may be useful to provide incentives to farmers' markets who agree to open in areas with higher levels of food insecurity.

Because the number of farmers' markets is relatively low in the areas and during the years involved in the study, it's difficult to determine if farmers' markets could have an impact on food insecurity among SNAP participants. However, based on the results of this study, supercenters were associated with a decrease in food insecurity among SNAP participants at the county level as the number of supercenter stores increased. These stores have been found to have a larger variety and higher quality food than smaller stores (Glanz, 2007). This may be one reason why many individuals prefer to shop at these types of stores, regardless of how close they are to where they live (Rose and Richards, 2004; USDA 2009). This may be an indication that

the USDA should work on expanding access to supercenters in areas that lack access. Local government may also want to think about setting up accessible transportation, such as a bus route, for individuals who do not have access to transportation.

Future Research and Conclusion

In recent years, farmers' markets have increased in popularity among the public and have been seen as a more affordable option for increasing food access across the country (Brace, 2020). Future research should continue to look at the expansion of farmers' markets and its impact on food insecurity. Findings from the COVID-19 pandemic may prove to be particularly interesting, as farmers' markets gained even more popularity. Studying the effects of access to farmers' markets would be greatly strengthened by expanding access to food environment and food insecurity data on a more granular level. As discussed earlier, examining data on a county level presents challenges due to the heterogeneity in many areas. Being able to examine more granular data would allow for researchers and policymakers to better identify and target what stores and resources are needed to reduce food insecurity among SNAP participants. In addition, this study only looked at the state of Michigan for the years 2009 and 2016. Including additional states and years could allow for a more detailed view of farmers' market impact on food insecurity among SNAP participants.

While farmers' markets can offer additional options for purchasing healthy and affordable food, ensuring that they are present in all communities is crucial for people from all backgrounds to reap the benefits. SNAP participants who are unfamiliar with farmers' markets may also not be aware that they're able to redeem their benefits at select markets. USDA should continue to offer free EBT equipment to farmers' markets and provide a marketing tool to make

it clear when farmers' markets accept SNAP benefits. Finally, while farmers markets do have the opportunity to provide additional food access, they may not be a complete replacement for larger food stores, such as supercenters, where many individuals prefer to shop. Expanding access to these types of stores is also crucial for reducing food insecurity among SNAP participants.

Appendix: Supplemental Tables

Table A1: Descriptive statistics for 2016 data

Variable name	Variable Description	Min	Median	Mean	Max	SD
SNAP_FIPERCENT	Percent of SNAP participants experiencing food insecurity	52.2	78.3	77.17	96.3	7.95
FMRK_DENSITY	Farmers markets accepting SNAP per 1000 people	0	.01	.0261	.28	.0415
GROCPH	Grocery stores per 1000 people	.04	.2	.248	.94	.15
SUPERCPTH	Supercenters per 1000 people	0	.02	.024	.08	.021
CONVSPTH	Convenience stores per 1000 people	.24	.52	.58	1.26	.214
SPECSPTH	Specialized food stores per 1000 people	0	.08	.0888	.47	.0775
SNAPSPTH	SNAP authorized stores per 1000 people	.41	1.01	1.007	1.84	.287
MEAL_COST	Average meal cost for SNAP participants	2.53	2.91	2.933	5.38	.339
POVERTY_RATE	Poverty rate	5.8	15.2	15.12	23.4	3.77
PERCENT_WHITE	Percent of population that's white	55.0	96.0	92.88	99.0	7.6

Table A2: Descriptive statistics for 2009 data

Variable name	Variable Description	Min	Median	Mean	Max	SD
SNAP_FIPERCENT	Percent of SNAP participants experiencing food insecurity	39.0	8.0	67.2	83.0	8.94
FMRK_DENSITY	Farmers markets accepting SNAP per 1000 people	0	0	.012	.18	.0242
GROCPATH	Grocery stores per 1000 people	.07	.24	.27	.92	.143
SUPERCPTH	Supercenters per 1000 people	0	.02	.012	.09	.02
CONVSPTH	Convenience stores per 1000 people	.26	.56	.601	1.32	.230
SPECSPTH	Specialized food stores per 1000 people	0	.07	.087	.41	.077
SNAPSPTH	SNAP authorized stores per 1000 people	.33	.89	.9	1.68	.3004
MEAL_COST	Average meal cost for SNAP participants	1.99	2.34	2.35	2.75	.121
POVERTY_RATE	Poverty rate	6.6	16.3	16.0	26.7	3.98
PERCENT_WHITE	Percent of population that's white	52.0	94.0	91.2	98.0	8.214

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