

An Evaluation of Food Deserts in America

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JEL Classifications: I14, I32, I38

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This article is part of a theme set of articles on Food Deserts which explore the complexity and seriousness of food deserts, as well as presenting estimates of their magnitude and impact on consumers. Food deserts have many definitions but generally refer to locations where consumers do not have access to supermarkets that provide a good variety of quality, affordably-priced healthy foods. The authors of these articles address this issue using various types of national, state and community level data and provide an overview of the issue. The analyses in the following articles can help inform the debate on how to address this complex issue.

The first article, by Paula Dutko of the USDA's Economic Research Service, examines the definition and scope of food deserts within the United States, previously identified on the Census tract level and based on 2000 Census data and 2006 store locations. This article focuses on socioeconomic characteristics from before and after the food desert designation, identifying persistent differences between food deserts and other areas of the United States, as well as identifying which of these characteristics may be most highly predictive of whether a tract will be designated as a food desert.

The second article, by Dave Weatherspoon, James Oehmke, Marcus Coleman, Assa Dembele, and Lorraine Weatherspoon of the Agricultural, Food and Resource Economics, and the Food Science and Human Nutrition Departments at Michigan State University, discusses consumer preferences and behavior at the community level. The authors utilize a unique data set to discuss the ranking of fruits and vegetables purchased in one of Detroit's food deserts and compare them to national purchasing

Articles in this Theme:

Food Deserts Suffer Persistent Socioeconomic Disadvantage

Will Long Term Food Desert Consumers Purchase Fresh Fruits and Vegetables?

Effects of the Revised Food Packages for Women, Infants, and Children (WIC) in Connecticut

Food Deserts: Demand, Supply, and Economic Theory

patterns. Then the income and own-price responsiveness by food desert consumers are compared to the national and regional study estimates. The article concludes by illuminating the constraints these consumers face that influence purchase and consumption patterns and by identifying policy options.

The third article, by Tatiana Andreyeva of the Rudd Center for Food Policy and Obesity at Yale University, investigates the impact of the recently revised Women, Infants and Children (WIC) food program on the food offerings in poor neighborhoods in Connecticut. Upon the recommendations from the Institute of Medicine and the United States Department of Agriculture, the WIC food packages were revised to offer foods that better reflect dietary recommendations and promote healthy weight in WIC participants. The main changes included

the provision of cash-value vouchers for fruits and vegetables, new whole grain products, lower fat content of dairy foods, and reduced juice quantities. This article discusses the impact of the revised WIC packages on the provision of healthy foods in convenience and grocery stores. The author concludes by discussing the potential for improving demand for and supply of nutritious foods for all consumers by refining national food assistance programs.

The final article, by Alessandro Bonanno of The Pennsylvania State University, illustrates supply and demand conditions that could explain the existence of food deserts and the role these factors play according to different conceptual frameworks. This author concludes that several demand and supply factors may play a role in creating food deserts even when the market works efficiently and that evaluating these markets under frameworks that assume market failures may not necessarily be appropriate. This article provides further insight into the impact of supplier decisions, rather than consumer choice, on food access.

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Food Deserts Suffer Persistent Socioeconomic Disadvantage

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Keywords: Diet, Food Access, Food Deserts, Food Retail, Health

The diet and health of Americans has recently received more prominent national attention. With the rising incidence of obesity and diet-related disease, more researchers, health officials, and policymakers are looking at what drives individual decisions about what and when we eat. Increasingly, researchers are recognizing the important role played by an individual's "food environment"—the outlets closest to an individual's place of school, work or residence where he or she is likely to obtain food; as well as the types of food these outlets provide, the prices at which they are available, and the marketing by which these options are presented to the consumer. One aspect of the food environment that has garnered particular attention is the availability of affordably-priced healthful foods such as fresh produce, low-fat dairy, lean meats and whole grains.

As part of a national program to provide funds for improving food environments in areas with limited availability of nutritious and affordable foods, the Economic Research Service (ERS) at the U.S. Department of Agriculture worked with members of the Department of Treasury, and of Health and Human Services, to create a definition of "food deserts" on a Census-tract level. Census tracts are geographical areas smaller than counties and contain populations of 1,000 to 8,000 people, with an ideal population of about 4,000. In the 2000 Census, the contiguous United States was divided into approximately 65,000 tracts. The tract-level definition of food deserts was intended to facilitate the allocation of grants and loans provided by Federal agencies to low-income communities in which a substantial portion of the population lacked access to stores

in which they could purchase nutritious food at affordable prices. Using data from the 2000 Census, as well as store location data as of 2006, ERS identified over 6,500 Census tracts that met the definition of a food desert. Store locations were provided by TDLinx, a proprietary database of food retailers in the United States, and by a list from USDA's Food and Nutrition Service of stores authorized to accept Supplemental Nutrition Assistance Program (SNAP) benefits—formerly called food stamps. Population and store data were the most recent data available at the time of the analysis.

To qualify as a food desert, a tract has to meet both a low-income standard and a low-access standard. A tract is considered low-income if it has a poverty rate of 20% or higher. Alternatively, a tract may still qualify as low-income if the median family income within the tract is lower than 80% of the median family income for the entire state or surrounding metropolitan area. To be defined as low-access, a tract must have at least 500 people or 33% of the population living beyond a specific distance threshold from the nearest supermarket—farther than one mile in urban areas, or farther than ten miles in rural areas. While many outlets may offer affordable and nutritious food, the tract-level definition of food deserts focuses on supermarkets, supercenters and large grocery stores. By industry definition, these stores all carry a variety of food and often offer this food at lower prices than other outlets such as convenience stores or drug stores. This definition of food deserts does not consider farmers' markets because of a lack of national data and the often seasonal nature and limited hours of these vendors.

Comparing Populations of Food Deserts to Other Areas

Identifying ways in which food desert areas differ from other parts of the country can help isolate the factors that influence the formation of food deserts, as well as highlight focal points for policymakers to design efficient and effective solutions. In an effort to distinguish how food desert areas differ socioeconomically and demographically from other areas, ERS researchers used data from the 1990 and 2000 Census, as well as from the 2005-2009 American Community Survey (American Community Survey, 2012) to investigate characteristics of the 6,529 tracts that are identified as food deserts based on 2000 Census data. The study provides a comparison of characteristics such as racial composition, median income, poverty rates, education and unemployment in food desert tracts to those in other areas in each of the three time periods to identify ways in which food desert tracts consistently differ from areas with sufficient access to affordable and healthful food. This analysis also used some of these characteristics from year 2000 data to determine which of these are predictive of whether a low-income tract will also suffer from low access.

Research reveals that tracts identified as food deserts based on 2000 Census data and 2006 store locations suffer socioeconomic disadvantage relative to other areas, and that this relative disadvantage is persistent in the years before and after food desert status was designated (Dutko, Ver Ploeg, and Farrigan, 2012). Not surprisingly, given the food desert definition, tracts identified as food deserts tend to have higher rates of poverty. They are also home to residents with lower educational attainment, lower incomes, and higher rates of dependence on public assistance. Lower income levels indicate that individuals have fewer resources with which to purchase healthy foods; and less

education can imply lower levels of knowledge about the health effects of poor nutrition. The population of food desert tracts tends to be smaller than in other areas, and unemployment rates tend to be higher. A small market with relatively low purchasing power may not be perceived as profitable for food retailers, providing a disincentive for retailers to locate in these areas. In addition, the proportion of households that do not have access to a vehicle for private use is higher in food deserts than other areas. This is significant, as vehicle availability may play a key role in enabling people who live far from a grocery store or supermarket to purchase healthful food.

High Poverty Rates Are Strongly Linked to Food Desert Status

While a tract must have substantial rates of poverty or low income among its population to qualify as a food desert, the tracts with the highest poverty rates are more likely to suffer from low access than other low-income tracts (Dutko, Ver Ploeg, and Farrigan, 2012). In very dense, low-income urban tracts, a one percentage point increase in the poverty rate implies an 82% increase in the likelihood that the tract will be a food desert. Residents of low-income tracts in the Northeast are less likely to suffer low access than residents of low-income tracts in other regions of the country. This may reflect the more densely-populated nature of many Northeastern cities, which provides sufficient sales volume for larger retail food stores to operate profitably.

While we observe persistent socioeconomic disadvantage in food desert tracts, we do not know whether this reflects the plight of a persistently poor population, or whether it reflects the status of these areas as temporary harbors for households who move into food deserts during difficult times and then leave when their welfare improves. If individuals tend

to live in food deserts for an extended period of time, the length of exposure to a poor food environment may mean greater negative health consequences. Over the 20-year period investigated in this study, urban food desert areas experienced a population loss of about 10%, while rural food desert areas saw a growth in population of slightly less than 1% (Dutko, Ver Ploeg, and Farrigan, 2012). Changes in population in nonfood-desert areas were smaller in scale but of a similar direction: other urban areas experienced a population loss of 4.8%, while other rural areas saw a 6.8% growth in population. From such patterns, we may infer that the population in food desert tracts is less dynamic than in other areas, in that population loss or gain is smaller in these tracts and people do not move into or out of food desert areas as frequently. Growth in population may imply that residents of food desert tracts are exposed to poor food environments for longer periods of time, and more people are exposed to these environments over time; while population loss suggests that individuals are escaping environments of limited access to healthy foods. Further information regarding population mobility into and out of food desert tracts could provide crucial insights to policymakers as to the best means for addressing food access problems.

Transportation Also Plays a Role in Food Access

The ways in which residents of food deserts travel to and from the supermarket also play a large role in determining food access. The Census and American Community Survey provide data on how the working population travels to and from work, as well as the approximate length, in minutes, of this commute. Because many individuals may do their food shopping on their way home from work, ERS researchers used this measure as a proxy for the commute to

places of business in general, including supermarkets.

Transportation patterns tend to differ between food deserts and other areas, and relative transportation patterns are different in urban and rural areas. For example, this study finds that across time, residents of food deserts in rural areas tend to have longer commutes to work than their counterparts in other rural areas (Dutko, Ver Ploeg, and Farrigan, 2012). This characteristic is measured by the proportion of residents in a tract traveling greater than 45 minutes to his or her place of work. A difference in commute times between rural food desert residents and other rural shoppers may be reflective of the fact that reliance on public transportation is higher in rural food deserts than in other rural areas.

In contrast, people living in urban food deserts have shorter commutes to work than residents in other urban areas, as measured by the proportion of workers traveling less than 25 minutes to their workplace (Dutko, Ver Ploeg, and Farrigan, 2012). Urban food desert residents use private vehicles in slightly greater proportion than workers in other urban areas, despite lower rates of vehicle access in food deserts. Alternative means of transportation, such as biking or walking, are also more prevalent for workers in urban food deserts than other urban workers.

Differences in means of transportation between food desert residents and other individuals may reveal additional information about food access. The ability to obtain healthful foods for individuals living in food desert areas may not be as limited as socioeconomic factors such as income and distance to the nearest store indicate. Improvement in vehicle availability across both food deserts and other areas over the past 20 years suggests that while residents of food desert tracts appear to be disadvantaged both economically and in terms of

food access, growing access to vehicles can allow them to overcome some of these barriers.

Overall, the disadvantages faced by individuals living in areas identified as food deserts appear to be numerous and persistent. While determining a causal relationship between these socioeconomic or demographic characteristics and food desert status is more difficult, this study finds that high poverty rates are predictive of which low-income areas are more likely to be food deserts. These results suggest that limited food access may result from a variety of factors, and various solutions for underserved areas are likely needed.

Addressing the Problem of Food Deserts

Some initiatives focus on attracting new supermarkets or supercenters to food desert areas by providing loans, grants, or tax incentives. The proposed Healthy Food Financing Initiative (2012) and California Fresh Works Fund (2012) are both examples of programs that provide incentives to locate affordable food retailers in underserved communities. In some cases, smaller, less dense populations in food deserts may mean that improving the selection at small grocery stores and convenience stores, or even providing produce stands are viable alternatives to building large stores that require a minimum volume of sales to remain profitable. Local efforts in some cities are already experimenting with this. New York City's Healthy Bodegas Initiative (2010), as well as Pennsylvania's Fresh Food Financing Initiative (2004) provides expertise and grants or loans to help smaller stores carry more fresh, healthy foods.

Alternatively, providing better and cheaper alternatives for transportation to and from the grocery store may be a viable solution in some low-access areas. If growing vehicle availability is not sufficient to ease access

problems, improving public transportation in rural areas or ensuring safe walking and biking environments in urban areas may be part of the solution. Efforts to improve the food retail environment in New Orleans include a proposal for a store that would provide free shuttle service to anyone purchasing at least \$50 worth of groceries; other cities have considered reducing bus fares for SNAP recipients to lower the cost of travel.

In addition, providing consumers with information about diet and health may result in more nutritious food choices, especially in food desert areas in which low levels of education are prevalent. State-level efforts such as SNAP Education (*SNAP-Ed Connection*, 2012), or Share Our Strength's Shopping Matters and Cooking Matters programs (*Bringing Innovative Solutions to Childhood Hunger*, 2012) can educate shoppers about the importance of eating a healthy diet, as well as offer guidance on attaining healthier diets on a limited budget.

An updated identification of tracts that qualify as food deserts using more recent population and store location data may provide further insight into the dynamics of food access problems. A second and more recent measurement of a tract's food desert status will allow researchers to identify those characteristics that are associated with persistent status as a food desert, as well as to gauge the effectiveness of measures to improve access.

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Will Long Term Food Desert Consumers Purchase Fresh Fruits and Vegetables?

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Keywords: Consumer Demand, Food Deserts, Fruit and Vegetables

Food deserts are places where healthy food is absent or, when available, in limited supply, expensive and usually of poor quality. Detroit, Michigan is one of the most severe food deserts in the United States in terms of size and duration. Some areas of Detroit have had limited access to nutritious foods since the 1969 riots and certainly for most of the city, since the closing of the last supermarket chain in the city in 2007—Farmer Jack, an A&P subsidiary (Smith and Hurst, 2007). There is a debate about whether food deserts emerge because consumers do not purchase healthy foods, or whether the limited availability of healthy food determines consumer purchasing patterns.

The objective of this article is to illuminate consumer behavior after healthy foods are reintroduced into a food desert. Empirical evidence from a natural experiment is used to analyze how food desert consumers respond to the introduction of a small store that sells competitively priced, normal quality fresh fruit and vegetables (FFV). We take advantage of this experiment by collecting and analyzing the sales receipt data since the store's opening. In addition, this information is supplemented with survey data collected in the neighborhood.

Detroit Overview

In 2007 Detroit had an estimated 500,000 people, with more than half of the city's population, living in food deserts (Gallagher, 2007). Most inner-city Detroit residents rely on convenience, liquor, or other nonmainstream grocery stores for food (Gallagher, 2007). These "fringe retailers" focus on high-calorie, high-fat and/or salty snack foods and sugary drinks, and are located on average 0.2 miles from

households. However, mainstream grocers, including small independent grocers, are on average two to three times that distance (Gallagher, 2007) and in food desert neighborhoods can be substantially farther. In addition, 49% of those surveyed in our target population did not own a vehicle. Proximity to grocery stores is further complicated by abandoned buildings and vacant land that constitute 40% of the land area in Detroit—a sub-city the size of San Francisco has been abandoned (Gallagher, 2009).

Piety Hill Neighborhood, the Natural Experiment

The Piety Hill community is a predominantly African-American neighborhood—which represents the racial demographic of Detroit—where most of the residents are elderly, low income—median household income in 2008 was \$20,150 for this zip code which expands beyond the boundary of the Piety Hill neighborhood, (City Data, 2012) and lack personal transportation (Weatherspoon et al., 2012a). This neighborhood is plagued by abandoned and/or burned-out buildings, which by most standards are uninhabitable, but typically provide shelter for squatters. A few years ago, Piety Hill was serviced by a local grocer that had limited FFV selections and approximately 27 liquor/convenience stores. Prior to the opening of the nonprofit retailer, Peaches & Greens in Fall of 2008, Piety Hill was a food desert due to the poor quality and high prices of nutritious foods.

Peaches & Greens operates a small produce store that sells only FFV and limited refrigerated items such as milk, water and so on; and a truck that sells FFV in the streets similar to how an ice cream truck would circle a neighborhood. They primarily focus on providing good quality FFV at a competitive price to a previously underserved, poor,

inner city neighborhood. We partnered with this nonprofit in the early stages of their project; our role has primarily been data analysis which they use for management purposes.

Data

Two data sets are used to illuminate consumer behavior in this neighborhood, a household survey and daily cash-register receipt data. The Piety Hill Household Food Preferences Survey was implemented in November and December 2009 at community centers, a street corner, and Peaches & Greens. All individuals entering the community centers, the Peaches & Greens store, and walking by a street corner with busy pedestrian traffic—across from both Peaches & Greens and the local liquor store—were asked to complete the survey and offered as an incentive a \$5 gift coupon to Peaches & Greens. There were a total of 161 individual respondents in the sample population of which 90% did not shop at Peaches & Greens. Of the respondents, 85.3% were African American, 76.6% were female and 51.8% were between 35 and 54 years of age—children were

excluded from the survey, and only one respondent per household was interviewed. The survey respondents represented a slightly younger demographic than the community as a whole, although the survey instrument was designed to capture information about household purchasing patterns and thus also represents purchasing patterns of adult children caring for their parents, relatives or other elderly. The survey population also had a higher proportion of female respondents than that for Detroit, which may reflect in part larger numbers of female-headed households in lower socio-economic strata and females with primary responsibilities for household food purchases. These primary data were complemented by secondary data from Peaches & Greens cash-register data, national scanner data from Nielsen representing national fruit and vegetable purchasing habits, and published community food security data.

Fresh Fruit and Vegetable Preferences in Piety Hill

The cash register and survey data verify that food desert respondents have

preferences similar to the rest of the nation. Seven of the top ten most purchased FFV are also in the top ten most purchased FFV nationally as shown in Table 1. The most purchased fruit (bananas) and vegetable (tomatoes) were the same for both populations. In the Piety Hill community lemons, plums, kiwi, garlic, sweet potato and celery make the top 10 list, but are not in the top 10 nationally—on average approximately 15-20 fresh fruit and 10-20 vegetables are available at the store when open. The fruits and vegetables that are nationally ranked but not in the top 10 for these consumers are: watermelon, pineapple, onion, green beans and broccoli. Within this community, 75% of sales revenue and 79% of units sold come from fruit, meaning that fruit purchases were approximately 3.8 times as large as vegetable purchases in terms of units sold (Weatherspoon et al., 2012b). Additionally, Table 1 shows the estimated national average per pound price of each item. When compared relatively, the Peaches & Greens FFV prices rival the national averages. It is important to note that a unit at Peaches and Greens refers to an individual fruit/

Table 1: Fruit and Vegetable Ranking by Daily Frequency of Purchase at Peaches & Greens, National Rank, Quantity and Pricing.

Rank	Fruit					Vegetable				
		National Rank ^a	Q	\$/unit	National \$/lb ^c		National Rank ^a	Q	\$/unit	National \$/lbs ^c
1	Banana (one)	1	21.93	0.27	0.45	Tomato (lbs)	1	1.68	0.76	0.99
2	Apple (one)	2	7.59	0.53	1.07	Pepper (one)	9	1.01	0.56	2.13
3	Orange(one)	4	8.85	0.46	0.57	Lettuce (one head/ bunch)	3	1.93	1.18	2.94
4	Grape (lbs)	5	4.89	1.78	1.68	Cucumber (one)	8	1.62	0.5	N.A.
5	Pear(one)	9	5.95	0.55	1.04	Garlic (one clump)	^b	1.04	0.33	N.A.
6	Lemon (one)	^b	5.46	0.43		Sweet potato (one)	^b	1.67	0.73	0.9
7	Plum(one)	^b	9.13	0.52	1.24	Carrot(1 lb bag)	6	2.08	1.36	0.77
8	Strawberry(1.25 lb bag)	6	2.37	2.31	2.28	Cabbage (one)	10	2.51	0.58	0.62
9	Peach (one)	7	10.82	0.48	1.84	Celery (2 lb bag)	^b	1	1.27	0.9
10	Kiwi (one)	^b	5.53	0.37	1.8	Corn (one ear)	5	2.9	0.34	1.8

^aNational Rank is from A.C. Neilson 2004-2006. ^bThese items were not nationally ranked. ^cUSDA, Economic Research Service (2012), 2008 estimated average prices

vegetable. If we were to compare a pound for pound price, we would see that they are closely related. This is an indication that Peaches & Greens tries to competitively price their products in an attempt to make them affordable to their clientele.

Will Price and Income Changes Affect Purchases?

Fruit and vegetable price and income elasticities—quantity responsiveness to small changes in price or income—were calculated from Peaches & Greens register-tape data and are shown in Table 2 (Weatherspoon et al., 2012a and b). The Detroit fruit price elasticities are compared to the Dunham and Eales (2010) meta-analysis of the prior studies that utilized market level data along with their own estimates from two Northwestern U.S. supermarket locations; vegetable price elasticities were compared to You, Epperson and Huang (1996). Dunham and Eales (2010) suggest that elasticities calculated from retail level data are more elastic than elasticities from market level data, hence, their results were elastic for all fruit with the exception of bananas. Our results show that all price elasticities for FFV were inelastic, meaning that given a price change, consumers were less responsive than the Dunham and Eales (2010) population but similar to the nationally estimated level. In terms of vegetables, the estimates are close to zero which are reasonable when compared to the You, Epperson and Huang (1996) estimates. These findings have major implications for the effectiveness of price based programs to influence consumers to purchase more FFV in a food desert. An effective program would have to heavily subsidize the price to attain a large increase in the consumption of fruit but may not be effective with vegetables.

Income elasticities calculated from the cash-register data (Weatherspoon et al., 2012a and b) are compared with elasticities calculated from

Table 2: Food Desert Own-Price and Income Elasticity Comparisons to Regional and National Estimates.

Fruit & Vegetable Product	Piety Hill Price Elasticity ^a	Regional & National Price Elasticities	Piety Hill Income Elasticity ^b	National Estimated Income Elasticities ^c
Banana	-0.529	-0.24 - -0.98 ^b	1.18	0.63
Orange	-0.721	-0.27 - -1.37 ^b	1.74	0.9
Apple	-0.504	-0.16 - -1.19 ^b	2.15	-0.19
Tomato	-0.1	-0.41 ^c	0.4	0.8
Pepper	-0.08	-0.25 ^c	0.16	0.39
Lettuce	-0.05	-0.01 ^c	0.06	0.64

^aPiety Hill elasticities were estimated with a Rotterdam model and were significant at the $\alpha = 0.01$ level, Weatherspoon et al., 2012a and 2012b. ^bDunham and Eales, 2010. ^cYou et al., 1996.

national data (You, Epperson and Huang, 1996)—income elasticities were calculated based on expenditure levels in a demand systems model (see Weatherspoon et al., 2012a for details). The three Piety Hill fruit income elasticities are greater than one. For every dollar increase in expenditure on fruit, there will be more than a dollar allocated to the consumption of bananas, apples and oranges, making them luxury fruits in this community. These elasticities are notably higher than the national estimates, none of which are greater than one. Piety Hill income elasticities for vegetables range from .06 for lettuce to .40 for tomato, which are noticeably lower than the national elasticities (You, Epperson and Huang, 1996).

Given that the average income in Piety Hill is less than half the national average and that the income elasticity of fruit is higher than the national average, substantial gains in fruit consumption could be achieved with increased income. Although the causes of poverty/low income are complex and likely beyond the reach of food policy, there are ways for food policy to deal with FFV expenditure. In particular, the Double-Up Bucks program in Michigan provides coupons worth up to \$20 that can be redeemed only for FFV at specified

retailers and only on a matching basis: for example, for a \$2 purchase the consumer would pay \$1 and the coupon would match that \$1. This program essentially doubles the amount of income available for FFV purchases. The effect of the Double-Up Bucks program can be seen in comparing data from June and July 2010, when Peaches & Greens participated in a trial run of the Double-Up Bucks program, and data from June and July 2011, when the program operated at scale—no other Piety Hill retailers were eligible. Fruit purchases in value terms increased by 67% year-over-year, vegetable purchases increased by 6%, and combined purchases increased by 56%—includes cash and coupon value. In contrast, in the May and August year-over-year comparisons, combined FFV purchases increased only nominally. Thus, it appears that the Double-Up Bucks program had an important impact in this inner-city community, and it seems reasonable that other programs with meaningful income effects would also have impact—the Double-Up Bucks dummy was not significant in the model.

This raises the policy question: what other factors constrain healthy eating and can food policy help to significantly reduce these constraints?

Other Factors Constraining Healthy Eating and Potential Policy Responses

According to the Piety Hill Household Food Preferences Survey, approximately 49% of respondents consumed FFV one to six times per week, which is below the USDA 2009 Food Guide Pyramid recommendations for health of three cups of vegetables and two cups of fruit per day for most adults and below the 2009 CDC estimate of 32.5% of U.S. adults consuming fruit two or more times per day (Grimm et al., 2010). This suggests that greater knowledge would be important to increasing FFV consumption which is critical for improving the health of this vulnerable population.

Survey respondents revealed that they faced major constraints to purchasing certain food products, particularly FFV that are extremely perishable, heavy and/or require time for preparation. These constraints are exacerbated by a lack of: transportation—less than 50% of those surveyed had access to a vehicle; cooking facilities; safe storage; and utilities which were the top reasons why easy to consume products were preferred. Additionally, 41% of respondents indicated that they did not have access to FFV for the following reasons: cannot carry FFV—they were old, injured, or otherwise unfit to carry a ten-pound bag of groceries a half mile to one mile from the nearest grocer to their residence; cannot get to a grocery store; local store does not have FFV they liked; and the local store does not have any FFV at all. This survey was conducted several months after Peaches & Greens was opened on a full time basis. The majority of respondents had not been to the store yet—3.7% indicated Peaches & Greens as their primary shopping location, 5% as their secondary shopping location, 1.2% as their tertiary shopping location and 90% never shopped at Peaches & Greens—suggesting that increased knowledge of

local food options may be an important policy target.

Summary

Detroit's food desert consumers respond to the same economic stimuli in determining FFV consumption as the rest of the nation, even after living in a community largely devoid of quality, competitively priced FFV for several decades. In particular, fruit consumption is very responsive to income, and thus income-based incentives could make a significant difference on purchase and consumption patterns. Fruit purchases are mildly responsive to price changes with estimated elasticities in the middle of national estimates. Lack of knowledge about nutritious levels of FFV consumption and access are also important constraints to consumption, and can be addressed through policy interventions. However, the issues are complex and additional factors may be influential. Thus there is a need for more detailed research on food desert consumers to develop a comprehensive set of policy interventions.

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Effects of the Revised Food Packages for Women, Infants, and Children (WIC) in Connecticut

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The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) provides healthy foods (via WIC food packages), nutrition education, and medical referrals to approximately half of the infants born in the United States, 25% of children under five years of age, 29% of pregnant women and 26% of postpartum women (Oliveira and Frazao, 2009). By creating demand for a limited number of specific healthy foods among millions of low-income households, WIC has significant capacity to influence purchases of WIC-prescribed foods, their supply in WIC stores, and ultimately access to healthy foods for WIC and non-WIC individuals.

In 2009, WIC implemented revised food packages, based on recommendations from the Institute of Medicine (Institute of Medicine, 2005) that better reflect dietary recommendations and promote good nutrition and healthy weight in WIC participants. The main changes included the provision of cash-value vouchers for fruits and vegetables, the addition of whole grain and soy products, some restrictions on the fat content of milk, and reduced milk and juice allowances. These were the most significant WIC food package changes since the program's inception in 1972, and provided a unique natural experiment to assess their effects on the food environment in low-income communities. This article briefly reviews the findings from research on how the WIC food package revisions influenced the food retail landscape and access to healthy foods in Connecticut.

The Connecticut Study

To understand the impact of the revised WIC food packages on the food environment and access to healthy foods—proxied by WIC-approved food categories—Andreyeva et al (2012) conducted a pre-post evaluation of stocking inventories in convenience and grocery stores (other than supermarkets) in the state of Connecticut. The study included all food stores from five Connecticut towns selected to represent communities of diverse income and food retail characteristics. Researchers completed a three-wave systematic inventory of 245 non-chain grocery and convenience stores in spring 2009—before implementation of the WIC food package revisions in Connecticut on October 1, 2009—and in spring 2010 and spring 2011—approximately six and 18 months after implementation. The number of WIC-approved stores varied from 30 in 2011 to 36 in 2009. Supermarkets were not part of this analysis as healthy foods were available in these stores before the WIC policy change. Trained raters used a standardized inventory tool to assess availability, prices, and variety for 65 food products, as well as produce quality. The 65 food products included the various WIC-approved foods, such as milk, whole grain bread and tortillas, fresh/canned/frozen fruits and vegetables, cereal, tofu, soy milk, brown rice, juice, eggs, peanut butter, dry beans, cheese, baby foods, and canned fish. The assessment also included less healthy substitutes of the WIC-approved foods, such as white rice and white bread. The methodology followed the protocol of the Nutrition Environment Measures Survey in Stores (NEMS-S) that was shown to have a high degree

of inter-rater and test-retest reliability (Glanz, et al. 2007).

To summarize the multiple dimensions of food access such as availability, variety, and prices and quality, the study developed a composite score of the healthy food supply (described in Andreyeva, et al. 2012). The score weighted availability and variety of whole grain products and fruits and vegetables most heavily, as these are foods particularly deficient in the diets of many Americans (Institute of Medicine, 2005). The score assigned a greater weight to fresh fruit and vegetables than to frozen and canned fruit and vegetables, given that the lack of fresh produce is a bigger problem in convenience stores. Changes in the composite scores for WIC-authorized stores and for stores not participating in WIC measured the effect of the WIC food package revisions. Estimation was based on a three-level linear random intercept model that controlled for store size, participation in the Supplemental Nutrition Assistance Program (SNAP) and WIC, and a set of control variables describing the food environment surrounding each store. These included proximity to a supermarket, population density, census tract household income, and competition among food stores and fast food outlets in the area—measured by kernel density of competing establishments within half a mile of each store.

Significant Improvements in Access to Healthy Foods due to the WIC Revisions

Within six to seven months after implementation of the new WIC food packages, the provision of healthy foods in convenience and grocery stores in Connecticut had improved significantly. Most of the improvements occurred in WIC-authorized stores, although non-WIC stores also showed progress. Although the availability of many of the assessed healthy foods—including fresh fruits

and vegetables and low-fat milk—increased following the WIC food package revisions in WIC-authorized stores, the most substantial gains were for whole grain products. Only 8% of WIC-authorized convenience and grocery stores—regardless of the size—had any whole wheat/whole grain bread at baseline; 81% did so after the revisions took effect. The Connecticut WIC program has a minimum inventory requirement that every WIC store should stock at least six packages of WIC-approved whole wheat or whole grain bread at any time of service (Connecticut WIC Program, 2012).

The fact that only 81% of WIC stores had any whole wheat/whole grain bread in stock at the time of the 2010 inventory suggests that some stores were not in compliance. Anecdotal evidence indicates that overall availability of whole wheat/whole grain bread in 16-oz loaves—the only WIC-allowed size—was problematic in the short run after implementation of the new WIC packages, as manufacturers started to produce 16-oz loaves. Until implementation, the typical loaf of bread weighed 18 or 24 ounces, and some stores—particularly the smaller stores—were unable to secure a steady supply of WIC-approved 16oz whole wheat/whole grain bread. Results from the 2011 inventory confirm this hypothesis as all WIC stores at that point had the required 16-oz whole wheat or whole grain bread.

WIC's minimum inventory requirements explain some, but not all of the improvements in the availability of newly-approved WIC foods. Brown rice, another new product in the revised WIC food packages, was not part of WIC's required minimum inventory, so WIC stores could choose not to carry it. Still, its availability in WIC convenience and grocery stores increased from 22% in 2009 to 94% in 2010 and 100% in 2011, suggesting that customer

demand encouraged WIC stores to stock this healthy product. Much longer shelf-life of brown rice versus breads can be another reason why more stores carried this product than bread.

Interestingly, the proportion of non-WIC stores that carried whole wheat/whole grain bread and brown rice after the WIC revisions also increased, to 35% and 25%, relative to 25% and 15% at baseline in 2009. These stores were not subject to WIC's minimum inventory requirements and did not service WIC customers that were redeeming vouchers for newly approved WIC foods. Yet many chose to add whole wheat/whole grain bread and brown rice to their inventories, although to a smaller extent relative to WIC-authorized stores. Competition with WIC stores might explain some of this spillover effect. Furthermore, higher demand from WIC stores might have improved distribution chains as suppliers started carrying new WIC foods to serve all small stores. Better access to whole grain products in stores, which hopefully translates into increased purchases and consumption of whole grains, can help reduce inadequacies in whole grain intake among WIC participants. For example, 1999-2004 national data showed that fewer than 5% of U.S. adults met dietary recommendations to consume at least three daily servings of whole grains (O'Neil, et al. 2010).

In addition to improved availability, the variety of whole grain products—brown rice, whole wheat/whole grain bread, whole grain cereal, whole grain tortillas—also increased, from an average of four to an average of seven varieties in WIC stores, and from three to four varieties in non-WIC stores. Whole grain cereals were the main contributors to the increased variety count of whole grain products—two and three respectively—and their growth in non-WIC stores accounted for 50%

of the variety increase. The main contributor to the growth in varieties of whole grain products in WIC stores was brown rice.

An important result of the WIC food package revisions is that it had a greater positive impact on those most in need for improvement in access to healthy foods. Low-income communities had fewer choices of healthy foods in convenience and grocery stores at baseline, but experienced more significant advances than wealthier areas in availability and variety of healthy foods and produce quality after the WIC revisions. Between 2009 and 2010, the composite score of healthy food supply increased 16% in WIC stores in higher-income areas and 39% in lower-income areas. The selection of foods in neighborhood stores is particularly important for low-income residents without adequate transportation who have to rely on these stores. Greater improvement in the provision of healthy foods in low-income communities might help reduce income-related disparities in food access and health. Poor diet quality and related excess body weight continue to be barriers to healthy life for many Americans, especially among people of lower socioeconomic status. Prior research has demonstrated that the food environments where people make food choices are related to their nutrition (Booth, et al. 2001), body weight (Robert and Reither, 2004), and chronic health conditions (Diez Roux, et al. 2001).

The observed improvements in the provision of healthy foods were measured six to seven months after implementation of the WIC food package revisions. A second measurement was obtained a year later, in the spring of 2011, to determine whether improvements seen in the short term were maintained and perhaps increased. Across all measures of the provision of healthy foods, including the composite score of healthy food

supply and availability, and variety of healthy foods, there was no significant change between 2010 and 2011 in either WIC or non-WIC stores. All improvements in access to healthy foods that were achieved shortly after the WIC revisions in 2010 were sustained a year later. This suggests that the beneficial changes in food access have become accepted and integrated into the food retail landscape and will likely maintain this course in the future, assuming the relevant policy environment does not change. At the same time, the improvements seen in 2010 did not expand further in 2011.

Similar beneficial results of the WIC food package revisions on the provision of healthy foods were seen in other states. A four-state evaluation study by the Altarum Institute completed a pre-post store inventory assessment of small food stores in New Hampshire, Pennsylvania, Wisconsin, and Colorado (Gleason, et al. 2011). Availability of most of the newly-approved healthy WIC foods increased after implementation of the revised WIC food packages. For example, significant increases in availability were seen in WIC stores for soy milk, whole wheat bread, whole wheat tortillas, and brown rice in New Hampshire, Pennsylvania, and Wisconsin (Gleason, et al. 2011). Low-fat (1%) milk increased in availability in stores in New Hampshire and Wisconsin, which were the two states not allowing WIC participants to buy reduced-fat (2%) milk. Availability of fresh fruit improved in three study states, with less significant increases for vegetables that were more available than fruit at baseline and had less room for improvement (Gleason, et al. 2011). In Connecticut, all WIC-approved stores had fresh fruit after the revisions—growth from 50% at baseline, and availability of fresh and frozen vegetables also increased significantly. Differences in baseline availability and WIC's minimum inventory requirements might explain some of the differences in

findings across states. For example, the state of Connecticut required WIC stores to stock at least one variety of fresh fruit and one variety of fresh vegetables, but not all states had the same requirement for WIC stores to provide fresh produce.

From a public policy perspective, it is important to demonstrate sustainability of any positive changes that new policies or programs generate. It is well-known that the effectiveness of some policies can decline over time to the extent that their costs can no longer justify their benefits. While the study in Connecticut did not find any further improvements in the provision of healthy foods between 2010 and 2011, it did find that the successful results from 2010 were sustained a year later. This is good news for WIC policymakers, WIC participants, and low-income communities. Future research should examine if the effects of the WIC revisions can be sustained and increased over the long term, especially as new participants and stores filter through the WIC program. It is also important to understand how to achieve further expansions in the effects of the WIC revisions on access to healthy foods.

In summary, the WIC food package revisions successfully increased availability of many healthy foods because they addressed both the demand and the supply issues of access: (a) they created demand for new healthy foods through WIC vouchers provided to WIC participants, and (b) they immediately improved supply via minimum stocking requirements to WIC-authorized stores.

Food Retailer Practices, Attitudes and Beliefs about the Supply of Healthy Foods

Food retailers such as convenience stores and groceries are an integral part of the food environment and could be a promising venue for improving availability of healthy foods

in low-income communities. Prior research has shown that stocking decisions of such stores can be linked to dietary outcomes among store customers. For example, living near convenience stores selling fruits and vegetables was linked to higher produce intake among store clients that resided in the area (Bodor, et al. 2008). To better understand stocking decisions among small food retailers and their barriers to providing healthy foods, the inventory study in Connecticut included a survey of managers and owners of WIC-authorized convenience and grocery stores other than supermarkets. In addition, control non-WIC stores were selected, matched on store type and proximity to WIC stores, usually within the same census tract (Andreyeva, et al. 2011).

In-person interviews (30-45 minutes each) were completed with 68 store owners or managers directly involved in ordering food products. All WIC-authorized convenience and non-chain grocery stores (n=40) were recruited, with 35 agreeing to participate (88% response rate). More non-WIC control stores were recruited, of which 33 stores participated in the survey (65% response rate). To assess pre-post changes due to the WIC revisions, interviews were completed before and after implementation of the revised WIC food packages—spring 2009 and spring 2010. The subjects were interviewed on their business practices, attitudes and beliefs about the supply of healthy foods, supplier networks, perceived demand and profits for different categories of foods, barriers to carrying healthy foods, and WIC-related issues, including implementation of the revised WIC food packages.

To explain limited availability of healthy foods in convenience and small grocery stores, it is important to understand both the demand and the supply perspectives of such businesses. Small neighborhood stores might

face significant barriers in stocking healthy foods, varying from limited supply networks to inadequate storage capacity or refrigeration. Another reason for not stocking nutritious food could be lack of demand among the store clientele. Previous assessments from focus groups suggested that retailers would stock healthy foods if they perceived sufficient demand (Gittelsohn, et al. 2006). The WIC revisions provided a unique opportunity to test the hypothesis of whether demand or supply determine availability by generating demand for newly-approved WIC foods—via new subsidies—so that the most likely barrier to stocking healthy foods would be supply limitations.

Both issues of demand and supply were highlighted as important by small retailers in the Connecticut study. Customer demand however was always the dominant business factor behind stocking decisions, suggesting that retailers' perceptions of little demand for healthy foods among their customers explained few options of healthy foods prior to the WIC revisions in these stores. Survey respondents reported significantly weaker demand for healthy foods such as fruit and vegetables, whole grain products, lower-fat milk as compared to soda and salty snacks. Supply barriers were reported as secondary in explaining limited offerings of healthy foods. Less healthy foods were also perceived as providing a higher profit margin (Andreyeva, et al. 2011). There was substantial variation in the types of suppliers used, from convenient manufacturer delivery for chips and soda to self-supply for fresh fruits and vegetables.

At baseline, WIC-authorized convenience and grocery stores in the state of Connecticut anticipated few problems in accommodating new WIC requirements to provide a larger selection of healthy WIC-approved foods. Retailers already had suppliers to provide these foods or could

identify new suppliers upon need. Most felt confident about finding additional shelf space or equipment to provide the new WIC foods. A few stores were not sufficiently equipped for some of the new requirements, such as carrying fresh fruit and vegetables at all times, potentially leading to loss of their WIC authorization status. Knowing how to handle and store produce was one skill that some small retailers identified as lacking (Andreyeva, et al. 2011).

Post-implementation survey of the same stores showed that none of the WIC-authorized stores had dropped out from the program due to inability to meet new WIC requirements. The majority of WIC-authorized stores was successful in implementing the revised WIC food packages, increased availability of healthy foods, and reported higher demand for many of the new healthy WIC foods. Similar findings were reported in two studies that interviewed managers or owners of small WIC stores in eight cities across the United States (Ayala, et al. 2012; Gittelsohn, et al. 2012). Most respondents reported an increase in sales of newly-approved WIC foods, regardless of the supply mechanism used.

Increased program requirements were not a deterrent to stores, and improved demand from WIC participants was an important incentive to serve these customers and continue participation in the WIC program. In fact, in the spring of 2012 when the state of Connecticut had an open enrollment to become an authorized WIC store, hundreds of non-WIC stores applied and many successfully joined the WIC program. This suggests that access to healthy foods in the state might have improved even further, as the newly-authorized WIC stores had to carry a number of healthy WIC foods, which might have been previously lacking on their shelves. To understand the long-term effects of the WIC revisions on WIC stores, ongoing monitoring of store

participation and inventories and search for strategies to overcome supply barriers is important for future research.

WIC Policy Demand and Supply Changes Improve Access to Healthy Foods

The results of the reviewed studies on the effect of the WIC food package revisions on access to healthy foods suggest an immediate and potentially long-term success. Policies designed to promote consumption of healthy foods and address the supply issues improve availability of healthy foods in underserved communities. The recent revisions to the WIC food packages subsidized consumption of important healthy foods for low-income women and children, while simultaneously addressing supply issues by requiring retailers to stock minimum amounts of certain nutritious foods. As a result, there were significant improvements in availability of many healthy foods in WIC and—to a smaller degree—non-WIC convenience and grocery stores in Connecticut, especially in low-income communities. These findings provide evidence for the potential of national food assistance and nutrition programs to increase demand for healthier food choices and improve the food environment through policy change. National food policy that promotes consumption of healthy foods, but also requires changes in supplies, can improve local food environments for program participants and non-participants alike. As the WIC food package revisions were designed to be cost-neutral, this can occur at no additional cost to taxpayers.

For More Information

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Food Deserts: Demand, Supply, and Economic Theory

Alessandro Bonanno

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The 2008 U.S Farm Bill defines food deserts as areas with limited access to affordable and nutritious food, particularly composed of lower-income neighborhoods and communities—for other definitions see USDA, 2009). Identifying and measuring food deserts is not easy, as it depends upon what food stores one decides to consider, on how “neighborhoods and communities” are defined and on the meaning given to “affordable and nutritious food” (see USDA, 2009).

Essentially, the food deserts concept links supply of nutritious food, and the availability of food outlets providing it, to the cost low-income consumers face in obtaining it. Even though larger stores (supermarkets and supercenters) appear able to sell food at lower prices than smaller ones, empirical evidence that larger stores’ presence improves consumers’ diet is mixed. While supermarket access is associated with increased daily consumption of fruits and vegetables among food stamp recipients (Rose and Richards, 2004), at least one study (Cummins, et al. 2005) found no significant changes in consumption habits after entry of a large food retailer.

However, limited access to large food stores may result in higher search and transportation costs for low-income individuals and failure to adopt economizing strategies (Leibtag and Kaufman, 2003). This is in addition to the higher prices consumers may face because isolated stores can act as local monopolies or because smaller ones, which can be accessed with lower transportation and search costs, operate inefficiently. Thus, some studies have focused on the lack of supermarkets and supercenters as the characterizing aspect of a food deserts (Morton and Blanchard, 2007).

Not much attention has been given to establish an economic framework that could justify food deserts’ existence. The two most relevant examples are chapter 5 of the 2009 USDA report to Congress on the issue—which summarizes some of the concepts also illustrated here—and Bitler and Haider (2011). This article illustrates the role played by different demand and supply drivers of retail location which could contribute to the emergence of food deserts, and how different economic frameworks can explain their existence. In doing so, we keep the distinction between “large” and “small” food stores made above.

Drivers of Food Retail Location

The interaction of demand and supply forces determines the number and types of food store that consumers have access to, and the quality and type of food products available to them. This section illustrates how some of these factors can play a role in the food desert phenomenon. Demand-side factors will be discussed first; supply-side ones follow.

Demand-side Factors

Market size: The size of a market is a key determinant of retail outlets’ location: simply put, for a food (as well as non-food) retailer to be profitable, the market served must be large enough to ensure that costs are covered and a profit is made. This means that there should be enough consumers interested in patronizing the store and that these consumers need to have enough purchasing power to buy the goods sold. From a conceptual standpoint, as Bitler and Haider (2011) suggest, if nutritious food is a normal good, demand for it will increase with income; thus, demand for stores supplying nutritious food will be lower in

low-income areas (note that this argument works if population is held constant).

Population and income growth:

Opening a new food store requires investments in fixed cost, which can be considerable in the case of large stores—see more on this point in the “Supply-side Factors” subsection below. Growing markets are appealing as they give assurance of longer-term returns for the investments made and a longer livelihood of the store; not surprisingly, some studies (for example, Morton and Blanchard, 2007) find food deserts more likely in areas with declining or aging population.

Poverty rate and rate of adoption of income support programs:

A high poverty rate can be a deterrent for most stores, due to a larger portion of the population having low purchasing power. However, the possibility of accessing support programs such as the Supplemental Nutrition Assistance Program (SNAP) or the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) could represent alternative sources of income for poorer households and a source of demand which could appeal to some food stores. Thus, although areas with higher poverty rates may be characterized by lower food access, areas with similar poverty rates but with more effective assistance programs may be less likely to become a food desert (Bonanno, Chenarides, and Goetz, 2012). Also, the quality of the food products offered may improve for those stores benefiting from program participation: for example a case study found WIC approved small stores to have adapted the level of “healthfulness” of the products offered in response to changes in program requirements (Andreyeva et al., 2012).

Consumers’ preferences (taste heterogeneity): Differences in preferences driven by consumers’ heterogeneity (related to education level, ethnicity, etc.) may lead to different

demand for nutritious food across areas. Disparities in food access across ethnic and income groups have been documented in more than one occasion (see for example Powell et al. 2007). While the market size argument can explain the lack of food stores in prevalently low-income areas, more complex mechanisms may be in place. Less-educated consumers may also show lower levels of nutrition education and lower demand for nutritious food. Also, markets which are predominately inhabited by homogeneous ethnic groups may be targeted by some particular types of food stores with focused offering, which may result in lower product varieties and, arguably, less availability of healthy options.

Supply-side Factors

Fixed (investment) cost: For food retailers, the main investment costs are associated with building facilities, refrigeration installments, and to the provision of square footage (both selling area and not) to supply the basic retail function to consumers as well as delivering additional variety and services (from parking lots to salad bars). The higher the price of property, land, or facilities’ rent, the more unlikely a store will open its doors, particularly in areas where the demand is low. As, arguably, low-income areas are usually characterized by lower property prices, the trade-off between the profitability of the investment and its magnitude lead investment decisions to favor areas where profitability is higher (more on this point in the next section).

Sourcing, sorting and distribution costs: the main function of retailing is to acquire, sort, and resell goods to consumers. Therefore, logistics and distribution play pivotal roles in the activities of a food retailer (particularly in the case of perishable goods). These costs can become prohibitive in areas where transportation infrastructures (for example road conditions, presence of highways, etc.) are poor, or where

retailers need to build new logistics structures (i.e. excessive distance from pre-existing distribution centers). Similarly, isolated areas, distant from wholesale hubs, may not be appealing as sourcing cost may be higher.

Other factors: Other important variable inputs for food retailing, such as energy (mainly electricity for refrigeration, heating, and illumination) and labor, may not be as relevant for food deserts’ creation as those discussed above; in the case of labor, in particular, this is likely to be cheaper in low-income areas. However, in areas where mostly unskilled labor is available, additional cost of personnel training may be required; although it may possibly lower long-run costs, it may still play the role of a deterrent. Other factors impacting food store location decision are local/state-level tax regimes, zoning laws, retail image, crime rates, presence of public transportation and others, whose detailed discussion are beyond the scope of this article.

Can Different Economic Frameworks Explain Food Deserts?

This section discusses how different economic frameworks can explain how food deserts can be one of the possible outcomes of the interaction of demand and supply factors—an equilibrium outcome. The frameworks illustrated include perfect competition and more complex ones where food retail firms’ decisions take place in multiple stages and consider also heterogeneity in consumers and stores.

Perfect Competition

In a perfectly competitive world, both consumers and food retailers are homogeneous, no one in the market can withhold information from others, retailers do not have pricing power, there are no transaction costs, the goods sold across retailers are substantially identical, and there are no barriers to enter or exit the market. In this context (as Bitler and Haider

illustrate in more detail) areas experiencing a sizeable decline in population and/or income, under the assumption of nutritious food being a normal good, could show a shrinking demand curve that will intersect the long-run average cost of retailing food in its downward-sloping portion, leading to a downward sloping long-run supply curve and a resulting reduction in the number of stores over time. This implies that, in this framework, the food desert phenomenon is driven primarily by a shrinking market size; under the assumption of no barriers of store entry and exit, fewer and fewer stores will operate in a market as demand shrinks.

Variable Profits vs. Fixed Cost

Realistically, in order to enter a market, food retailers need to invest in fixed costs—entry and exit is not costless. Thus, food retailers decide first whether or not to enter and then they compete with the other entrants for consumers' dollars. This is an exemplification of the "entry threshold crossing" model presented by Bresnahan and Reiss (1991). The entry decision for each food retailer takes place considering whether its expected future variable profit, proportional to the size of the market, exceeds the fixed costs needed to enter and operate. As the number of entrants increases, the market is split between more stores and variable profits decrease. In this case, a food desert will emerge if a very limited number of, or no, food stores find it profitable to enter the market, either because of the large fixed cost, or the small expected variable profits, or both. In other words, the difference between short-term profitability and fixed cost determines the likelihood of observing entry.

Food Stores Providing Different Quality Levels

Consider now a scenario where food retailers' decisions follow a three-stage process: first, stores decide whether or

not to operate in a market; then, those which have entered the market set the level of quality—assortment and level of service—offered to consumers; last, they compete with one another. Since quality, which is a food retailers' choice variable, comes with fixed costs, this framework treats the level of investment as a choice variable (in the vein of Sutton's Endogenous Fixed Cost model, as in Sutton, 1991). Ellickson (2006, 2007) shows that modeling the food retailing industry this way leads food retailers to separate "naturally" into two different groups: one made of "low-quality" small stores, such as some small independents and convenience stores; and one made by larger "high-quality" ones, such as supermarkets and supercenters, needing more investments to provide the quality that some consumers demand. While one can expect the number of small stores to grow with market size, the number of large stores does not increase endlessly with it. A similar argument can justify a limited number of entrants of the "low quality" type—if market size is small, only a small number of firms' variable profits will exceed fixed costs. For the "high quality", large stores, the equilibrium number of firms in the market is a function of the size of the market, investment costs, and the relative costliness of investing in quality to satisfy quality-valuing consumers. In this case, a small number of firms in the market can be an equilibrium outcome only if market size is small and large stores make minimal quality investments. Also, the two features of the market that allow for the absence of "high-quality" food stores are a very high cost of quality investment—for example, a prohibitively high price of land—and/or extremely small market size (result obtained manipulating some of the formulas in Ellickson (2006, 2007)). In other words, according to this economic model, variable retailing costs no longer plays a role in observing areas with limited food access.

Heterogeneous Food Retailers and Consumers

By combining different assortments of physical products and levels of service offered to consumers (Betancourt and Gautschi, 1990), food retailers assume the characteristics of differentiated products. The level of fixed cost necessary to provide such services or to expand stores are internally determined because owners decide strategically to create "better" stores, offering more features and higher quality products so that competition in price is softened and they can gain higher profits by becoming attractive to less price-sensitive consumers (Bonanno and Lopez, 2009). As a result, such stores will likely shy away from low-income areas. The existence of fixed costs to obtain this "vertical" store differentiation, where food stores can be ranked in function of the services and the quality of the products offered, and consumers' heterogeneity across markets, leads both food stores and consumers to sort themselves according to their respective store-features and preferences. The outcome of this process is that stores of different types—and therefore the different quality of foods they carry on their shelves—will not be available in all markets. Consequently, some areas will not have large, or "better", stores providing food products which could be healthier. Also, as these types of food stores may be targeting higher-income consumers and may charge higher prices—perhaps necessary to recover the additional costs sustained—their presence would not help low-income consumers to purchase as much nutritious food as they need, which may result in a food desert. For a more thorough discussion of the concepts in this section please refer to Bitler and Haider (2011) and their references.

Concluding Comments

As illustrated above, several demand and supply factors may play a role in

the creation of food deserts. Also, as food deserts could emerge in scenarios where the market works efficiently, as in perfect competition, or in others where retailers may benefit from some pricing power due to product differentiation. Interpreting food deserts as resulting from market failures may not be accurate. Across all frameworks, and as economic intuition suggests, the lack of market potential, or the small market size, is one of the most important determinants for food store location. Issues related to structural economic problems—for example, lack of employment opportunities resulting in high unemployment and/or poverty rates—may explain shrinking markets which can be a combined result of migration, aging population etc. However, the effectiveness of initiatives that help the existing low-income population acquire food, such as SNAP and WIC programs, might provide enough market demand to attract more and/or better quality stores. Also, the magnitude of retail costs, in particular fixed costs, used by retailers to deliver “quality” to consumers seems to be another factor playing a role in the observance of food deserts. Flexible financing programs releasing funds, either in the form of grants or low-interest loans, to cover different types of investment costs needed to bring food stores into underserved low-income areas may prove effective to help curb the issue. One example of such flexible financing programs is the Pennsylvania Fresh Food Financing Initiative which allows funds’ requests for different uses, such as feasibility studies, construction grants, infrastructure improvements, security improvements, and personnel training.

For More Information

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